Research Article

Studies on Camel Management Under Various Microenvironment of Shelter Systems

Champak Bhakat*, D.Chaturvedi, S. Raghavendra and P.K Nagpaul

An investigation was carried out on three male Jaisalmeri camels which were allotted randomly into three comparable shelters in switch over design for 21 final trial days. Three different type of shelters were, 1-Thatched roofed open type kuchchha shelter(TROTK).2- Asbestos roof close type concrete shelter(ARCTC). 3 - Loose housing system. Temperature humidity index was higher in macro-environment followed by asbestos roofed, loose house and thatched roofed shelter. The cardinal physiological responses during morning and evening time under three shelters were significantly correlated ($P<0.01$). Rectal temperature, pulse rate and respiration rate during evening and morning under 3 treatment groups differed significantly ($P<0.01$). All cardinal physiological responses were significantly ($P<0.01$) increased after work as compared to pre-work condition. The levels of blood creatinine, and urea were found comparatively lower in the morning than in the evening, while glucose and triglycerides were observed higher in all three shelter groups. The highest percent decrease in both glucose and triglycerides values were found in the evening under ARCTC, tree shelter, TROTK. Overall thatched roofed open type kuchchha shelter is the most economical, followed by loose housing and the asbestos roof close type concrete shelter.

Keywords: Camel, Shelter Management, Microenvironment, Physiological response.

INTRODUCTION

Rapid change in agroecological condition and industrialisation in the recent past has its impact on camel management practices. Camel husbandry systems are in a changing mode as camel keepers move from their traditional extensive mode to more restricted and intensive feeding system. This change is exhibited more in the greater part of city areas, rural areas nearer cities and the irrigated regions etc.

A direct environmental consequence is the stimulation of the neuro-endocrine system, resulting in the loss of or conservation of heat to maintain the body temperature within the narrow optimal range for biological activity. During environmental stress, animal makes every attempt to maintain a constant condition or status of the entire body at the cost of its energy available. In order to maintain a thermal balance between the heat, they produce or gain from their environment. This will need tests based on the study of the physiological reactions, like respiration, pulse, body temperature etc. of the camel in relation to micro and macro climatic

elements for ascertaining the heat tolerance or adaptability to a particular type of climate. The physiological responses of animal are influenced by microclimate within the animal shelter. In thermo-neutral temperature, no extra efforts for the camel are needed when they are located in the range. The hot humid conditions exerted more stress than hot dry condition (Rai et al 1988). Hence, a suitable and economically viable housing system needs to be developed which can sustain the rural economy.

MATERIALS AND METHODS:

Three male Jaisalmeri camels, aged around eight to ten year, maintained at NRCC, Bikaner were selected and allotted randomly into three comparable shelters in switch over design for 21 final trial days. All camels were allowed to work (ploughing of agricultural land) daily up to their showing of fatigue signs and then kept back of their respective shelter for rest. The study was conducted during hot humid season of August to October. The fundamental construction of each shelter was almost same having a covered and open area viz: Shelter 1.Thatched roofed open type kuchchha

* Scientist (SS) Incharge Camel Management Unit, N.R.C On Camel, P.B No - 07, Email - bhakat@scientist.com

shelter (TROTK) which was constructed according to locally available ecofriendly agricultural materials. The roof made up of Khemp (Leptadenai Pyrotechnica). One side of roof was supported by wall and other side was by pillars (14"). Kuchchha manger was constructed with mud plastering inside covered area. The enclosure were made up with balli / bamboo of 6 ft height. Front side of enclosure was having a gate which was of sliding type. The height of roof was 15ft (Back) and 12 ft (front) with sufficient slope. The covered area was 33 ft (length) x 14 ft (breath). Total area space of this shelter has length - 40 ft, Breath - 33ft. It was an open type shelter. Dimension of manger : Length-32 ft, Breath -2.5 ft, inside deepth 1.5 ft, height of front wall from ground 3.5 ft. shelter 2- Asbestos roof close type concrete shelter (ARCTC): The covered area was covered by asbestos roof with concrete wall at 3 sides with sufficient ventilation. The manger was of concrete / pucca type. The open area, floor, enclosure dimension etc were almost similar as mentioned above. It was close type shelter. shelter 3 - Under tree shed / loose housing system (UT / LH) : In this system the open type paddock was provided which was enclosed by wire fencing. Some Kikar trees (Prosopis Juliflora) were there to provide shed to camels. The floor in all cases was kuchchha, with loose sand dune. Round type kuchchha manger was constructed with mud plastering just beneath the tree sheds. The dimension of manger, height of fence etc were almost equal to other two types of shelter. 14kg Moth chara (Phaseolus aconitifolius) as a dry fodder and 2 kg concentrate was provided to all the camels. The residual amount of concentrate and dry fodder were measured at every 2hr interval to find out actual intake amount. The measured quantity of ad libitum water was provided to each group once in a day and feeding-watering behaviour were recorded by coding method. The DM of feed samples was determined by drying the sample in a hot air oven at $99 \pm 1^\circ \text{C}$ temperature for overnight.

Micro and macro climatic components :

Micro climatic component like maximum temperature, minimum temperature, dry bulb temperature, wet bulb temperature, relative humidity (RH) were recorded under thatched roofed, asbestos roofed shelters and also under

tree shed. The meteorological observations for macroclimatic data were taken from Govt. weather station, Bikaner. The temperature humidity index (THI) were worked out (McDowell 1972) with the help of dry bulb and wet bulb temperatures, recorded at 8.00 AM and 3.00 PM.

Physiological Responses :

The cardinal Physiological responses like rectal temperature, pulse rate and respiration rate were recorded daily at different time intervals such as morning time at 8.00 AM (before work), just after work at 11.00AM around, evening time at 4.00 PM around (after 5hr rest under different shelters) and again after 20hr rest in their respective shelter. Rectal temperature ($^\circ \text{C}$) was recorded by putting a clinical thermometer in the rectum of camel for 1 minute. Pulse rate (beats / min) of each camel was recorded in the middle coccygeal artery by placing fingertips with minimum disturbance of camel. Respiration rate of each camel was recorded with help of stethoscope / chest movement. After every seventh day interval, blood samples were collected in morning and evening from three shelter groups and blood serum was processed for biochemical analysis viz : serum glucose, creatinine, triglycerides and urea. The suitable statistical procedures were applied for the analysis of experimental data (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

Micro and Macro environment :

The Mean $\pm$ SE of climatic components in different micro and macro environment were presented in Table - 1. The maximum temperature remained on higher side in macro environment as compared to other 3 shelters in all the periods. The overall average maximum temperature ($^\circ \text{C}$) of macro environment and micro environment like ARCTC, LH and TROTK were 39.86 ± 0.29 , 37.83 ± 0.33 , 35.83 ± 0.32 and 33.81 ± 0.34 , respectively. The presence of shelter reduced maximum temperature under it's shed. The minimum temperature was the higher under asbestos roofed close type concrete shelter and it was followed by under tree, thatched roofed shelter and macro environment over all the period. This might be due to the reason that asbestos roofed concrete shelter was somewhat close type shelter than the thatched roof kuchchha shelter, which was an open type shed. The present study was in agreement with the findings of

Table 1: MEAN $\pm$ SE of Climatic Components in Different Micro and Macro Environment.

Table 1: MEAN $\pm$ SE of Climatic Components in Different Micro and Macro						
			Days of Final Trial			
			1-7	8-14	15-21	Overall
Micro environment	Thatch roofed open type kuchchha shelter	MAX ($^{\circ}$ C)	33.36 ^a $\pm$ 0.53	34.86 ^a $\pm$ 0.26	33.21 ^a $\pm$ 0.75	33.81 ^a $\pm$ 0.34
		MIN ($^{\circ}$ C)	25.28 ^b $\pm$ 0.52	23.93 ^b $\pm$ 0.51	24.93 ^b $\pm$ 0.53	24.71 ^b $\pm$ 0.31
		RH ₁ (%)	46.29 ^c $\pm$ 3.38	33.86 ^c $\pm$ 3.16	44.00 ^c $\pm$ 2.62	41.38 ^c $\pm$ 2.07
		RH ₂ (%)	16.14 ^d $\pm$ 1.34	11.14 ^d $\pm$ 0.55	17.57 ^d $\pm$ 0.81	14.95 ^d $\pm$ 0.81
		THI ₁	62.46 ^e $\pm$ 0.24	63.64 ^e $\pm$ 0.39	62.67 ^e $\pm$ 0.37	62.93 ^e $\pm$ 0.22
		THI ₂	66.27 ^f $\pm$ 0.25	67.41 ^f $\pm$ 0.18	66.26 ^f $\pm$ 0.20	66.64 ^f $\pm$ 0.17
	Asbestos roofed close type concrete shelter	MAX($^{\circ}$ C)	37.43 ^g $\pm$ 0.46	38.78 ^g $\pm$ 0.29	37.29 ^g $\pm$ 0.71	37.83 ^g $\pm$ 0.33
		MIN ($^{\circ}$ C)	27.29 ^h $\pm$ 0.52	26.07 ^h $\pm$ 0.50	26.93 ^h $\pm$ 0.53	26.76 ^h $\pm$ 0.31
		RH ₁ (%)	49.43 ⁱ $\pm$ 3.47	36.85 ⁱ $\pm$ 3.18	47.29 ⁱ $\pm$ 2.67	44.52 ⁱ $\pm$ 2.11
		RH ₂ (%)	19.43 ^j $\pm$ 1.36	14.00 ^j $\pm$ 0.72	21.14 ^j $\pm$ 1.06	18.19 ^j $\pm$ 0.90
		THI ₁	71.74 ^k $\pm$ 0.46	73.39 ^k $\pm$ 0.44	71.91 ^k $\pm$ 0.43	72.38 ^k $\pm$ 0.29
		THI ₂	78.25 ^l $\pm$ 0.26	78.68 ^l $\pm$ 0.30	79.15 ^l $\pm$ 0.26	78.69 ^l $\pm$ 0.17
	Loose housing type shelter	MAX ($^{\circ}$ C)	35.43 ^m $\pm$ 0.52	36.79 ^m $\pm$ 0.21	35.28 ^m $\pm$ 0.70	35.83 ^m $\pm$ 0.32
		MIN ($^{\circ}$ C)	26.29 ⁿ $\pm$ 0.53	25.00 ⁿ $\pm$ 0.56	25.92 ⁿ $\pm$ 0.52	25.74 ⁿ $\pm$ 0.31
		RH ₁ (%)	47.29 ^o $\pm$ 3.35	34.85 ^o $\pm$ 3.17	45.29 ^o $\pm$ 2.67	42.48 ^o $\pm$ 2.08
		RH ₂ (%)	17.14 ^p $\pm$ 1.33	11.71 ^p $\pm$ 0.57	19.14 ^p $\pm$ 0.97	16.00 ^p $\pm$ 0.89
		THI ₁	65.65 ^q $\pm$ 0.22	66.93 ^q $\pm$ 0.45	66.66 ^q $\pm$ 1.05	66.42 ^q $\pm$ 0.39
THI ₂		70.22 ^r $\pm$ 0.29	71.21 ^r $\pm$ 0.12	69.42 ^r $\pm$ 0.17	70.28 ^r $\pm$ 0.19	
Macro environment	MAX($^{\circ}$ C)	39.47 ^s $\pm$ 0.41	40.83 ^s $\pm$ 0.23	39.30 ^s $\pm$ 0.67	39.86 ^s $\pm$ 0.29	
	MIN ($^{\circ}$ C)	23.26 ^t $\pm$ 0.44	21.94 ^t $\pm$ 0.53	22.83 ^t $\pm$ 0.63	22.67 ^t $\pm$ 0.32	
	RH ₁ (%)	44.29 ^u $\pm$ 3.24	31.86 ^u $\pm$ 3.29	42.29 ^u $\pm$ 2.59	39.47 ^u $\pm$ 2.07	
	RH ₂ (%)	14.43 ^v $\pm$ 1.38	8.86 ^v $\pm$ 0.46	16.14 ^v $\pm$ 0.96	13.14 ^v $\pm$ 0.89	
	THI ₁	77.88 ^w $\pm$ 0.44	79.27 ^w $\pm$ 0.63	78.12 ^w $\pm$ 0.26	78.42 ^w $\pm$ 0.29	
	THI ₂	84.06 ^x $\pm$ 0.43	87.42 ^x $\pm$ 0.72	84.36 ^x $\pm$ 0.25	85.19 ^x $\pm$ 0.46	
Similar superscripts do not differ significantly (P<0.01) from each other.						

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Khush Singh et al. (1989). The overall average minimum temperature ($^{\circ}$ C) of ARCTC, LH, TROTK and M.E were 26.76 ± 0.31 , 25.74 ± 0.31 , 24.71 ± 0.31 and 22.67 ± 0.32 , respectively.

Over the whole period, RH (morning) was higher under asbestos roofed concrete shelter and it was followed by under tree, thatched roofed shelter and macro-environment. The overall average RH morning (RH₁ %) of ARCTC, LH, TROTK and M.E were 44.52 ± 2.11 , 42.48 ± 2.08 , 41.38 ± 2.07 and 39.47 ± 2.07 , respectively. Similar trend was found in case of RH (evening). The overall average RH evening (RH₂ %) of ARCTC,

LH, TROTK and M.E were 18.19 ± 0.90 , 16.00 ± 0.89 , 14.95 ± 0.81 and 13.14 ± 0.89 , respectively. Kaushish et al (1983) reported the average temperature, RH and THI of goat house were 24.2° C, 32.7%, 58.8 and 39.9° C, 55.9% and 60.3 in the morning and evening time respectively. The higher values of RH (morning and evening) was obtained in asbestos roofed close type concrete shelter as compared to thatched roofed open type kuchchha shelter. This might be due to higher condensation power of moisture (present in air) by asbestos roofed and concrete shelter. The asbestos roof, concrete wall condensed the

moisture and held it in that microenvironment, leading to high R.H. On the other hand thatched roofed open shelter had less congenial conditions for condensation of the water vapor and thatched materials had superior protective power against moisture, which resulted in less moisture in that micro-environment. Over the whole period, RH (morning) was higher than RH (evening) in all three shelters as well as in macro environment. This might be due to more condensation of moisture, which is present in air in the early morning. As the day progressed, moisture becomes lesser and thus, at evening time RH value is dropped.

Over the whole period, temperature-humidity index (morning) was higher in macro-environment and followed by asbestos roofed close type concrete shelter, under tree and thatched roofed open type kuchchha shelter. The overall average of THI-morning (THI_1) in ME, ARCTC, LH and TROTK were 78.42 ± 0.29 , 72.38 ± 0.29 , 66.42 ± 0.39 and 62.93 ± 0.22 , respectively. Similar trend was found in case of THI (evening). The overall average THI-evening (THI_2) in ME, ARCTC, UT / LH and TROTK were 85.19 ± 0.46 , 78.69 ± 0.17 , 70.28 ± 0.19 and 66.64 ± 0.17 , respectively. The lower values of THI were obtained under tree shed and thatched roofed shelter as compared to asbestos roofed shelter in all the periods. This might be due to less moisture and less temperature under tree shed and thatched roofed shelter as compared to asbestos roofed shelter. The RH (M) and RH (E) were highly correlated under all environments viz: asbestos roofed close type concrete shelter, thatched roofed open type kuchchha shelter, under tree/loose housing and macro environment. The correlation values ranged from 0.71 to 0.75. All the values were significant ($P < 0.01$). Ghosh and Pan (1994) reported that THI (E) was 82.06 ± 2.58 and 68.80 ± 0.58 during hot-humid and cold-humid season respectively.

The 't' test values revealed that RH (morning) and RH (evening) under 3 treatment groups and macro environment differed significantly ($P < 0.01$). THI (morning) and THI (evening) in 3 treatment shelter and macro environment also differed significantly ($P < 0.01$). During the whole period THI (evening) was higher than THI (morning) in all shelters and macro environment. This might be due to higher values of dry bulb and wet

bulb temperature during evening time as compared to morning time. Barlett (1990) found that the floors of low thermal resistance were suitable for hot climatic condition to keep the animals cool.

Cardinal Physiological Responses :

The mean $\pm$ SE of Rectal Temperature (RT), Respiration Rate (RR), Pulse Rate (PR) under three shelter groups are presented in table - 2. The close scrutiny of the table revealed that there was not much difference in rectal temperature, respiration rate, pulse rate during morning hours, after work, evening hours and after 20 hr rest in three shelter groups. The mean values ($^{\circ}\text{C}$) of RT_1 (morning), RT_2 (after work), RT_3 (evening), RT_4 (after 20 hr rest) in three treatment groups varied from 36.59 ± 0.12 to 36.62 ± 0.16 , 39.60 ± 0.14 to 39.62 ± 0.12 , 38.39 ± 0.13 to 38.40 ± 0.13 and 36.60 ± 0.11 to 36.61 ± 0.10 , respectively. The mean values (beats/min) of RR_1 (morning), RR_2 (after work), RR_3 (evening), RR_4 (after 20 hr rest) in three shelter groups varied from 10.24 ± 0.37 to 10.52 ± 0.40 , 27.47 ± 0.91 to 27.86 ± 0.86 , 12.29 ± 0.40 to 12.85 ± 0.49 and 10.28 ± 0.36 to 10.57 ± 0.39 , respectively. The mean values (beats/min) of pulse rate viz : PR_1 (morning), PR_2 (after work), PR_3 (evening), PR_4 (after 20 hr rest) in three treatment groups ranged from 45.00 ± 1.08 to 45.67 ± 1.14 , 67.90 ± 1.48 to 68.62 ± 1.62 , 50.23 ± 1.27 to 50.76 ± 1.21 and 45.28 ± 1.01 to 45.71 ± 1.11 , respectively.

The RT (Evening) and RT (Morning) under three shelters (Asbestos Roofed close type concrete shelter, Thatched Roofed open type kuchchha shelter, Loose housing) were significantly correlated ($P < 0.01$). The correlation values ranged from 0.49 to 0.62. Similarly, RR(Evening) & RR(Morning), PR(Evening) & PR(Morning) under three treatments were highly correlated. The values for RR and PR varied from 0.87 to 0.97 and 0.88 to 0.98, respectively. All the values were significant ($P < 0.01$). The 't' test value revealed that RT (evening) and RT (morning) under 3 treatment groups differed significantly ($P < 0.01$). The body temperature was higher during evening as compared to morning, this is mainly due to higher environmental temperature in evening time, which increases the body temperature of camels. The diurnal variation in camel is very prominent by virtue of which, it

Table 2: Mean $\pm$ SE of Rectal Temperature (RT), Respiration Rate (RR), Pulse Rate (PR) under three shelter groups.

Shelter	Time of observation	n	RT (°C)	R.R (Beats/min)	PR (Beats/min)
TROTK	Morning	21	36.59 ^A $\pm$ 0.12	10.24 ^D $\pm$ 0.37	45.00 ^G $\pm$ 1.08
	After Work	21	39.62 ^B $\pm$ 0.12	27.47 ^E $\pm$ 0.91	68.14 ^H $\pm$ 1.44
	Evening	21	38.39 ^C $\pm$ 0.13	12.29 ^F $\pm$ 0.40	50.23 ^I $\pm$ 1.27
	After.20h Rest	21	36.60 ^A $\pm$ 0.11	10.28 ^D $\pm$ 0.36	45.28 ^G $\pm$ 1.01
ARCTC	Morning	21	36.60 ^A $\pm$ 0.11	10.52 ^D $\pm$ 0.40	45.67 ^G $\pm$ 1.14
	After Work	21	39.60 ^B $\pm$ 0.14	27.86 ^E $\pm$ 0.86	68.62 ^H $\pm$ 1.62
	Evening	21	38.40 ^C $\pm$ 0.13	12.85 ^F $\pm$ 0.49	50.76 ^I $\pm$ 1.21
	After.20h Rest	21	36.61 ^A $\pm$ 0.10	10.57 ^D $\pm$ 0.39	45.71 ^G $\pm$ 1.11
UT/LH	Morning	21	36.62 ^A $\pm$ 0.16	10.42 ^D $\pm$ 0.35	45.33 ^G $\pm$ 1.02
	After Work	21	39.61 ^B $\pm$ 0.12	27.66 ^E $\pm$ 0.74	67.90 ^H $\pm$ 1.48
	Evening	21	38.39 ^C $\pm$ 0.14	12.76 ^F $\pm$ 0.41	50.42 ^I $\pm$ 1.05
	After.20h Rest	21	36.61 ^A $\pm$ 0.16	10.47 ^D $\pm$ 0.36	45.42 ^G $\pm$ 1.03
Similar superscripts do not differ significantly ($P < 0.01$) from each other. n - Number of observations.					

Table 3: Mean $\pm$ SE of camel blood biochemical attributes under different shelter management.

Parameters	ARCTC		TROTK		L.H	
	Morning	Evening	Morning	Evening	Morning	Evening
Glucose (mg/dl)	105 $\pm$ 2.33	91 $\pm$ 2.33	97 $\pm$ 2.96	91 $\pm$ 3.23	108 $\pm$ 3.46	90 $\pm$ 4.06
Creatinine (mg/dl)	1.91 $\pm$ 0.09	2.20 $\pm$ 0.10	2.01 $\pm$ 0.15	2.15 $\pm$ 0.13	1.70 $\pm$ 0.06	1.92 $\pm$ 0.01
Triglyceride (mg/dl)	36 $\pm$ 1.53	27 $\pm$ 0.67	40 $\pm$ 1.20	31 $\pm$ 0.88	35 $\pm$ 5.85	22 $\pm$ 5.20
Urea (mg/dl)	65.48 $\pm$ 6.47	71.06 $\pm$ 3.98	70.23 $\pm$ 2.20	74.68 $\pm$ 1.74	63.09 $\pm$ 3.89	72.18 $\pm$ 5.21

can load the heat in body according to the increment of environmental temperature. Bhakat (1997) reported that raised slotted floor with thatched roofed shelter is best suited for crossbred goat. The significant ($P < 0.01$) differences were observed in RR (evening) and RR (morning) and PR (evening) and PR (morning) in 3 shelter treatments. The values were higher in evening than morning time, which might be due to higher environmental temperature. All the values (higher and lower) obtained in the experiment were within the normal range.

The cardinal physiological signs before work (BW) and after work (AW) viz: RT (AW) and RT (BW), RR (AW) and RR (BW) and PR (AW) and PR (BW) under 3 shelter groups varied significantly ($P < 0.01$). All cardinal physiological responses were increased after work as compared to before work condition. This is due to higher energy requirement which increases BMR consequent to increment in rectal temperature, pulse rate and respiration rate. Similar type of observations was recorded by Rai et al (1986) during hot humid season.

Biochemical analysis :

The mean $\pm$ SE of camel blood biochemical attributes under different shelter management is given in table-3. The levels of morning blood creatinine, and urea were found comparatively lower than evening, while glucose and triglycerides were observed higher in all the three shelter groups. The higher level of blood glucose and triglyceride in the morning as compared to evening in all the three groups may be due to higher metabolic rate, to meet out heat stress during day time. Further, the values for blood creatinine and urea were found comparatively higher in evening than morning, which lead to higher rate of urea cycle and dephosphorylation of ATP to supplement more energy during day time. The least change in diurenal variation in blood glucose, triglyceride, urea and creatinine in thatch roofed open type kuchchha shelter management resulted in superiority of this system over loose housing and asbestos roofed close type concrete shelter management.

Behavioural aspect of camel in different shelter:

The intakes of concentrate and fodder in asbestos roofed close type concrete shelter, thatched roofed open type kuchchha shelter and under tree shed were almost similar. Maximum consumption of concentrate was found within 2 hr of supply. It ranged from 80.00 % to 80.65 %. The remaining amount of concentrate was also finished to consume in next 2 - 4 hr. It ranged from 19.35 % to 20.00%. No residual amount of concentrate was found after 4 hr of supply in all 3 treatment groups. Daily average fodder consumption (kg) under thatch roofed open type kuchchha shelter, asbestos roofed close type concrete shelter and loose housing were 12.50 ± 0.30 , 11.50 ± 0.29 , 12.00 ± 0.35 , respectively. Within 0 - 2 hr of fodder supply maximum amount of fodder was consumed in all 3 treatment groups. It ranged from 20.00 % to 20.86 %. This time period was followed by 2 - 4hr, 4 - 6hr, 6 - 8hr, 8 - 10hr and 10 - 12hr. The rate of fodder consumption was found to decline as the day progressed and it become minimum at night time. The amount of water intake (lt /day) in asbestos roofed close type concrete shelter, thatched roofed open type kuchchha shelter and under tree shed were 32.45 ± 1.10 , 31.26 ± 1.03 , 31.58 ± 1.12 , respectively.

The measured quantity of ad-labium water was provided to all camels under various shelter treatments. Time for consumption of particular amount of water varied from 8.43 ± 0.55 to 8.79 ± 0.51 minutes.

Almost same time involvement in standing and lying posture were observed under asbestos roofed close type concrete shelter, thatched roofed open type kuchchha shelter and under tree shed. Maximum time involved in standing posture was during 0 - 2hr, 2 - 4 hr of feed supply. Then it was gradually reduced as the time lapsed, in all shelter groups. As the day light disappeared all the camels has a tendency to go on lying posture. Maximum time involved in lying posture were during 10 - 12 hr at night time in all shelter cases.

Economic Analysis :

The variable cost for feeding of three groups (per camel) was also analysed. Based on the market rate of each feed stuffs during experimental period and average consumption of fodder and concentrate, cost per camel were worked out. One kg concentrate animal feed and 1kg cotton seed cake were consumed by all camels under 3 shelter groups. Total variable cost per camel per day under thatched roofed open type kuchchha shelter, asbestos roofed close type concrete shelter and loose housing were Rs. 56.25, Rs.52.65 and Rs.54.45, respectively.

The fixed cost for construction of three types of shelter at the time of experiment was considered. The total cost (materials, fittings, labour cost) involved for construction of thatched roofed shelter was Rs. 19369. The present value of PAR (Plinth Area Rate) of asbestos roofed concrete type close shelter was Rs. 157200, where as renovation and repairing cost was Rs.7790/- . The total cost involved for loose housing was Rs. 2955/-.

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