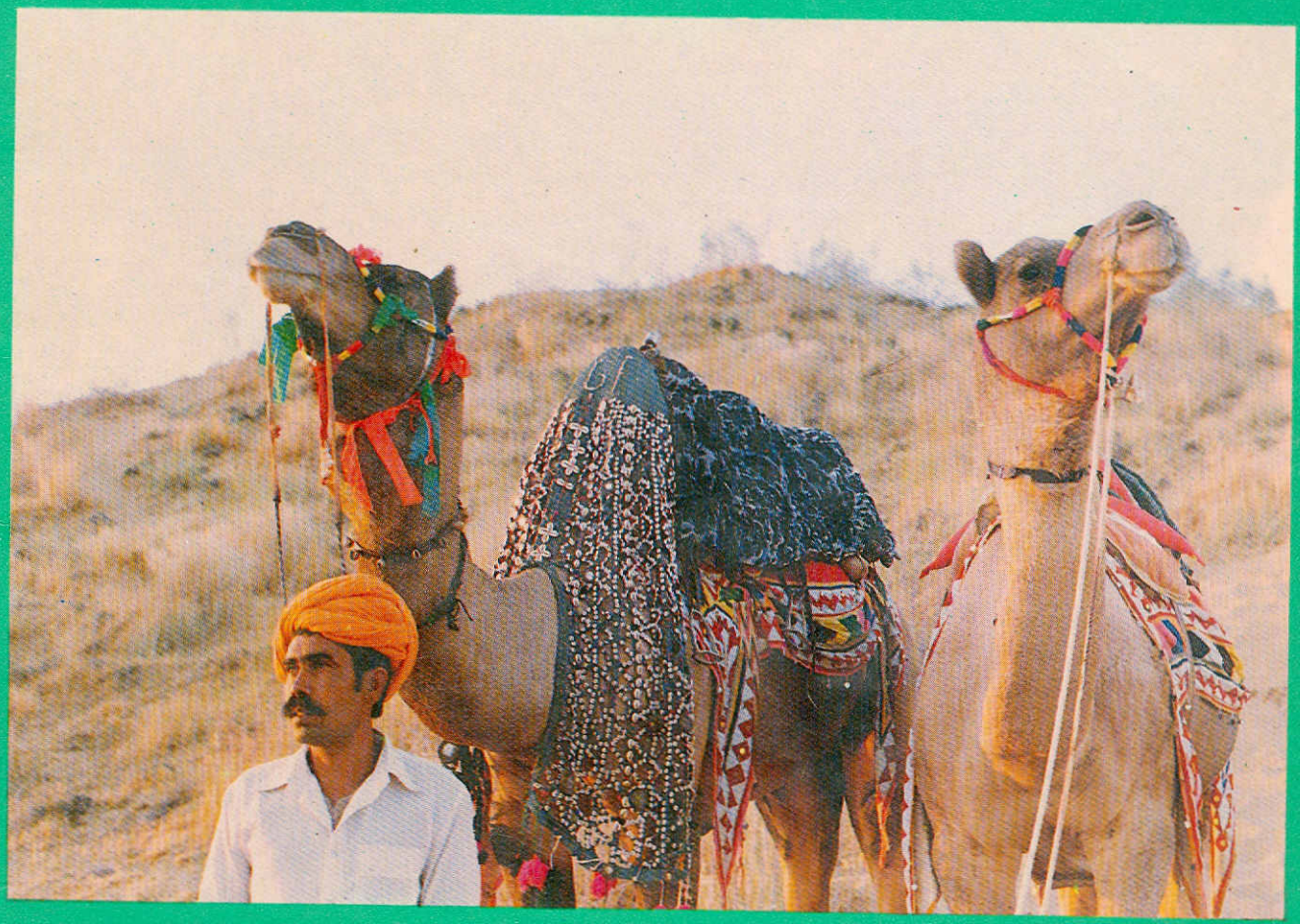
ICAR

ANNUAL REPORT 1990-91



NATIONAL RESEARCH CENTRE ON CAMEL
BIKANER

भाकृअनुप
ICAR

ANNUAL REPORT 1990-91

(Estd. 5th July, 1984)

Project Director : Dr. N.D. Khanna

NATIONAL RESEARCH CENTRE ON CAMEL
BIKANER

CONTENTS

1.
PREFATORY REMARKS

The camel production system in India has undergone fast fundamental changes from subsistance nomadism shifting towards semi-sedentary cash demanding system. This is more pronounced in those camel keeping rural areas which are contiguous to the urban settlements. The camels of rural and semi-urban camel keeping families in arid and semi arid areas, therefore, must become more productive and economically competitive, if these communities concerned are to make substantial sustenance from camel keeping. Apart from draught, transport and agricultural operation, the future role of camel is assumed to lie in their capacity to produce milk for human consumption and to an extent in provision of meat. If the camel is to retain its unique advantageous position of adaptability to extreme difficult climate, than its capacity to utilise low quality feed resources and convert them into animal power, protein and other byproducts must be improved upon. These special features of camels are, therefore, not only a scientific challenge but are of importance to the basis of land use planning as provider of bioenergy for agricultural operations, transport and a source of sustenance for the people who live in the marginal dry land areas.

There have been varied levels of national efforts for augmenting camel research, however, the overall efforts remain sparse because of shortage of resources in different department and comparatively less interest in camel research. The research efforts must be directed towards husbandry, health control and productivity variables important for future utility of the camel, both under semi-intensive and semi-sedentary systems. The problems concerning health management and improving reproductive efficiency warrants immediate attention. A balance has also to be maintained between selection for higher production traits coupled with an increasing rate of offtake and maintenance of distinctive advantage of adaptation to the harsh environmental conditions, endurance, mobility and superior draftability.

It is against this background that the future research programmes of the National Research Centre on Camel, Bikaner have been formulated to establish applied camel research and development programmes. The camel with estimated 1.4 m. population can substantially contribute towards uplifting the economic status of people inhabiting in desertic land where animal husbandry is prime vocation.

N.D. Khanna
Project Director

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. A post of Hindi Translator has also been created during the year 1989-90. Year wise staff position is given in Table 1.

Table 1. Staff position

Staff categories	Sanctioned posts			Positions filled (Year-wise)						
	6th plan	7th plan	Total	84-85	85-86	86-87	87-88	88-89	89-90	90-91
R.M.P.	1	-	1	1	1	1	1	1	1	1
Scientific	1	7	8	-	1	3	3	2	4	5
Technical										
Category I	2	1	3	2	2	2	3	3	3	3
Category II	-	3	3	-	-	-	1	3	3	3
Category III	2	2	4	-	2	2	3	3	3	3
Administrative	4	7	11	3	6	7	7	8	10	10
Auxiliary	2	3	5	1	2	2	3	5	5	5
Supporting	11	13	24	11	11	14	22	22	23	24
	23	36	59	18	25	31	43	47	52	54

The names of the staff member in position during 1990-91 are given below :-

Project Director	:	N.D. Khanna
Scientific		
Principal Scientist (Animal physiology)	:	Dr. A.K. Rai
Senior Scientist (Animal Nutrition)	:	Dr. R.C. Jakhmola
Senior Scientist (Animal Gen. & Breeding)	:	Dr. S.N. Tandon
Senior Scientist (Animal Health)	:	Vacant
Senior Scientist (Animal Reproduction)	:	Vacant
Scientist (Animal Nutrition)	:	Dr. A.K. Nagpal (Joined on 16.1.91)
Scientist (Animal physiology)	:	Sh. A.K. Roy
Scientist (Animal Biochemistry)	:	Vacant

Technical		
Farm Technician, T-7 (Animal Health)	:	Dr. U.K. Bissa
Vety. Officer, T-6 (Livestock Farm Supdt.)	:	Dr. Narendra Sharma
Farm Manger (Agric.) T-6	:	Sh. Ram Kumar
Agril. Asstt. T -II -3	:	Sh. J.C. Joshi
Library Asstt. T-II-3	:	Sh. Ram Dayal
Jr. Engineer, T-II-3	:	Sh. Dau Lal Purohit
Livestock Asstt., T-I-3	:	Sh. Mohan Singh (Promoted w.e.f. 1.1.91)
Livestock Asstt., T-2	:	Sh. Ramchander Bheel
Lab. Techn. T-1	:	Sh. Nand Kishore
Administrative		
Asstt. Adm. Officer	:	Sh. Santokh Singh
Asstt. Accounts Officer	:	Sh. N.D. Sharma
Superintendent	:	Sh. Ashok Malick
Stenographer	:	Sh. P.K. Nair (Promoted w.e.f. 26.02.91)
Junior Stenographer	:	Sh. Ram Kumar
Senior Clerk	:	Sh. Kanwar Pal
Senior Clerk	:	Sh. A.K. Yadav (Promoted w.e.f. 26.02.91)
Junior Clerk	:	Sh. Jamil Ahmed Sh. Anil Kumar Sh. Vishnu Kumar
Auxiliary		
Driver	:	Sh. Shivji Ram Sh. Prabhu Dayal Sh. Mehboob Hussain Sh. Rafiq Alam Sh. Mani Lal
Supporting		
SSG I to V	:	24*

(*One SSG-1 retired on invalid pension)

3.
FINANCIAL STATEMENT

During the year 1990-91, Rs.50.00 lakhs were sanctioned under 'plan' and Rs. 28.40 lakhs were sanctioned under 'Non plan'. The expenditure during the year under 'Plan' was 35.86 lakhs and under 'Non plan' was 28.56 lakhs. The details are provided in the Table 2.

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

S. No.	Head of account	1989-90		1990-91			
		Plan	Non-Plan	Plan		Non-Plan	
		Expenditure		B. Est.	Exp.	B. Est.	Exp.
1.	Estt. Charges	7.84	4.87	12.00	-	14.60	16.79
2.	Travelling Exp.	0.43	0.25	1.00	0.20	0.50	0.45
3.	Other Charges	14.80	8.16	21.00	16.02	11.80	10.55
4.	Equipments	4.67	0.11	-	4.13	-	0.77
5.	Works	14.65	0.13	16.00	15.51	1.50	-
	Total	42.39	13.52	50.00	35.86	28.40	28.56

4.
CAMEL HEALTH

Clinical Cases

In all 220 cases were treated for digestive disorder (38), respiratory infections (13), blood & circulatory system (4), gynecological (9), contagious ecthyma (12), ectoparasitic & skin affections (81), snake bite (1), injuries & wounds (31) & other 31 cases.

Prophylactic measures :

(i) The animals & sheds were sprayed with insecticides twice a year for prevention and control of ectoparasites.

(ii) The camles were treated with broad spectrum anthelmentic twice at an interval of 6 months.

(iii) New born calves were given vitamin A 600000 I.U. as a prophylactic measure.

(iv) As a prophylatic measure quinipyramine sulphate & chloride was injected twice a year to all the animals. No case of trypanosomiasis was recorded during the year.

Mortality

During the year 1990-91. 4 animals died in the age group of 0-3 months & 5 animals died in the age group of 3 months to 3 years. The deaths were due to respiratory infection (3) heat stroke (2) digestive disorder (1) & snake bite (1). Two animals died just few hours after birth. The details are given in table 3.

Table 3. Mortality per 1000 camel day per day (1990-91)

Age group	Sex	Camel days	Animals died	Mortality	Percent mortality
0-3 months	Male	583	3	5.146	
	Female	754	1	1.326	
	pooled	1337	4	2.992	10.9
3-36 months	Male	13448	3	0.223	
	Female	16229	2	0.123	
	pooled	29677	5	0.169	6.2
Above 3 Years	Male	11617	-	-	
	Female	35001	-	-	
	pooled	46618	-	-	-
Overall	Male	25648	6	0.234	
	Female	51984	3	0.058	
	pooled	77632	9	0.116	4.2

5. LAND AND RANGE DEVELOPMENT

The range land of the centre is extended over 824 ha. The area is being fenced in phases and the development activities are mainly restricted to the fenced area.

About 100 ha land was sown with rainfed crops namely guar *(Cyamopsis tetragonoloba)* Moth *(Phaseolus aconitifolius)* and Bajara *(Pennisetum typhoides)* and was directly utilise by the camels in the field. Pasture of Blue panic was estabished using root-slips in about 5 hr area. old established pature were dressed. Irrigation channel was laid down covering a distance of 1 km. In the newly fenced area 20,000 plants of different varieties were sown and12,000 plants which were sown earlier were maintained.

Sand-dunes were suitably leveled in the area and new office-cum-residential complex.

6.
RESEARCH PROJECTS

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

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

Project Leader : A.K. Rai
: N.D. Khanna
: A.K. Roy

Endurance for ploughing and fatigue

The symptoms of fatigue in livestock are almost common but the sequence of their appearance and relative importance of a particular symptom may vary from species to species. These are also influenced by the behavior of the animal. During the year under report fatigue symptoms of camels were recorded. The endurance for work performance was studies using plough, loading car and riding at different speed. The correlations of work performance with different body measurements were worked out.

Six adult camels maintained under uniform management were used in the experiment. The animals were trained for ploughing. The study was conducted during hot humid months (August and September). The soil texture of the land was sandy and the field was under regular cultivation. The ploughing operation was started at 8.30 a.m. and was continued till the animals could not work further. The rectal temperature, pulse and respiration rate was recorded and the blood sample was collected before and after the ploughing. The total ploughed area was measured for each animal and the time taken was recorded. The force exerted by camles while ploughing was measured using load cell fixed between animal and the plough. The draught force (kgf) generated was recorded during different periods of working for atleast 50 meters each time and averaged. The ploughing capacity was calculated using the formula.

Ploughing capacity = Area ploughed x 100 / Body weight

The camels could plough continuously for 4.25 ± 0.27 hrs and covered an area of 3136 ± 168 m^2. The mean area ploughed per hour was 740.5 ± 13.6 m^2 with depth ranging from 9 to 15 cm (Table 4). The angle of the plough was 21 ° from the horizontal plane. The camels produced 14.01 ± 1.24 percent body weight as draught, which ranged from 9.24 to 16.91 percent. The horse power generated was 1.10 ± 0.09 (range : 0.78 to 1.32). The ploughing capacity per 100 kg body weight was found to be 523.28 ± 11.74 m^2 (range : 483 to 586 m^2/ 100kg).

The average percent increase in pulse and respiration rate was found to be 39.2 and 142 respectively after the appearance of fatigue. The rectal temperature showed an increase of 2.7° C (7.32%) over the initial value i.e. 36.9° C. The blood pH and pO_2 increased, whereas, pCO_2 decreased significantly after ploughing. The haemoglobin also registered a marginal decrease (Table 5).

After continuously ploughing for 3.5 hrs animals showed reluctance to plough

further. The symptoms of fatigue began to appear. The camels produced grunting sound and tended to sit during the course of ploughing. It was coupled with frequent micturition and defection. The incoordination of limb movements was exhibited and by 4th hr animals were not in a position to work any further. Such behavior was common in all the camels used in the experiment, however, the actual time for appearance of these symptoms varied. The animals used in this experiment could be divided into two groups, according to their body weight i.e. higher body weight (645 ± 10.1 kg) and lower body weight (551 ± 2.4 kg). It was observed that the animals with higher body wight ploughed more area (3500m^2) than the animals of the lower body weight (2772m^2). The ploughing capacity also varied accordingly in these groups viz. 543.2± 8.42 and 503.4 ± 14.92kg respectively in higher and lower body weights. The endurance for more work was positively related to the body weight of these animals under the present working conditions.

In another experiment 5 adult trained Bikaneri camels were used for ploughing and the biometrical observations were correlated with the tractive force, speed and horse power generated. The tractive force was measured as mentioned above. The biometrical observations and draught force generated are presented in Table 6. The correlation coefficients (Table 7) reflected that all the body measurements except for body length were negatively correlated with the tractive force, speed and horse power, while, the body length showed positive correlation.

The loading car fabricated by CIAE, Bhopal was suitably modified for the camels. Bikaneri, Jaisalmeri and Kutchi camel were used in the loading car to produce a draught of 20% of their body weights. The animals were made to pull the car on the metal road till they exhibited symptoms of fatigue and refused to work further. The time, distance and horse power generated were recorded and correlated with their body measurements.

The Bikaneri camels at 20% of their body weight as draught (122 ± 1.93 kg) worked for a period of 54.33 ± 2.33 minutes and covered a distance of 3.43 ± 0.13 km before exhaustion. The horse power generated was 1.67 ± 0.09. This was followed by the performance of Kutchi and Jaisalmeri animals (Table 8). The correlation coefficient of these observations with biometric parameters are presented in Table 9. It is reflected from the table that all the biometric parameters are significantly and positively correlated with the tractive force ($P<0.05$). Height at withers, heart girth, body weight and body length are also correlated significantly ($P<0.05$) with the horse power. However, study with larger number of animals are needed.

Endurance for riding.

A comparative study was conducted to test the endurance of Bikaneri, Jaisalmeri and Kutchi breeds of camel for riding at slow and medium paces. The camels of each breed well trained for riding were used on typical 'Kutcha' desert road.

At one stretch 25 km distance was covered by Bikaneri and Jaisalmeri with slow pace, whereas, Kutchi could cover only 20 km (Table 10). Symptoms of fatigue as described above were observed after 330, 300 and 255 minutes of continuous riding in Bikaneri, Jaisalmeri and Kutchi respectively. The speed of Jaisalmeri was more than the other two breeds at this pace. Although the

speed of Kutchi camels was slightly better than the Bikaneri but it showed the least endurance.

At medium pace the performance of Bikaneri breed was better than Jaisalmeri and Kutchi. As compare to slow pace the riding time at medium pace was reduced to approximately 1/3, whereas, the speed on an average was almost doubled.

The pulse respiration and rectal temperature significantly ($P< 0.01$) increased in all the breeds at both the speeds, however, the increase was of lesser magnitude at slow pace. At slow pace the rise in pulse rate and rectal temperature was higher in the Bikaneri followed by Kutchi and Jaisalmeri, while the increase in respiration rate was marked in Jaisalmeri and Kutchi (Table 11). After 2 hr rest the respiration rate returned to normal levels.

At medium pace the cardinal responses exhibited stress due to riding in Bikaneri, Jaisalmeri and Kutchi camels in descending order. This matched with riding time of the individual breeds.

The number of erythrocytes showed a declining trend after riding. It attained statistical significance ($P< 0.05$) only in Jaisalmeri at both the speeds. The packed cell volume decreased significantly ($P< 0.05$) in all the breeds at slow speed, but at medium speed only a trend was observed. The haemoglobin content behaved similar to PCV. Pre experimental values were obtained following rest (Table 12). No appreciable change was observed for MCV and WBC count after the riding.

There was a marginal increase in the blood pH at rectal temperature after riding at slow and medium speed in all the breeds which came to the initial levels after rest. (Table 13). The pCO_2 increased during slow speed but there was a marginal decrease in case of medium speed. The pCO_2 values were comparable to initial levels after rest. The pCO_2 also increased after riding which dropped near its initial levels after rest. The pH, pCO_2 and pO_2 exhibited the similar trends when the values were calibrated at 37°C. The bicarbonate (HCO^-_3) increased significantly after riding at slow speed, however, there was a marginal decrease in Jaisalmeri and Kutchi breeds during medium speed which returned to the initial level after rest (Table 14). Similarly total carbondioxide contents (TCO_2) increased during slow speed after riding but there was not a uniform pattern in case of medium speed. There was appreciable increase in the base excess-blood (BEb) and standard bicarbonate (SBC) after riding during slow and medium speed except in Kutchi breed where it decreased marginally during medium speed. Both BEb and SBC values were comparable to their initial levels after rest. There was a significant increase in the base excess in the extra cellular fluid (BE ecf) after riding which came near it initial levels after rest. Oxygen saturation -calculated (% sO_2c) was slightly more in the blood samples taken after riding which was restored to the initial level after rest.

Sub project : Studies on dehydration and rehydration of camel during winter.

A.K. Rai and N.D. Khanna.

The study on dehydration and rehydration was conducted on 3-5 years old camels during winter months (December 90-January 91). Six camels were put to twice a week schedule of watering during pre-experimental period of 2 month and fed *ad-lib* Moth chara. The camels were divided into 2

groups of 3 animals each. The water intake of one group was completely withheld for a period of 21 days and on 22nd day water was offered ad-lib followed by a regular twice a week watering schedule. The other group served as control. The urine and faecal collection bags were used for collection of total urine and faeces voided during this study from all the camels. The representative samples of urine and faeces were preserved daily for conducting the metabolic trial. The blood samples were collected daily at 8.30 a.m. for biochemical estimations. A record of individual feed and water intake was maintained for both the groups.

The span of dehydration was divided into periods. Each period represented the watering period of control group i.e. one watering day to the next watering day.

During 21 days of dehydration the camels lost 11.4% body weight (Fig.1). The rate of loss in body weight and dry matter intake gradually but continuously declined with the advancement of period of dehydration (Fig. 2). The loss in weight was compensated within 4 days of rehydration showing an average daily gain of 13 Kg. The control camels gained marginally during the experimental period. The DMI reduced to almost half after 15 days of water restriction. On 21st day of dehydration the average fall in DMI was 57%. Normal intake of dry matter was observed within 4 days of rehydration. In control camels the dry matter consumption was 12.8 ± 0.43 g/kg body weight.

The water consumption of control camels was 78.33 ± 4.16 ml/kg body weight on the day of watering (Fig. 3). The camels under dehydration when offered water on 21st day consumed 89.4 ± 1.45 water (158.5 ± 4.43 ml/kg body weight). On subsequent watering the consumption was 45.0 ± 7. 09 (73.08 ± 12.82 ml/kg body weight) which was comparable to controls.

The excretion of urine was 6.01 ± 0.24 ml/kg body weight in the camels under regular schedule of watering (twice weekly) with the restriction of water the volume of urine voided decreased by 71% (Fig. 4). The decrease was gradual but continuous.

The concentration of urea, creatinine, sodium and potassium in urine of control camel were 15.33 ± 2.18 mg/dl, 2.639 ± 0.56 mg/dl, 20.98 ± 4.29 meq/1 and 292.25 ± 17.13 meq 1 respectively (Fig. 5 to 8). The level of urea, sodium and potassium increased with the dehydration. Although dehydration, the concentration of creatinine in urine remained higher than that of controls. On the peak dehydration 340% increase was observed as compared to control. There was remarkable rise in the level of sodium. It is increased from 12.33 to a maximum of 160.13 meq/1.

Apparently highly concentrated urine was excreted during the last phase of dehydration (15-21 days). White crystalline deposits (Uric acid ?) were found when the urine was drained from the collection bags of the dehydrated animal 18th day onwards.

The urine and faecal samples for each period were analysed for the digestibility coefficients during dehydration and rehydration (Table 15). Increasing trend was observed in the digestibility coefficients of all the components excepts for crude fibre (CF) which showed a decline after 12-14 days of dehydration. The digestibility of crude protein showed 18% increase which was statistically significant ($P < 0.01$). The CF digestibility progressively decreased upto 25% ($P < 0.01$) with the dehydration.

The digestibility coefficients improved significantly ($P < 0.01$) immediately after rehydration.

The intake of nitrogen sharply and continuously decreased from 111.63 g/d (1-4 days) to 42.79 g/d (19-21 days).

Accordingly the retention of nitrogen showed continuous decline with the advancement of dehydration but it remained on a positive balance upto 12 -14 days (Table 16). Further decline (15-18 days) exhibited negative balance of nitrogen. However, during the last period (19 - 21 days) positive nitrogen balance was found.

Table 4. Draughtability and ploughing capacity of camels during hot humid months

Camel No.	Body weight (kg)	Draft/100kg body weight (kg f)	Area ploughed (m^2)	Time taken (hrs)	H.P. generated	Ploughing capacity (% body weight)
85	640	9.24	3500	4.68	0.78	546.88
89	664	13.34	3500	5.07	1.20	527.11
188	630	15.87	3500	4.75	1.32	555.55
324	546	11.98	2700	3.75	0.88	494.51
216	554	16.91	2950	3.75	1.23	532.49
213	552	16.69	2667	3.50	1.20	483.15

Table 5. Shift in blood gases and heamoglobin values before and after ploughing

Parameters	At rectal temperature		At 37°C temperature	
	O hr.	After ploughing	O hr.	After ploughing
Haemoglobin (g%)	13.96 ± 0.44	12.34 ± 0.51	13.96 ± 0.44	12.34 ± 0.51
Rectal Temp.(°C)	37.08 ± 0.14	39.76 ± 0.34	37.08 ± 0.14	39.76 ± 0.34
pH	7.41 ± 0.01	7.45 ± 0.02	7.40 ± 0.01	7.50 ± 0.03
pCO_2 (mm Hg)	49.98 ± 1.56	47.94 ± 2.94	49.79 ± 1.43	42.66 ± 3.26
PO_2 (mm Hg)	95.60 ± 23.64	168.40 ± 17.05	95.40 ± 23.36	156.40 ± 17.58

Table 6. Biometry and draughtability of Bikaneri camels

Parameters	Camel No.					Mean± SE
	1	2	3	4	5	
Body Weight	640	664	694	711	688	679.4 ± 12.4
Leg length (cms) :-						
Fore	152	151	155	151	152	152.2± 0.735
Hind	158	153	162	160	162	159.0 ± 1.673
Body length (cms)	170	170	160	166	178	168.8 ± 2.939
Neck Length (cms)	130	116	140	127	125	127.6 ± 3.881
Height at withers	212	200	215	206	208	208.2 ± 2.577
Heart girth	221	222	230	226	222	224.2 ± 1.685
Tractive Force (Kg.)	110.31	116.40	108.99	109.89	118.22	112.76 ± 1.89
(Range)	(77-153)	(77-161)	(64-165)	(59-155)	(92-159)	
Speed (Kmph)	3.67	3.27	2.95	3.21	3.05	3.23 ± 0.124
Distance (Mts)	50x4	50x4	50x4	50x4	50x4	
Mean Horse Power	1.50	1.14	1.19	1.31	1.34	1.30 ± 0.06
(Range)	(1.05-2.08)	(0.93-1.95)	(0.70-1.80)	(0.70-1.84)	(1.04-1.80)	

Table 7. Correlation coefficients of body measurements with tractive force, speed & horse power

Parameters	Tractive force	Speed	Horse Power
Body weight	-0.124	-0.789*	-0.821*
Leg length			
Fore	-0.435	-0.473	-0.658
Hind	-0.272	-0.502	-0.613
Body length	0.836*	0.198	0.553
Neck length	-0.731	-0.250	-0.566
Height at wither	-0.611	-0.075	-0.345
Heart girth	-0.615	-0.662	-0.913**

* Significant at 5%
(Based on five observations)

** Significant at 1%

Table 8. Biometry and draughtability of different breeds of camel hitched to hydraulic loading cart

Parameters	Bikaneri	Jaisalmeri	Kutchi
Leg length :			
Fore	153.33 ± 2.33	150.00 ± 2.65	151.00 ± 2.31
Hind	159.00 ± 1.53	157.00 ± 2.89	162.00 ± 1.00
Body weight (cm)	170.33 ± 3.48	165.00 ± 3.00	164.67 ± 2.33
Neck length (cm)	129.33 ± 4.81	108 .33 ± 3.76	113.00 ± 3.57
Height at withers (cm)	206.67 ± 1.76	199.33 ± 4.48	199.33 ± 1.33
Heart girth (cm)	225.00 ± 2.65	216.33 ± 4.48	219.33 ± 2.67
Body wight (kg)	681.00 ± 2.08	602.00 ± 27.50	626.33 ± 17.95
Tractive force (kgf)	122.75 ± 1.93	110.88 ± 5.01	114.60 ± 3.04
Time (min)	54.33 ± 2.33	58.33 ± 1.67	53.33 ± 1.67
Distance (km)	3.43 ± 0.13	3.30 ± 0.00	3.30 ± 0.00
Speed (kmph)	3.67 ± 0.18	3.53 ± 0.12	3.73 ± 0.13
Horse power	1.67 ± 0.09	1.46 ± 0.10	1.58 ± 0.07

Table 9. Correlation coefficient of body measurements with tractive force, speed and horse power

Parameters	Tractive force	Speed	Horse Power
Body weight	0.976 **	0.290	0.792*
Leg length :			
Fore	0.679*	0.178	0.558
Hind	0.591	0.342	0.573
Body length	0.825*	0.247	0.683*
Neck length	0.644*	0.166	0.525
Height at wither	0.760*	0.318	0.681*
Heart girth	0.860*	0.672*	0.962**

* Significant at 5%
(Based on 9 observations)

** Significant at 1%

Table 10. Endurance for riding in different breeds of camel

	Bikaneri	Jaisalmeri	Kutchi
Distance (km)			
slow pace *	25.00	25.00	20.00
Medium pace **	18.33	15.00	15.00
Time (Min)			
Slow pace	330.00	300.00	255.00
Medium pace	106.67	105.00	98.33
Speed			
Slow pace	4.50	5.00	4.70
Medium pace	10.27	8.57	9.16

* Slow pace = 4-5 km/h ** Medium 8-10 km/h

Table 11. Cardinal responses during endurance test for riding

	Bikaneri	Jaisalmeri	Kutchi	Control
Pulse rate (Per min)				
Before riding				
Slow*	36.0 ± 3.46	48.0 ± 1.58	42.0 ± 3.93	40.0 ± 4.04
Medium **	43.0 ± 2.91	41.0 ± 4.67	54.0 ± 4.16	48.0 ± 0.44
After riding				
Slow	59.00 ± 2.40	63.0 ± 4.37	65.0 ± 3.53	39.0 ± 2.19
Medium	86.0 ± 8.88	88.0 ± 5.29	88.0 ± 4.62	51.0 ± 3.33
After 2hr rest				
Slow	51.0 ± 1.76	53.0 ± 2.67	41.0 ± 1.20	45.0 ± 3.71
Medium	57.0 ±4.04	62.0 ± 2.00	61.0 ± 1.67	52.0 ± 1.57
After 24hr rest				
Slow	46.0 ± 2.31	45.0 ± 1.53	39.0 ± 2.40	49.0 ± 1.73
Medium	41.0 ± 3.53	46.0 ±2.00	53.0 ± 3.71	52.0 ± 4.41
Respiration (Per min)				
Before riding				
Slow	7 ± 0.33	6 ± 0.67	5 ± 0.58	6 ± 0.58
Medium	5 ± 0.33	6 ± 0.67	7 ± 0.83	6 ± 0.44
After riding				
Slow	10 ± 0.33	18 ± 0.88	16 ± 1.15	7. ± 0.00
Medium	23 ± 2.65	22 ± 1.15	22 ± 0.33	7 ± 0.33
After 2hr rest				
Slow	8 ± 0.33	8 ± 1.33	7 ± 0.58	7 ± 0.67
Medium	11 ± 0.92	10 ± 1.33	9 ± 1.26	6 ± 0.88
After 24hr rest				
Slow	5 ± 0.33	7 ± 0.33	6 ± 0.58	6 ± 0.58
Medium	6 ± 0.44	6 ± 0.11	7 ± 0.44	7 ± 0.88
Rectal temperature (°C)				
Before riding				
Slow	37.5 ± 0.26	36.8 ± 0.50	36.6 ± 0.24	37.4 ± 0.23
Medium	37.0 ± 0.23	36.9 ± 0.10	37.6 ± 0.26	37.3 ± 0.09
After riding				
Slow	40.3 ± 0.47	39.1 ± 0.37	39.2 ± 0.36	37.7 ± 0.31
Medium	40.4 ± 0.21	40.2 ± 0.32	40.2 ± 0.20	37.5 ± 0.32
After 2hr rest				
Slow	38.9 ± 0.37	38.3 ± 0.15	37.5 ± 0.21	37.7 ± 0.32
Medium	38.0 ± 0.29	38.3 ± 0.20	38.0 ± 0.34	37.4 ± 0.32
After 24hr rest				
Slow	37.2 ± 0.29	37.1 ± 0.17	36.8 ± 0.31	37.4 ± 0.19
Medium	36.8 ± 0.15	37.3 ± 0.40	37.5 ± 0.26	37.6 ± 0.15

* Slow pace = 4-5 km/h ** Medium pace 8-10km/h

Table 12. Haematological changes during endurance test for riding

	Bikaneri	Jaisalmeri	Kutchi	Control
RBC (x 10^{12}/L)				
Before riding				
Slow*	10.07 ± 1.14	9.20 ± 0.29	11.07 ± 1.53	11.00 ± 1.56
Medium **	09.73 ± 0.76	9.47 ± 0.75	09.20 ± 0.60	09.73 ± 0.50
After riding				
Slow	08.43 ± 0.73	7.8 ± 0.06	09.33 ± 0.63	09.37 ± 1.04
Medium	08.93 ± 0.87	8.37 ± 0.12	09.40 ± 0.70	09.07 ± 0.13
After 2hr rest				
Slow	10.33 ± 0.58	09.17 ± 0.46	10.36 ± 0.22	09.03 ± 0.70
Medium	09.57 ± 0.98	08.07 ± 0.44	07.63 ± 0.71	09.57 ± 0.20
After 24hr rest				
Slow	10.96 ± 1.00	07.93 ± 0.52	09.27 ± 0.32	09.07 ± 0.95
Medium	10.36 ± 1.24	08.77 ± 0.47	09.37 ± 0.38	09.30 ± 0.38
WBC (X 10^{9}/L)				
Before riding				
Slow	12.03 ± 1.60	14.20 ± 1.12	-	11.87 ± 4.80
Medium	12.17 ± 1.05	14.47 ± 0.85	14.30 ± 0.74	13.7 ± 1.14
After riding				
Slow	11.70 ± 1.15	12.27 ± 0.61	11.33 ± 0.85	14.40 ± 3.09
Medium	11.03 ± 1.10	14.57 ± 1.15	14.20 ± 0.91	13.50 ± 0.95
After 2hr rest				
Slow	13.47 ± 1.29	10.97 ± 0.76	14.33 ± 0.85	14.37 ± 2.67
Medium	12.83 ± 0.73	15.67 ± 0.62	14.40 ± 0.67	13.60 ± 0.76
After 24hr rest				
Slow	13.33 ± 2.35	12.83 ± 0.88	12.23 ± 0.52	15.6 ± 2.90
Medium	12.47 ± 0.44	15.87 ± 1.10	14.30 ± 0.55	13.90 ± 0.73
MCV (f l)				
Before riding				
Slow	24.22 ± 1.25	26.96 ± 0.37	26.63 ± 0.43	26.83 ± 1.52
Medium	25.08 ± 0.79	26.04 ± 0.15	25.29 ± 1.19	25.63 ± 0.19
After riding				
Slow	23.96 ± 1.16	26.59 ± 0.29	25.99 ± 0.23	25.38 ± 0.52
Medium	24.60 ± 0.99	26.30 ± 0.44	24.83 ± 0.22	25.55 ± 0.22
After 2hr rest				
Slow	25.75 ± 1.14	27.04 ± 0.36	25.25 ± 0.58	26.00 ± 0.51
Medium	25.08 ± 1.01	26.08 ± 0.08	24.48 ± 0.30	25.42 ± 0.23
After 24hr rest				
Slow	26.42 ± 1.56	25.96 ± 1.42	25.38 ± 0.40	25. 63 ± 0.44
Medium	24.92 ± 0.84	26.42 ± 0.37	24.89 ± 0.31	26.38 ± 0.63

	Bikaneri	Jaisalmeri	Kutchi	Control
PCV (%)				
Before riding				
Slow	24.35 ± 1.96	25.41 ± 1.02	28.47 ± 4.48	29.93 ± 5.67
Medium	24.16 ± 1.63	26.00 ± 2.67	24.21 ± 2.56	25.39 ± 0.74
After riding				
Slow	20.06 ± 0.87	21.39 ± 0.36	24.51 ± 1.55	24.53 ± 1.93
Medium	21.93 ± 1.58	23.00 ± 0.58	24.28 ± 1.92	24.02 ± 0.23
After 2hr rest				
Slow	26.43 ± 0.76	24.90 ± 1.41	26.24 ± 1.12	23.50 ± 1.26
Medium	23.89 ± 1.41	21.95 ± 0.86	19.87 ± 1.54	24.98 ± 0.60
After 24hr rest				
Slow	28.6 ± 1.73	22.38 ± 1.33	24.04 ± 1.01	24.24 ± 4.25
Medium	25.67 ± 2.24	24.73 ± 0.78	24.62 ± 1.17	25.49 ± 1.76
Hb (g/dl)				
Before riding				
Slow	13.37 ± 1.04	13.03 ± 0.13	12.70 ± 0.38	12.07 ± 0.69
Medium	13.07 ± 0.90	12.57 ± 0.17	13.40 ± 0.64	13.53 ± 0.56
After riding				
Slow	11.10 ± 0.79	10.37 ± 0.30	11.63 ± 1.10	12.37 ± 0.73
Medium	11.73 ± 0.82	11.83 ± 0.29	12.53 ± 0.41	12.93 ± 0.38
After 2hr rest				
Slow	12.57 ± 0.85	12.53 ± 0.38	13.10 ± 0.79	11.97 ± 0.59
Medium	12.93 ± 0.62	11.53 ± 0.55	12.03 ± 0.91	12.83 ± 0.58
After 24hr rest				
Slow	14.23 ± 0.99	12.00 ± 0.62	12.83 ± 0.59	11.77 ± 1.19
Medium	13.93 ± 1.24	12.37 ± 0.45	13.17 ± 0.39	13.27 ± 0.63

* Slow pace ** Medium pace

Table 13. Acid base status during endurance test for riding at rectal temmperature

	Slow pace				Medium pace			
	Bikaneri	Jaisalmeri	Kutchi	Control	Bikaneri	Jaisalmeri	Kutchi	Control
pH								
O hr	7.330 ± 0.146	7.351 ± 0.032	7.356 ± 0.006	7.311 ± 0.006	7.351 ± 0.020	7.419 ± 0.035	7.439 ± 0.038	7.382 ± .013
After riding	7.361 ± 0.033	7.399 ± 0.019	7.395 ± 0.017	7.279 ± 0.019	7.423 ± 0.032	7.158 ±0.143	7.372 ± 0.029	7.411 ± 0.024
After 2 hr rest	7.333 ± 0.027	7.324 ± 0.007	7.375 ± 0.013	7.346 ± 0.007	3.388 ± 0.015	7.478 ± 0.071	7.512 ±0.069	7.513 ± 0.098
After 24 hr rest	7.330 ±0.001	7.378 ± 0.022	7.350 ±0.030	7.333 ± 0.020	7.358 ± 0.022	7.453 ± 0.032	7.391 ± 0.054	7.374 ± 0.024
pCO_2								
O hr	56.13 ± 20.15	51.23 ±3.57	50.30 ± 0.55	53.13 ± 0.50	51.17 ± 2.31	44.37 ± 2.97	41.97 ± 3.84	48.30 ± 1.83
After riding	62.97 ± 02.69	58.07 ±3.42	52.43 ±1.68	57.03 ± 2.66	48.00 ±0.55	38.03 ± 11.98	42.90 ± 1.61	43.93 ± 3.15
After 2 hr rest	58.50 ± 01.83	54.53 ±4.38	50.60 ± 1.93	52.27 ± 0.79	48.97 ± 2.02	37.27 ± 10.50	32.87 ± 5.93	34.70 ± 9.10
After 24 hr rest	51.97 ± 01.53	48.20 ± 1.12	53.50 ± 1.44	51.73 ± 1.26	46.50 ± 1. 81	41.60 ± 3.84	46.20 ± 7.06	49.60 ± 1.57
pO_2								
O hr	125.33 ± 32.83	157.00 ± 9.07	144.67 ± 6.17	160.00 ± 11.06	183.60 ± 6.67	223.30 ± 4.37	223.00 ± 5. 77	210.00 ± 10.12
After riding	156.33 ± 14.68	160.33 ± 3.44	161.00 ±21.50	150.00 ± 8.74	201.70 ± 5.36	223.70 ± 11.92	229.30 ± 2.03	208.00 ± 20.74
After 2 hr rest	134.67 ± 05.04]	152.33 ± 22.70	165.00 ± 09.71	167.67 ± 13.35	169.70 ± 4.37	213.70 ± 9.82	220.00 ± 6.08	205.00 ± 19.55
After 24 hr rest	119.33 ± 12.86	159.00 ± 5.77	136.33 ± 1.76	172.33 ± 4.70	162.30 ± 2.60	200.70 ± 12.78	212.30 ± 11.05	203.70 ± 16.15

Table 14. Acid base status during endurance test for riding caculated parameters

	Slow pace				Medium pace			
	Bikaneri	Jaisalmeri	Kutchi	Control	Bikaneri	Jaisalmeri	Kutchi	Control
HCO_3								
O hr	25.73 ± 1.72	28.57 ± 0.35	28.53 ± 0.29	26.93 ± 0.46	28.53 ± 0.03	28.87 ± 0.38	28.57 ± 0.43	28.90 ± 0.85
After riding	34.93 ± 1.75	35.5 ± 0.95	31.83 ± 0.84	26.47 ± 1.04	30.87 ± 2.02	26.57 ± 2.21	27.6 ± 0.10	27.93 ± 0.81
After 2 hr rest	30.83 ± 1.31	28.27 ± 0.62	29.7 ± 1.10	28.2 ± 0.42	29.5 ± 1.11	28.20 ± 1.50	26.9 ± 0.45	28.35 ± 0.55
After 24 hr rest	27.57 ± 0.72	28.63 ± 1.12	28.17 ± 0.54	27.67 ± 0.84	26.47 ± 1.10	29.13 ± 0.94	27.63 ± 1.24	29.10 ± 0.70
TCO_2								
O hr	27.43 ± 2.24	30.17 ± 0.32	30.13 ± 0.29	28.53 ± 0.46	30.10 ± 0.06	30.23 ± 0.32	29.80 ± 0.36	30.37 ± 0.92
After riding	36.63 ± 1.73	37.13 ± 1.05	33.30 ± 0.85	28.07 ± 1.04	32.17 ± 2.02	27.51 ± 2.50	28.80 ± 0.10	29.27 ± 0.88
After 2 hr rest	32.43 ± 1.30	29.83 ± 0.68	30.73 ± 0.88	29.73 ± 0.39	30.93 ± 0.58	29.50 ± 1.50	28.10 ± 0.50	29.65 ± 0.55
After 24 hr rest	29.13 ± 0.74	30.10 ± 1.10	29.23 ± 0.15	29.23 ± 0.82	27.90 ± 1.11	29.20 ± 0.96	28.93 ± 1.43	30.57 ± 0.64
BEb								
O hr	1.95 ± 0.95	2.63 ± 0.82	2.70 ± 0.35	1.30 ± 0.40	2.63 ± 0.50	4.40 ± 1.10	4.90 ± 0.96	3.73 ± 0.83
After riding	9.47 ± 2.08	10.37 ± 0.59	7.13 ± 0.93	1.15 ± 0.45	9.25 ± 2.25	5.57 ± 1.26	4.45 ± 0.15	3.63 ± 0.57
After 2 hr rest	4.8 ± 1.62	2.1 ± 0.64	4.30 ± 0.92	2.60 ± 0.44	4.60 ± 1.01	4.05 ± 1.65	3.13 ± 0.41	4.07 ± 0.58
After 24 hr rest	1.37 ± 0.45	3.43 ± 1.30	1.77 ± 0.47	2.80 ± 0.90	2.2 ± 1.20	5.50 ± 0.91	3.0 ± 0.61	3.77 ± 1.07

	Slow pace				Medium pace			
	Bikaneri	Jaisalmeri	Kutchi	Control	Bikaneri	Jaisalmeri	Kutchi	Control
SBC								
ohr	25.00	27.00	27.07	25.30	27.00	28.43	28.77	27.87
	±1.51	±0.65	±0.26	±0.23	±0.38	±0.87	±0.76	±0.65
After riding	32.33	33.1	30.53	24.97	30.70	29.30	28.45	27.80
	±1.65	±0.47	±0.58	±0.91	±1.85	±0.98	±0.15	±0.45
After 2 hr rest	28.67	26.77	28.33	27.00	28.53	28.20	27.47	28.17
	±1.62	±0.33	±0.72	±0.32	±0.77	±1.30	±0.33	±0.47
After 24 hr rest	26.00	27.67	26.33	26.37	25.77	29.27	27.33	27.90
	±0.55	±1.00	±0.35	±0.84	±1.07	±0.72	±0.46	±0.81
BEecf								
ohr	-0.3	2.73	2.77	0.60	2.73	4.17	4.77	3.70
	±1.14	±0.72	±0.35	±0.58	±0.38	±0.98	±0.67	±0.92
After riding	10.10	10.97	7.27	-0.10	7.07	4.33	1.97	3.23
	±2.14	±0.77	±1.02	±1.22	±2.54	±0.47	±1.64	±0.69
After 2 hr rest	5.17	2.33	4.40	2.47	4.57	1.10	2.57	2.83
	±1.70	±0.54	±1.16	±0.048	±1.18	±2.76	±0.38	±0.98
After 24 hr rest	1.47	3.30	1.93	1.67	0.77	5.07	2.53	3.80
	±0.72	±1.39	±0.61	±1.09	±1.43	±0.97	±0.59	±1.08
% SO_2C								
ohr	94.40	99.20	99.1	99.17	99.53	99.76	99.80	99.70
	±4.44	±0.17	±0.1	±0.17	±0.09	±0.03	±0.06	±0.06
After riding	98.77	99.07	98.97	98.67	99.67	99.80	99.73	99.67
	±0.55	±0.41	±0.63	±0.34	±0.07	±0.06	±0.03	±0.13
After 2 hr rest	98.47	98.57	99.40	99.33	99.43	99.80	99.83	99.73
	±0.35	±0.83	±0.11	±0.17	±0.03	±0.06	±0.03	±0.12
After 24 hr rest	97.97	99.33	99.00	99.40	99.37	99.77	99.67	99.63
	±0.52	±0.09	±0.25	±0.10	±0.07	±0.03	±0.09	±0.12

Table 15. Digestibility coefficients during dehydration and rehydration

Days	Dry matter	Organic matter	Crude protein	Ether extract	Crude fibre	Nitrogen free extract
Dehydration						
1-4	59.92 ±3.16	68.56 ±3.72	55.15 ±4.70	17.72 ±8.66	58.57 ±4.88	80.01 ±2.08
5-7	62.79 ±2.83	68.69 ±3.43	54.91 ±4.90	15.01 ±9.31	53.67 ±5.11	80.45 ±2.10
8-11	62.09 ±2.37	64.96 ±2.83	53.00 ±3.70	14.56 ±6.92	43.40 ±4.57	79.83 ±1.63
12-14	66.62 ±3.27	71.20 ±0.80	65.07 ±1.01	28.52 ±2.01	49.67 ±1.44	83.80 ±0.45
15-18	60.20 ±3.20	65.52 ±0.14	61.53 ±0.50	18.95 ±0.31	36.79 ±0.24	80.51 ±0.07
19-21	60.63 ±4.09	74.14 ±3.20	61.11 ±3.20	25.27 ±9.47	43.79 ±4.51	82.35 ±1.45
Rehydration						
22-24	70.16 ±3.51	75.11 ±1.15	72.52 ±1.37	45.55 ±2.52	59.23 ±1.89	84.60 ±0.72
Control	61.19 ±1.61	67.92 ±1.61	56.31 ±1.65	26.50 ±3.63	36.49 ±2.93	81.78 ±0.67

Table 16. Nitrogen balance (g/d) during dehydration and rehydration under Moth Chara feeding

Days	Nitrogen intake	Nitrogen excretion		Balance
	Feed	Feaces	Urine	
Dehydration				
1-4	111.63±16.25	49.60±8.08	16.96±3.00	45.07±13.55
5-7	90.59±12.29	40.71±6.86	27.08±3.17	22.79±07.66
8-11	63.79±13.03	28.33±4.63	34.80±3.52	0.54±08.70
12-14	64.13±12.04	20.41±3.50	34.93±3.19	0.37±09.22
15-18	50.02±03.23	21.08±1.37	32.51±2.00	-3.54±03.76
19-21	42.79±01.73	14.58±2.02	16.82±1.67	11.38±04.94
Rehydration				
22-24	95.40±05.81	28.31±2.46	38.02±3.69	29.07±07.18
Control	115.65±15.49	50.10±6.44	30.45±4.33	35.10±09.36

Fig. 1 CHANGES IN BODY WEIGHT DURING DEHYDRATION AND REHYDRATION

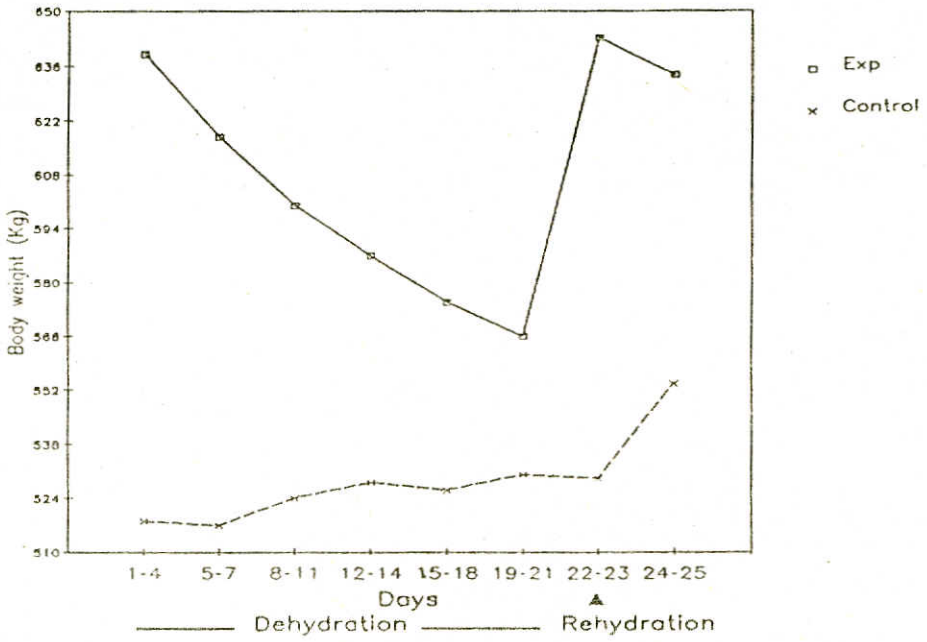


Fig. 2 DRY MATTER INTAKE DURING DEHYDRATION AND REHYDRATION

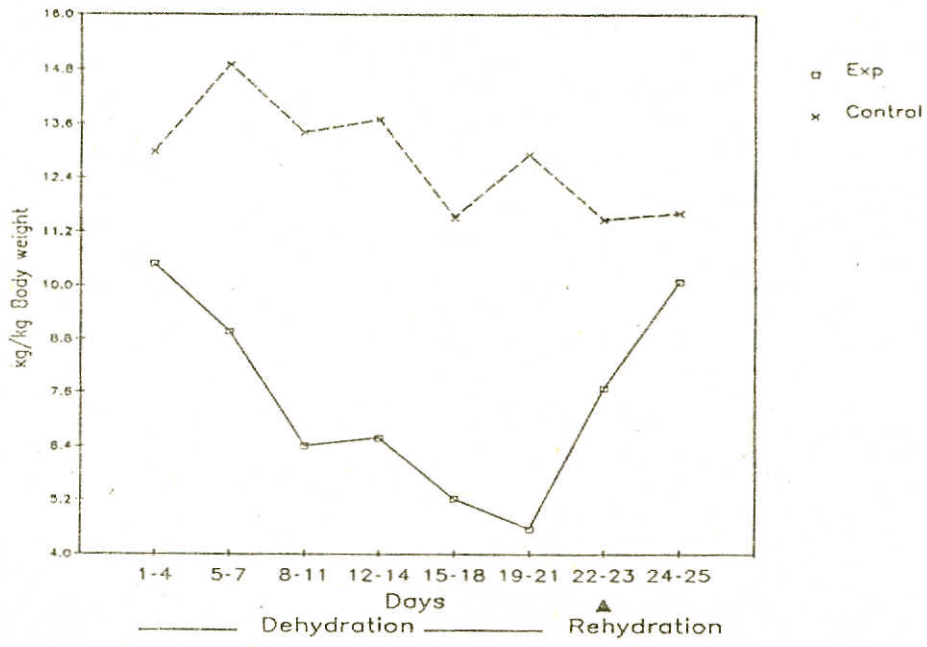


Fig. 3 WATER INTAKE DURING DEHYDRATION AND REHYDRATION

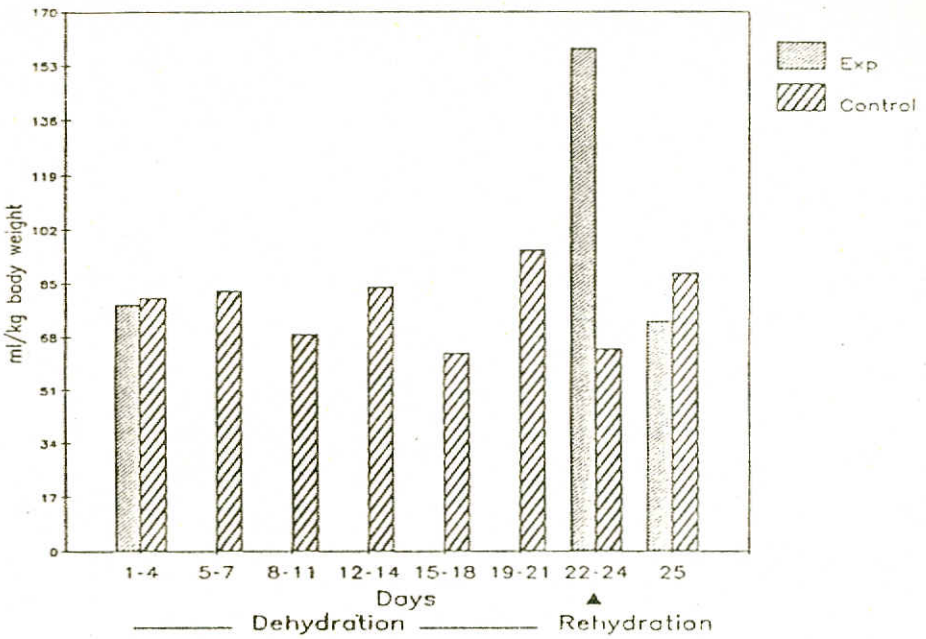


Fig. 4 EXCRETION OF URINE DURING DEHYDRATION AND REHYDRATION

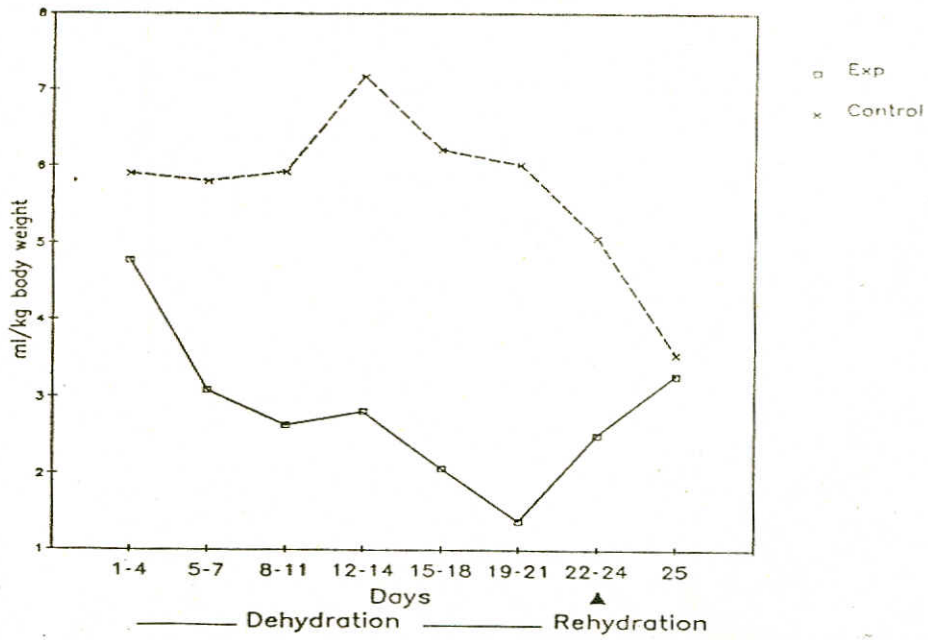


Fig. 5 UREA IN URINE DURING DEHYDRATION AND REHYDRATION

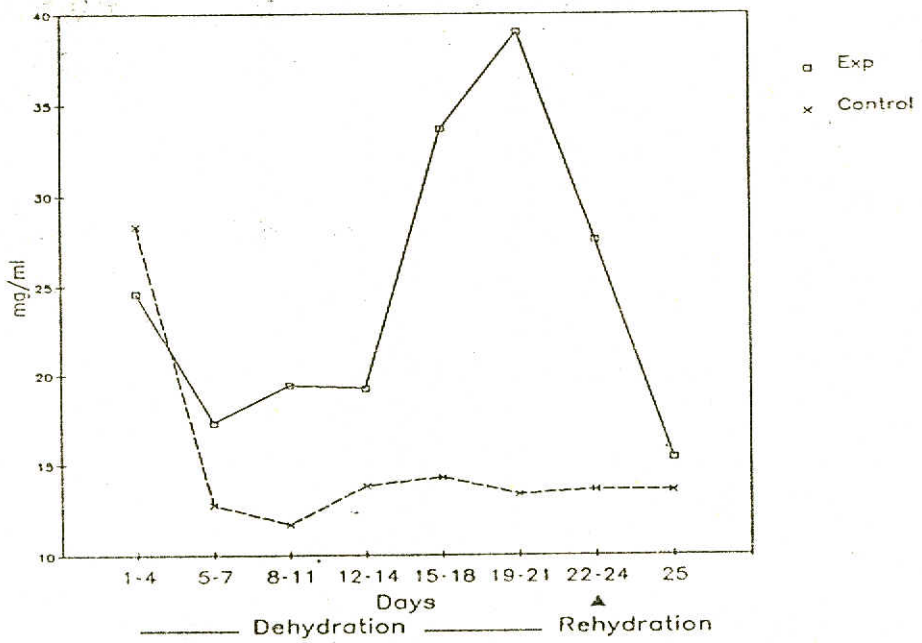


Fig. 6 CREATININE IN URINE DURING DEHYDRATION AND REHYDRATION

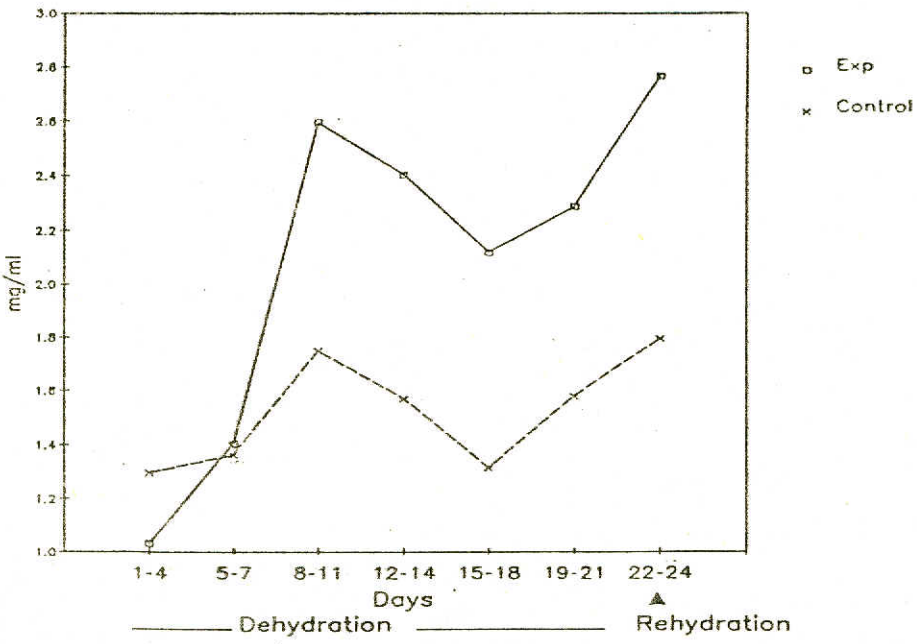


Fig. 7 SODIUM IN URINE DURING DEHYDRATION AND REHYDRATION

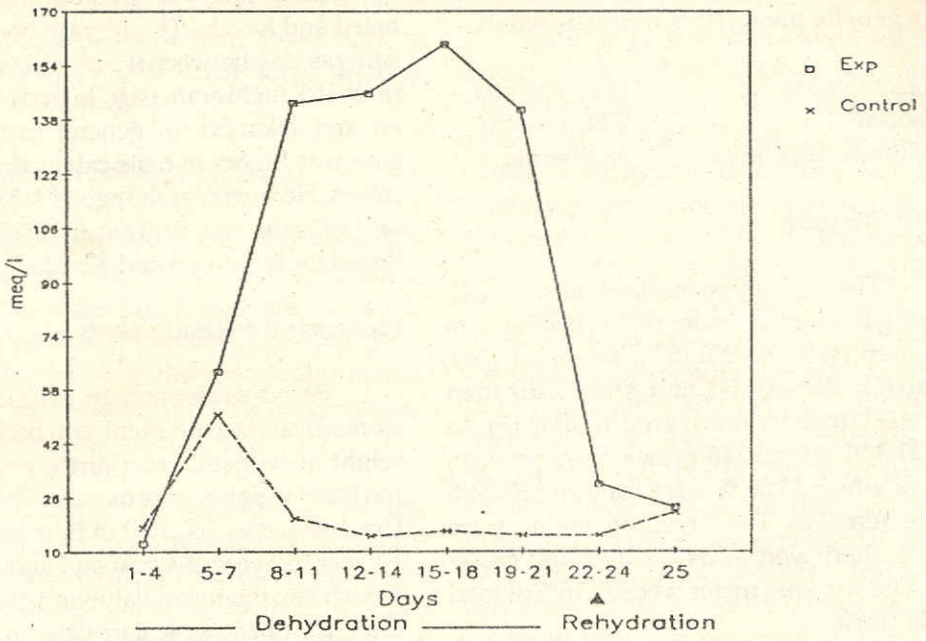
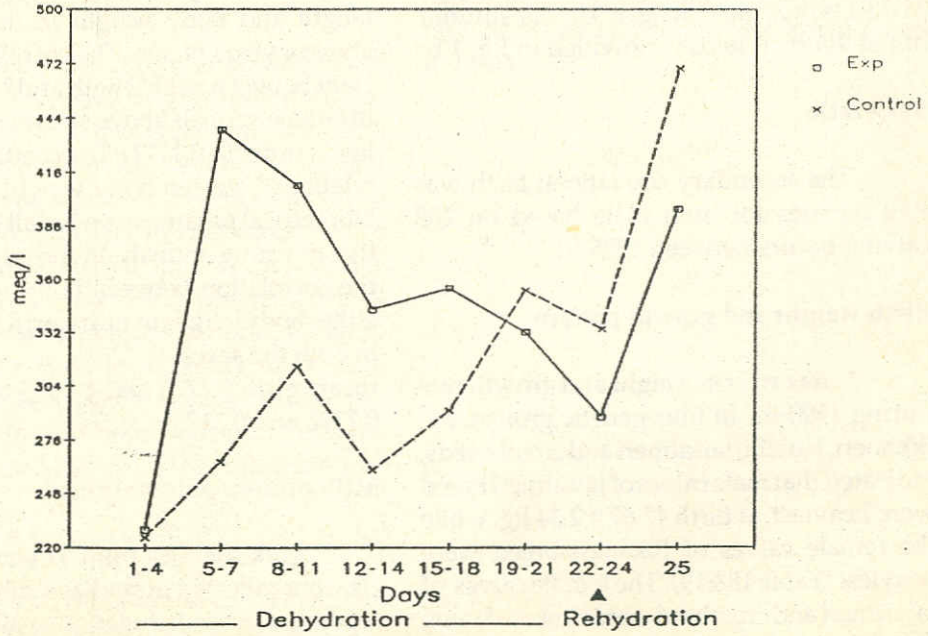


Fig. 8 POTASSIUM IN URINE DURING DEHYDRATION AND REHYDRATION



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

Title : Studies on quantitative and qualitiative genetic parameters in India camels

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

Herd Strength

The camels maintained at N.R.C.C. during the period under report belonged to Bikaneri (125), Kutchi (59), Jaisalmeri (51), Arab (1), Marwari (1), and Arabi x Bikaneri cross (11) breeds/ breed group (Table 17). As on 31.3.91 a total 248 camels were present, out of which 33.06 % were male and 67.94% were females. The breeding males were 19.5%, there were 46.34% calves and growers. The working males were 32.16% of total male stock.

Age group and sex wise herd structure consisting of all genetic groups as on 31.3.91 is presented in fig. 9. The constitution of the Bikaneri herd is provided in fig. 10.

Sex - ratio

The secondary sex ratio at birth was 1.12 females for each male based on 208 calving occure between 1985-91.

Birth weight and growth pattern

Data on birth weight and growth rate during 1990-91 of four genetic groups viz. Bikaneri, Kutchi, Jaisalmeri and crossbreeds, indicated that male calves of Jaisalmeri breed were heaviest at birth 47.67 ± 2.34 kg. while the female calves of Bikaneri breed were heaviest (Table 18&19). The female calves of Jaisalmeri and crossbred were almost of same weight at birth. Both male and female calves of Kutchi animals were lightest in weight at birth. The pooled birth weight was highest in Bikaneri followed by Jaisalmeri, Crossbreed and Kutchi. The average body weight gain per day between 0-3 months was maximum in Kutchi animals followed by Jaisalmeri and Bikaneri. In general early weight gain was higher in male calves than female calves. However, at the age of 1-2 years, the rate of gain was highest in Bikaneri, followed by Jaisalmeri and Kutchi.

Biometrical Measurements

Breed evaluation in respect of five biometrical measurement viz. Body length, height at withers, heart girth, neck length and body weights were made in 150 animals. The data were classified in four age groups 0-1 year, 1-2 year, 2-4 year and above 4 years in each sex the mean value in presented in Table 20. Phenotypic correlations between body weight and biometrical parameters have been presented in Table 21. All the correlations were positive except between neck length and body weight in male animals above 4 years of age. The correlation coefficient between neck length and body weight in female animals above 4 years of age was of lower order (+ 0.1171). The coefficient of correlations between body weight and rest of biometrical parameters were all highly positive in young animals. In the adult animals, the correlation between body weight with either body length or heart girth were higher in both the sexes
(heart girth 0.7723 and 0.5816 body length 0.7175 and 0.3175).

Milk protein polymorphism

Milk samples from 31 lactating camels were collected in sterlized tubes, fat was separated by centrifugation at 3000 rpm for 30 minutes. Four milk protein viz. ∝ - casein

β –lactoglobulins, β – casein and k- casein were studied by starch gel electrophoresis system. No polymorphism was recorded. The k-casein exhibited two bands. The faster band took deeper stain than slower band in all the samples. The other three proteins exhibited single band.

Blood protein polymorphism

Sera samples from camels were subjected to horizontal starch gel electrophoresis for transferrin polymorphism. In all four phenotypes under the control of three types of transferrins were observed designated as TfF for fast moving, TfM for intermediate and TfS for slow moving.

Techniques of sepration of serum protein by polyacrylamide gel electrophoresis and isoelectrofocusing using micro gel electrophoresis system were standerised. The serum proteins resolved into 15 bands in PAGE and 22 bands in isoelectroforecsis.

Calf Mortality

High calf mortality is known major constraint to increasing productivity of camels. Post-natal losses ranging from 20% to 40% upto 1 year of age have been reported form different countries. The present sutdy desribes calf mortality in 1225 camel calves born during 1961-90 and reared under farmbred semi - intensive management system at the camel Breeding Farm, Bikaner. Age and sex spceific mortality rates were calculated based on the concept of live period unit approach. Specific death rate (SDR) was computed by emloying following formula :

$$SDR = \frac{D_{ix}}{(M_{ix} - D_{ix}) + a^1 i x}$$

Where D_{ix} is population died in ith sex in an age group during period x to x + 1, M_{ix} is population of ith sex alive at x period and a^1 ix is fraction of time each dead animal lived in x to x + 1 Period.

Mortality in camel calves aged 0-6 months was 11.39 % while sex specific mortality in the male calves was 13.47% and female calves 9.30% (Table 22). Mortality in camel calves aged 6-12 months was 2.79% while mortality in the male calves in this age group was 3.42% and in the female calves was 2.79% (Table 23). Sex and period had no statistically significant effect on the calf mortality in both the age groups (Table 24 & 25). Diagrammatically, the calf mortality from 0-6 months and 6-12 months is presented in fig.. 11 &12. The overall camel calf mortality from birth till one year age was 13.56%. The most common cause of death in the calves aged 0-6 was diseases of digestive system (31.25%) followed by diseases of respiratory system (26.69%) (Table 26). Similar trend was also observed in the calves aged 6-12 months (Table 27). Risk for mortality was highest during winter months in the calves aged 0-6 months which in incidentally breeding and calving season of camels in India.

Table 17. Breed, age and sex wise camel distribution at the NRCC farm during 1990-91

Breed Genetic group	Age group	Opening balance (1.4.90)		Addition				Deletion				Closing balance (31.3.91)	
				Calvings		Purchase		Deaths		Disposals			
		M*	F**	M	F	M	F	M	F	M	F	M	F
Bikaneri													
	0-3 months	11	09	05	07	-	-	01	01	-	-	02	06
	3-12 months	01	05	-	-	-	-	02	01	-	02	02	-
	1-3 years	16	17	-	-	-	-	-	-	01	02	15	14
	3-15 years	17	53	-	-	01	-	-	-	02	05	26	60
Kutchi													
	0-3 months	-	03	06	06	-	-	-	-	-	-	05	04
	3-12 months	-	-	-	-	-	-	-	-	-	-	01	06
	1-3 years	09	10	-	-	-	-	01	01	-	-	05	08
	3-15 years	07	20	-	-	-	-	-	-	-	-	10	20
Jaisalmeri													
	0-3 months	-	04	03	05	-	-	-	-	-	-	03	04
	3-12 months	03	04	-	-	-	-	-	-	-	-	-	01
	1-3 years	-	-	-	-	-	05	-	-	-	-	03	12
	3-15 years	03	16	-	-	02	06	-	-	-	-	05	23
Arabi													
	3-15 years	01	-	-	-	-	-	-	-	-	-	01	-
Marwari													
	3-15 years	-	-	-	-	01	-	-	-	-	-	01	-
Arabi x Bikaneri													
	0-3 months	-	-	02	02	-	-	02	-	-	-	-	02
	3-12 months	-	-	-	-	-	-	-	-	-	-	-	-
	1-3 years	02	02	-	-	-	-	-	-	-	-	02	-
	3-15 years	01	04	-	-	-	-	-	-	-	-	01	06
TOTAL		71	147	16	20	04	11	06	03	03	09	82	166

M* = Male
F** = Female

Table 18. Birth weight of different genetic group (1990-91)

Breed	Birth weight (Kg)		
	Male calves	Female calves	Pooled
Bikaneri	42.75±1.25 (4)	46.67±2.60 (6)	45.00±1.17 (10)
Kutchi	38.17±1.58 (6)	38.00±1.34 (12)	38.09±1.11 (12)
Jaisalmeri	47.67±2.34 (3)	43.00±1.89 (5)	44.62±1.39 (8)
Cross breed	-	42.50±4.41 (2)	42.50±4.41 (2)

Figure in parentheses indicate number of observations

Table 19. Average body weight gain (g/day) in different genetic groups

Age group	Bikaneri			Kutchi			Jaisalmeri		
	Male	Female	Pooled	Male	Female	Pooled	Male	Female	Pooled
0-3 months	898.18 (4)	712.20 (6)	786.86 (10)	1016.87 (6)	988.57 (5)	1003.92 (11)	1021.43 (3)	994.20 (5)	1002.06 (8)
3-6 months	534.92 (7)	457.58 (8)	495.35 (15)	-	437.50 (3)	437.50 (3)	-	507.41 (4)	507.41 (4)
6-12 months	299.35 (9)	334.03 (8)	316.16 (17)	-	248.15 (3)	248.15 (3)	-	291.67 (4)	291.67 (4)
1-2 years	280.56 (10)	258.25 (8)	270.70 (18)	139.78 (6)	172.74 (9)	159.66 (15)	257.53 (2)	235.06 (8)	243.61 (10)

Figure in parentheses indicate number of observations

Table 2 . Mean values of certain biometrical parameters in camel (1990-91)

	AGE GROUP							
	0-1 year		1-2 year		2-4 year		Above 4 year	
	Male (12)	Female (18)	Male (9)	Female (15)	Male (13)	Female (5)	Male (23)	Female (51)
Body length (cm)	86.75 ±02.28	85.39 ±01.77	113.22 ±01.62	113.27 ±01.43	141.61 ±02.14	146.00 ±05.33	162.61 ±01.48	157.86 ±01.24
Height at withers(cm)	128.50 ±01.77	130.39 ±01.30	166.44 ±01.61	162.53 ±01.39	188.61 ±02.06	193.00 ±03.93	207.13 ±01.49	193.03 ±01.12
Heart girth (cm)	119.75 ±03.19	119.50 ±01.97	162.89 ±01.36	161.40 ±01.40	192.23 ±01.85	202.00 ±04.74	220.30 ±01.62	212.51 ±01.26
Neck length (cm)	63.33 ±01.26	68.89 ±02.55	88.89 ±01.61	89.73 ±01.66	106.92 ±02.27	114.20 ±03.10	118.52 ±02.00	117.94 ±00.93
Body weight (Kg)	105.00 ±06.61	105.22 ±05.33	254.00 ±09.52	242.00 ±09.66	420.15 ±09.78	474.40 ±15.34	645.13 ±11.91	592.73 ±19.90

Figure in parentheses indicate number of observations

Table 4. Phenotypic correlation between body weight and certain bio-metrical parameters

	AGE GROUP							
	0-1 year		1-2 year		2-4 year		Above 4 year	
	Male	Female	Male	Female	Male	Female	Male	Female
Body length	0.8307	0.6213	+0.7605	+0.8467	+0.4490	+0.4649	+0.7175	+0.3175
Height at withers	0.9108	0.5076	+0.2057	+0.2768	+0.3458	+0.2824	+0.4127	+0.1553
Heart girth	0.9465	0.6778	+0.8847	+0.8895	+0.6987	+0.4960	+0.7723	+0.5816
Neck length	0.3853	0.7234	+0.8402	+0.4210	+0.6728	+0.3514	-0.2863	+0.1171

Table 22. Period wise mortality in camel calves aged 0-6 months

Period	No. of deaths		Population		S.D.R. %		Pooled S.D.R. %
	Male	Female	Male	Female	Male	Female	
1961-64	28	13	107	105	33.92	13.46	22.89
1965-68	08	09	109	96	7.80	10.25	8.93
1969-72	09	15	113	113	8.28	14.94	11.48
1973-76	03	01	67	49	4.62	2.08	3.54
1977-80	08	04	54	66	16.83	6.32	10.83
1981-84	09	07	66	53	15.42	15.05	15.26
1985-88	06	03	56	59	11.70	5.29	8.33
1989-90	05	00	52	60	10.30	0.00	4.61
Polled	76	52	624	601	13.47	9.30	11.39

Table 23. Period wise mortality in camel calves aged 6-12 months

Period	No. of deaths		Population		S.D.R. %		Pooled S.D.R. %
	Male	Female	Male	Female	Male	Female	
1961-64	02	02	79	92	2.58	2.20	2.37
1965-68	08	01	101	87	8.04	1.15	4.83
1969-72	03	01	104	98	2.94	1.03	2.00
1973-76	01	01	64	48	1.58	2.10	1.80
1977-80	01	04	46	62	2.19	6.74	4.76
1981-84	02	00	57	46	3.61	0.00	1.97
1985-88	00	01	50	56	0.00	1.81	0.95
1989-90	00	02	47	60	0.00	3.39	1.89
Polled	17	12	548	549	3.42	2.21	2.79

Table 24 Factors affecting mortality in camel calves aged 0-6 months

Source of variance	df	Sum of squares	Mean squares	F
Due to period	7	556.3	79.4	0.115 NS
Due to sex	1	126.6	126.6	0.183 NS
Remainder	8	5511.8	688.9	
Total	16	6194.7		

NS = Non significant

Table 25 Factors affecting mortality in camel calves aged 6-12 months

Source of variance	df	Sum of squares	Mean squares	F
Due to period	7	113.2	16.2	0.114 NS
Due to sex	1	0.0	00.0	0.000 NS
Remainder	8	1134.7	141.8	
Total	16	1247.9		

NS = Non significant

Table 26 Causes of mortalty in camel calves aged 0-6 months (1961-90)

Causes of mortalty	Male	Female	Total	Mortality %
Diseases of digestive system	25	15	40	31.25
Diseases of respiratory system	22	16	38	29.69
Diseases of urinary system	01	01	02	1.56
Debility/Anaemia	08	06	14	10.94
Injury	05	01	06	4.69
Heat stroke	04	03	07	5.47
Unknown causes	11	10	21	16.60
Total	76	52	128	

Table 27 Causes of mortalty in camel calves aged 6-12 months (1961-90)

Causes of mortalty	Male	Female	Total	Mortality %
Diseases of digestive system	07	02	09	31.03
Diseases of respiratory system	03	02	05	17.24
Diseases of urinary system	02	00	02	6.90
Debility/Anaemia	01	01	02	6.90
Injury	03	06	09	31.03
Heat stroke	01	01	02	6.90
Total	17	12	29	

Fig. 9 HERD STRUCTURE AS ON 31.03.1991

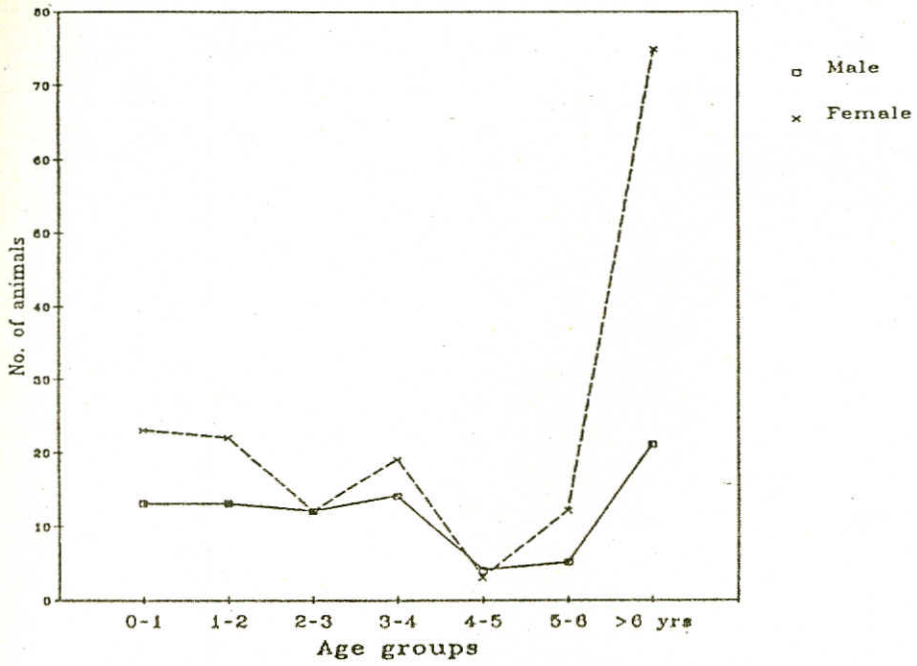


Fig. 10 HERD STRUCTURE OF BIKANERI CAMELS as on 31.03.1991

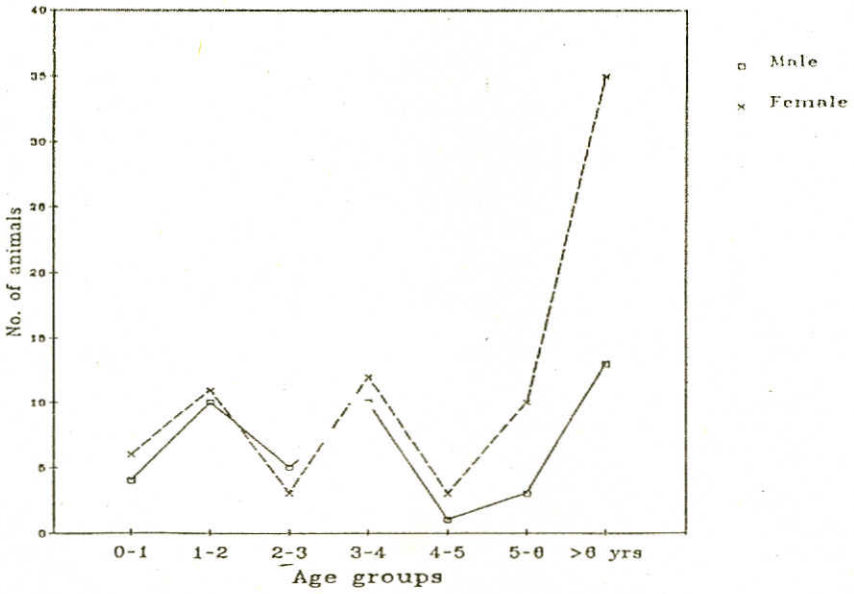


Fig. 11 MORTALITY IN CALVES 0-6 MONTHS AGE

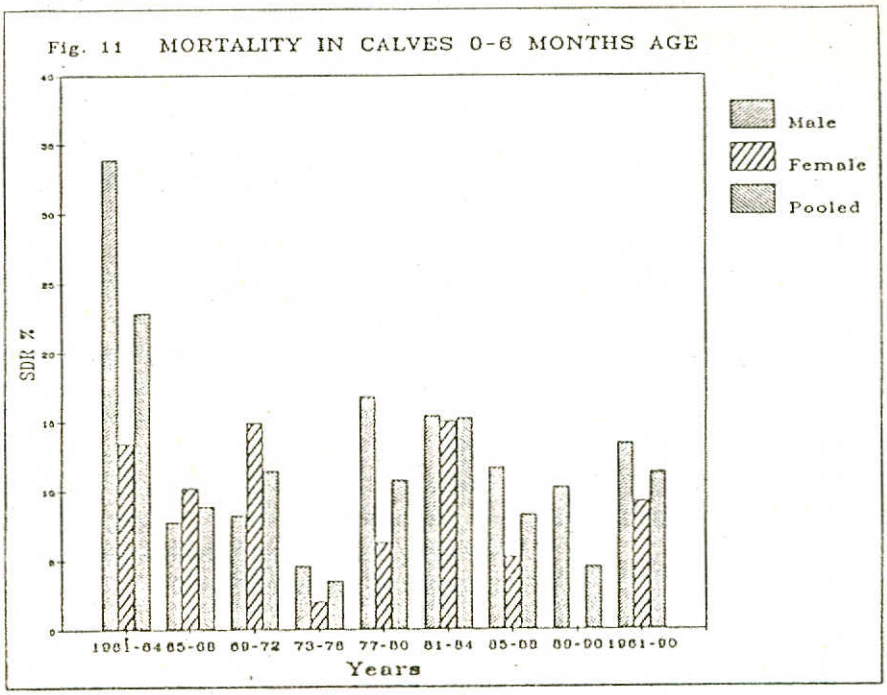
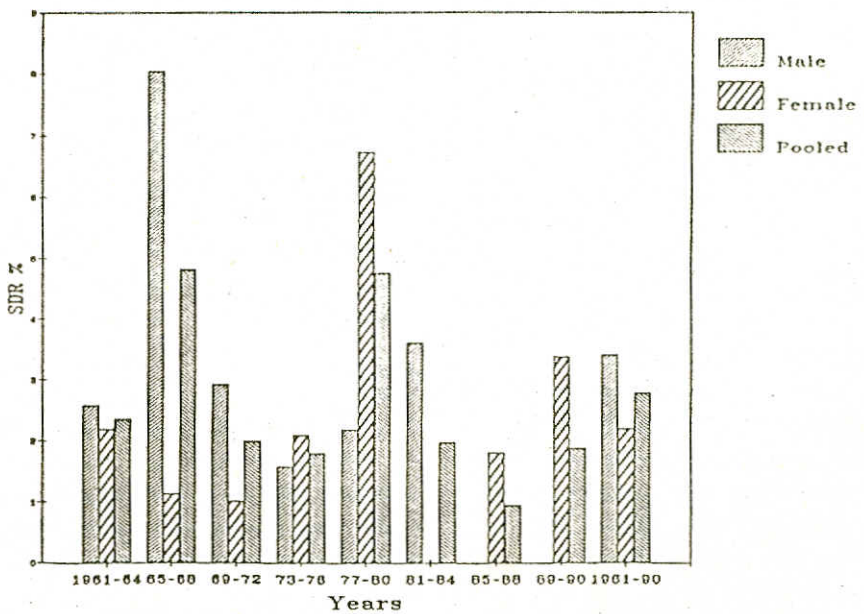


Fig. 12 MORTALITY IN CALVES 6-12 MONTHS AGE



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

Title : To development suitable management practices for rearing camel

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

Body Weight

Growing calves: Average body weight of Bikaner, Kutchi, Jaisalmeri and crossbred camels as on 31.3.91 are presented in Table 28. Male animals of adult age group were heavier than female animals in all the four genetic groups. The weight trend indicated in general males were heavier than females.

Pregnant females : The data available on 27 pregnant females of three breeds viz. Bikaneri 10, Jaisalmeri 6 and Kutchi 11 animals showed a wide range of body weight gain in the first trimester. The body weight gain in three breeds ranged from 2.55 ± 6.34 to 15.33 ± 6.71 kg which may not be truly due to pregnancy but may be due to physiological gain. There was a decreasing trend in subsequent trimesters (Table 29). The % birth weight in relation to total body weight gain in 4 trimesters indicated hightest 35.40% in Bikaneri followed by 35.10 in Jaisalmeri and 33.80% in Kutchi animals. The body weight gain in 4 trimesters have been presented in fig. 13.

Study was also conducted in body weight loss in lactating animals and body weight gain in suckling calves (fig. 14 & 15). These animals were maintained on normal feeding schedule which consisted of ad lib mothchara *(Phaseolus aconitifolius)*. The lactating females lost 16.27 % body weights upto 7th month of lactation. The loss was gradual but continues. The rate of weight loss was highest in the 1st month (4.51%) with average 2% loss in subsequent months. Whereas, the weight of non lactating camels marginally fluctuated during this period (fig. 14). The rate of weight gain from birth to weaning was almost constant in the calves (fig. 15). On an average it increased from 40 to 165 kg at the time of weaning.

Milk Production

Six lactating females were used for studies on milk production as a pilet experiment. The animals were provided supplementary ration for production. The calves were allowed to suckle after the milking. The peak milk yield (kg/day) was observed between 1-2 months of lactation (7.6 kg/d). It declined thereafter and reached 6 kg/d between 3-4 months. After 6 months of lactation the yield was 4.9 kg/d.

Reproductive Parameters

During the year 67 breedable females were present at the farm. The conception rate was 77.61%, it was estimated that 1.98 services were required per pregnancy (Table 30). The calving rate was 41.94 % and percentage of calving was 81.25. The foetal losses were 18.75% the calving interval for the period 90-91 was 713.94 ± 9.69. The age at first service was 1040.83 ± 5.39 days. age at first calving 1491.17 ± 6.40 days and gestation length for male and female calvings were 387.00 ± 2.76 and 388.47 ± 2.08 days respectively.

Mortality (1990-91)

The mortality rate during the year was well within the limits. In all 9 animals (6 males and 3 females) died. The mortality rate in calves aged 0-3 months was 2.992 per 1000 camel days per day. While no mortality was observed in animals above 3 years. Pooled mortality during 1990-91 was 0.116 per 1000 camel days per day (4.26% per year).

Table 28. Average body weight (Kg) of different genetic group of camels as on 31.03.91

Age group	Bikaneri		Kutchi		Jaisalmeri		Cross breed	
	Male	Female	Male	Female	Male	Female	Male	Female
0-3 months	64.00 ±14.00 (2)	81.83 ±06.79 (6)	90.67 ±06.67 (6)	81.67 ±14.58 (6)	72.33 ±14.77 (3)	91.20 ±09.91 (5)	- - -	76.00 ±16.00 (2)
3-6 months	-	-	-	-	-	-	-	-
6-12 months	120.00 (1)	-	-	-	-	-	-	-
1-2 years	244.67 ±09.50 (9)	241.64 ±11.16 (11)	- - -	206.00 ±08.33 (3)	- - -	245.50 ±05.61 (4)	- - -	- - -
2-3 years	297.20 ±28.20 (5)	287.33 ±15.09 (3)	266.00 ±23.11 (5)	285.78 ±09.78 (9)	253.33 ±36.67 (3)	195.00 ±15.04 (2)	- - -	- - -
3-4 years	405.00 ±13.22 (12)	393.00 ±19.52 (11)	375.00 ±05.01 (2)	- - -	- - -	348.57 ±10.32 (7)	410.00 ±0.00 (2)	445.00 ±55.00 (2)
Above 4 years	617.33 ±17.02 (15)	577.83 ±09.79 (47)	576.75 ±44.73 (8)	563.74 ±14.73 (19)	574.80 ±12.73 (5)	537.00 ±11.61 (21)	598.00 (1)	545.00 ±54.80 (4)

Note : Figures in parentheses denote number of observations.
- Observations not available.

Table 29. Breed wise average weight gain (during pregnency) in relation to birth weight of calves

Breed	Ist Trimester	IInd Trimester	IIIrd Trimester	IVth Trimester	Average birth weight of calves	Birth weight in relation to % weight gain of dams
Bikaneri	5.60±7.37 (10)	13.40±6.35 (10)	36.80±8.07 (10)	68.50±6.80 (10)	43.90±2.47 (10)	35.4%
Jaisalmeri	15.33±6.71 (6)	9.67±7.11 (6)	30.00±5.25 (6)	75.17±7.00 (6)	45.67±1.98 (6)	35.1%
Kutchi	2.55±6.34 (11)	14.64±4.98 (11)	29.00±3.44 (11)	65.73±7.74 (11)	37.82±1.11 (11)	33.8%

Figure in parentheses denote number of observations

Table 30. Average values of certain reproductive parameters (1990-91)

Parameter	
Age at first service (days)	1040.83±5.39 (6)
Age at first calving (days)	1491.17±6.40 (6)
Gestation length (days)	
Male	387.00±2.76 (12)
Female	388.47±2.08 (15)
Calving interval (days)	713.94±9.69
% of calving 39/48	81.25
% Conception 52/67	77.61
Calving rate	41.94
No. of services per conception	1.98

Fig. 13 BODY WEIGHT GAIN DURING PREGNANCY

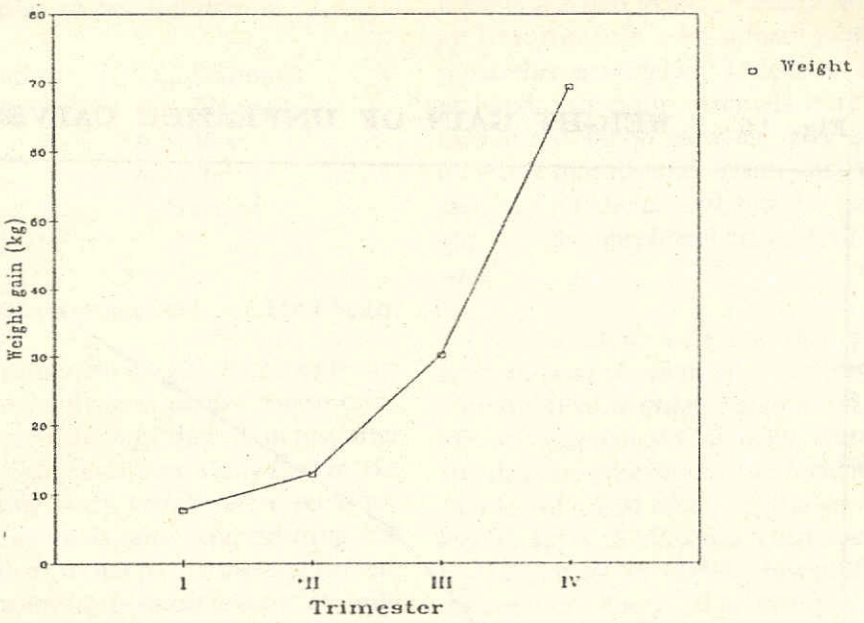


Fig. 14 BODY WEIGHTS OF LACTATING/NON LACTATING CAMELS

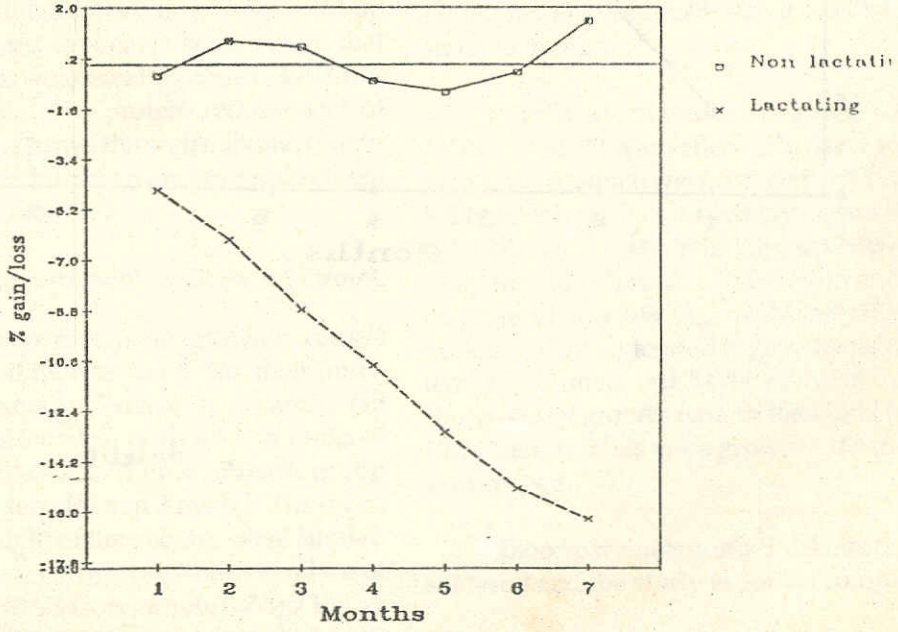
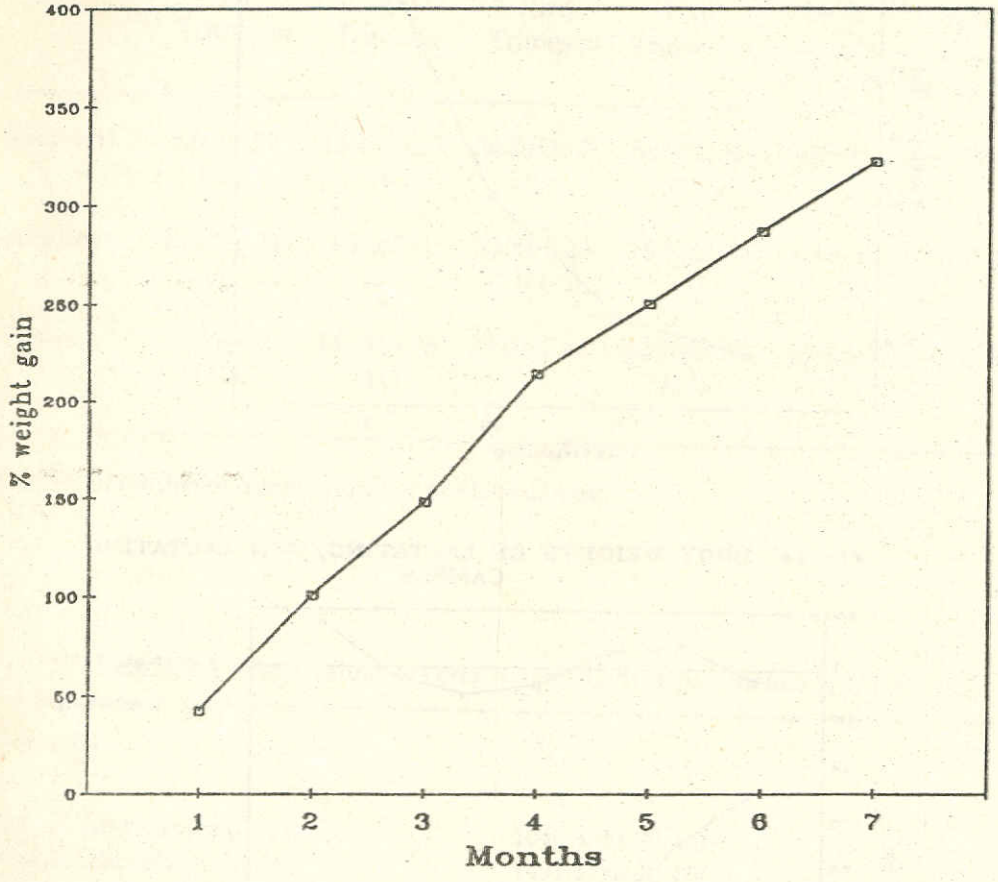


Fig. 15 **WEIGHT GAIN OF UNWEANED CALVES**



Project Code No. P.I. 90/4 - ICN/ L-30/5220

Title Studies on camel nutrition

Project Leader	: R.C. Jakhmola
Associates	: A.K. Nagpal
	: A.K. Roy
	: A.K. Rai
Technical Assistance	: N. Sharma

Nutrient Requirement of Camel (< 1 Year).

Six camel calves of about 2 month age were fed on mothchara ad lib + concentrate. Calves suckled milk of their dam just after manual milking was over. Daily feed intake and monthly body weight were recorded (Table 31). Animals gained more during first 2 months than in later part of the experiment. It was theoretically possible to calculate milk intake by calf from its dam based on the requirements of energy. These requirements were derived based on the review of literature on ruminants and are subjected to modification as database on camel may build up in near future. Estimates have shown that camel calves were suckling about 5 to 9 litres of milk daily. The protein requirement of calves were also met through milk and roughage calculated through energy requirement estimates. (Table 32)

Nutrient Requirement of Growing Camel.

An experiment on growing camels was initiated inorder to predict their nutrient requirements. Twenty four camels (15 females and 9 males) of about 11 months of age were alloted to 3 groups (each group consisted 5 females and 3 males). The mean age and weight of the animals were similar. Animals were fed in groups on three plane of nutrition. HPN (Concentrate 0.7 kg/100 kg W). MPN (Concentrate 0.4 kg/100 kg W) and LPN (No concentrate). The concentrate was procured from co-operative feed plant, Bikaner and had 18.8% CP and 2.4 Mcal ME/ kg DM. Animals were offered moth chara *(Phaseolus acontifolius)* fodder as lib and watered once daily. Animals were weight fortnightly. Blood samples were collected once in 2 months and serum samples were analysed for cholesterol, total protein, urea, glucose, alkaline phosphatase, and transaminase.

As animals were fed in groups and it was not possible to monitor intake of individual animal, average intake of DM, CP and ME was calculated (Table 33). During first 108 days of experiment moth chara (CP = 11.5%; ME = 2.04 Mcal/kg) intake was 1.59 kg/100 kg W in LPN and it increased to 1.7 kg/100 kg W in MPN. However, intake declined to 1.4 kg/100 kg W when concentrate level was increased to 700g/100 kg W in HPN. This could have been due to changes in microbial fermentation pattern in the rumen. Similarly, intakes of ME and CP in HPN was also reduced and it was nearly same as in mpn.

Similarity, of intake of ME and CP in HPN and MPN was reflected in live weight gain (LWG), which were similar in HPN and MPN which were considerably higher than LPN (Table 33). The relation-ship between body weight (W) of camel and age of animal in three treatments (fig. 16,17 and 18) revealed that males tended to grow faster than females. Camels fed HPN or MPN have shown better growth pattern than LPN (fig.. 18), where animals were growing at a much slower pace.

Blood parameters of animals are being analysed and the study is not yet complete.

Based on the model worked out val-

ues for ME and CP required to maintain desired gain in groups (Table 34). It was stipulated that HPN could give 700g/day rate of growth while MPN was fed for LWG of 400g/ day. LPN was left as control. Comparison between intake of ME and CP with those required by animal, indicated that camels fed HPN received less ME than actually required for stipulated growth rate. Hence the gain reduced. ME was only limitation observed while CP was enough in the ration. Practical difficulty in preparing complete ration, gave dependence on commercial concentrate which were made basically for cattle and were used in present experiment. Acording to model, the metabolisability of energy was considered similar in different plane of nutrition. This gave a negative balance of energy at LGW of 228.9 in LPN. However, under LPN animals could have used energy much more efficiently, due increase in proportional number of rumen microbes feeding on cell wall carbohydrates. The necessary correction would therefore be made in model.

Studies on Lactating Camels

Four newly calved Bikaneri camels were offered either mothchara alone (R) or in combination with green barley (G), concentrate (C) or both. Quantities of green and concentrate were limited to 3 kg DM and 4.0 kg DM respectively per head per day. Thus four treatments {(R) mothchara ad lib ; CP = 11.7% ; ME 1.98 Mcal/kg ; (RG) Barley green (CP = 16.6 ; ME 2.22) in addition to ad lib mothchara, RC Concentrate (CP = 20.0% ; ME = 2.40) in addition to mothchara ad lib) and RCG Green barley 3kg + concentrate4 kg + mothchara ad lib), were made and animals were offered these diets for a period of 40 days. These camels were being milked first time, so practical difficulties have been faced to restrain the animals. Calves were allowed to suckle the milk once manual milking is over. Intake of mothchara was recorded daily. Animals being offered green and concentrate were allowed to consume all of these before offering mothchara. Intake of dry matter, CP, ME are given in Table 35 along with body weight. Milk yield was adjusted for that suckled by calves according to calculation shown in Table 31. Camels fed on mothchara (R) consumed least DM,CP and ME and lost maximum weight during experiment (0.667 kg/day). RC and RG were similar their performance when green and concentrate both were offered over mothchara animals consumed maximum DM, CP and ME produced maximum milk (observed as well as estimated). Loss in body weight was also least (0.317 kg/day) in this group.

Data were reorganised for whole experimental period to give an idea how good the model calculations can predict nutrient requirement for lactating animals. In the model milk yield was fitted, that was estimated in Table 35. Intake of DM, CP ME and loss in body weight are described in Table 36. Estimated quantities of ME and CP that were required by animals are presented in Table 37. A comparison between requirement and that received by animals have shown that model was estimating higher values for ME at low plane of nutrition.

Attempts would therefore be made to put necessary corrections in the model based on the experience on digestion pattern of different feeds in camel. Table 38 presents relationship between intake of ME and CP with daily milk yield. Data suggests that a multifactor regression is possible to predict yield of the milk based on the intake data. Attempts would be made to isolate those factors which have a good relationship with milk yield.

Evaluation of Feed Resources for Camel

A. Evaluation of pala leaves *(Zizyphus nummularia)*: During the year attempts were made to evaluate pala (dry leaves of *Zizyphus nummularia)*, in order to generate database on chemical composition and energetic value of different feeds for camel. Data are being analysed.

Attempts were also made to observe effect of intensity of watering on feed intake and nutrient digestibility of different roughages. Mothchara have been evaluated. Results are being analysed. However, informations on intake, dry matter digestibility and water intake by animal are presented in Table 39. Intake of DM decreased progressively form 75.64± 1.75 g/kg $W^{0.75}$ in group where water was offered once daily to 60.21 ± 4.868 g/kg $W^{0.75}$ where water offered twice a week. Animals receiving water once a week ate only 48.96 ± 6.291 g DM/ kg $W^{0.75}$. Intake of water (l/day) also reduced as intensity of watering declined.

B. Evaluation of Guar Phalgati *(Cyamposis tetragonoloba)* :

Four healthy adult Bikaneri male camels (541.00 ± 18.064 kg) were fed Guar phalgati as sole feed ration for an experimental period of 84 days and thereafter a metabolic trial of 5 days collection period was conducted. The feed, residue, faeces and urine were analysed for proximate constituents.

Guar phalgati contained 6.81 percent CP, 28.21 percent DF, 0.59 percent EE, 54.99 percent NFE and 9.40 percent total ash on DM basis (Table 40).

The digestibility coefficients of DM, OM, CP, CF, EE, and NFE were 76.56, 77.45, 72.47, 61.87, 9.11 and 85.52 respectively. The DCP%, TDN% and ME (Kcal/g) values were 5.13, 69.73 and 2.51 respectively on DM basis.

Mean nitrogen balance was found to be 68.45 ± 3.34 g/d sufficient to maintain the animals (Table 41). The lower DMI (1.387 ± 0.647%) and higher feed efficiency values (37.156 ± 4.344) of Guar phalgati indicate the suitability of this feed for maintanance purpose during normal and drought periods.

C. Impact of formeta green barley *(Hordeum vulgare)* supplementation on feed, water utilization and growth performance of growing camels :

Studies on feed, water intake and growth performance of camel calves (1.5 to 2 years) was conducted by replacing 30% of DM intake by fometa green barley with ad lib. intake of dry mothchara for 85 days in cool, dry winter season of 1989. Calves were divided into two groups. Group I was offered water once daily and group II only once a week. Proximate composition of mothchara and fometa green barley is given in Table 42. While digestibility coefficients of DM, OM, EE, CF and NFE were higher in animals on weekly watering schedule, CP digestibility was grater in animals offered water daily. Likewise nitrogen balance (g/d) was higher in group I camels (78.320) than in group II camels. The nutrient intake g/kg $W^{0.75}$ in terms of DM, DCP, TDN in former group were 74.173, 7.920, 63.135 similar to the respective values of 77.760, 7.662 and 66.873 in later group (Table 43).

Daily water intake from feed and free source was higher in animals on daily watering schedule (22.855 litres) than in animals on weekly watering schedule (12.798 litres). Water intake from free source was

double (60%) in former group animals as compared to 29 % in latter group animals. Further free water intake and total water intake percent on metabolic body weight basis were also higher in former group. The results indicate that growing camels when fed dry mothchara and formeta green barley the weekly watering schedule was not able to meet their water requirements and need extra drinking water for maintaining their growth rates during winter.

Table 31 Studies on growing camels (less than 1 year) : feed intake and growth rate of calves during 180 days of experiment

	Days in experiment				
	0-30	30-60	60-90	90-120	120-180
Intake (kg/day)					
Dry matter	0.74	1.507	1.89	1.95	2.88
ME (Mcal)	1.45	3.06	3.33	4.03	5.65
CP (g)	65.89	160.54	221.65	226.19	256.59
Body weight (W)					
Initial (kg)	85.00	105.80	127.50	140.30	155.80
Final (kg)	105.80	127.50	140.30	155.80	194.00
Body wt gain (g/day)	669.00	725.00	425.00	517.00	542.00
Requirement					
NE maintenance (mcal/day)	2.407	2.821	3.225	3.505	4.187
NE growth (mcal/day)	1.294	1.531	0.935	1.199	1.400
ME (Mcal/day)	6.82	8.76	7.12	8.20	9.71
ME to be supplied through milk (Mcal)	5.37	5.70	3.19	4.17	4.06
Kg of milk DM needed	1.02	1.08	0.60	0.78	0.77
Kg of FCM needed	8.50	8.98	5.03	6.57	6.40

Assumptions : metabolisability = 50%
kf = 0.396
km = 0.678

Table 32 Studies on growing camel (< 1 year) : requirement of CP by early ruminating calves

	Days in experiment				
	0-30	30-60	60-90	90-120	120-180
CP rrequirement (g/day)					
TP maintenance	32.3	36.4	39.9	41.8	46.5
TP growth	108.7	113.3	68.5	81.6	82.7
True protein (total)	141.0	149.7	108.4	123.4	129.2
Amino acid protein required in intestine (g/day)	266.7	285.2	206.5	235.0	246.1
Estimated aminoacid protein in intestine made available through					
feed (g/day) *	36.9	89.9	124.1	126.7	143.7
milk **	230.0 * 3	188.6	105.6	138.0	134.4
Total	266.9	278.5	229.7	264.7	278.1

* Considering that 56.0% of roughage - N was actually converted into aminoacid

** Efficiency of milk digestion was considered as 70%

* 3. Higher efficiency of utilisation of milk protein (90%) assumed in preruminating calves (< 3 months)

Table 33 Experiment on growing camels : effect of different plane of nutrition on intake of nutrients and daily gain

	HPN	MPN	LPN
Intake (daily)			
Dry matter (kg)	4.30	4.68	3.28
ME (Mcal)	9.31	9.91	6.69
CP (g)	604.00	611.00	377.00
DM intake (g/kgW$^{0.75}$)	76.50	84.20	54.96
Intake (g/kg W)	20.90	22.00	15.90
DM (g)	20.90	22.00	15.90
CP (g)	2.94	2.88	1.83
ME (kcal)	45.30	46.70	32.50
Body weight (kg)			
initial	205.60	212.30	205.80
Body weight gain (g/day)	422.00	455.00	228.00

HPN = 1.5 kg concentrate + mothchara ad lib
MPN = 1.0 kg concentrate + mothchara ad lib
LPN = No concentrate & mothchara ad lib

Table 34 Studies on growing camels : theoretically calculated amounts of ME and CP needed to achieve desired growth

	HPN	MPN	LPN
Energy (Mcal/day)			
NE maintenance	4.692	4.756	4.684
NE growth	1.970	1.257	0.594
NE (Mcal/day)	11.640	10.230	8.710
Crude protein requirment (g/day)			
TP maintenance	49.44	50.12	49.47
TP growth	102.69	68.42	35.37
Total TP	152.13	118.54	84.84
CP rrequired to meet TP (g/day)	482.90	376.30	269.30
Difference between supplied nutrition and required nutrients			
ME (Mcal)	-2.33	-0.32	-2.02
CP (g)	121.10	234.70	107.70

Table 35 Studies on milch camels : Effect of intake of DM, CP and ME on milk yield

	Ration*			
	R	RG	RC	RCG
Intake (kg/day)				
Dry matter	8.230	15.160	15.230	18.150
	± 0.111	± 0.103	± 0.048	± 0.119
Crude protein	0.733	1.470	1.800	2.170
	± 0.009	± 0.009	± 0.004	± 0.012
ME (Mcal)	16.110	30.570	31.420	37.940
	± 0.205	± 0.200	± 0.036	± 0.233
DM (kg/100 kg W)	1.420	2.250	2.340	2.740
	± 0.048	± 0.061	± 0.045	± 0.040
Milk yield (kg/day)				
observed	4.750	5.740	6.190	7.260
	± 0.410	± 0.430	± 0.170	± 0.800
Estimated **	11.150	12.140	12.000	16.240
Body weight (W)				
initial (kg)	580.000	676.300	653.000	662.500
	± 20.740	± 15.290	± 12.390	± 14.510
final (kg)	560.000	662.500	635.500	653.000
	± 20.350	± 14.510	± 14.430	± 12.400
Loss in body weight	0.667	0.458	0.583	0.317
(kg/day)	± 0.225	± 0.115	± 0.070	± 0.109

* R = Roughage (ad lib)
RG = Roughage ad lib + GREEN 3 kg DM/head/day
RC = Roughage ad lib + cencentrate 4.0 kg DM/head/day
RCG = Green (3 kg DM) + concentrate (4.0 kg DM) + roughage
** On the basis of calculated values for milk yield assumed to be suckled by calves (Table - 34) in addition to that observed.

Table 36 Studies on lactating camels : mean intake of nutrients and milk yield during experiments

	Days in experiment				
	0-30	30-60	60-90	90-120	120-180
Intake (daily)					
DM (kg)	15.510	17.590	16.120	15.780	10.080
	± 0.058	± 0.061	± 0.042	± 0.078	± 0.096
ME (mcal)	31.640	36.890	33.580	32.680	19.940
	± 0.114	± 0.120	± 0.083	± 0.153	± 0.189
CP	1626.000	2110.000	1913.000	1848.000	927.800
	± 5.340	± 5.430	± 3.750	± 6.800	± 9.970
Intake (g/kg $W^{0.75}$)					
DM	117.500	134.800	125.000	124.800	81.500
	± 2.020	± 2.320	± 1.580	± 1.550	± 1.710
ME (kcal)	238.800	282.8000	260.000	258.500	161.300
	± 3.820	± 4.660	± 3.160	± 3.590	± 3.570
CP	12.300	16.200	14.800	14.610	7.500
	± 0.200	± 0.270	± 0.190	±0.210	± 0.150
Body weight (kg)					
Initial	676±15.3	663±14.5	653±12.4	636±14.4	619±13.1
final	663±14.5	653±12.4	636±14.4	619±13.1	570±20.4
Loss in weight (g/day)	433±82.9	317±109.3	583±70.1	558±79.8	804±399.2
Milk yield (kg/day)					
observed	5.9±0.50	7.6±0.60	5.9±0.10	6.2±0.37	4.9±0.43
estimated*	14.9±0.60	16.5±0.62	10.9±0.10	12.8±0.37	11.3±0.43
Temperature (°C)					
min	8	-	19.5	24.5	24
max	36.5	-	44.5	45.5	41

* as in table 35

Table 37 Studies on lactating camels : requirement of ME and CP (calculations based on model)

	Days in experiment				
	0-30	30-60	60-90	90-120	120-180
Energy requirement (Mcal/day)					
NE maintenance	10.61	10.46	10.34	10.14	9.93
NE milk	10.94	12.16	8.04	9.42	8.55
Total	21.55	22.62	18.38	19.56	18.48
ME (NE/0.63)	34.21	35.91	29.18	31.05	29.33
ME of weight loss	3.37	2.46	4.53	4.34	6.25
CP requirement (g/day)					
TP maintenance	77.40	076.90	76.40	075.70	75.00
TP milk*	447.00	495.00	327.00	384.00	339.00
Total	524.40	571.90	403.4	0459.70	414.00
CP of weight loss	48.00	35.00	65.00	62.00	90.00
RDP	1120.00	1176.00	955.00	1017.00	960.00
VDP	105.00	151.00	15.00	64.00	17.00
CP to be supplied from ration (g/day)	1633.00	1769.00	1293.00	1441.00	1311.00
difference between supplied nutrient and required nutrient **					
Energy (ME)	0.80	3.44	8.93	5.97	-3.14
CP	41.00	375.00	685.00	469.00	-293.00

* True-protein secreted into the milk (estimated in Table 2)

** ME required - ME of weight loss-ME supplied through ration.

Table 38 Studies on lactating camels : relationship between milk yield and daily intakes of ME and CP

Y	X	Regression	r
Milk yield (kg/day)	DM intake (kg/day)	5.97+0.487x	0.548
Milk yield (kg/day)	CP intake (kg/day)	8.87+2.619x	0.469
Milk yield (kg/day)	ME intake (kg/day)	6.71+0.212x	0.537
Milk yield (kg/day)	ME intake over maintenance	6.65+3.509x	0.515
Milk yield (g/kg $W^{0.75}$)	ME intake (kcal/kg $W^{0.75}$)	77.37+0.110x	0.414
Milk yield (g/kg $W^{0.75}$)	CP intake (g/kg $W^{0.75}$)	66.12+2.77x	0.483
Milk yield (g/kg $W^{0.75}$)	DM intake (g/kg $W^{0.75}$)	40.91+0.53x	0.558

Table 39. Nutritional evaluation of mothchara : effect of intensity of watering on intake and digestibility

	Intensity of watring		
	Daily	Twice in a week	Once in a week
DM intake			
kg/day	5.93±0.155	4.76±0.45	3.83±0.413
g/kg $W^{0.75}$	75.64±1.75	60.21±4.868	48.96±6.291
kg/100 kg W	1.76±0.047	1.40±1.109	1.145±0.154
DM digestibility			
g/kg DM intake	662.8±27.70	626.6±20.68	647.0±41.34
Water intake			
kg/head/day	12.12±0.57	10.05±0.49	5.90±0.725

Table 40. Nutritive value of Guar phalgati *(Cyamposis tetragonoloba)*

Parammeter	Composition	Digestibility % (n=3)
DM	92.54	76.56
OM	90.60	77.45
CP	6.81	72.47
CF	28.21	61.87
EE	0.59	9.11
Ash	9.40	-
FE	54.99	85.52
Nutritove value		
DCP	5.13	-
TDN	69.73	-
ME (Mcal/kg)	2.51	-

Table 41. Nitrogen balance, growth, feed efficiency and water intake of 4 adult camels

Parameter/Animal nos	153	159	166	182	Mean ± SE
Nitrogen balance (g/d)					
N intake (feed)	-	113.42	113.42	109.52	112.12±1.30
N voided					
Faeces	-	27.78	37.04	27.86	30.89±3.07
Urine	-	12.95	14.52	10.85	12.77±1.06
N balance	-	72.69	61.86	70.81	68.45±3.34
Growth (kg)					
Initial body wt	590.00	518.00	510.00	546.00	541.00±18.06
Final body wt	616.00	541.00	526.00	566.00	562.24±19.73
Body wt gain	26.00	23.00	16.00	20.00	21.25±02.14
ADG	0.309	00.294	0.190	0.238	0.258±0.027
Feed efficiency					
DMI (%)	1.207	1.461	1.498	1.384	1.387±0.0647
DMI kg/kg wt gain	28.005	33.644	44.499	38.476	37.156±4.3440
Water intake					
Water intake %	5.489	5.637	5.878	5.471	5.619±0.094
Water intake/kg/DMI	4.575	3.857	3.924	3.953	4.077±0.167

Table 42. Proximate composition of feed stuffs (% DM basis)

Component	Dry moth chara	fometa green barley
Organic matter	89.10	95.29
Crude protein	11.51	12.87
Ether extract	3.61	4.71
Crude fibre	13.27	12.43
Ash	10.90	4.71
Nitrogen free extract	61.61	65.28

Table 43. Growth, digestibility coefficients, nitrogen balance, nutrient intake, feed efficiency and water intake of adult camels

Parameters	Group I (Daily watering) (n=3)	Group II (Weekly watering) (n=2)
A. Growth		
Av. initial body w. (kg)	252.500	293.500
Av. final body w. (kg)	271.833	308.250
Av. body w. gain (kg)	19.333	14.750
A.D.G. (g)	227.450	173.530
B. Digestibility coefficients		
DM	83.22	84.78
OM	87.86	88.01
CP	88.22	82.86
EE	79.90	83.41
CF	72.49	78.00
NFE	90.05	91.16
C. Nitrogen balance (g/d)		
N-intake		
Feed	97.91	99.177
N-voided		
Faeces	12.007	21.008
Urine	7.583	13.366
N- balance	78.320	64.803
D. Nutrient intake (g/kg $W^{0.75}$)		
DMI	74.173	77.760
DCP	7.920	7.662
TDN	63.135	66.873
E. Feed efficiency		
DMI kg/kg body w. gain	21.207	32.403
F. Water intake		
Phaseolus aconitifolius	2 : 38 : 60	4 : 67 : 29
F.G. barley : Free water		
Free water intake (%)	5.228	1.246
Total water intake (%)	8.775	4.254

Fig. 16 GROWTH PATTERN OF CAMELS FED ON HPN

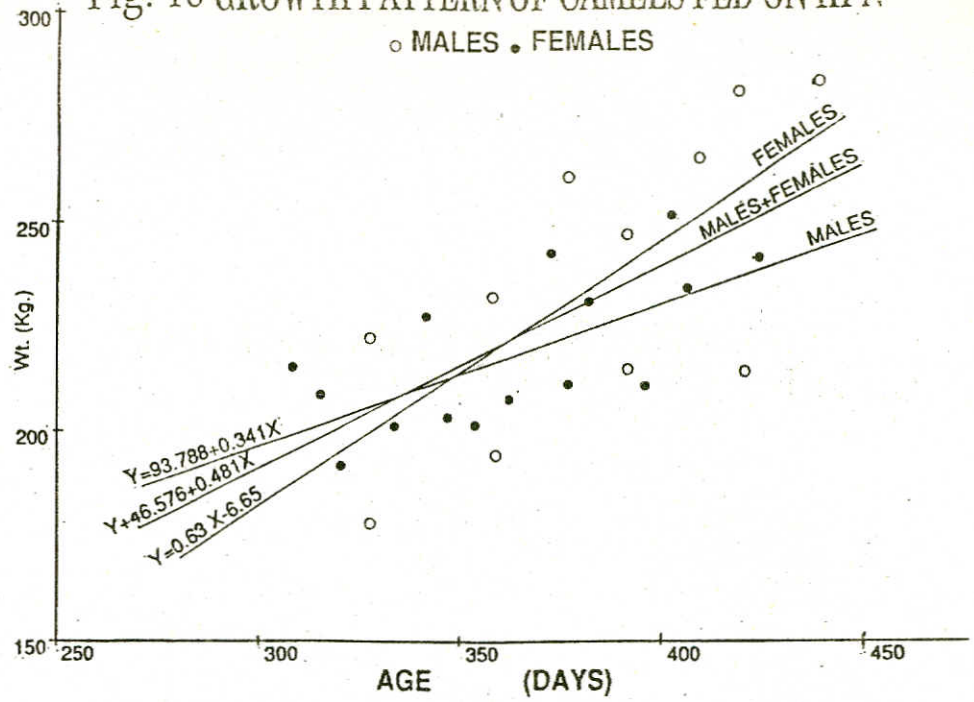


Fig. 17 GROWTH PATTERN OF CAMELS FED ON MPN

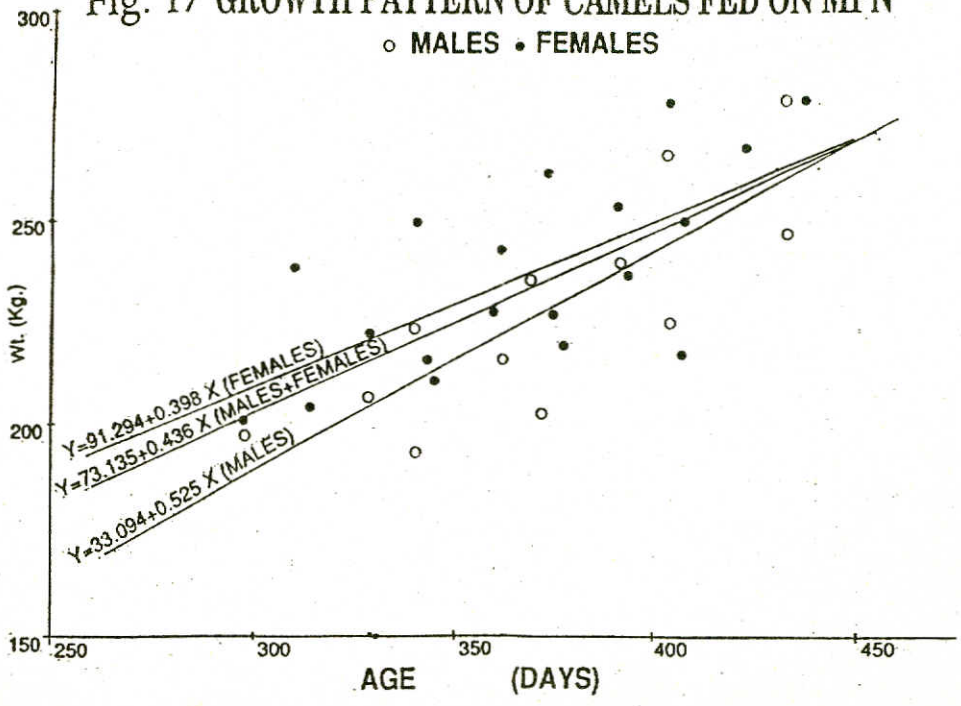
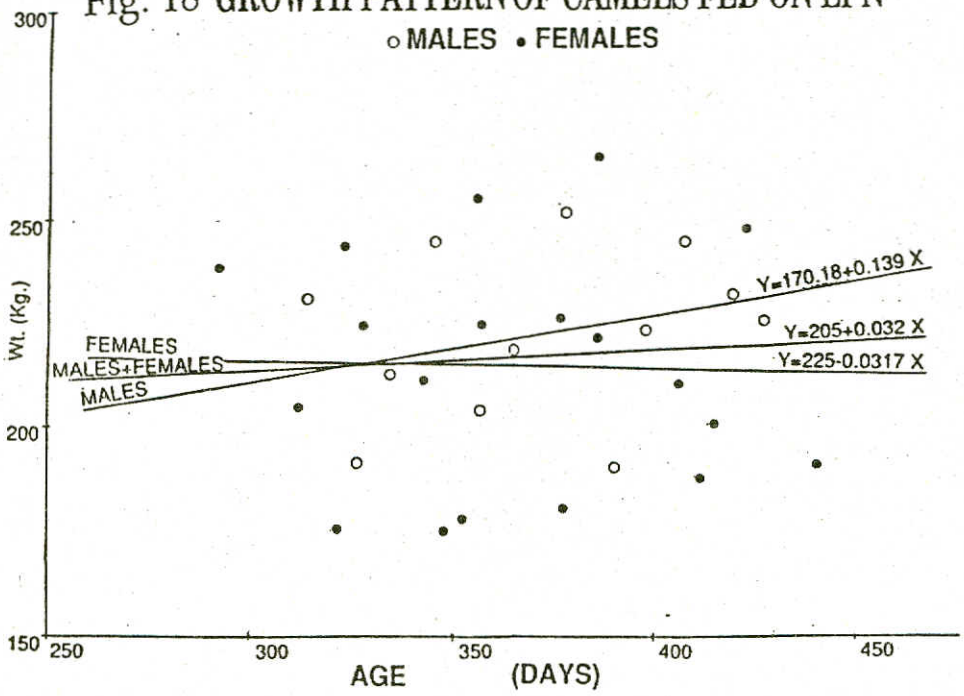


Fig. 18 GROWTH PATTERN OF CAMELS FED ON LPN



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

Title : Studies on Camel Reproduction

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

Efforts were made to generate necessary facilities for the research work in this project. The available facilities were utilised for semen collection and evaluation work. Research on artificial insemination was also initiated on a limited scale.

Semen collection

The semen samples were collected from seven camel studs once or twice in a week. The studs were fed 14 kg. of Moth chara or Guar hay and 2 kg of concentrate daily. They were offered water once a day and were under uniform management. The studs belonged to the age group of 7 to 13 years and the body weight ranged from 600 to 950 kg. The semen was collected between 7.00 and 8.00 a.m. during summer and 8.00 and 9.00 a.m. during winter season. The camel studs were usually not utilised for any work but for mild exercise from time to time.

The behavior of camel studs and ejaculation time varied from animal to animal. Some times the studs kept mounted on the female for five minutes and yielded no semen. The stud approached the female but did not mount. Such behavior was common during non rutting season. Normally the studs took three to six minutes in a single ejaculate which came out after a number of pelvic jerks during mating process. Split ejaculate method was also tried but the second fraction of semen rarely contained sperms. The semen samples were collected with the help of bovine artificial vagina maintained at 38°C and properly lubricated with glycerin/ paraffin liquid . The semen was shifted immediately after collection to a water bath maintained at 38°C.

Semen evaluation

The semen samples were evaluated for volume, colour, consistency, motility, sperm concentration and live sperm percentage (Table 44). Normally the semen samples had medium gel formation immediately after collection which dissolved after 10 to 30 minutes. It was not possible to remove the gel mechanically. The samples with milky white colour had little or no gel formation. The motility was observed only in such three

Table 44. Semen evalution

Parameters	Mean ± SE	Range
Ejaculation time (min)	3.50 ± 0.318 (32)	1-6
Volume (ml)	4.25 ± 0.420 (52)	0.5-14.5
Sperm concentration ($x10^6$)	500.28 ± 53.568 (18)	155-900
Live sperm (%)	92.75 ± 0.683 (31)	81.0-97.4

Figures in parentheses indicate number of observation.

samples although the samples collected without gel were rare. The sperms were lashing their tail but there was no wave motion. No sperms could be seen in ten samples collected during rutting as well as non rutting season (July to September) and the time taken for an ejaculate was less than 2 minutes. However in the month of June ejaculation time was generally more than 5 minutes. The percent live sperm count did not change after 24 hours at refrigeration temperature when the semen was mixed with camel skim milk (1 : 1).

Scanning electron microscopy (SEM) of spermatozoa :

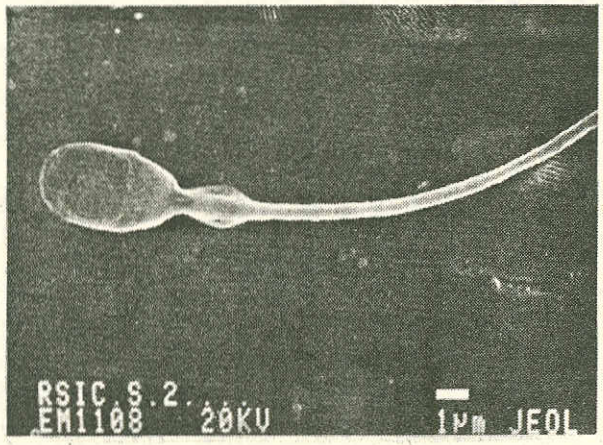
(Assisted by Dr. Anita Ranga, Research Associate, U.G.C., Punjab University, Chandigarh)

After collection of semen the spermatozoa were fixed (with 2.5% glutaraldehyde), washed and dehyrated with ethyl alcohol. The morphological structure of spermatozoa was examined by SEM. The elliptical head, short neck, mid piece and club shaped tail were sharply demarcated (Plate 1). The percentage of live spermatozoa was 98.24± 1.31. The immature spermatozoa were 1.52%. The common abnormalities observed were; bent and curled tails (5.81%), double headed sperms (0.27%) and the protoplasmic droplets at the anterior end (3.02%) and posterior end (0.32%) of the mid piece.

Artificial insemination :

Artificial insemination was attempted in six females during second half of the breeding season (February)1991. The animals were divided into two groups having three animlas each. Group A was treated with 1000 I.U. Folligon (FSH) I/m and Chorulon (LH) 1500 I U was given after 96 hours. The animals were inseminated with neat semen. With the help of plastic cathetor 3 to 5 ml semen was deposited at utero-cervical junction. Group B was treated with chorulon 1500 I U intravenously just before insemination. Camels inseminated without any treatment served as control.

Only two animals of group B were found pregnant by using per rectum pregnancy diagnosis and observing "cocking of tail" method.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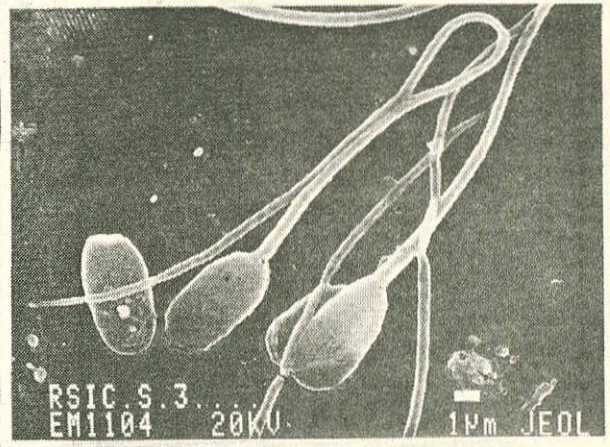
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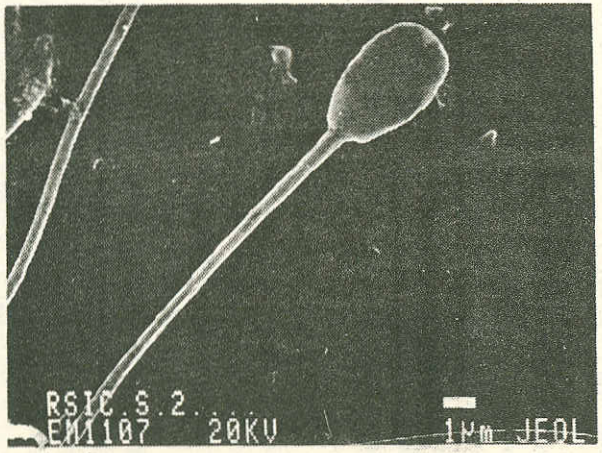
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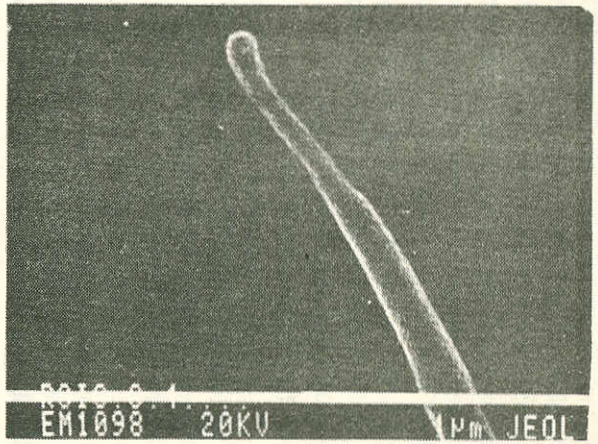
EM1098 20KV
μm JEOL

7. INTER INSTITUTIONAL COLLABORATION

1. Pharmacokinetics of sulphamethoxazole in camel

Report by Dr. M. Kapoor. Department of Pharmacology, College of Veterinary and Animal Sciences, Bikaner.

Studies on pharmacokinetics of sulphamethoxazole (SMZ) were conducted on 12 healthy camels of both sexes weighing between 220-300 kg.

In the first study 6 camels were fasted for 36 hrs. and than administered SMZ orally at the rate of 100 mg/kg of body weight. Blood samples were collected, in heparinized tubes, at various intervals starting from 0.5 hr to 72 hrs. after the drug administration.

The peak plasma concentration was reached at 20 hrs. after administration of SMZ the MIC of SMZ was maintained for 30 hrs. starting from the 10th hr. to the 40 th hr.

The t. 5 Beta of SMZ was calculated to be 18.16 hrs. with an elimination rate constant 0.0.038/hr.

In the second study SMZ was administered by an intravenous injection in the jugular vein to 6 camels @ 100 mg/kg. body weight Blood samples were collected at various intervals starting from 5 minutes after the injection up to 72 hrs. in heparinized tubes. Plasma separated from these blood samples was analyzed by spectrophotometric method. The mean plasma level of SMZ decreased progressively from 290/∝/ml at 5 minetes. to 8.5/∝/ml at 24 hrs. The drug was not detectable in blood at 72 hrs. after the injection.

2. Invesstigations on cytogenetic profile of Indian Camel

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

The blood samples of 20 male animals were received from National Research Centre on Camel, Bikaner and whole blood cultures were set using TC- 199 media. 5'-Bromodeoxyuridine a base analogue was incorporated with the media for two successive cell cycles, whereas in one initial cycle culture grew in normal medium. The slides stained with giemsa gave differential staining of chromatids and also revealed sites of exchanges between sister chromatid. The overall sister chromatid exchange frequency in the Kutchi camel was found to be 4.80 per cell where as in Jaisalmeri camel it was found to be 6.74 per cell or 3.37 per cell per generation. The frequency was derived on the basis of scoring of cells from 10 animals of each breed which included 50 metaphase spreads per individual.

The sites of nucleolar organiser regions (NORs) were also localised in the chromosomes of Jaisalmeri camel. It was found that six pairs of NORs can be elucidated. The NORr were present on both acrocentric as well as metacentric chromosomes.

Between 9 & 12 NORs could be discerned on metaphase spread. This variations has been attributed to the fact that the culture may not always reveal all NOR sites but only those which are functionally active at a particular period. The absence of NOR from one homologue of a pair could be either due to inadequate staining or fuctional inactivity of r-DNA cistrons.

3. Experimental and clinical studies on would healing in camel *(camelus dromaderius)*

Final report of Ph.D. Project by Dr. N.R. Purohit, Department of Surgery and Radiology, College of Veterinary and Animal Sciences, Bikaner.

Studies on wound healing was conducted in 24 camels of National Research Centre on Cemel. The camels were divided into four groups of 6 animals each.

In three groups, 180 full thickness cutaneous excisional open wounds of the size 2.5 x 2.5 cm, ten in each animal (5 on each side of the dorsal -median-plane) were surgically created on the gluteal (rump) regions. The right gluteal wounds of these groups were treated with neem oil, protamine zinc insulin and camel- tissue-extract respectively. While the left gluteal wounds were treated with normal saline (control). The dressing was done daily for 12 days then on alternate days. The clinical observation were made daily. The healing process was evaluated at 4 days interval upto day 20 by percent healing. Biopsy samples were used for histopathological and histochemical examination and biochemical estimations for collagen, hydroxyproline, hexosamine, ascorbic acid, zinc, copper, magnesium and iron.

In the fourth group, 120 cutaneous incisional wounds were made. In each camel, linear 1.5 cm long, ten vertical cutaneous incisions were surgically made on either side of the dorsal median plane on gluteal region. In each wound, the topical prepartions under study were applied respectively, prior to closure. The mechanical evaluation viz. breaking strength tensile strength, extensibility and energy absorption was done on postwounding day 4,8,12,16 and 20 by strip in-vitro method using locally fabricated and modified tensiometer on the principle of flowing water method in the Department of Surgery and Radiology, Veterinary College.

The dressing preparations were also evaluated in the management of 52 clinical cases of wounds in the camels.

On the basis of overall observations, it was revealed that the dressing materials were well tolerated and enhanced the tissue repair in order of insulin, tissue extract and neem oil.

The microbiological examination was done in the department of Veterinary Microbiology. The examination of 49 clinical wounds revealed 21 different bacterial species. The percent sensitivity of the bacterial isolates was also carried out.

The belief that wound healing is slower in camel seems to be untrue. The camel skin is well vascularized and the phenomenon of wound healing in camel is endowed with all potentialities of restoring the integrity of living tissues. General pattern of tissue, repair in camel is nearly similar to that of other animal species, however, the results of various parameters are comparable.

Careful clinical judement, early surgical mangement with gental handling of

wound tissue, aqua therapy of through wound irrigation, effective topical medication and sufficient rest brings about quick and better recovery in the clinical wounds in the camels.

4. Impact of draught stress on thyroid status

Report by Dr. S.P. Agrawal, Department of Veterinary Physioloy, Haryana Agrticultural University, Hisar-125004

The blood sera of Bikaneri draught camels were received from NRCC Bikaner for hormone estimation. These animals were involved in riding and haulage in two/four wheel carts with a payload of 1500/2500 kg respectively for 4 hours.

The blood samples were collected just before the start of exercise. at hourly interval during exerciese and at 2,4,8 and 24 hours of rest. Samples from control (non-exercised animals) were collected at periods corresponding to exercised animals. Sera were analysed for T4 and T3 concentration using specific RIA kits supplied by BARC, Bombay. The data revealed that in draft animlas, the serum T4 and T3 leveles elevated from their basal values during haulage followed by gradual decline during rest to attain pre-exercise values by the next morning. In control animals, the leveles were maintained at peroids corresponding to haulage but slightly elevated during periods corresponding to rest. The results indicated a mild stimulation of thyroid status during exercise.

5. Adaptive responses of camel to dehyration and rehydration following water restriction

Report of Ph.D. Project by Deepti Khanna, Department of Zoology, Dungar (Autonomous) College, Bikaner.

Dehydration and rehydrtation studies were carried out on six camels during winter. The animals were offered water twice a week for a pre-experimental period of two months and mentained on mothchara as a sole feed. Three camels were dehydrated for a period of 21 days and the other three served as control. The water was offered to dehydrated camels on 22nd day and subsequently twice a week as per schedule. The animals were weighed daily. The feed and water consumption was also recorded daily.

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

(a) Haematological studies - RBC,WBC, Platelet, Heamoglobin, Haematocrit, MCV, MCH, ESR, blood ph and blood gasses.
(b) Biochemical studies - Blood glucose, total protein, albumin, bilirubin, blood urea, creatinine, LDH, ACP, ALP, GOT and GPT.
(c) Serum electrolytes - Sodium, Potassium and Calcium.
(d) Hormonal studies - T3 and T 4.

6. Camel pastoralism in Rajasthan

Report (abridged) by Prof. Ilse Kohler - Rollefson
Visiting fellow from San Diego State University, San Diego, CA 92182, USA.

Primary data on present status of camel breeding and situation of camel pas-

toralists were collected to informal interviews in two district of Rajasthan i.e. Bikaner and Pali. It afforded an iteresting contrast between camel production and utilisation patterns in a barren, agricultrually unproductive area (Bikaner) and a more fertile and intensively cultivated region (Pali).

The Cultural context of Camel Breeding

The larger herd of camels are owned and maintained only by members of Raika/ Rabri cast. Other groups that own small numbers of camel breeding stock are Jats, Rajputs and Muslims.

The camel certainly place a central and indetifying role in their cultrue as it is evidenced by the oral tradition. It is said in a local folk tale that the first Raika was created by Mahdev for the specfic purpose of taking care of the first camel that Parvati had just created from clay. It is historicaly well documanted that the Raikas were incharge of the supply and maintenance of the large number of camels required by the Rajput army's.

It has to be emphasised that not all Raikas or Rabris are large scale camel breedings; many of them specialised in sheep breeding. Partly on the basis of distinction two divisions are recognised within cast - the camel breeding Maur and the sheep and goat keeping (along with camel) Chalkia.

Utilisation Patterns

Traditionally, the relationship between the Raikas and their camels has been shaped by certain principles which are still followed rather strictly : 1 They do not kill camels or eat camel meat. 2. They do not sell camel milk- this is disdained as equal to "starving or selling one's children". 3. They do not sell camel wool. 4. They are not allowed to process camel milk into yoghurt of ghee. 5. They do not sell the dead animal, i.e. the bones or hide.

Muslims and Jats apparently have no qualms about selling camel wool; they also market the hides and sell the bones to fertilizer factories.

The prime rationale of camel breeding is for sale as draught animals. There is a strong and increasing demand for draught camels. The economic importance of camels in transporting goods in Rajasthan is substantial.

Ownership of a camel cum cart is a viable economic enterprise - making it possible to transport a wide variety of goods (such as phog wood, grain, fodder, etc, .) for profit. A government sponsored loan programme for the purchase of camels and camel carts has been extremely succesful, leading to an average annual income increase of Rs. 3.772 per beneficiary.

Camels are also in high demand for ploughing in the sandy areas where they have been shown to represent the most cost efficient traction energy source.

Milk

Camels are not systematically expolited for milk. With the exception of the men taking care of the herds. Camel milk is not an important dietary ingredient. Milk yields were reported to be between three to four liters per day. This milk is either consumed fresh or boiled with tea, sometime also used to make rice-pudding. For the Raika herdsmen that accompay camels on migrations,

the milk usually represents their sole sustenace and they sometimes subsist on camel milk for many weeks. camel milk becomes especially tasty when boiled and sweetened with suger. The only Muslim camel breeder interviewed declared that he milked his female camel up to five times a day achieving a yield of around 10 liters.

Hair

Camels are shorn once a year, starting in their first year. Shearing takes place in spring, usually around the time of the Holi fastival (February/March). The average yield per camel is 1.5 kg. The hair are then spun into yarn, an activity both men and women engage in. The balls of yarn are passed on to the local weavers (Meghwal) who process them into typical rugs, often mixing the camel hair with cotton or goat hair. camel hair are also used for stuffing saddle cushions, making ropes, shawls, coats and charpoys. Products made out of camel hair certainly form an important part of village material culture in Rajasthan.

Dung/Urine

Camel dung is used as fuel and fertilizer and represents a marketable resouce. The fertilizing pooperties of camel dung are rated lower than those of sheep/goat dung, but higher than of cow dung. As fuel, camel dung is preferred to cow dung cakes, because it gives even heat for a very long time. (Sheep/Goat dung is considered too valuable to be used as house hold fuel.) In the Pali area a heap ("Dhigli") of camel dung, accumulated after about 100 days from a single camel, fetches 100 Rupees.

In the Bikaner area, Camel dung can be sold as fuel to brick factories at the price of 700-800 Reupees per cart load (ca. 12 quintals).

Camel urine is also appreciated for its fertilizing effects, and for this reason farmers often request herds to come to rest in their fields.

Skin and Bones

Although not utilized by the Raikas. other castes have uses for these products. Bones can be sold to fertilizer factories. The leather made from camel skin is used for making shoes, bags and saddley. The famous Bikaneri "Surahi", a caraffe like container elaborately decorated with gold lacquer work is also made from camel hide.

Management Systems

Migratory patterns

The systems of camel management very to a considerable extent. depending on the ecological setting and the extent of agricultural development in the area.

In the agriculturally deficient areas of Bikaner, camel herds roam unsupervised for most or larger parts of the year. The camels come back to the villege on their own to drink water from the well. There is no danger from predators or thieves and everybody within a radius of 50 km known the animlas by their brand mark. Camles are collected only during the rainy season to prevent them from inflicting damage to the Kharif crop. In areas where grazing is scarcer, the herds are taken to regions further afield for about months out of the year. These migratroy tolas (herd) area accompannied by 3-4 men which take truns in periodically returning to their village.

In the Pali area, where crop cultivation is much more important and a fair

Table 45. Size Distribution of Raika Camel Herds

Herdsize	Bikaner	Pali
1-20	-	1
21-50	-	3
51-100	7	1
101-150	6	21
151-200	1	-
201-400	2	-
n	16	26

percentage of land is irrigated to produce a rabi crop, it has become extremely difficult to maintain camels on a larger scale. Camel herds and herdsmen have to migrate for hundreds of kilometers in search for grazing and in some cases have become totally separated form their villages.

In some instances it is possible to accommodate small herds within the vicinity of their villeges through out the year.

However, most herd owners have to engage in extremely complex arrangements to ensure the year-round provision of forage for their animals. January and Fabruary are very low in terms of feed availability; then in March the rabi crop is begun to be harvested and these fields with their khejri and neem trees become available. By July, herds from Marwar have to migrate far to the east, i.e. to the border with Madhya Pradesh, such as Karauli near Sawai Madhopur, and forested areas in Madhya Pradesh. Herds from Mewar go as far east as Indore.

It is the general consensus that 15 years ago camels were able to stay within short distances for their home villages, but that it is becomeing more and more prob lematical to maintain herds.

The Table 45 below underlines the differences in herd sizes between Pali and Bikaner districts: Very large herds, i.e. above 150 head were not encountered in the Pali area, whereas very small herds were absent from Bikaner district.

It was not possible to collect any detailed data on age and sex compostition of herds. While Bikaneri breeders are able to keep their young male camles until the age of 4-5 years when they fetch top proces, breeders in Pali generally tried to market their animals as early as possible, i.e. at the age of less than 1 year.

In both areas, the percentage of unproductive females is probably quite high, since no effort is being made to cull barren or aged females form the herds.

Breeding Practices

The Rikas are experienced and throughtful animla breeders by any standards. While female breeding stock is not screened for any particular charcteristics, the Raikas are intimately familiar with the lineages of their camels and can give infromation on the performacne of the last 7-8 generations. This knowlede is transmitted from father to son. The Raikas are not only familiar with the genetic make-up of their own animals, but also know the best camels in their areas. The selection of a stud male is

considered a matter of great imprtance that must handled with utmost discriminnation. Criteria entering into the evaluation are (1) pedigree (2) mother's and sister's performances (especially interms of milk yield), (3) conformation, (4) coulour, (5) facial expression. To prevent inbreeding, stud males are exchanged at regular four year intervals with neighbouring herd owners, usually on a friendship basis and without cash being involved in tranaction.

The Raikas also aim at producing a certain type of breed of camel, i.e. Bikaneri, Jaisalmeri, and Mewari which are fairly well defined and can easily be indentified. Breeding stock is exchange during marriage interactions.

Indigenous knowledge System

The Raikas have an extremely detailed knowledge of camel diseases and afflictions and resort to an arsenal of different therapies and medicines. While disease classification is rather standerdized, the types of treatments and medicnes varies regionally, withfew similarities between practices employed in Bikaner and Pali. This probably reflects individual experiences as well as different resource availability. Firing is a universally popular treatment. Mange and Trypanosomiasis are the most economically significant diseases. The discreption of individual types of treatment would be beyond the scope of this report, and will be included in a separate publication. However, it needs to be emphasized that while the Raika system of knowledge and beliefs includes certain elements of superstition, it agrees in large parts with modern veterinary principles and certainly deserves to be taken serious.

The Role of the camel in Rajasthani Culture

The camel always ranked third, after the elephant and horse, the frequency of depictions, and arguably, as object of admiration and affection. Camels were used to pull cannons into the battlefield and to carry a special type of swivel gun. Their main significance, then as now, presumable pertained to the transportation of people and supplies through desert areas, and not only of armies but of normal citizens and peasants. during the 18th and 19th centruies camels were used to deliver mail and messages along certain set routes. Whereas virtually all non Indian camel pastroralists are Muslims, the Raika system is shaped by Hindu principles and traditions. It is also clear that the camel breeding activities of the Raika represent a typical caste specialization which could have evolved only in response to a large demand for camels for non-food proposes. This bring s up the interesting question of the antiquity of their system. According to this legend the camel was introduced to Rajasthan by Pabu, a 14th century Rathore folk hero.

The Future of the camel in Rajasthan : An outlook

The disadvantaged classes with the opportunity to earn a livelihood. As living beings they have certain advantage over machines as well. While there is every indication that the demand for draught camels will intensify, the prospects for breeding camels are severly threatened. Due to a severe decrease in pasture resources the situation of most camel pastoralists has become desperate.

One should bear two imprtant factors in mind : (1) the above mentioned immense singnificance of the camel in transportation (2) the fact that from a long-term perspective the camel is much better adapted to the ecological setting of Rajasthan and especially the Thar desert. Agricultural intensification and irrigation have already lead to a lowering of the ground water level and tube-wells

may eventually dry out. Salinization of the soil an concomitant decline in crop yields can already be observed along the Indira Gandhi canal may spread further. Camels on the other hand are able to efficiently exploit the native drought resistant vegetation, they require much less water than buffaloes and cows.

7. Physical -Chemical properites of Camel Milk Fat in collaboration with the Dairy Chemistry Division, National Dairy Research Institute, Karnal.

The camel colostrum contained more minerals (ash), total proteins, casein serum proteins and low levels of lactose. The camel colostrum had high acidity, low pH and COB positive.

The camel milk had average 2.8% fat and 2.68% protein content. The casein was low in camel milk as compared to cattle and buffalo. The ash, calcium and lactose contents were almost similar to bovine milk.

The melting point of camel milk fat ranged between 39.9 to 42.8° C. The iodine value raged between 35.5 to 43.0 with an average of 39.5. Saponification value ranged between 209 to 213. Reichert Meissl value (1.7-2.1) and Polenske value (0.7-1.0) revealed that camel milk fat was devoid of butyric (C_4) acid and that other short chain fatty acids (C_6-C_{10}) were also much less to those in bovine fat.

8. PUBLICATIONS

List of articles published during the year.

1. Agarwal, S.P.. Rai, A.K. and Khanna, N.D. 1991. Serum progesterone leves in female camels during oestrous cycle. Indaian Journal of Animal Sci ences, 61 (1) : 37-39.
2. Khanna, N.D. 1990. Camels in India from the proto-historic to the present times. Indian Journal of Animal Sciences, 60 : 1093-1101.
3. Khanna, N.D. and Rai, A.K. 1990. Scient ific camel management can check de sertification. Indian Farming. 40 (6) : 33-35.
4. Khanna, N.D. and Rai, A.K. 1991. Camel rearing in Indian Arid Zone. Annals of Arid zone, 30 (1) : 1-10.
5. Khanna, N.D. Rai, A.K. and Tandon, S.N. 1990. Population trends and distribu tion of camel population in India. Indian Journal of Animal Sciences, 60 (3) : 331-337.
6. Khanna, N.D., Tandon, S.N. and Rai A.K. 1990. Breeding parameters of Indian camels. Indian Journal of Animal Sciences, 60 (11) : 1347-1354.

List of articles submitted for publication during the year

1. Agarwal, S.P., Rai, A.K. and Khanna, N.D. 1990. Cortisol response of male camel *(Camelus dromedarius)* under differ ent types of work load. Journal of Nuclear Agricultrue and Biology, IARI (In press).
2. Agarwal, S.P., Rai A.K. and Khanna, N.D. 1990. Effect of mating on hormone levels of male camels *(Camelus drome darius)* under different types of work load. Indian Veterinary Journal. (In press)
3. Khanna, N.D. 1991. Adikal se vertman tak Bhartiya parivesh mein oont. krishi Chayanika. (In press).

4. Rai, A.K., Agarwal. S.P. and Khanna, N.D. 1991. Induction for early puberty in female camels. Indian Journal of Animal Sciences. (In Press).

5. Rai, A.K. Khanna, N.D. Agarwal, S.P. 1991. Effect of feeding leucaena leucocephala with phaseolus aconitifolius on growth and thyroid status of camel calves. Indian Journal of Animal Sciences. (In press).

6. Rai, A. K., Roy A.K. and Khanna, N.D. 1991. A note on speed and strides of different breeds of camel. Indian Journal of Animal Sciences. (In press).

9. VISITORS

The National Research Centre on Camel, Bikaner received 2906 visitors during the year 1990-91. These included scientists, educationsts, administrators and Indian foreign tourist.

10. ADVISORY COMMITTEE

1. Dr. N.D. Khanna, Project Director, Chairman
   National Research Centre on Cemel, Bikaner.
2. Dr. C.L. Arora, Assistant Director General Member
   Indian Council of Agricultural Research, New Delhi.
3. Dean,
   College of Veterinary and Animal sciences Bikaner.
   Member
4. Dr. C.S. Mathur, Ex- Dean,
   Member
   College of Veterinary and Animal Sciences, Bikaner.
5. Dr. A.K. Rai, Principal Scientist
   Member
   National Research Centre on Camel, Bikaner
6. Sr. Accounts Officer
   Member
   Central Arid Zone Research Institute, Jodhpur
7. Shri Santokh singh, Assistant Administrative Officer
   Member
   National Research Centre on Camel, Bikaner.

11
सारांश

राष्ट्रीय उष्ट्र अनुसंधान केन्द्र में 1990-91 के सत्र में केन्द्र पर नीचे लिखे विषयों पर अनुसंधान किया गया।

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

इस सत्र में केन्द्र पर 59 स्वीकृत पदों में से 5 पद रिक्त थे। केन्द्र पर परियोजना निदेशक के अतिरिक्त, 5 पद वैज्ञानिक, 9 पद टैक्नीशियन, 10 पद प्रशासकीय तथा 29 पद ड्राईवर व सहायक कर्मचारी कार्यरत थे।

केन्द्र के उष्ट्र प्रजनन फार्म पर 1-4-90 को ऊँटों की कुल संख्या 218 थी, जिसमें बीकानेरी नस्ल के 129 कच्छी नस्ल के 49, जैसलमेरी नस्ल के 30, अरबी नस्ल का 1 तथा अरब X बीकानेरी संकर नस्ल के 9 ऊँट थे।

वर्ष के अन्त में फार्म पर ऊँटों की संख्या 248 थी। इस सत्र में केन्द्र पर 36 बच्चे पैदा हुए जिसमें से 16 नर तथा 20 मादा थे। केन्द्र में 67 प्रजनन योग्य मादा थी जिनमें से 52 ज्ञाभिन हुई। इस वर्ष अप्रसूता ऊँटनी के प्रथम गर्भधारणा की आयु 1040.83 ± 5.39 दिन, पहली ब्यात की आयु 1491.17 ± 6.40 दिन, गर्भावधि 388 दिन, एक गर्भ से दूसरे गर्भ धारण करने का अन्तराल 713.94 ± 9.69 दिन; वत्सजनन 81.25 प्रतिशत तथा गर्भधारण 77.61 प्रतिशत था।

केन्द्र के फार्म पर मृत्यु दर 0 से 3 माह की आयु में 10.9 प्रतिशत , 3 से 36 माह में 6.2 प्रतिशत रही तथा 3 साल से अधिक की आयु में कोई मृत्यु नहीं हुई। इस वर्ष फार्म पर किसी भी गम्भीर बीमारी का प्रकोप नहीं था।

केन्द्र हेतु 1990-91 के दौरान 50 लाख योजना मद में तथा 28.4 लाख गैरयोजना मद में बजट स्वीकृत था। जिसमें से 35.86 लाख योजना मद में तथा 28.56 लाख गैरयोजना मद में व्यय हुआ।

चरागाह विकास के क्षेत्र में वृक्षारोपण व घास प्रत्यारोपण व टिब्बा स्थिरीकरण इत्यादि कार्य किये गये। घास प्रत्यारोपण में सेवण, ग्रामना, अजंन आदि के चरागाह विकसित किये गये। वृक्षारोपण में 20 हजार पौधे लगाए गए। मुख्यतः उन पौधों को लगाया गया, जो ऊँट के पोषण के लिए उपयुक्त हैं। इनमें मुख्यतः बबूल की उन्नत किस्में, सरेस, नीम, खेजडी व बोरडी इत्यादि है। चरागाह विकास हेतु प्रथम चरण में तारबन्दी व पानी की व्यवस्था हेतु एक ट्यूब वैल खुदवाने का कार्य किया गया। वर्ष 1990-91 के अन्त तक लगभग 500 एकड भूमि की तारबन्दी की जा चुकी है।

इस केन्द्र के द्वारा ऊँट पालको को ऊँट प्रजनन की सुविधा निःशुल्क देय है। वर्ष 1990-91 के दौरान आस-पास के क्षेत्र से ऊँट पालकों एवम् किसानों द्वारा लाई गई 167 ऊँटनियों को प्रजनन हेतु उत्तम नस्ल के नर ऊँट उपलब्ध करवाये गये।

राष्ट्रीय उष्ट्र अनुसंधान केन्द्र द्वारा नस्ल सुधार कार्यक्रम के अन्तर्गत उन्नत नस्ल के ऊँट राजस्थान सरकार के पशु पालन विभाग के माध्यम से ग्राम पंचायत स्तर पर दिये जाते रहे हैं। वर्ष 1990-91 मे 2 नर ऊँट प्रजनन हेतु दिये गये।

1. ऊँट की बोझा ढोने की क्षमता पर अध्ययन

इस अनुसंधान परियोजना के अंतर्गत उष्ट्र की मानक कार्य क्षमता एवम् मानक कार्य क्षमता की शारीरिक आकृति/शरीर क्रिया विज्ञान एवम् जीव रसायन के क्षेत्र में परस्पर सम्बन्धों पर अध्ययन किया गया। जिसके अंतर्गत बीकानेरी, जैसलमेरी व कच्छी नस्ल के ऊँटों की हल चलाने की क्षमता व सवारी ढोने की सामर्थ्यता, थकावट के लक्षण एवम् सहिष्णुता पर अध्ययन किये गये। हल चलाते समय ऊँटों ने अपने शरीर भार का 14 % खिचाव 1.1 अश्व-शक्ति के साथ उत्पन्न किया। ऊँटों ने लगातार सवा चार घंटे हल चलाने की क्षमता प्रदर्शित की। प्रतिघंटा लगभग 750 वर्ग मीटर क्षेत्रफल पर 9 से 15 सेंटीमीटर गहराई तक हल चलाया। अधिक शारीरिक भार वाले ऊँटों ने कम शारीरिक भार वाले ऊँटों की तुलना में अधिक जुताई की।

बीकनेरी नस्ल के ऊँटों ने अपने शरीर भार का 20 प्रतिशत खिचाव 1.6 अश्व-शक्ति के साथ भारण गाडी चलाते हुए प्रदर्शित किया। ऊँटों ने भारण गाड़ी लगभग 55 मिनट तक लगातार चलाकर 3.4 किलोमीटर दूरी तय की। कच्छी व जैसलमेरी नस्ल के ऊँटों में यह क्षमता अपेक्षाकृत कम रही।

ऊँटों की सवारी ढोने की क्षमता का अध्ययन रेतीली भूमि पर किया गया। बीकानेरी व जैसलमेरी ऊँटों ने २५ किलोमीटर व कच्छी नस्ल के ऊँटों ने केवल 20 किलोमीटर की यात्रा धीमी गति से एक सवारी के साथ तय की। जैसलमेरी ऊँटों की गति बीकानेरी व कच्छी नस्ल के ऊँटों से अधिक रही। मध्यम गति सवारी में बीकानेरी ऊँटों का प्रदर्शन अपेक्षाकृत जैसलमेरी व कच्छी ऊँटों से अच्छा रहा। इसके अतिरिक्त ऊँटों की कार्य क्षमता व शारीरिक मापन मे सहसंबंधों का भी अध्ययन किया गया।

2. ऊँट की अनुवांशिकी तथा अभिजनन विषयों पर अध्ययन

इस परियोजना के अंतर्गत भारतीय ऊँट के परिमाणात्मक व गुणात्मक संबंधी क्षेत्रों मे उत्पति के संदर्भ में अध्ययन किया गया।

शारीरिक भार में वृद्धि, नर बच्चों में मादा बच्चों की अपेक्षा अधिक थी। कच्छी नस्ल के बच्चों में शारीरिक भार में वृद्धि दर अपेक्षाकृत अधिक थी, यद्यपि जन्म के समय उनका वजन अन्य नस्लों की तुलना में कम था।

शारीर के विभिन्न अंगों के माप का शारीरिक भार में संबंध ज्ञात किया गया। अधिकतर संबंध धनात्मक है गर्दन की लम्बाई व शरीर भार में ऋणात्मक संबंध चार वर्ष से बड़े नर ऊँटों में ही ज्ञात हुए।

ऊँट के दूध में प्रोटीन का विश्लेषण करने पर ऊँट के दूध में चार प्रकार की प्रोटीन (एल्फा केजीन, बीटा केजीन, के-केजीन व बीटा लेक्टो ग्लोब्युलिन)पाई गई। विभिन्न ऊँटों के सीरम प्रोटीन का विश्लेषणात्मक अध्ययन किया गया। विभिन्न नस्ल के भिन्न-भिन्न आयु वर्ग के ऊँटों की शारीरिक भार में वृद्धि का तुलनात्मक अध्ययन भी किया गया।

3. ऊँट के रख रखाव पर अध्ययन

इस परियोजना के अंतर्गत ऊँटों के विकास हेतु अनुकूल प्रबन्ध व्यवस्था को विकसित करने हेतु अनुसंधान कार्य किये गये।

विभिन्न नस्लों के ऊँटों में अलग-अलग आयु वर्ग में शारीरिक भार का तुलनात्मक अध्ययन करने पर सिद्ध हुआ कि जन्म से वयस्क होने तक बीकानेरी नस्ल के ऊँटों का वजन अन्य नस्ल के ऊँटो जैसे कच्छी, जैसलमेरी व अरब-बीकानेरी संकर नस्ल से अधिक होता है कच्छी नस्ल के ऊँटों का वजन जन्म से वयस्क होने तक अन्य नस्ल के ऊँटों की अपेक्षा कम रहा। ऊँटों के रख रखाव तथा प्रमुख

बीमारियों के नियंत्रण हेतु शोध कार्य जारी है। ऊँट के बच्चों की मृत्यु दर घटाने हेतु उचित प्रबन्ध व्यवस्था विकसित की गई।

ऊँटों को खिलाये जाने वाले चारे व दाने की मात्रा का सही अवमूल्यन किया गया तथा प्रतिकूल परिस्थितियों में चारे दाने की खिलाई जाने वाली मात्रा और उससे पशुओं के स्वास्थ्य पर पड़ने वाले प्रभाव पर अध्ययन किया गया तथा यह पाया कि इस तरह के परिवर्तन से स्वास्थ्य पर कोई विशेष प्रतिकूल प्रभाव स्थाई रुप से नहीं होते।

प्रतिकूल मौसम में ऊँटों में गर्भाधारण करने की संभावना पर अध्ययन किया गया। ऊँटों में अन्तर ब्यांत समय को कम करने हेतु अध्ययन व शोध कार्य किये गये तथा इसे 2 वर्ष से घटाकर औसत अन्तर ब्यांत अवधि 1.6 वर्ष करने में सफलता प्राप्त की।

प्रथम गर्भाधारण आयु को चार वर्ष से घटाकर 2.6 वर्ष करने में सफलता प्राप्त की। गर्भावस्था के दौरान भार में बढ़ोतरी पर शोध कार्य कर अनुमानित भार बढ़ोतरी का पता लगाने में सफलता प्राप्त की।

दुधारू ऊँटनियों में भार कम होने का प्रतिशत गैर दुधारू ऊँटनियों के भार का तुलनात्मक अध्ययन करने पर पाया कि वजन में कमी ब्याने के प्रथम माह में अधिकतम आती है तथा शनैः शनैः यह दर कम होती जाती है। गैर दुधारू पशुओं में वजन सामान्यतः स्थिर रहता है।

4. ऊँटों के पोषण पर अध्ययन

उक्त परियोजना के अन्तर्गत ऊँटों में चारे जैसे ग्वारफलगटी, मोठचारा तथा पाला की गुणवता एवम् पौष्टिकता का अध्ययन किया गया अन्य चारों जैसे जलकृषि पद्धति द्वारा उत्पादित जौ का हरा चारा सुबबूल का चारा की गुणवता की भी जाँच की गई। दूध पीने वाले ऊँट के बच्चों में प्रथम तीन माह के दौरान लगभग प्रतिदिन 667 ग्राम शारीरिक भार में वृद्धि हुई जबकि नौ माह की आयु में चारा व दाना देने पर 512 ग्राम प्रतिदिन रह जाती है

प्रथम वर्ष में ऊँट के बच्चों के लिए प्रतिदिन 246 से 266 ग्राम प्रोटीन एवम् 6.8 से 9.7 मेगो कैलोरी चयापचन उर्जा की आवश्यकता होती है। एक वर्ष से अधिक आयु वर्ग में ऊँट के बच्चों को तीन श्रेणी में विभाजित कर उन्हें सूखा चारा; सूखा चारा व एक किलेग्राम दाना; सूखा चारा व डेढ किलोग्राम दाना प्रतिदिन देने पर शारीरिक वृद्धि क्रमशः 288, 422 व 455 ग्राम प्रतिदिन हुई।

दुधारू ऊँटनियों में दूध क्षमता 5 से 7.6 लीटर मापी गई जो बच्चों के दूध पीने के अतिरिक्त थी। दुधारु ऊँटनियों के लिए प्रतिदिन प्रोटीन एवम् उर्जा की आवश्यकता क्रमशः 1.3 से 1.7 किलोग्राम प्रोटीन एवम् 29 से 34 मेगा कैलोरी उर्जा की आवश्यकता होती है। यह आंकडे गणितन मूल्यांकित है।

5. ऊँट के प्रजनन पर अध्ययन

इस परियोजना के अंतर्गत ऊँटों में प्रजनन क्रिया का अध्ययन किया गया। जिसके अंतर्गत ऊँटों का वीर्य एकत्र करने की विधि विकसित की गई। कृत्रिम गर्भाधान का परीक्षण किया गया व इसमें प्राथमिक सफलताएं मिलने की आशा है।

6. सहयोगिक कार्यक्रम

केन्द्र ने अन्य अनुसंधान संस्थानों तथा विश्वविद्यालयों के साथ छः विषयों पर सहयोगिक अनुसंधान कार्य किया। इस मद में स्नातकोत्तर विद्यार्थियों द्वारा ऊँटों पर अध्ययन भी शामिल है।

7. प्रकाशन

इस सत्र में छः शोध पत्रों का प्रकाशन किया तथा छः शोधपत्र प्रकाशन हेतु भेजे गये।

वर्ष 1990-91 में केन्द्र पर लगभग 3000 लोगों का अभ्यागमन हुआ।

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12.
ACKNOWLEDGEMNTS

The centre gratefully acknowledges the support and guidance provided by Dr. R.M. Acharya, Deputy Director General (AS), Indian council of Agricultural Research, New Delhi. The advice and valuable suggestions given by the Advisory committee were of immense value in management of the centre.

PROJECT DIRECTOR	:	DR. N.D. KHANNA
TELEGRAM	:	CAMCENTRE, BIKANER
TELEPHONE	:	OFFICE : 5489 FARM : 5683
POSTAL ADDRESS	:	NATIONAL RESEARCH CENTRE ON CAMEL, POST BOX 07, JORBEER, BIKANER 334 001 (RAJ.), INDIA.
PUBLISHED BY	:	PROJECT DIRECTOR NATIONAL RESEARCH CENTRE ON CAMEL BIKANER
EDITORIAL BOARD	:	DR. N.D. KHANNA DR. A.K. RAI
SECRETARIAL ASSISTANCE	:	SHRI P.K. NAIR SHRI DINESH MUNJAL
PUBLICATION COMMITTEE	:	DR. A.K. RAI DR. S.N. TANDON SH. SANTOKH SINGH
PRINTED BY	:	PAVAN ART PRESS ASHOK KUTEER, BIKANER TEL : 3767