



ANNUAL REPORT 1989-90



NATIONAL RESEARCH CENTRE ON CAMEL
BIKANER



ANNUAL REPORT .1989-90



(Estd. 5th July 1984)

PROJECT DIRECTOR : DR. N. D. KHANNA

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1. INTRODUCTION

There are overwhelming supporting evidences from archaeology, literature, arts, numismatics as well as religious and social aspects which reflect the presence and importance of camels in India from protohistoric period to the present times. References on camel and camel utility are available in Rigveda, Ramayana, Mahabharata and several other ancient literature. Documentary evidence of fixing scale of ration for the camels used in fights during Mauryan period (c. 322-232 BC), is available in Arthashastra of Kautilya. During later period and in the Mugal period, camels were used for transport and in the army. References to the systematic camel breeding, cross breeding with exotic breeds, scale of ration and management practices have been elaborately described in Aine-Akberi. The importance of camel breeding was recognised during early British period. A camel Breeding Farm was established at Hisar in 1809. Systematic research on camel diseases was initiated in 1890 by the Imperial Bacteriologist at the College of Sciences, Poona. Early investigations on Surra in the Indian camels were published during the first decade of the twentieth century.

Distribution of dromedary camels in India is presently confined to the dry lands of North-Western India. The majority of 0.32 m sq km hot arid zone is spread out in parts of Rajasthan, Gujarat, Haryana where camel is an important domestic animal. India has 1.3 m camels (base 1987) which is about 7% of the global camel population (18.5 m) and ranks third highest in the world after Somalia and Sudan.

Seventy percent of Indian camel population is concentrated in Rajasthan. The highest camel density, 3.06 per sq km and 4.78 per 100 persons was observed in 11 arid districts of Rajasthan having 208751 sq km area. Camels in this part constitute about 10% of

the total domestic herbivore livestock biomass.

Due to restrictive resource endowment, livestock farming has an economic edge in the dry lands. Camels constitute an influencing component of the desert eco-system and dry lands livestock production system. Presently, camel keeping forms an important vocation of the rural people in the dry lands. In the dry lands economy, camel plays many roles including transport, both wheeled and riding as a provider for agricultural power, source for water carrying and subsistence in the rural system. Camel milk, hair and hide are also utilized. The camel is ecologically well suited to the life in the hot dry land because of its extraordinary capability to adapt to the extreme climate. A report from the National Bank for Agriculture and Rural Development has revealed that almost 70-80% of loans were distributed in the arid Rajasthan for the purchase of camels and camel carts. The credit flow was very high in this sector and was predicted to increase in years to come. Distribution of camel energetics in the western Rajasthan during 1961 to 1983, revealed 32% increase. The need of augmenting research for camel improvement is, therefore, beneficial to the people living in the rainfed arid zone.

The priorities and thrust of the National Research Centre on Camel (NRCC), Bikaner during 8th plan period are :

1. Camel genetic resource evaluation.
2. Camel genetic improvement.
3. Studies on camel draught and its improvement.
4. Investigations on nutritional requirements of camel, feed resource determination and evaluation.
5. Improvement of camel reproductive efficiency.

6. Improvement of camel health and research on major camel diseases, monitoring, surveillance and control.
7. Studies on traditional camel management, its improvement and socio-economic impact of camel keeping.
8. Camel products (milk and fibre) evaluation and utilization.

2. STAFF POSITION

At the time of establishment of the NRCC, 23 positions were sanctioned during 1984. Subsequently additional 35 positions were added during 7th plan period. Year wise staff position is given in table 1.

Table 1. Staff Position

Staff categories	Sanctioned posts			Positions filled (year-wise)					
	VI Plan	VII Plan	Total	84-85	85-86	86-87	87-88	88-89	89-90
R.M.P.	1	—	1	1	1	1	1	1	1
Scientific	1	7	8	—	1	3	3	2	4
Technical									
Category I	2	2	4	2	2	2	3	3	3
Category II	—	3	3	—	—	—	1	3	3
Category III	2	1	3	—	2	2	3	3	3
Administrative	4	6	10	3	6	7	7	8	10
Auxiliary	2	3	5	1	2	2	3	5	5
Supporting	11	13	24	11	11	14	22	22	23
	23	35	58	18	25	31	43	47	52

The names of the staff members in position during 1989-90 are given below :

- Project Director : Dr. N. D. Khanna
- Scientific
- Principal Scientist : Dr. A. K. Rai
- (Animal Physiology)
- Senior Scientist : Dr. R. C. Jakhmola Joined on 08.11.89
- (Animal Nutrition)
- Senior Scientist : Dr. S. N. Tandon
- (Animal Gen. & Breeding)

Senior Scientist (Animal Reproduction)	: Vacant	
Scientist (Animal Nutrition)	: Dr. A. K. Nagpal	Joined on 27.07.89
Scientist (Animal Physiology)	: Sh. A. K. Roy	Transferred on 09.01.90 Joined on 28.03.90
Technical		
Farm Technician, T-7 (Animal Health)	: Dr. U. K. Bissa	
Vety. Officer, T-6	: Vacant	
Livestock Farm Supdt., T-6	: Dr. N. Sharma	
Farm Manager, (Agric.) T-6	: Sh. Ram Kumar	Joined on 31.10.89
Agril. Assistant, T-II-3	: Sh. J. C. Joshi	
Library Assitant, T-II-3	: Sh. Ram Dayal	
Jr. Engineer, T-II-3,	: Sh. Dau Lal Purohit	
Livestock Assistant, T-2	: Sh. Mohan Singh Sh. Ram Chander Bheel	
Lab. Technician, T-1	: Sh. Nand Kishore	
Administrative		
Asstt. Adm. Officer	: Sh. Santokh Singh	
Asstt. Accounts Officer	: Sh. N. D. Sharma	Joined on 30.09.89
Superintendent	: Sh. Balwant Rai	Transferred on 18.08.89
	: Sh. A. K. Mallick	Joined on 09.11.89
Junior Stenographer	: Sh. M. Padmakumar Sh. Ram Kumar	
Senior Clerk	: Sh. Kanwar Pal	
Junior Clerk	: Sh. Ashok Kumar Yadav Sh. Jamil Ahmed Sh. Anil Kumar Sh. Vishnu Kumar	Joined on 17.02.89 Joined on 01.06.89
Auxiliary		
Driver	: Sh. Shivji Ram Sh. Mehboob Hussain Sh. Prabhu Dayal Sh. Rafiq Alam Sh. Mani Lal	
Supporting		
SSG-I to V	: 23	

3.

FINANCIAL STATEMENT

At the beginning of the 7th plan, Rs. 98.5 lakhs were sanctioned for strengthening the centre. During the last year of the plan, an additional amount of Rs. 43 lakhs was further sanctioned. Year wise statement of expenditure both Plan and Non-plan is given in table 2.

4.

CAMEL RESOURCE AT THE CENTRE

There were 183 camels at the beginning of the year 1989. These animals comprised of 118 Bikaneri, 37 Kutchi, 18 Jaisalmeri, 9 crossbreds between Arabi and Bikaneri and one Arabi. During the year, 58 calvings took place where sex ratio of males: females was 0.87: 1. There were 9 deaths and 18 animals were culled (Table 3). At the end of the year there were 218 animals which included 129 Bikaneri, 49 Kutchi, 30 Jaisalmeri, 9 crossbreds and one Arabi. Age group wise males and females at the farm are presented in fig. 1. The ratio of males: females was 0.49: 1.00. There were 12.38% animals of 0-3 months, 9.17% of 3 months to 1 year, 24.77% of 1 to 3 years and 53.67% of 3 to 15 years age group. The mortality was 4.13%. During the year, 9 studs were used for breeding at the farm and other 6 studs were utilized for providing service to the female camels brought from the nearby villages. In all, 113 animals were brought by the camel keepers to the centre for getting serviced. Five adult males were transferred to the Animal Husbandry Department of Rajasthan Government for distribution to Panchayat Samities in the camel breeding areas of the state.

Table 2. Statement of expenditure (Rs. in lakhs)

Sl. Head of account No.	1985-86		1986-87		1987-88		1988-89		1989-90			
	Expenditure		Expenditure		Expenditure		Expenditure		Expenditure			
	Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan	Plan	Non-Plan		
1. Estt. Charges	0.80	2.94	2.03	3.67	4.77	3.70	5.72	4.14	8.00	7.84	4.30	4.87
2. Travelling Exp.	0.06	0.20	0.10	0.25	0.22	0.25	0.23	0.25	0.60	0.43	0.25	0.25
3. Other charges	4.51	6.65	4.72	8.57	12.83	8.90	18.72	8.50	15.00	14.80	8.00	8.16
4. Equipments	3.57	0.81	6.99	1.21	6.97	0.08	3.14	0.11	4.70	4.67	—	0.11
5. Works	5.09	—	8.16	—	5.36	—	12.19	—	14.70	14.65	1.00	0.13
Total	14.03	10.60	22.00	13.70	30.15	12.93	40.00	13.00	43.00	42.39	13.55	13.52

Table 3. Breed, age and sex wise camel distribution at the NRCC Farm during 1989-90

Breed/ Genetic group	Age group	Opening balance (1.1.89)				Addition				Deletion				Closing balance (31.3.90)		Total	
		M		F		M		F		M		F		M	F		
Bikaneri	0-3 Months	—	1	19	16	—	—	—	—	—	—	—	—	—	11	9	20
	3-12 Months	14	16	—	—	—	—	—	—	—	1	—	—	—	1	5	6
	1-3 Years	10	14	—	—	—	—	—	—	1	1	3	2	16	17	33	
	3-15 Years	15	46	—	—	—	—	—	—	1	1	6	3	17	53	70	
	Above 15 Years	—	2	—	—	—	—	—	—	—	—	—	3	—	—	—	—
Kutchi	0-3 Months	2	3	5	9	—	—	—	—	—	—	—	—	—	—	3	3
	3-12 Months	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1-3 Years	4	—	—	—	—	—	—	—	—	—	—	—	—	9	10	19
	3-15 Years	4	21	—	—	—	—	—	—	—	—	—	1	7	20	27	
	0-3 Months	—	—	3	6	—	—	—	—	—	—	—	—	—	—	4	4
Jaisalmeri	3-12 Months	—	2	—	—	—	—	—	—	—	—	—	—	3	4	7	
	1-3 Years	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	3-15 Years	3	13	—	—	1	3	1	—	—	—	—	—	3	16	19	
Arabi	3-15 Years	1	—	—	—	—	—	—	—	—	—	—	—	1	—	1	
Arabi X Bikaneri	0-3 Months	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	3-12 Months	2	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	1-3 Years	1	4	—	—	—	—	—	—	—	—	—	—	2	2	4	
	3-15 Years	—	—	—	—	—	—	—	—	—	—	—	—	1	4	5	
Total		58	125	27	31	1	3	6	3	9	9	9	71	147	218		

M = Male F = Female

5. CAMEL HEALTH

Clinical cases

In all 165 clinical cases were treated during the year 1989-90 consisting of digestive disorders (31), respiratory infections (16), reproductive disorders (7), urinary tract infections (2), surgical (29), mange (62), mastitis (4), snake bite (2), heat stroke (3) and unspecified cases (9).

Prophylactic measures

- i) Ectoparasites: The animals and sheds were sprayed with insecticides twice a year.
- ii) Endoparasites: The faecal samples were examined at regular interval. Anthelmintics were given twice a year to the whole herd.
- iii) New born calves were given vitamin A, 600000 IU as a prophylactic measure.
- iv) No case of trypanosomiasis was recorded during the year. However,

chemoprophylactic agent (quinipyramine sulphate and chloride) was injected twice a year to all the animals.

Mortality

During the year 1989-90, 3 animals died in the each age groups of 0-3 months, 3 months-3 years and above 3 years. The deaths were due to enteritis (3), respiratory infection (2), accidents (2), cirrhosis of liver (1) and snake bite (1). The mortality at the end of the year was 4.13%.

The overall mortality was calculated to be 0.0961 per 1000 camel days per day. In general, the mortality was higher in young calves as compared to animals of higher age groups. Males had higher mortality rate than the females (Table 4).

Table 4. Mortality during the year 1989-90

Age group	Sex	Camel days	No. of animals died	Mortality/ 1000 camel days/day	Overall mortality
0-3 months	M	715	3	4.1958	1.8657
	F	893	—	0.0000	
3 months-3 years	M	18373	1	0.0544	0.0779
	F	20144	2	0.0993	
Above 3 years	M	14246	2	0.1404	0.0561
	F	39265	1	0.0255	
Pooled	M	33334	6	0.1800	0.0961
	F	60302	3	0.0497	

6.

LAND AND RANGE DEVELOPMENT

Range resource of the Centre is 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 250 ha. About 70 ha land was sown with rainfed crops, namely, Guar (*Cyamopsis tetragonoloba*) Moth (*Phaseolus aconitifolius*) and Bajra (*Pennisetum typhoides*). Sewan (*Lasiurus indicus*) and Anjan grass (*Cenchrus ciliaris*) were also sown in about 10 ha.

In the range land area, 12,000 trees were planted. The main species were Bordi (*Zizyphus nummularia*), Khejri (*Prosopis cineraria*), Neem (*Azadirachta indica*), Siris (*Albizia lebbek*), Vilayti babool (*Prosopis juliflora*), Parkinsonia (*Parkinsonia aculeata*) and Israeli babool (*Acacia tortilis*). During the year, Centre had established its own nursery where about 5000 seedlings were raised. Sand dune stabilization was also undertaken in the fenced plots. About 3 km. long farm road was made in the farm area.

7.

RESEARCH PROJECTS

Project code no. P.I. 86/1-ICN/L-50/5220

Title : 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

During the year 1989-90, studies were initiated to find out the breed differences in draughtability and riding potential of camels. Camels of Bikaneri, Jaisalmeri and Kutchi

breeds of about 4 years age were trained for riding and pulling load on desert tracks. In draughtability experiment on two wheel cart, payloads used were 3 kg/kg body weight of the camel. The animals at this payload resented to work beyond 2 hours covering a distance of about 10 km at an average speed of 5 km/h. The riding potentials of Bikaneri, Jaisalmeri and Kutchi camels were investigated by making them run on a sandy track at a medium pace for 2 hours. The average speed worked out to be 10 km/h.

Haematological observations after load pulling stress namely, RBC, WBC, PCV,

MCV and haemoglobin did not show significant changes from the control values. Increase in the frequency of respiration and pulse rate after 2 h load pulling was 277% and 89% respectively, which remained higher by 111% and 38% even after 2 h rest. The rectal temperature increased by 4.6°C (12.7%) and remained higher by 1.9°C (5.2%) after 2 h rest. All the above physiological values were found to be normal after 24 h rest (Table 5).

The respiratory frequency, pulse rate and rectal temperature measured before and after the riding showed highly significant increase in all the three attributes and the magnitude of increase reflected Kutchi camels to be at higher stress than Jaisalmeri, whereas, Bikaneri showed the least stress (Table 6 and 7).

Although 2 h rest was not sufficient to bring back these responses to normal levels comparable to controls but this period was enough to reduce these considerably. The observations recorded next morning matched with the normal values.

Significant changes were not observed for the haematological attributes after 2 h riding except for PCV of Bikaneri camels which showed slight increase after 2 h riding (Table 8).

Biochemical changes in the blood of camels consequent to 2 h riding and after 2 h and 24 h rest were recorded. The blood glucose level showed an increase after 2 h riding stress and gradually declined following rest. Lactate dehydrogenase activity also tended to increase after riding. The cholesterol levels did not show any uniform trend (Table 9).

Change in pH and blood gases after pulling load @ 3 kg/kg body weight for 2 h on a two wheel cart followed by 2 h and 24 h rest caused 240% increase in pO₂ at rectal temperature which corresponded to 173% at 37°C and 40% decrease in pCO₂ at rectal temperature which corresponded to 50% at

37°C. The load stress also resulted in elevation of pH (Fig. 1). After 2 h rest, initial levels of pO₂ and pH were attained, although pCO₂ remained slightly lower. There was drastic increase in pO₂ following 24 h rest.

Responses of the Bikaneri and Jaisalmeri camels were at variance for changes in pH and blood gases due to 2 h riding at the speed of about 10-12 km/h. At rectal temperature magnitudes for decrease in pCO₂ and increase in pO₂ were higher for Jaisalmeri than that of Bikaneri (Fig. 2). At 37°C, pCO₂ response was similar, however, instead of increase there was slight decrease in pO₂ of Bikaneri but not of Jaisalmeri camel. This caused an elevation of blood pH of the Bikaneri and contrary to this there was depression of blood pH of Jaisalmeri. These changes reflected varied endurance of the two breeds for riding at this speed. Similar to draught experiment, there was marked increase in pO₂ of Jaisalmeri after 24 h rest.

Speed and strides of three different breeds of camel were recorded after covering a distance of 1 km, 5 km and 10 km at a medium pace (Table 10). The speed and strides were calculated by measuring the distances between the foot prints produced by the movement of camels at different gaits on 100 m tracks specially prepared for the purpose. The distance between foot impressions with each step recorded were (i) fore right to fore right, (ii) fore left to fore left, (iii) hind right to hind right and (iv) hind left to hind left.

In general, 5 km warming distance improved the speed during walk, trot and gallop except for Bikaneri where speed decreased by 21% and 5.4% respectively during trot and gallop. Further warming distance of 10 km did not exhibit any stimulatory effect on speed, however, it improved the speed of Kutchi during trot. It was noted that the speed of Bikaneri was higher than Jaisalmeri and Kutchi before

Table 5. Haematological and physiological changes in camels due to load pulling stress

Hours	Draught (n = 7)				Control (n = 7)			
	Work		Rest		Work		Rest	
	0	2	2	24	0	2	2	24
RBC (X 10 ¹² /L)	9.4 ±0.69	9.1 ±0.53	9.2 ±0.66	9.1 ±0.57	9.4 ±0.32	9.1 ±0.43	9.4 ±0.55	9.0 ±0.60
WBC (X 10 ⁹ /L)	13.27 ±0.67	13.3 ±0.82	13.7 ±0.41	13.4 ±0.73	14.5 ±0.46	13.9 ±0.61	14.3 ±0.93	13.0 ±0.74
MCV (fl)	26.6 ±0.61	26.7 ±0.72	26.8 ±0.53	26.3 ±0.44	27.1 ±0.62	26.6 ±0.40	27.0 ±0.83	27.4 ±0.38
PCV (%)	24.6 ±1.39	23.5 ±0.86	24.7 ±1.19	23.9 ±1.08	25.9 ±0.62	24.0 ±1.07	24.8 ±0.88	24.2 ±1.61
Hb (g/dl)	12.9 ±0.61	12.4 ±0.49	12.8 ±0.43	12.9 ±0.59	12.8 ±0.32	12.5 ±0.21	12.7 ±0.27	12.8 ±0.54
Respiration (per m)	9.0 ±0.42	34.0 ±2.83	19.0 ±1.90	8.0 ±0.52	8.0 ±0.31	9.0 ±0.22	9.0 ±0.22	8.0 ±0.00
Pulse (per m)	45.0 ±3.39	85.0 ±2.99	62.0 ±2.48	42.0 ±2.91	43.0 ±2.11	45.0 ±1.99	45.0 ±2.06	41.0 ±1.45
Rectal Temp. (°C)	36.3 ±0.23	40.9 ±0.32	38.2 ±0.11	36.2 ±0.19	36.2 ±0.19	36.5 ±0.12	36.9 ±1.50	36.3 ±0.17

n indicates number of observations

Table 6. Physiological changes in camels due to riding stress

Hours	Riding				Control			
	Work		Rest		Work		Rest	
	0	2	2	24	0	2	2	24
Respiration (per m)								
Bikaneri (n = 5)	8.0 ±0.75	31.0 ±1.86	17.0 ±1.89	9.0 ±0.24	8.0 ±0.58	9.0 ±0.58	10.0 ±0.49	8.0 ±0.60
Jaisalmeri (n = 6)	9.0 ±0.76	38.0 ±0.74	18.0 ±1.08	9.0 ±0.99	9.0 ±0.79	10.0 ±0.84	11.0 ±0.76	9.0 ±0.75
Kutchi (n = 6)	8.0 ±0.71	37.0 ±2.62	17.0 ±2.60	8.0 ±0.11	8.0 ±0.43	8.0 ±0.21	9.0 ±0.37	8.0 ±0.31
Pulse (per m)								
Bikaneri (n = 5)	40.0 ±3.27	76.0 ±4.84	56.0 ±0.75	39.0 ±3.38	41.0 ±2.84	45.0 ±1.85	47.0 ±1.89	43.0 ±3.44
Jaisalmeri (n = 6)	43.0 ±4.95	88.0 ±2.41	61.0 ±2.42	43.0 ±4.59	48.0 ±2.26	65.0 ±7.61	50.0 ±1.00	48.0 ±2.64
Kutchi (n = 6)	37.0 ±6.78	85.0 ±2.23	57.0 ±1.46	44.0 ±1.26	45.0 ±1.33	46.0 ±0.91	48.0 ±1.05	43.0 ±1.09
Rectal Temp. (°C)								
Bikaneri (n = 5)	36.7 ±0.17	40.0 ±0.43	37.5 ±0.17	36.6 ±0.15	36.7 ±0.19	37.1 ±0.25	37.3 ±0.21	36.7 ±0.17
Jaisalmeri (n = 6)	37.1 ±0.23	40.9 ±0.33	38.2 ±0.18	36.9 ±0.21	37.2 ±0.23	37.5 ±0.17	37.5 ±0.11	37.2 ±0.23
Kutchi (n = 6)	36.6 ±0.07	40.7 ±0.27	38.0 ±0.16	36.7 ±0.10	36.8 ±0.21	37.1 ±0.23	37.3 ±0.18	36.7 ±0.11

n indicates number of observations

Table 7. Percent increase in respiration, pulse and rectal temperature after 2h riding followed by 2h rest

	Respiration		Pulse		Rectal Temp.	
	2h Riding	2h Rest	2h Riding	2h Rest	2h Riding	2h Rest
Bikaneri	288	113	90	40	8.9	2.2
Jaisalmeri	322	100	105	42	10.2	3.0
Kutchi	363	113	130	54	11.2	3.8

Table 8. Haematological changes in camels due to riding stress

Parameters	Riding stress				Control			
	0h	Work 2h	Rest 2h	24h	0h	2h	2h	24h
RBC								
(X 10 ¹² /L)								
Bikaneri (n = 5)	9.9 ±0.72	10.0 ±0.42	10.2 ±0.65	10.1 ±0.80	10.1 ±0.37	10.8 ±0.44	10.9 ±0.19	10.3 ±0.54
Jaisalmeri (n = 6)	9.7 ±0.46	9.8 ±0.49	9.1 ±0.62	8.5 ±0.72	9.1 ±0.27	9.5 ±0.32	9.5 ±0.28	8.6 ±0.51
Kutchi (n = 6)	10.0 ±0.45	10.0 ±0.48	10.6 ±0.51	9.9 ±0.86	9.8 ±0.39	10.3 ±0.33	9.3 ±0.46	9.6 ±0.27
WBC								
(X 10 ⁹ /L)								
Bikaneri (n = 5)	14.9 ±0.88	15.9 ±1.31	15.4 ±1.78	15.8 ±1.20	13.0 ±1.31	12.1 ±1.57	13.2 ±0.76	14.2 ±0.67
Jaisalmeri (n = 6)	14.1 ±0.82	15.4 ±0.91	15.3 ±1.25	12.8 ±1.81	14.7 ±1.51	15.0 ±1.43	14.7 ±0.61	14.0 ±1.38
Kutchi (n = 6)	14.2 ±0.89	12.8 ±1.28	14.1 ±1.60	11.3 ±1.59	12.1 ±0.76	12.7 ±0.51	12.7 ±1.01	12.8 ±0.99
MCV (fl)								
Bikaneri (n = 5)	25.4 ±0.77	26.1 ±0.97	26.5 ±1.03	25.3 ±0.71	25.8 ±0.59	26.1 ±0.65	25.5 ±0.72	25.7 ±1.14
Jaisalmeri (n = 6)	26.0 ±0.45	26.4 ±0.37	27.3 ±0.17	27.5 ±0.69	26.8 ±0.33	25.7 ±0.54	26.7 ±0.27	27.2 ±0.56
Kutchi (n = 6)	25.4 ±0.43	25.7 ±0.53	25.6 ±0.61	25.1 ±0.71	26.2 ±0.22	25.6 ±0.52	25.5 ±0.39	25.7 ±0.27
PCV (%)								
Bikaneri (n = 5)	24.4 ±0.99	27.8 ±0.87	25.8 ±1.27	25.1 ±1.29	25.8 ±0.75	27.4 ±0.43	27.7 ±0.49	25.6 ±0.76
Jaisalmeri (n = 6)	25.4 ±1.29	26.4 ±1.49	24.8 ±1.66	23.6 ±1.54	25.1 ±0.53	25.2 ±0.47	25.5 ±0.97	23.4 ±1.36
Kutchi (n = 6)	25.6 ±0.73	25.7 ±1.07	26.6 ±0.82	25.2 ±1.65	25.8 ±1.03	26.4 ±0.71	24.0 ±0.69	24.6 ±0.93
Hb (g/dl)								
Bikaneri (n = 5)	13.2 ±0.23	13.2 ±0.13	13.2 ±0.41	13.0 ±0.56	13.6 ±0.29	14.0 ±0.52	14.2 ±0.36	13.2 ±0.23
Jaisalmeri (n = 6)	13.6 ±0.58	13.7 ±0.71	12.6 ±0.52	12.5 ±0.57	12.6 ±0.27	13.7 ±0.49	13.1 ±0.29	12.3 ±0.50
Kutchi (n = 6)	13.5 ±0.45	13.2 ±0.40	13.8 ±0.46	12.9 ±0.66	13.4 ±0.33	13.5 ±0.47	13.0 ±0.32	13.0 ±0.33

n indicates number of observations.

Table 9. Effect of riding stress on some biochemical parameters

	Riding		Rest
	0h	2h	2h
Glucose (mg/dl)			
Bikaneri	91.4 ± 3.98	119.7 ± 12.36	108.5 ± 2.80
Jaisalmeri	88.1 ± 9.57	137.7 ± 10.55	128.2 ± 10.59
Kutchi	85.8 ± 11.76	131.5 ± 13.35	130.0 ± 8.96
Lactate dehydrogenase (IU/L)			
Bikaneri	139.4 ± 1.44	182.9 ± 8.96	190.4 ± 31.00
Jaisalmeri	219.4 ± 39.96	261.8 ± 68.54	249.5 ± 42.57
Kutchi	173.5 ± 6.38	202.7 ± 15.59	198.5 ± 14.89
Cholesterol (mg/dl)			
Bikaneri	37.1	59.4	54.7
Jaisalmeri	53.4	35.3	29.7
Kutchi	42.2	59.4	21.1

Table 10. Speed and stride of different breeds of camel

Gait	Breed	Speed (km/h)			Length of stride (m)			Duration of stride (s)			Stride (per sec)		
		1 km*	5 km*	10 km*	1 km	5 km	10 km	1 km	5 km	10 km	1 km	5 km	10 km
Walk	Bikaneri	5.93	6.12	5.58	2.45	2.70	2.60	1.46	1.59	1.70	0.70	0.63	0.59
					± 0.028	± 0.003	± 0.003						
					(58)	(42)	(45)						
	Jaisalmeri	5.46	5.61	5.50	2.39	2.40	2.38	1.57	1.53	1.56	0.64	0.66	0.64
					± 0.006	± 0.003	± 0.004						
					(72)	(48)	(44)						
	Kutchi	5.89	5.84	5.54	2.32	2.31	2.33	1.43	1.43	1.51	0.70	0.70	0.66
					± 0.017	± 0.007	± 0.014						
					(60)	(40)	(36)						
Trot	Bikaneri	13.05	10.33	12.08	2.82	3.02	3.23	0.79	1.06	0.96	1.28	0.95	1.04
					± 0.021	± 0.026	± 0.014						
					(56)	(40)	(54)						
	Jaisalmeri	11.39	15.49	13.24	2.67	3.23	3.14	0.85	0.75	0.85	1.19	1.33	1.18
					± 0.008	± 0.017	± 0.005						
					(74)	(46)	(48)						
	Kutchi	10.33	11.90	14.79	2.46	3.30	3.44	0.86	1.01	0.84	1.16	0.99	1.19
					± 0.011	± 0.019	± 0.031						
					(60)	(42)	(45)						
Gallop	Bikaneri	25.15	23.79	23.20	4.74	4.95	4.99	0.69	0.76	0.78	1.47	1.32	1.29
					± 0.015	± 0.011	± 0.019						
					(58)	(39)	(44)						
	Jaisalmeri	23.27	29.88	26.55	4.08	4.83	51.12	0.64	0.57	0.68	1.57	1.74	1.47
					± 0.015	± 0.017	± 0.023						
					(73)	(44)	(32)						
	Kutchi	21.71	29.73	20.69	4.01	4.78	4.40	0.68	0.58	0.76	1.51	1.73	1.32
					± 0.035	± 0.019	± 0.016						
					(60)	(44)	(47)						

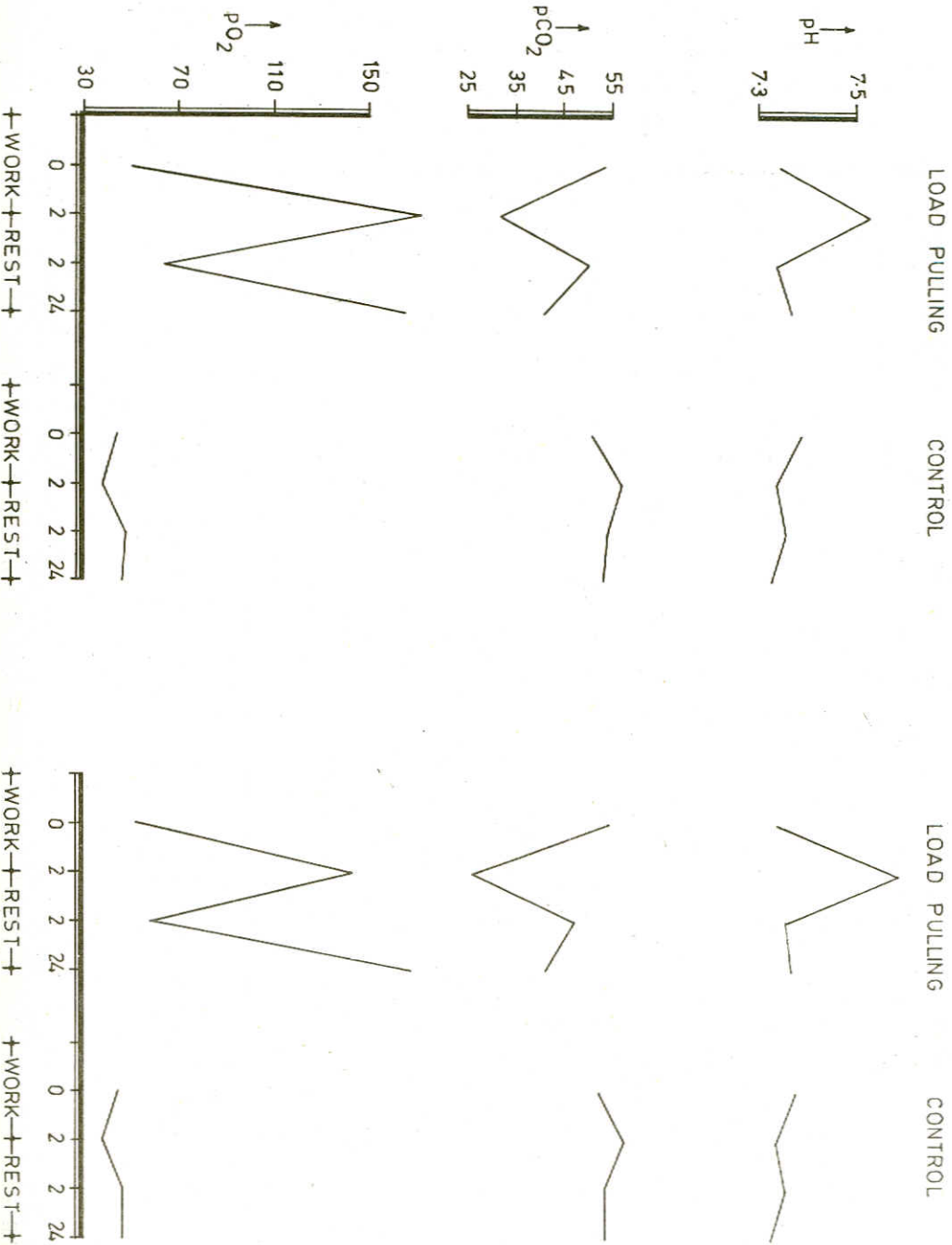
* After 1, 5 and 10 km warming at a slow pace.

Figure in parentheses indicate number of observations.

CHANGES IN pH AND BLOOD GASES OF CAMEL DUE TO LOAD PULLING IN A TWO WHEEL CART

AT RECT. TEMP.

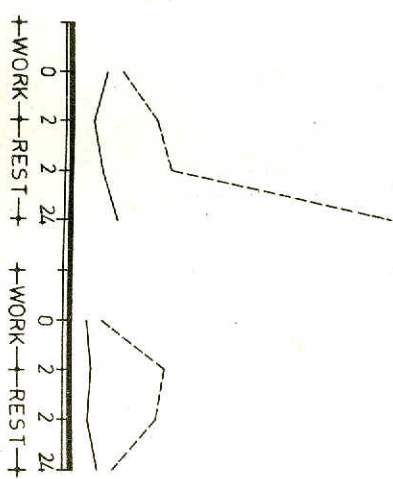
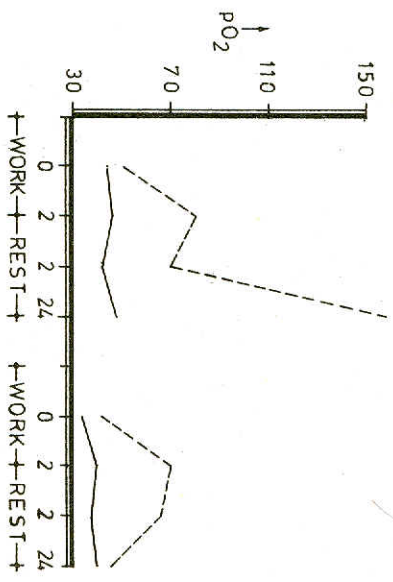
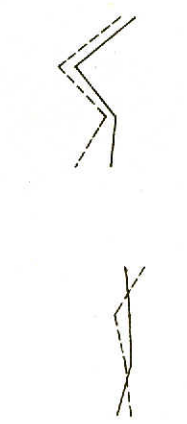
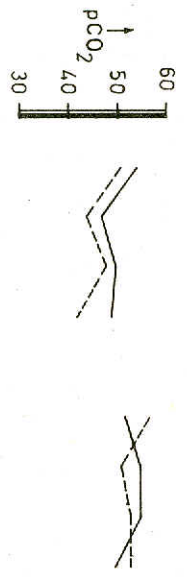
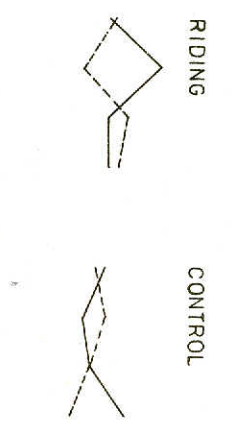
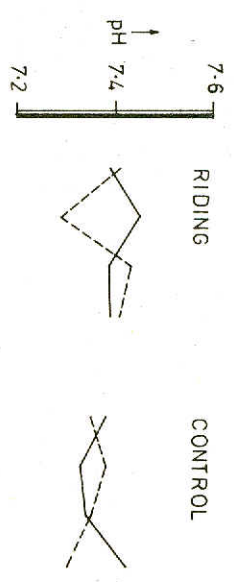
AT 37°C



CHANGES IN pH AND BLOOD GASES OF CAMELS DUE TO RIDING FOLLOWED BY REST

AT RECT. TEMP

AT 37°C



warming exercise. However, after warming, the speed of Jaisalmeri became higher than Kutchi and Bikaneri. Overall average percent

increase in the length of stride in the three breeds were as under :

Mode	Bikaneri	Jaisalmeri	Kutchi
Walk to Trot	17%	26%	32%
Walk to Gallop	89%	96%	89%
Trot to Gallop	62%	55%	45%

The average duration of strides of Bikaneri, Jaisalmeri and Kutchi respectively were :

Mode	Bikaneri	Jaisalmeri	Kutchi
Walk (sec.)	1.58	1.55	1.46
Trot (sec.)	0.94	0.82	0.90
Gallop (sec.)	0.74	0.63	0.67

Average speed (km/h) and stride/sec during walk, trot and gallop were as under :

	Speed km/h			Stride/sec.		
	Walk	Trot	Gallop	Walk	Trot	Gallop
Bikaneri	5.61	11.82	24.05	0.64	1.09	1.36
Jaisalmeri	5.50	13.37	26.57	0.65	1.23	1.59
Kutchi	5.76	12.34	24.06	0.68	1.11	1.52

The speed of Kutchi was more than Bikaneri and Jaisalmeri during walk while during trot and gallop the speed of Jaisalmeri was highest followed by Kutchi and Bikaneri. Speed and strides of Kutchi and Bikaneri camels were also calculated while pulling carts with 16q payload after covering a distance of 5km on a typical desert track (Table 11). There was no difference in speed of the two breeds (5 km/h), because average length of strides was more in the case of Bikaneri animals (2.25 m) as compared to Kutchi (2.12 m) while the strides per second were more in the case of Kutchi animals (0.65 m) as compared to Bikaneri animals (0.61 m).

Draughtability of different camel breeds on different terrains

Draughtability of Bikaneri, Jaisalmeri and Kutchi males aged 4-5 years was measured on Kutcha and Pakka roads. Observations were recorded on plain as well as mild and steep uphill slopes on both the types of the road. Typical two wheel cart with arrangement to fix load cell and monitor was used with a payload of 18q. The draught produced on plain Kutcha road was 120 kg. by Bikaneri and Jaisalmeri. It was reduced to 81 kg on plain Pakka road. Draught as a percent of body weight was 17.7% for Bikaneri and 20.2% for Jaisalmeri, however,

Table 11. Speed and stride under load (16 q) pulling stress

Breed	No. of observations	Speed		Duration of stride (sec)	Stride (per sec)	Length of stride (m)
		m/sec	km/h			
Kutchi	37	1.38	5.0	1.53	0.65	2.12
Bikaneri	23	1.38	5.0	1.64	0.61	2.25

with similar payload on plain Pakka road it was reduced to 8-14%. Kutchi animals produced 46.5 ± 5.30 kg. draught which was only 8% of the body weight on plain Pakka road.

On Kutcha road having mild uphill slope, draught produced was slightly higher in case of Jaisalmeri (147.0 ± 2.04 kg) than Bikaneri (142.6 ± 0.84 kg). This difference, however, was more marked on steep uphill slope (Jaisalmeri- 193.1 ± 20.83 kg and Bikaneri-

163.6 ± 2.90 kg). The draught as percent of body weight was accordingly higher for Jaisalmeri (24.7%) than Bikaneri (21.1%) on mild and steep Up-hill slope of Kutcha road (Jaisalmeri-32.5%, Bikaneri-24.2%).

Kutchi animals produced draught 103.9 ± 5.48 kg and 256.5 ± 37.32 kg respectively on mild and steep uphill slopes of Pakka road. The draught as a percent of body weight was 18.0 and 44.5% respectively on mild and steep uphill slopes.

Project code 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

Herd structure

Data on herd composition during 1975 to 1989 were classified according to five age groups and sex (Table 12). The ratio of males and females during these years remained fairly constant (32.7 to 33.5 : 66.5 to 67.3). Adult animals above 4 years of age constituted 47 to 52% of the herd, whereas, 30% animals were between 1 to 4 years and 20% were calves upto one year. The herd composition also did not vary much during last 15 years. The number of mature males in the stock varied from 7.5 to 12% in different years and were utilized for breeding and transport.

Age group and sex wise structure of Bikaneri herd as on 01.01.1990 is presented in Fig. 3. Growing animals (upto 4 years) constituted 56.2% of the herd, whereas, full grown were 43.8%. Out of the males, 74% were growing stock and only 26% were adult, whereas, 44.7% of females were growing stock and 55.3% were adult breeding females.

Sex ratio

The secondary sex ratio at birth was 1.12 males for each female based on data comprising of 1014 calvings. Significant year to year variation was observed (Fig. 4). The highest ratio of males to females was 2.10 : 1.00 (n = 31) recorded in the the year 1975, whereas, the lowest ratio was 0.64 : 1.00 (n = 18) during 1986.

Inter-calving period

Because of seasonality in breeding, the calving interval in the Indian camel is long.

Analysis of 612 calvings recorded from 1961-1990 revealed that average inter-calving period (912.88 ± 35.67 days) was highest during the initial yers (1961 to 1966) of establishment of the farm.

This parameter showed a decreasing trend and was reduced to 713.05 ± 20.40 days during 1989 to 1990 (Table 13). These results further revealed that the inter-calving period exhibited decreasing trend with the increasing parity. The calving interval, however, showed reverse trend after 5th parity.

Birth weight and growth pattern

Data on birth weight and growth rate recorded during 1989-90 of three genetic groups, namely, Bikaneri, Kutchi and Jaisalmeri were analysed (Table 14 and 15). The results indicated that the Bikaneri calves were the heaviest and Jaisalmeri the lightest. The growth rate in the initial stages was higher for Kutchi as compared to other two breeds.

Life-time calvings

Analysis of data on 705 females for life-time calvings revealed maximum 8 calvings (Table 16). Highest percentage of females were those who had completed 6 life-time calvings (23.83%) and the lowest were those with 2 life-time calvings (3.69%). The average life-time calvings were 4.49 ± 0.12 .

Average span of life

Average life span of 47 animals died during 1985 to 1989 was analysed (Table 17). The average life was 14.56 ± 0.59 years. The females tended to live slightly longer (14.71 ± 0.63 yr) in comparison to males (13.57 ± 2.08 yr).

Biometrical measurements

Five body measurements viz, leg length (fore and hind), body length, heart girth, height at withers and hump factor were measured in the growing animals in first three months after birth (Table 18).

Table 12. Herd composition (%)

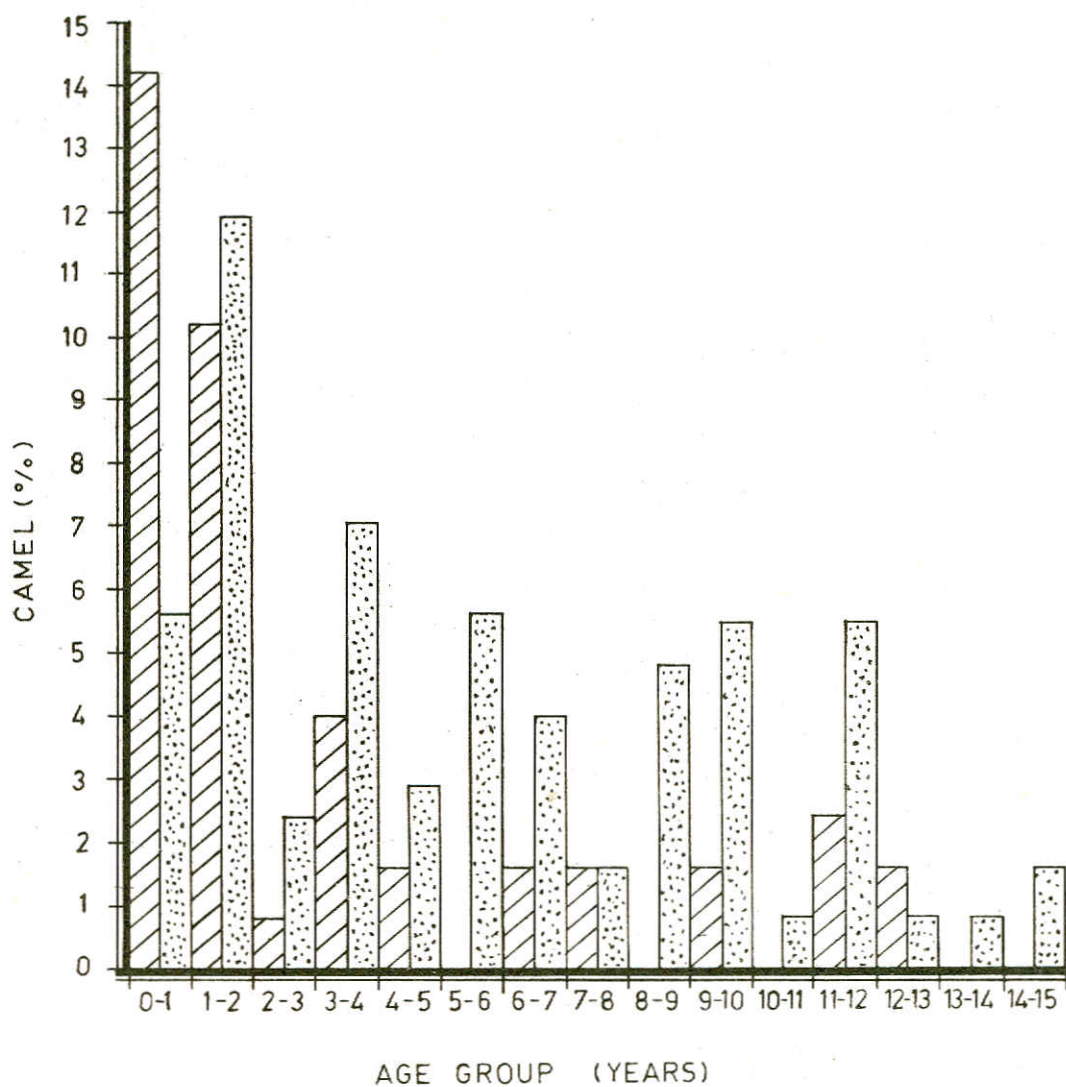
Age groups	1975-79		1980-84		1985-89	
	M	F	M	F	M	F
0 - 1 year	10.3	10.7	9.8	8.3	8.7	10.1
1 - 2 years	7.1	6.5	6.3	5.7	6.5	6.2
2 - 3 years	4.4	5.3	4.9	5.9	4.4	5.6
3 - 4 years	4.1	4.5	4.4	5.6	2.1	4.4
Above 4 years	7.5	39.6	7.3	41.8	11.8	40.2
Total	33.4	66.6	32.7	67.3	33.5	66.5

M = Male, F = Female

Table 13. Inter-calving period (parity and period-wise)

Parity and period	No. of observations	Mean value (days)
Parity		
1	150	799.04 ± 18.56
2	166	783.61 ± 16.02
3	123	741.25 ± 12.03
4	77	741.21 ± 18.86
5	49	709.40 ± 15.60
6 and above	27	872.48 ± 59.49
Period		
1961-66	68	912.88 ± 35.67
1967-72	240	742.74 ± 09.40
1973-78	120	739.60 ± 14.17
1979-85	154	775.38 ± 20.64
1986-88	10	731.10 ± 29.23
1989-90	20	713.05 ± 20.40

CAMEL HERD STRUCTURE AS ON 1.1.90



MALE ----- [hatched box]

FEMALE ----- [dotted box]

SECONDARY SEX RATIO AT BIRTH

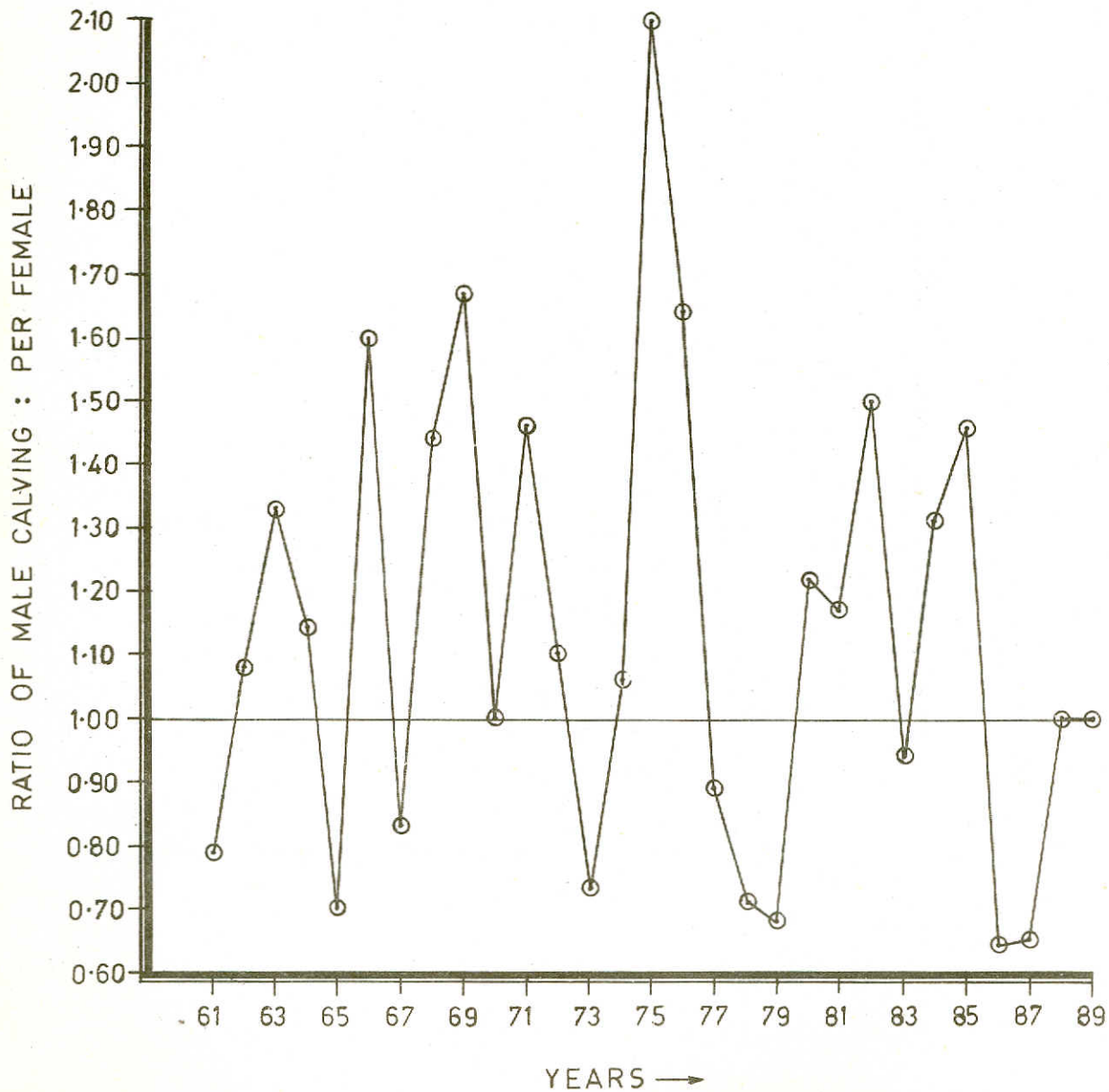


Table 14. Birth weight of different genetic groups

Genetic groups	Birth weight (kg)	
	Male calves	Female calves
Bikaneri	38.89 ± 1.01 (19)	38.68 ± 0.89 (16)
Kutchi	30.17 ± 1.22 (5)	32.75 ± 2.47 (9)
Jaisalmeri	27.67 ± 0.56 (3)	32.60 ± 2.22 (6)

Figure in parantheses indicate number of observations.

Table 15. Average body weight gain (g/day) in different genetic groups

Age group	Bikaneri	Kutchi	Jaisalmeri
0-3 months	641.70 (24)	785.6 (18)	751.6 (9)
3 - 6 months	—	539.6 (15)	457.8 (5)
6 - 12 months	134.19 (7)	289.8 (15)	227.5 (5)
1 - 2 years	189.01 (28)	186.3 (7)	208.2 (2)

Figure in parantheses indicate number of observations.

Table 16. Life-time calvings of Bikaneri camels (1961-89)

Calvings	No. of observations	Percentage
2	26	3.69
3	102	14.47
4	144	20.43
5	155	21.98
6	168	23.83
7	70	9.93
8	40	5.67

Average life-time calvings 4.49 + 0.12

Table 17. Life span of camels during 1985-89

Years	No. of observations	Mean value
1985	06	14.67 ± 1.67
1986	16	15.94 ± 1.11
1987	11	15.45 ± 1.36
1988	07	12.57 ± 1.00
1989	07	13.72 ± 1.56
Male	06	13.57 ± 2.08
Female	41	14.71 ± 0.63
Pooled	47	14.56 ± 0.59

Table 18. Biometrical parameters of growing camel

Traits	Age groups (months)		
	0—1 (n = 7)	1—2 (n = 10)	2—3 (n = 6)
Leg length (cm)			
Fore	94.57 ± 1.60	100.70 ± 1.16	101.67 ± 0.67
Hind	95.00 ± 1.64	104.90 ± 2.99	107.00 ± 1.73
Body length (cm)	66.14 ± 1.40	74.00 ± 2.04	83.67 ± 2.34
Heart girth (cm)	92.29 ± 2.16	104.10 ± 5.87	125.33 ± 3.93
Height at withers (cm)	115.43 ± 2.16	129.00 ± 5.55	140.33 ± 1.86
Hump factor (cm)	11.91 ± 0.88	12.13 ± 3.58	15.50 ± 0.58
Body weight (kg)	49.00 ± 3.69	65.10 ± 3.70	100.00 ± 3.61

n indicates number of observations.

Certain breeding parameters

During the years 1986 to 1990, the average conception rate was 91.9% (n = 233), calving rate was 77.1% (n = 214) and 1.94 services were required per conception (n = 347). Total prenatal losses were 22.9%, out of which 7% were cases of abortion, 8.6% retained after-birth cases and 2.3% dystokia. Mortality in the young calves was 6.38% (n = 141).

Camel semen evaluation

(Assisted by Dr. Anita Ranga, Research Associate, U.G.C., Punjab University)

The semen evaluation studies were carried out using 7 breeding males, 8 to 11 years of age. Semen was collected with the help of cattle artificial vagina (a v). A rubber ring was used on the liner to make a constriction in the a v. Internal temperature of a v was kept at 37°C. Semen collection was started with the onset of breeding season i.e. from November onwards. About 30 semen samples were evaluated using standard techniques. The

colour of ejaculates varied from transparent white to milky white though creamish white ejaculates were more common. Immediately after collection, the ejaculates exhibited a viscid gelly-like consistency but it started liquefying after a mean interval of 9 minutes at 37°C. There was a wide variation in the volume of the semen collected from different animals (2 to 30 ml) and also from the same animal (3 to 30 ml). Although 70 to 90 percent spermatozoa were found alive but no motility was observed in any of the ejaculates collected. The abnormalities included double headed sperms, sperms with bifurcated tails protoplasmic droplets at the mid piece and sperms with curled/bent tails. The characteristics of the ejaculate are given in table 19.

In addition, standardization of techniques for estimating glucose-6-phosphate, fructose 1, 6-diphosphatase, phosphohexose isomerase, LDH, ATPase, proteins, total carbohydrates in the semen are in progress.

Table 19. Semen evaluation during breeding season

	Average	Range
(A) Macroscopic examination		
i) Colour	Creamish white	Transparent white to creamish white
ii) Volume (ml)	6.33 ±1.431	2—30
iii) Consistency of gel	Thick gel	Thin watery to thick gel
iv) pH	7.62 ±0.011	7.6—7.8
(B) Microscopic examination		
i) Motility	Nil	Nil
ii) Sperm concentration (10 ⁶ /ml)	259.36 ±16.53	139—517
iii) Live %	91.5	70—90
Dead %	8.5	5—9
iv) Abnormalities	Bent tails double headed sperms, bifurcated tails protoplasmic droplets at mid piece.	
(C) Copulation time	7 min 16 sec 3—10 min	

Biochemical parameters

Some biochemical constituents in the sera of camels of different age groups were estimated. Glucose level in the serum of young calves (2-3 months) was significantly higher than that of the animals above three years. Quantitation of alkaline phosphatase and lactate dehydrogenase activities revealed progressive decline with the advancement of age. Creatine kinase (CK), acid phosphatase (ACP) and aspartate aminotransferase (AST) activities of 9-12 months old animals were comparable with that of 2-3 years old animals. AST activity was, however, higher in the growing animals as compared to adults. Calcium, phosphorus, total proteins and cholesterol levels in camels above 3 years of age were comparable with that of other domestic ruminant species.

Sodium and potassium were estimated in the serum of different age groups from 2

months to adult-hood. Both these electrolytes were higher in the serum of young calves (2-3 months) as compared to adult camels (Table 20).

The venous blood samples of camel calves aged 2-3 months were collected and analysed using Blood Gas Analyser. The pH of blood of the calves was found to be slightly lower than adult camels, pCO_2 values were quite comparable while pO_2 values were higher in calves (113.0 ± 6.80 mm Hg) as compared to adult camels (32-65 mm Hg). The calculated parameters at $37^\circ C$ viz; HCO_3 , TCO_2 , BEb, SBC and BEecf were lower in the calves than adults (Table 21).

Blood samples of newly born calves (within 1 h of birth) and after one week were studied for RBC, WBC, MCV, PCV and Hb. No significant difference was observed for these attributes between different age groups (Table 22).

Table 20. Serum, sodium and potassium levels of camel

	No. of observations	Sodium (meq/l)		Potassium (meq/l)	
		Average	Range	Average	Range
2—months	25	153.4 ± 0.84	141.8—159.0	7.9 ± 0.16	6.7—9.4
3—4 years					
Male	6	149.3 ± 0.51	147.0—150.0	7.5 ± 0.22	5.8—8.5
Female	6	148.5 ± 0.77	145.5—150.0	7.3 ± 0.16	6.8—7.9
Above 4 years					
Male	13	149.3 ± 1.63	135.0—153.0	6.0 ± 0.11	5.5—7.0
Female	9	142.7 ± 2.43	132.0—151.5	5.1 ± 0.16	4.7—6.2

Table 21. pH and blood gases of camel calves (2-3 months)

	Average (n = 6)	Range
Haemoglobin (g/dl)	11.6 ± 0.15	10.0 — 13.0
At 37°C pH	7.19 ± 0.02	7.13 — 7.23
pCO ₂ (mm Hg)	61.9 ± 5.36	51.0 — 67.2
pO ₂ (mm Hg)	113.0 ± 6.80	91.0 — 132.0
HCO ₃	23.8 ± 0.42	21.6 — 25.9
TCO ₂	25.7 ± 0.44	23.6 — 27.9
BE _b	4.4 ± 0.92	7.8 — 1.9
SBC	21.5 ± 0.71	18.8 — 23.4
BE _{ecf}	4.6 ± 0.91	7.8 — 1.8
% SO ₂ C	96.6 ± 0.65	94.0 — 98.4

n indicates number of observations

Table 22. Haematology of calves and adult camels

	No. of observations	RBC (X 10 ¹² /l)	WBC (X 10 ⁹ /l)	MCV (fl)	PCV (%)	Hb (g/dl)
Calf						
Newly born (1 h)	5	9.36 ±0.46	—	24.76 ±1.21	24.2 ±1.28	12.5 ±0.57
One week	6	9.72 ±0.84	16.7 ±2.64	25.40 ±0.48	24.5 ±1.96	12.3 ±0.80
Adult						
Male	10	10.36 ±0.36	10.38 ±0.51	21.35 ±0.62	21.14 ±1.26	12.8 ±0.48
Female	10	10.12 ±0.29	14.61 ±0.37	25.05 ±0.43	27.8 ±0.70	12.3 ±0.26

Project code no. P.I. 86/3-ICN/L-05/5220
Title : To develop suitable management practices for rearing camels.
Project Leader : S.N. Tandon
Associates : N.D. Khanna
A.K. Rai
Technical Assistance : N. Sharma

Body weight

Average body weights of Bikaneri, Kutchi, Jaisalmeri and crossbred camels as on 31.3.1990 are presented in table 23. The different age groups of Bikaneri in general had higher body weights as compared to the animals of other breeds, whereas, the adult body weight of Kutchi and Jaisalmeri animals were comparable.

Change in body weight of studs during rutting period

A study was conducted to compare weight loss/gain by the breeding males during rutting and non-rutting season. The breeding males on an average lost 16.24% of body weight during the months of December to March and regained 17.09% during April to July. These animals further gained 4.91% during August to November. The non-breeding males on other hand steadily gained body weights throughout the year viz; December to March 6.96%; April to July 7.66% and August to November 6.53%.

Reproductive parameters

90 breedable females were available during 1989-90. The conception rate was 80%. 1.65 services were required per pregnancy. The average copulation time was 4 minutes and 44 seconds \pm 0.19 sec. The calving rate was

88.6%. There were 2 abortions, 5 still births and one case of mid-term foetal loss. The average weight of placenta in the case of female calf births was 6.58 ± 0.32 kg (n = 13) for Bikaneri, 6.80 ± 0.39 kg (n = 4) for Kutchi and 6.93 ± 0.89 kg (n = 3) for Jaisalmeri breeds. In the case of male births, the placental weight was 7.64 ± 0.21 kg (n = 9) in Bikaneri breed.

Out of 58 calves born during 1989-90 the male female ratio was 1:1.15. Maximum calvings (84%) occurred during the months of January and February. Breed-wise calvings are presented in table 24. A comparison of some of the reproductive traits viz; gestation length, age at first service, age at first calving and inter calving period from 1961 to 1989-90 is presented in table 25. A significant improvement has been achieved for age at first service, age at first calving and inter calving period. There was 20.29% reduction in age at first service, 20.88% reduction in age at first calving, 1.80% reduction in gestation period and 7.47% reduction in the calving interval during the year 1989-90 as compared to 1961 to 1985.

Non-seasonal breeding

To study breeding behaviour of camels during non-breeding season, two male studs were housed in the modified sheds which were kept cooled through grass curtains frequently sprinkled with water. This investigation was conducted during the months of June and July. This resulted in reduction of ambient temperature inside these sheds by about 6°C as compared to ambient temperature outside the shed. Two studs were treated as controls and were kept under normal housing conditions. Semen ejaculates from all 4 animals were collected using cattle a v. Semen volume varied from 4 to 5.6 ml and sperm concentration 3.6 to

Table 23. Average body weight (kg) of different genetic groups of camel (kg) as on 31.3.1990

Age groups	Bikaneri			Kutchi			Jaisalmeri			Crossbreds		
	No. of obser- vations	Average weight	No. of obser- vations	Average weight	No. of obser- vations	Average weight	No. of obser- vations	Average weight	No. of obser- vations	Average weight	No. of obser- vations	Average weight
0 - 6 months	27	70.59 ± 04.46	03	56.67 ± 01.77	04	62.00 ± 03.27	—	—	—	—	—	—
1 - 2 years	06	201.00 ± 11.56	14	210.14 ± 05.97	03	170.00 ± 15.29	—	—	—	—	—	—
2 - 3 years	09	298.22 ± 10.67	03	297.33 ± 17.92	02	266.00 ± 26.08	04	308.50 ± 26.92	03	448.00 ± 16.18	03	448.00 ± 16.18
3 - 4 years	04	391.25 ± 18.85	03	372.00 ± 09.88	01	402.00 ± 00.00	01	502.00 ± 00.00	02	561.00 ± 09.03	02	561.00 ± 09.03
4 - 5 years	10	531.40 ± 17.28	—	—	01	502.00 ± 00.00	07	513.43 ± 13.40	—	—	—	—
5 - 6 years	03	556.67 ± 41.85	04	505.50 ± 42.65	05	542.00 ± 19.81	05	542.00 ± 19.81	—	—	—	—
6 - 7 years	07	549.71 ± 14.89	01	520.00 ± 14.89	03	526.67 ± 09.96	—	—	—	—	—	—
7 - 8 years	11	631.27 ± 24.41	08	514.38 ± 23.06	—	—	—	—	—	—	—	—
8 - 9 years	08	640.50 ± 25.70	02	481.00 ± 33.00	02	580.00 ± 14.00	—	—	—	—	—	—
9 - 10 years	07	642.00 ± 22.90	07	596.00 ± 36.56	02	506.00 ± 20.00	—	—	—	—	—	—
Above 10 years	16	669.37 ± 12.98	02	506.00 ± 20.00	—	—	—	—	—	—	—	—
Total	108		47		28		09					

Table 24. Calvings in different genetic groups of camels during 1989-90

Months	Bikaneri		Kutchi		Jaisalmeri		Total
	M	F	M	F	M	F	
January	10	02	01	04	—	03	20
February	05	06	04	04	01	02	22
March	03	03	—	01	01	—	08
April	—	—	—	—	01	01	02
November	—	01	—	—	—	—	01
December	01	04	—	—	—	—	05
Total	19	16	05	09	03	06	58

M = Male, F = Female

Table 25. Some reproductive traits during 1961-85, 1986-88 and 1989-90

Traits	1961-85	1986-88	1989-90
Gestation length (days)	389.30 ± 00.08 (532)	382.20 ± 02.02 (36)	382.30 ± 02.17 (40)
Age at first service (days)	1390.00 ± 25.00 (60)	1239.67 ± 80.84 (12)	1108.73 ± 34.57 (11)
Age at first calving (days)	1882.00 ± 28.67 (93)	1635.67 ± 82.33 (12)	1489.00 ± 22.81 (5)
Calving interval (days)	770.61 ± 03.62 (582)	731.10 ± 29.23 (10)	713.05 ± 20.40 (20)

Figures in parenthesis indicate number of observations.

7.8×10^8 . The microscopic examination reveal comparatively more immature spermatozoa in the collections obtained during non-breeding season in both the groups as compared to collections made in the breeding season.

Twenty two adult females were selected for non-seasonal breeding, out of which 12 animals were given 1000 IU of Folligon and 10 served as controls. These females were randomly assigned to studs housed in the modified sheds as well as normal sheds for breeding. In all 5 animals conceived, 3 from Folligon treated group and 2 from control group and the conception rate was 25% and 20% respectively.

Out of these, four pregnant females were served by the sires kept in modified cooled sheds while one pregnancy was through sire kept under normal housing conditions. Only one animal carried pregnancy through full term while the rest four became empty within 2 to 2½ months.

Hair production

Data on hair produced by 185 camels of 4 genetic groups were classified according to age group and sex (Tables 26 and 27). The annual hair production indicated that the cross-breds produced maximum hair (1240 g) followed by Bikaneri (1225 g), Jaisalmeri (1165 g) and Kutchi (1089 g). The age group wise classification indicated that higher hair production at lower ages. More hair were produced by the males (1222 g) as compared to females (1163 g).

Milk production

Milk production was recorded in six animals. These animals were trained for twice a day milking. The average daily milk production varied from 4 to 11 litres/d on normal plane of nutrition.

Table 26. Camel hair production in different genetic groups

Genetic group	No. of observations	Hair (g)
Bikaneri	103	1225.24 ± 0.23
Kutchi	46	1089.13 ± 0.39
Jaisalmeri	26	1165.38 ± 0.48
Crossbred	10	1240.00 ± 1.25

Table 27. Age and sex wise hair production

Age & sex groups	No. of observations	Hair (g)
Age		
0—1 year	26	1382.58 ± 0.46
1—2 years	36	1369.44 ± 0.38
2—3 years	11	1318.00 ± 0.51
Above 3 years	112	1063.57 ± 0.21
Sex		
Male	61	1222.13 ± 0.41
Female	124	1163.83 ± 0.22

Impact of green feed supplementation

Studies on water intake and growth performance of camel calves (12-14 months) was conducted by replacing 30% of dry matter intake by "fometa" green barley with *ad-lib* intake of mothchara on the basis of calculated DMI at the rate of 2% of actual body weights which were recorded at fortnightly intervals. The calves were divided into three groups, A, B and C having 6, 4 and 2 calves respectively. Group C was introduced to the experiment in the month of March. Group A was offered water once daily and group B only once a week. No water was allowed at all to the animals of group C, throughout the experimental period.

Group A and B showed highest DMI in February (2.72 and 2.85 kg/100 kg body weight/day respectively). Dry matter consumption showed a reducing trend with the increase in ambient temperature (March to June). It was comparable in all the groups in the month of March but thereafter the decline was more marked in animals of group C followed by group B and group A (Table 28).

Actual replacement of dry matter by fometa increased from January to May. It ranged from 19.0-31.6% in group A, 18.8-32.4% in group B and 26.3-65.2% in group C. This indicated a gradual decline in the intake of mothchara by the animals with the advancement of summer. Animals of group C drastically reduced the consumption of

mothchara being completely deprived of water intake.

The average daily gain (ADG) ranged from 328 ± 34.8 g to 631 ± 58.8 g for animals offered daily water (Group A). The animals on once a week watering schedule (Group B) showed lower ADG in the months of May and June as compared to Group A. Animals without water (Group C) marginally gained or lost their body weights and indicated increased efficiency of utilization of feed in view of their less DMI/100 kg body weight/day as compared to the other groups.

Water intake of Group A animals gradually increased from 44 ± 3.98 to 94 ± 1.04 ml/kg body weight. The water intake was significantly higher in the animals on once a week watering schedule (Group B) as compared to animals on daily watering schedule (Group A).

The average consumption increased from 52 ± 6.45 to 108 ± 8.51 ml/kg body weight. These results indicated that growing calves on water restriction could manage their water requirements from fometa green upto April, however, this source was inadequate thereafter when extreme summer set in. Similarly, even once a week watering schedule was not enough to meet the water requirements of growing calves during extreme summer months (May & June) even with fometa green supplement at the rate of 30% DM replacement.

Table 28. Observations on growing camel calves (12-14 months) under different watering schedule with fometa as green supplement

Months	Body wt. (kg)	DMI (kg/d)	DMI/ 100 kg/d	ADG (g)	DM replac- ment by fometa (%)	Water uptake	
						(l/d)	ml/kg)
A. Daily watering							
Jan.	201.3	4.2	2.2	436	19.0	8.4	44
	+5.55	±0.09	±0.092	±48.3	±0.41	±0.76	±3.98
Feb.	214.5	5.7	2.7	425	26.2	7.8	37
	+5.90	±0.11	±0.076	±44.4	±0.45	±0.56	±3.08
Mar.	232.2	5.4	2.4	631	28.0	9.7	43
	+5.47	±0.18	±0.157	±58.8	±0.40	±0.95	±4.12
Apr.	242.3	4.9	2.1	328	30.6	15.0	63
	+6.25	±0.06	±0.056	±34.8	±0.39	±0.48	±3.32
May	254.8	4.8	1.9	417	31.6	23.2	94
	+6.44	±0.04	±0.043	±66.6	±0.28	±1.03	±1.04
June	265.3	5.0	1.9	339	30.2	22.1	85
	+5.79	±0.15	±0.033	±38.8	±0.34	±0.42	±2.65
B. Once a week watering							
Jan.	205.0	4.3	2.1	242	18.8	10.2	52
	+12.62	±0.12	±0.118	±77.3	±0.54	±1.12	±6.45
Feb.	221.0	6.3	2.8	516	23.7	12.0	54
	+14.18	±0.03	±0.252	±68.4	±0.28	±1.50	±4.98
Mar.	241.0	5.8	2.3	714	25.7	17.0	71
	+15.94	±0.14	±0.289	±63.5	±0.17	±2.01	±5.54
Apr.	251.0	5.2	2.0	339	28.9	19.7	78
	+18.66	±0.17	±0.090	±107.4	±0.95	±2.27	±6.13
May	247.3	4.6	1.8	167	32.4	27.2	1082
	+22.70	±0.15	±0.076	±51.1	±1.01	±3.03	±8.51
June	249.7	4.7	1.8	290	32.0	28.1	107
	+17.90	±0.15	±0.076	±74.5	±1.07	±0.93	±5.82
C. No. watering							
Mar.	248	5.7	2.3	—	26.3		
		±0.09	±0.036				
Apr.	254	5.0	2.0	200	30.0		
		±0.08	±0.034				
May	248	3.3	1.4	200	45.5		
		±0.27	±0.110				
June	254	2.3	0.9	200	65.2		
		±0.14	±0.052				

8. INTER INSTITUTIONAL COLLABORATION

(1) Studies on camel milk

Report by Dr. O.P. Singhal, Head,
Division of Dairy Chemistry, National
Dairy Research Institute, Karnal-132 001.

Chemical

Eleven samples of camel milk of two breeds, Bikaneri and Kutchi including colostrum and at different stages of lactation period were analysed for chemical, microbiological and immunological properties. Camel colostrum differed from normal milk in that it contained more minerals (ash), total proteins, casein, serum proteins and less lactose. However, the fat content of camel colostrum was very low (0.1%) as compared to the colostrum from cattle and buffalo. With successive milkings the composition rapidly approached that of normal milk. In physical properties also it behaved similar to cattle and buffalo colostrum and had high acidity, low pH and was COB positive. Even after seven days of parturition, the acidity was high (0.2% as lactic acid) and COB positive. Of the individual mineral constituents, calcium and chloride were present in higher concentration in colostrum than normal milk.

No significant difference in the composition of milk of the two breeds was observed. Among the major constituents, the camel milk was deficient in fat and protein content compared to cattle and buffalo milk. The fat content varied from 2.0 to 4.0% with an average of 2.8%, total proteins varied from 2.06-3.24% with an average of 2.68% and

lactose content varied from 4.3 to 5.6% with an average of 4.99%. The lactose content was almost similar to cattle and buffalo milk.

Immunological

Whey from camel colostrum and milk samples were fractionated on sephadex G-75. Four fractions were obtained. The first fraction corresponded to immunoglobulin which resolved as a major fraction in colostrum whey. Lactoferrin (a bacteriostatic protein) was also present in camel colostrum and milk.

Casein of camel milk pelleted at 10,000 rpm in 15 min suggesting a larger micelle size of camel casein. Casein of Kutchi breed was greenish blue in colour unlike Bikaneri breed. However, there was no difference in the gel filtration profile of whey proteins of Kutchi and Bikaneri breeds.

The sialic acid content in acid casein of camel milk was close to cow casein. Electrophoretic mobility of camel casein was slower as compared to bovine casein.

Microbiological

Microbiological quality of camel milk was good but had saltish taste. The MBR time ranged between 4½ to 5½ h and SPC counts between 100 to 1000. Some of the samples had very low SPC counts. Yeast and mould counts were absent in all the samples. The samples showed negative presumptive coliform test but acid production was observed. Both lactobacilli and spore formers were present in camel milk samples. Lactic

acid bacteria could produce acidity in all the samples at 37°C/24 hours but a firm gel was not produced.

Milk samples brought from Bikaner in ice when kept after 72 h of collections at 37°C got spoiled within 24 h but could be retained at refrigerated (5°C) temperature for a further period of one week. The camel milk samples could not withstand the sterilization on temperature. However, steaming for 10 to 15 min was observed to be satisfactory with regard to growth of lactic acid bacteria.

Chemistry of camel milk fat

Camel milk fat was prepared by direct cream method and analysed for fat contents and fatty acid profile. The m.p. of the camel milk fat ranged between 39.9 to 42.8°C, higher than bovine milk fat (33-35°C). The B.R. reading was also high (43.6-47.6) compared to bovine milk fat. The iodine value ranged between 35.5 to 43.0 indicating that the content of unsaturated fatty acids was in the range of bovine milk fat. Saponification value ranged between 209 to 213, much lower than the bovine milk fat which indicates that the content of short chain fatty acids is low as compared to bovine milk fat. R.M. value (1.7-2.1) and Polenske value (0.7-1.0) confirmed that the short chain fatty acids (C₄-C₁₀) are much less as compared to cattle and buffalo milk fat.

Fatty acid profile

Camel milk fat is devoid of butyric (C_{4:0}) acid which is considered as a marker fatty acid for cattle and buffalo milk fat. Other short chain fatty acids viz. C₆ to C₁₀ are also less as compared to cattle and buffalo milk fat. However, it had significantly high levels of myristic (C_{14:0}) and palmitoleic (C_{16:1}) acids. Other long chain fatty acids were more or less similar to bovine milk fat.

(2) Investigations on Cytogenetic profile of

Indian Camel Report by Dr. R. Sahai, Principal Scientist, National Institute of Animal Genetics, Karnal, 132 001.

The base line sister chromatid exchange frequency was estimated in single humped Bikaneri camel (*Camelus dromedarius*) by peripheral blood lymphocyte culture technique. The whole blood cultures were set up and 5-Bromodeoxyuridine was incorporated for two consecutive cell cycles in culture medium. The slides of the somatic chromosomes were treated with Bis-Benzimide and SSC followed by Giemsa staining. The sister chromatid exchange frequency was estimated for both males & females. It was found to be 5.05/cell or 2.52/cell/generation. This protocol resulted in differential staining of sister chromatids. There was no significant difference between the two sexes. On appraisal of the sites of SCE's showed that the distribution of the sister chromatid exchanges was non random.

The 16th to 25th chromosome pairs (small subacrocentric) showed none to negligible number of exchanges. The large chromosomes (1st to 15th pair of subacrocentric, 26th to 28th pair of submetacentric and 31st to 33rd pair of acrocentric) showed maximum number of exchanges.

(3) Endocrinological and reproductive behaviour of camels Report by Prof. S.P. Agarwal, Department of Vety. Physiology, Haryana Agricultural University, Hisar-125 004.

Female camel

Blood samples from six post-mated female camels were collected on two successive days of mating and then on alternative days till day 22 post-mating. Sera samples were analysed for progesterone concentration by RIA. Three different patterns of progesterone profiles were observed. In two camels, basal

levels persisted throughout the cycle. Two camels exhibited a short peak on day 9 preceded and followed by basal levels and in two camels the peak levels persisted till 22 days. These patterns depicted anovulatory, ovulatory but infertile and fertile status or conditions respectively. The results suggested that progesterone monitoring revealed true reproductive status of female camels at an early stage.

Male camel

Blood samples from stud camels of Bikaneri, Kutchi and Arabi breeds were collected at weekly interval on three occasions each before and after mating to study effect of mating stimulus on hormone levels. Sera were analysed for testosterone, cortisol, thyroxine (T₄) and triiodothyronine (T₃) using specific RIA kits. The testosterone levels were higher in Arabi and Kutchi breeds than Bikaneri camels. The basal cortisol levels were within 5 to 12 ng/ml. Both of these hormones conspicuously elevated in samples collected after mating. Among thyroid hormones, serum thyroxine levels were somewhat lower in Arabi than other two breeds and there was no effect of mating.

Effect of exercise/work on cortisol response in male camel

Dromedary camel of Bikaneri breed were given exercise in the form of riding and haulage in a two wheel and four wheel cart with a payload of 1500 and 2500 kg. respectively for four hours. Blood samples were collected just before the start of exercise, at hourly interval during exercise and at 2, 4, 8 and 24 hours of rest.

Samples from control (non-exercised camels) were collected at periods corresponding to exercised animals. Sera were analysed for cortisol by RIA using antibody coated tubes. The results showed basal levels to vary between 6 and 11 ng/ml.

which progressively increased during exercise to attain a peak value of around 25 ng/ml in all types of exercise. The levels returned to basal value after 2 to 4 hours of rest. The results showed an appreciable cortisol response to exercise in working camel.

(4) Wound healing in camels-Ph. D. Project

Report by N.R. Purohit, Department of Surgery and Radiology, College of Veterinary and Animal Science, Bikaner-334001.

Twenty four clinically healthy camels of either sex between the age groups of 3-7 years belonging to National Research Centre on Camel, Bikaner were utilized in this study of 2-3 weeks. These camels were randomly divided into four groups viz; A, B, C and D of six animals each. Animals of groups A, B and C were used for gross, biochemical, histopathological, histochemical evaluation and treatment trials. The animals of group D were used for mechanical evaluation of wound. Under tranquillization and epidural analgesia full thickness cutaneous open wounds of 2.5 × 2.5 cm were surgically imposed through excision on either side of the dorsal median plane of the gluteal (rump) region. The wounds over the right gluteal region of groups A, B and C were treated with Neem oil, Protamine zinc insulin and Tissue extract respectively, whereas, the wounds on the left gluteal area served as control which were treated with normal saline solution 24 hours after infliction of wounds. The dressing was done daily for first 12 days and later on alternate days.

The gross evaluation of wounds was done daily by observing the general appearance, extent of cicatrization, epithelial growth, colour, texture etc. The rate of healing (per cent healing) was determined by tracing wound area on sterile cellophane paper immediately after wounding and thereafter at 4 days interval.

The granulation tissue was collected on 4th, 8th, 12th, 16th and 20th day from a set of two wounds (Treatment and Control) from each animal of the group A, B and C, for biochemical analysis viz; collagen, hydroxyproline, hexamine, ascorbic acid, zinc, copper, iron and magnesium and histopathological/histochemical evaluation.

The mechanical evaluation of wound healing was done in group D. After creating surgical wounds on gluteal region different drugs were applied and wounds were closed with silk thread. On 4th, 8th, 12th, 16th and 20th day post wounding strips were carefully excised from healing wound for mechanical evaluation viz; breaking strength, tensile strength, extensibility and energy absorption. The results are being compiled and analysed.

- (5) Studies on camel skin-Ph. D. Project Report by Sunita Patil, Department of Zoology, M.S. University of Baroda, Vadodara-390 002.

The lamellar body secretion has been previously studied in birds, reptiles, cetaceans and rats. This present study was, therefore, taken up to investigate the lamellar body secretion in the animals like camels which are specially adapted to the desert conditions. Our main aim was to study the lipid pattern in the camel epidermis of both adult and foetal skin. But, due to non-availability of the foetal skin, only adult skin was used for the study.

The fluorescence microscopy for lipids showed that there are more of neutral lipids in the stratum corneum (SC) and more of phospholipids in the lower epidermis. Light microscopic studies showed that the SC was very thick, while the granular layer is 1-2 layers thick. The tissues were also processed for electron microscopy (EM). The EM studies are still under progress.

- (6) Studies on inorganic elements in the camel (*Camelus dromedarius*) seminal

plasma during rutting season—M.V. Sc. project.

Report by Jiledar Singh, College of Veterinary and Animal Science, Rajasthan Agricultural University, Bikaner-334 001.

Studies on inorganic elements in the camel seminal plasma and blood serum during rutting season and their association with ejaculate volume and sperm concentration were conducted on six adult stud camels. The semen was collected from each of stud camels on alternate days. The seminal plasma was separated by centrifugation at 4000 rpm for 30 minutes. Immediately after semen collection, 20 ml blood was taken and serum was separated. The ejaculate volume obtained from bull camels varied from 5.1 to 11.0 ml with an average of 7.76 ± 0.27 ml. There was no significant difference in the ejaculate volume between the bull camels. The overall mean of sperm concentration was 392.42 ± 15.01 millions per ml with range of 150 to 550 millions per ml.

The overall mean of calcium, inorganic phosphorus, magnesium, chloride, sodium and potassium in the seminal plasma of stud camels during rutting season were 11.47 ± 0.16 , 3.21 ± 0.06 , 2.57 ± 0.06 , 550.86 ± 3.64 , 401.51 ± 5.48 and 61.31 ± 1.19 mg per 100 ml respectively and in blood serum were 10.03 ± 0.17 , 5.2 ± 0.06 , 1.99 ± 0.06 , 416.84 ± 2.58 , 402.17 ± 2.78 and 12.35 ± 0.07 mg per 100 ml respectively. The coefficient of correlation of sodium, inorganic phosphorus, chloride and potassium contents of seminal plasma with ejaculate volume were not statistically significant. The concentration of calcium and magnesium in the seminal plasma did not exhibit much variation. There was no significant correlation between the levels of calcium, magnesium, inorganic phosphorus, chloride and sodium in the seminal plasma with sperm concentration. The values were -0.22, -0.15, -0.21, +0.17 and +0.09

respectively. However, the concentration of potassium in the seminal plasma was found to be positively and significantly correlated with the sperm concentration.

There was no significant correlation between inorganic elements viz., calcium, phosphorus, magnesium, chloride, sodium and potassium in the seminal plasma with that of blood serum.

- (7) Some seminal studies on camel (*Camelus dromedarius*) in arid zone of Rajasthan and electron microscopy of spermatozoa—M.V.Sc. project.

Report by Rajiv Kumar Nagpal, College of Veterinary and Animal Science, Rajasthan Agricultural University Bikaner-334 001.

Six sexually mature Bikaneri male camels were taken and subjected to semen collection thrice weekly. It was observed that the rutting season of male camel was from November to March. Signs of rut were loss in condition, furiousness, grunting and gurgling sound, excessive salivary secretion, dark tan coloured secretion from the poll glands, lashing of tail on the testes and genital organs, frequent micturation and typical posture with hind legs stretched wide apart etc. The sequential events in mating were as Courtship, force applied for making the females to sit on ground, positioning, mounting of the male camel, intromission, copulation, orgasm, ejaculation and dismounting. Mean reaction time was $9.05 + 0.21$ minutes.

The average volume, hydrogen ion concentration and sperm concentration of ejaculates were 7.76 ± 0.27 ml, 7.81 ± 0.05 and 392.41 ± 15.01 millions sperm per ml, respectively. Colour of the ejaculates were milky white and of thick viscid consistency. Motility of spermatozoa was not observed. The average live spermatozoa and head,

middle piece, tail and total abnormalities of spermatozoa of the ejaculates were 77.56 ± 0.38 , 3.60 ± 0.23 , 6.10 ± 0.30 , 3.97 ± 0.22 and 3.81 ± 0.25 percent, respectively. The average head length, head width, middle piece length, tail length and total length of spermatozoa of ejaculated semen were 5.12 ± 0.02 , 3.22 ± 0.008 , 8.32 ± 0.06 , 32.49 ± 0.12 and 45.92 ± 0.12 microns, respectively.

Electron microscopic study of spermatozoa revealed that in median section the head was lancet shaped. The anterior most of head was covered with acrosome. The neck was articulated with head slightly eccentric. The middle piece comprised of outermost cell membrane, mitochondrial sheath and axial filament complex (9+9+2).

- (8) Studies on sexual behaviour and semen evaluation in Indian camel—M.V.Sc, project of Lajja Ram.

Report by Prof. S.P. Agarwal Department of Veterinary Physiology Haryana Agricultural University, Hisar-125 004.

Sexual behaviour

The observations were made to study sexual behaviour. 26 adult breeding camel bulls on six different occasions on each animal and classified as furious, strong and mild, frothing of salivary secretions at the mouth and flow of poll gland secretions subjectively scored as copious, mild scanty, frequency of flapping of tail and ejection of soft palate, copulation time and number of jerks per mating. The intensity of behavioural expression of an animal varied at different occasions but its dominance in a certain category was often maintained. Of the total 36 observations, the furious, strong and mild sexual behaviour was recorded on 14 (39%), 17 (47%) and 5 (14%) occasions, respectively. Similarly, the frequency of copious, medium

and scanty frothing of saliva at the mouth was found on 30, 40 and 30% and that of poll gland secretion on 25, 55 and 20% of the total occasions, respectively. The frequency of soft palate ejection varied from 4 to 6 and that of tail movements from 21 to 29 per minute with an overall average of 5 and 26 respectively. The mean copulation time was found to be 364 ± 21 sec with a range of 242 to 466 sec. The number of jerks during mating ranged

between 4 to 15 with an average of 10 per act of copulation.

Semen evaluation

Data were collected with respect to macro and microscopic observations on semen and certain biochemical characteristics of the seminal plasma. The results are presented in table 29.

Table 29. Mean values of physical and biochemical attributes of camel semen

Characteristics	Camel No.						Overall
	179	180	53	59	52	67	Mean
Physical attributes							
Volume/ejaculate (ml)	9.2c ±1.0	6.9b ±0.5	7.2b ±0.8	6.2ab ±1.9	5.3a ±0.8	5.5a ±1.2	6.7 ±0.3
pH	7.3a ±0.2	7.3a ±0.3	7.4a ±0.2	7.2a ±0.1	7.2a ±0.1	7.2a ±0.1	7.3 ±0.1
Sperm conc. (million/ml)	521.2a ±129.4	526.7a ±80.9	562.8a ±55.8	585.8b ±72.1	542.5a ±84.2	559.3a ±100.6	566.4 ±19.5
Total sperm conc. (million/ejaculate)	4825.9c ±612.3	3623.4b ±470.5	4052.4bc ±506.6	4272.4bc ±483.2	2891.5a ±395.4	3093.1a ±312.3	3793.1 ±212.3
Live sperm (percentage)	57.0a ±2.6	57.8a ±3.3	59.2a ±4.4	60.5a ±3.3	61.8a ±2.0	58.1a ±2.8	59.1 ±0.5
Biochemical constituents							
Fructose (mg/100 ml)	360a ±49	454b ±84	564c ±64	621c ±43	443b ±99	426ab ±104	478 ±19
Glucose (mg/100 ml)	4.2b ±0.3	5.0b ±1.9	3.1a ±0.8	3.7ab ±0.2	3.8a ±0.9	6.5c ±0.6	4.4 ±0.2
Cholesterol (mg/100 ml)	226b ±3.7	25.9c ±1.9	16.1a ±1.6	20.0b ±1.6	16.8a ±1.0	15.3a ±0.8	19.5 ±0.7
Total protein (mg/100 ml)	1.2a ±0.6	1.3a ±0.8	1.0a ±0.6	0.7a ±0.3	0.6a ±0.3	0.5a ±0.1	0.9 ±0.1
Citric acid (mg/100 ml)	409bc ±0.8	42.0c ±4.9	35.6b ±4.6	38.7b ±3.7	23.4a ±1.8	36.4b ±1.5	36.2 ±1.1

Each mean is based on six observations values with different superscripts differ significantly (P/0.05).

9.

PUBLICATIONS

List of articles published during the year.

- (1) Agarwal, S.P., Agarwal, V.K., Khanna, N.D. and Dwaraknath, P.K. 1989. Serum estrogen and progesterone levels in camel during oestrus cycle. *Indian Vet. J.*, 66:605-608.
- (2) Agarwal, S.P., Khanna, N.D., Agarwal, V.K. and Dwaraknath, P.K. 1989. Circulating levels of thyroid hormones in pregnant camels (*Camelus dromedarius*). *Theriogenology*, 31(6):1239-1247.
- (3) Khanna, N.D. 1989. Camel, the important domestic animal of desert. pp 174-179 in *Bikaner Panchshat Samarika*, 1989. (Editor) Suraj Mal Singh Rathore, Rao Bikaji Sansthan, Bikaner.
- (4) Khanna, N.D. and Rai, A.K. 1989. A description of work performance of camel. *Indian J. Anim. Sci.*, 59(9):1172-1177.
- (5) Khanna, N.D., Rai, A.K. and Tandon, S.N. 1990. Population trends and distribution of camel population in India. *Indian J. Anim. Sci.*, 60(2):331-337.

List of articles submitted for publication

- (1) Khanna, N.D. Camels in India from the protohistoric to the present times. *Indian Journal of Animal Sciences*. (Vol. 60 No. 9-in Press)
- (2) Khanna, N.D. Adikal se vartaman samaya tak Bhartiya parivesh main Oont (Hindi). Submitted to *Krishi Chainika*.
- (3) Khanna, N.D. and Rai, A.K. Camel an important resource in the desert livestock enterprise and its role in the control of desertification. Submitted to *Indian Farming*.
- (4) Khanna, N.D. and Rai, A.K. The case of camel rearing in Indian arid land. Submitted to *International Journal of Animal Sciences*.
- (5) Khanna, N.D., Tandon, S.N. and Rai, A.K. Breeding parameters of Indian camels. Submitted to *Indian Journal of Animal Sciences*.

10.

RESEARCH PROGRAMME FOR 1990-91

The following research projects will be undertaken:—

- (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
: A.K. Roy
Technical Assistance : U.K. Bissa
- (2) Project Code No. P.I. 86/2-ICN/L-10/5220
Studies on quantitative and qualitative genetic parameters in Indian camels.
Project Leader : N.D. Khanna
Associate : S.N. Tandon
Technical Assistance : U.K. Bissa
- (3) Project Code No. P.I. 86/3-ICN/L-05/5220
To develop suitable management practices for rearing camels.
Project Leader : S.N. Tandon
Associate : N.D. Khanna
Technical Assistance : N. Sharma
- (4) Project Code No. P.I. 90/4-ICN/L-30/5220
Studies on Nutritional requirements of Indian camels.
Project Leader : R.C. Jakhmola
Associates : A.K. Rai
: A.K. Roy
Technical Assistance : N. Sharma
- (5) Project Code No. P.I. 90/5-ICN/L-31/5220
Studies on camel reproduction.
Project Leader : A.K. Rai
Associates : A.K. Roy
: N.D. Khanna

11. VISITORS

National Research Centre on Camel, Bikaner welcomed 2189 visitors during the year 1989-90. Prominent amongst these were Shri Bhajan Lal Ji, Hon'ble Minister for Agriculture, Govt. of India, Shri Shiv Charan Mathur, Hon'ble Chief Minister of Rajasthan State, Shri Bulaki Dass Kalla, Hon'ble Minister for Education and Public Works Department, Govt. of Rajasthan, Shri Hira Lal Indora, Hon'ble State Minister, Rajasthan Government, Dr. M.S. Swaminathan, Ex-Director General, ICAR, Dr. N.S. Randhawa, Director General, ICAR, Dr. R.M. Acharya, Deputy Director General (AS), ICAR, Dr. C. Prasad, Deputy Director General (Extension), ICAR, Dr. C.L. Arora, Asstt. Director General (AP&B), ICAR, Dr. A.L. Chaudhary, Director, Central Sheep & Wool Research Institute, Avikanagar, Dr. S.C. Chopra, Director, Central Institute for Research on Buffalo, Hisar, Dr. R.P.S. Tyagi, Member, Agricultural Scientists Recruitment Board, ICAR, New Delhi, Dr. B.S. Gill, Former Dean, College of Vety. Science & Animal Husbandry, Punjab Agril. University, Ludhiana, Professor P.K. Uppal, Project Director, National Research Centre on Equines, Hisar, Dr. Mohan Singh, Ex-Dean, College of Veterinary Science & Animal Husbandry, Bikaner, Rish Toni, Swiss Federal Research Station for Animal Production,

Switzerland, Berend de Ceial, Indo Swiss Goat Development & Fodder Production Project, Ajmer, Dr. A.P. Vyas, Director of Research, Gujarat Agriculture University, Ahmedabad, Dr. O.N. Kunzru, Joint Director (Extension), IVRI, Izatnagar, Dr. R. Sinha, Dean, Faculty of Veterinary & Animal Science, Bidhan Chandra Agriculture University, Mohanpur, West Bengal, Shri S. Rangnathan, Judge, Supreme Court, Dr. S.S. Sharma, Head, Faculty of Veterinary Medicine, Nigeria, Dr. G.N. Wahi, Director, Sheep Husbandry, Jammu, J&K State, Dr. G.M. Khan, Director, Sheep Husbandry, Kashmir, J&K State, Dr. G.A. Bally, Ex-Director, Sheep Husbandry, J&K State, Prof. Adel El Bettargy, Secretary, Land Reclamation, Cairo, Egypt, Dr. John Carlet, World Bank Team, Dr. A.C. Jain, World Bank, Roger Sloclie, World Bank Team, Dr. K.K. Iya, Ex-Director, NDRI, Karnal, Dr. Dessimir Neoleljseheva & Dr. Stoeotin, Popov, Bulgaria, Sh. U.R. Chopra, Divisional Railway Manager, Northern Railway, Bikaner, Shri Shantanu Kumar, IPS, Shri R.N. Tawade, Regional Manager, Bank of Maharashtra, New Delhi, Miss Rama Ghosh, Director Telecom, New Delhi, Shri Y.P. Sabharwal, Chief Income Tax Commissioner, Rajasthan, Jaipur and other visitors including scientists, administrators, tourists and others.

12.

ADVISORY COMMITTEE

- | | |
|---|---|
| <p>1. Dr. N.D. Khanna, Project Director, National Research Centre on Camel, Bikaner</p> | <p>5. Dr. A.K. Rai, Principal Scientist, NRCC, Bikaner</p> |
| <p>2. Dr. C.L. Arora, Asstt. Director General (AP&B), ICAR, New Delhi</p> | <p>6. Shri. B.L. Jhangira, Sr. Accounts Officer, CAZRI, Jodhpur</p> |
| <p>3. Dr. P.R. Jatkar, Dean, CVAS, Bikaner</p> | <p>7. Shri. Santokh Singh, Asstt. Adm., Officer, NRCC, Bikaner</p> |
| <p>4. Dr. C.S. Mathur, Ex-Dean, CVAS, Bikaner</p> | |
| <p>Chairman</p> | <p>Member</p> |
| <p>Member</p> | <p>Member</p> |
| <p>Member</p> | <p>Secretary</p> |
| <p>Member</p> | |

13.

DIARY OF EVENTS

- | | | |
|---------------------|--|--|
| <p>January '89</p> | <p>Dr. N.D. Khanna, Project Director and Dr. A.K. Rai, Principal Scientist attended workshop on AICRP, Sheep & Goat at Rajasthan Agricultural University, Bikaner.</p> | <p>Shri Anil Kumar joined as Junior Clerk.</p> |
| | <p>March '89</p> | <p>Dr. S.N. Tandon, Scientist was promoted as Senior Scientist (Animal Genetics & Breeding).</p> |
| <p>February '89</p> | <p>Dr. M.S. Swaminathan, Former Secretary of Union Agriculture Ministry & Director General, ICAR and Dr. N.S. Randhawa, Director General, ICAR visited NRCC.</p> | <p>Dr. A.K. Rai, Principal Scientist attended II workshop on AICRP on Utilization of Animal Energy at Narendra Dev University of Agriculture & Technology, Faizabad.</p> |

- June '89 Shri Vishnu Kumar joined as Junior Clerk.
- July '89 Dr. A.K. Nagpal joined as Scientist (Animal Nutrition).
- August '89 Shri Balwant Rai, Superintendent transferred to NRC on Weed Sciences, Jabalpur on promotion as Asstt. Adm. Officer.
- September '89 Shri N.D. Sharma joined as Asstt. Accounts Officer. Shri Shivji Ram promoted as vehicle driver (Mini bus). Dr. A.K. Nagpal attended National Seminar on Sheep & Goat Nutrition and Pasture Utilization, Central Sheep & Wool Research Institute, Avikanagar.
- October '89 Dr. N.D. Khanna, Project Director attended National Seminar on Genetics Applied to Livestock Production at Gujarat College of Veterinary Science and Animal Husbandry, Anand. Dr. S.N. Tandon, Senior Scientist attended National Symposium on Applied Reproduction in Farm Animals and VIII Convention of Indian Society for the Study of Animal Reproduction at Gujarat Agriculture University, Anand.
- November '89 Dr. N.D. Khanna, Project Director attended National top level workshop on Management of Research for Rainfed Region, Ahmedabad.
- Dr. R.C. Jakhmola joined as Senior Scientist (Animal Nutrition). Shri A.K. Mallick joined as Superintendent. Shri Kanwar Pal promoted as Senior Clerk.
- January '90 Dr. N.D. Khanna, Project Director was deputed to the International Fund for Agriculture Development (UNO), Rome for seven weeks as a Consultant to the Camel Research and Development network mission. Dr. A.K. Nagpal, Scientist, transferred to NRC for Mithun, Porba, Nagaland on Promotion as Senior Scientist.
- March '90 Dr. N.D. Khanna, Project Director was deputed to Arab Republic of Egypt for three weeks in the field of Camel Breeding and Management under Indo-ARE work plan for 1989-90. Dr. A.K. Roy joined as Scientist (Animal Physiology) The volley ball (shooting) team of the Centre under the captainship of Shri Mohan Singh was awarded runner's trophy in the ICAR Zonal Tournament held at Pali (Rajasthan) from 5th to 8th March, 1990.

सारांश

भारतीय कृषि अनुसंधान परिषद नई दिल्ली ने बीकानेर (राजस्थान) में दिनांक 5 जुलाई 1984 को राष्ट्रीय उष्ट्र अनुसंधान केन्द्र की स्थापना की तथा अपने इस अल्प समय में ऊँटों पर विभिन्न प्रयोग करने, उनकी उपयोगिता एवं कार्य कुशलता के बारे में अध्ययन किया गया है।

आठवीं पंचवर्षीय योजना के दौरान राष्ट्रीय उष्ट्र अनुसंधान केन्द्र के निम्नलिखित प्राथमिकताएं एवं कार्य क्षेत्र होंगे:

1. ऊँट के वंशानुगत संसाधन और उनका मूल्यांकन।
2. ऊँट की मालदुलाई की क्षमता एवं उसकी क्षमता बढ़ाने के बारे में अध्ययन।
3. ऊँट की नस्ल सुधार।
4. ऊँट की पोषण सम्बन्धी आवश्यकताओं के बारे में अध्ययन, आहार के स्त्रोतों का निर्धारण एवं उसका मूल्यांकन।
5. ऊँट की प्रजनन क्षमता में सुधार करना।
6. ऊँट के स्वास्थ्य को सुधारना/उन्नत करना एवं ऊँट की प्रमुख बिमारियाँ, उसकी रोकथाम एवं नियन्त्रण करने के बारे में अनुसंधान।
7. ऊँट पालन के परम्परागत तरीकों का सामाजिक, आर्थिक क्षेत्र में प्रभाव तथा उसमें सुधार करने के लिए अध्ययन।
8. ऊँट से प्राप्त उत्पादों (दूध एवं बाल) का उपयोग तथा मूल्यांकन।

52 स्वीकृत पदों में से 47 पद कार्यरत हैं। 7वीं पंचवर्षीय योजना के आरम्भ में केन्द्र के विकास के लिए 98.5 लाख रुपये की धनराशि स्वीकृत की गई थी। गत वर्ष के दौरान 43 लाख रुपये की अतिरिक्त धनराशि स्वीकृत की गई।

इस वर्ष के अन्त में 218 ऊँट थे जिनमें से 129 बीकानेरी, 49 कच्छी, 30 जैसलमेरी, 9 वर्ण संकर एवं एक अरब नस्ल के थे। इस वर्ष की अवधि में 58 बच्चे पैदा हुए। नर एवं मादा का अनुपात 0.87: 1, बच्चा पैदा करने की दर 88.6% एवं गर्भाधान की दर 80% थी। कुल मिलाकर मृत्यु दर 4.13% थी। ग्रामीणों के द्वारा लाई गई 113 मादाओं को उत्तम नस्ल के ऊँटों से गर्भाधान कराया गया।

निम्नलिखित तीन अनुसंधान परियोजनाओं पर विगत वर्षों में शोध कार्य किया गया।

1. परियोजना संकेत संख्या पी.आइ. 86/1-आई.सी.एन./एल-50/5220, ऊँट की मानक कार्यक्षमता एवं मानक कार्यक्षमता की शारीरिक, आकृति/शरीर विज्ञान एवं जीव रसायन के क्षेत्र में सम्बन्धों (परस्पर सम्बन्धों) पर अध्ययन।
2. परियोजना संकेत संख्या पी.आइ. 86/2-आई.सी.एन./एल-10/5220, भारतीय ऊँट के परिमाणात्मक एवं गुणात्मक सम्बन्धी क्षेत्रों में उत्पत्ती के संदर्भ में अध्ययन।
3. परियोजना संकेत संख्या पी.आइ. 86/3-आई.सी.एन./एल-05/5220, ऊँटों के विकास के लिए अनुकूल प्रबन्ध व्यवसाय को विकसित करना।

बीकानेरी, जैसलमेरी, कच्छी नस्ल के ऊँटों की दुलाई क्षमता एवं सवारी की सामर्थ्यता/योग्यता पर अध्ययन किए गए। उक्त विज्ञान जीव रसायन, शारीरिक आकृति, गति, लांघना एवं सहिष्णुता/सहनशीलता का अध्ययन कोलतार/डामर सड़क के सन्दर्भों में अध्ययन कर आँकड़े इकट्ठे/एकत्रित किए गए।

जन्म के समय वजन, विभिन्न आयु में शरीर का वजन, वृद्धि दर, गर्भाधारण की अवधि, दो बच्चों के मध्य पैदा होने का अन्तराल, लिंग अनुपात, झुण्ड की बनावट/आकार का अध्ययन किया गया।

1961 से 1990 तक के दौरान प्रजनन सम्बन्धी लक्षणों के आंकड़े निम्नलिखित हैं:-

लक्षण	1961-85	1986-88	1989-90
1. गर्भाधारण की अवधि (दिनों में)	389.30-00.08 (532)	382.20-02.02 (36)	382.30-02.17 (40)
2. प्रथम गर्भाधान के समय उम्र (दिनों में)	1390.00-25.00 (60)	1239.67-80.84 (12)	1108.73-34.57 (11)
3. प्रथम बच्चा होने के समय उम्र (दिनों में)	1882.00-28.67 (93)	1635.67-82.33 (12)	1489.00-22.81 (5)
4. दो बच्चों के मध्य का अन्तराल (दिनों में)	770.61-03.62 (582)	731.10-29.23 (10)	713.05-20.40 (20)

नोट: कोष्ठक में दी गई संख्या निरीक्षणों की संख्या दर्शाती है।

बिना प्रजनन काल के मौसम के प्रजनन पर, व प्रजननकाल में तथा बिना प्रजनन काल के मौसम में शुक्राणुओं पर मूल्यांकनों के आधार पर अध्ययन किया गया।

1. बढ़ते हुए बच्चों पर रक्त विज्ञान एवं जीव रसायन के सन्दर्भ में भी अध्ययन किया गया।
2. दूध उत्पादन के अध्ययन से यह भी पता चला है कि ऊँटों को अतिरिक्त पोषक आहार दिए बिना भी 4 से 11 किलोग्राम तक दूध प्रतिदिन प्राप्त किया जा सकता है।

वर्णसंकर नस्ल में उच्चतम 1200 ग्राम प्रतिपशु एवं कच्छी नस्ल मले त्पूनतम 1089 ग्राम प्रतिपशु बालों का उत्पादन पाया गया है।

1. राष्ट्रीय डेरी अनुसंधान संस्थान, करनाल के साथ दुग्ध सम्बन्धी अध्ययन में।
2. हरियाणा कृषि विश्वविद्यालय, हिसार के साथ अन्तः स्त्रावी ग्रथियों एवं प्रजनन व्यवहार के सम्बन्ध में।
3. राजस्थान कृषि विश्वविद्यालय, बीकानेर के साथ घाव का भरना/ठीक होना, एम. एस. विश्वविद्यालय, बड़ौदा के साथ ऊँट की त्वचा, राजस्थान कृषि विश्वविद्यालय, बीकानेर एवं हरियाणा कृषि विश्वविद्यालय, हिसार के साथ शुक्राणुओं के अध्ययन में।

वर्ष के दौरान 5 शोधपत्र का प्रकाशन किया गया एवं 5 शोधपत्र प्रकाशनार्थ भेजे गए हैं।

केन्द्र ने सयुक्त राष्ट्र संघ के कृषि विकास अन्तराष्ट्रीय निधि, रोम को ऊँट के लिए विशेषज्ञीय परामर्श प्रदान किया।

वर्ष के दौरान सम्माननीय मंत्री, वैज्ञानिक, प्रशासनिक सहित कुल 2189 भारतीय और विदेशी पर्यटकों द्वारा केन्द्र का अवलोकन किया गया।

14. ACKNOWLEDGEMENTS

The Centre was benefitted by the comprehensive guidance provided by the members of the Advisory Committee. Much of the Centre's progress and development during the year was due to the keen interest and support of Dr. R.M. Acharya, Deputy Director General (Animal Sciences) and Dr. N.S. Randhawa, Director General, Indian Council of Agricultural Research, New Delhi.

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RESIDENCE : 5152

POSTAL ADDRESS : NATIONAL RESEARCH CENTRE ON CAMEL,
P.B. NO. 07,
JORBEER, BIKANER : 334001
(RAJASTHAN).

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

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

STENOGRAPHIC ASSISTANCE : SHRI M. PADMAKUMAR

PUBLICATION COMMITTEE : DR. A.K. RAI
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SHRI N.D. SHARMA

PRINTED BY : JANSEVI PRINTERS
DAUJI MANDIR BHAWAN
BIKANER
TEL. : 5515 (Off.), 5955 (Res.)

