NICRA PROJECT

On

Assessing Resilience of Small Ruminant Production under Changing Climatic Condition in Semi-arid Zone

ANNUAL PROGRESS REPORT
(2011-2012)

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Co-operating Center

Division of Animal Physiology and Biochemistry
Central Sheep and Wool Research Institute
Avikanagar, Rajasthan - 304501

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Dr. S.M.K. Naqvi

PRINCIPAL INVESTIGATOR

CO-OPERATING CENTRE

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CENTRAL SHEEP AND WOOL RESEARCH INSTITUTE
AVIKANAGAR, RAJASTHAN- 304501

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1. **Reporting year : 2011-2012.**
2. **Title of the project :** Assessing resilience of small ruminant production under changing climatic condition in semi-arid zone.
3. **Name of the institute :** Central Sheep and Wool Research Institute Avikanagar, Rajasthan-304501.
4. **Name of P.I. :** Dr. S.M.K. Naqvi
5. **Name of the Associates with responsibilities :** Dr. V. Sejian
   Dr. D. Kumar
   Dr. A. Sahoo

Technical Program

Objective:-1

To study the effect of heat stress on growth, water, water requirement, physiological adaptability and blood biochemical changes on Malpura ewes.

THI during study period

S.No.	Week	Covered (Shed)		Open (Solar radiation)	
		Morning	Afternoon	Morning	Afternoon
1.	Week-1	28.03	35.64	31.08	37.74
2.	Week-2	29.09	36.96	31.8	38.21
3.	Week-3	29.39	35.64	32.54	37.3
4.	Week-4	29.07	35.76	33.62	35.85
5.	Week-5	29.63	37.7	32.82	38.03
6.	Post stress	28.8	36.8	-	-

(Reference:-Marai *et al.*, 2007)

The experiment conducted during peak summer session (May-June) for 42 days. Twenty four healthy adult Malpura ewes were used and were randomly divided into two group viz. GI (Control; n=12) and GII (Heat Stress; n=12). The control animals were maintained under shed, while heat stress animals were subject to heat stress by exposing them to direct solar radiation for 6 hours per day between 10:00 h and 16:00 h. GII ewes were exposed to average ambient temperature of 42- 46 ^{0}C during the experiment. This experimental procedure were fallowed for 35 days and remaining 7 days both group were maintained in animal shed to study the recovery of GII animals from heat stress. Body weight, Body condition score, Physiological response, and Blood collection was carried out at weekly interval.

Parameter studied:-

Body Weight (BW), Body Condition Score (BCS), Respiration Rate (RR), Pulse Rate (PR), Rectal Temperature (RT), Sweating Rate (SR), Feed and Water Intake, Estrus Percentage, Esturs Duration, Estrus Interval, Hemoglobin (Hb), Packed Cell Volume (PCV), Plasma Glucose, Urea BUN, Total Plasma Cholesterol, T_3 and T_4, Cortisol, Estradiol and Progesterone.

Figure 1: Animals kept under controlled condition in the shed

Figure 2: Animals exposed to natural heat stress

Objective:-2

To analyzed the quality of water available for livestock in five districts of Rajasthan.

This experiment mainly concerned with survey of different districts of Rajasthan to assess the quality of water available for livestock in reprehensive districts of Rajasthan. Survey was conducted during peak summer months of May- Jun, 2011. For this purpose five districts – Jalor, Tonk, Jodhpur, Bikaner and Bhilwara was selected. Care was taken that samples were collected from all water resources available in a particular district. Water sample were collected in sterilized bottle and stored properly until analysis. From each source one litter water sample was collected. The collected water samples were sanded for quality analysis. The parameters including for quality testing were:

Parameter studied:-

Color, Odor, Turbidity, pH, Fe, TSS, Cl, Residual Free Chlorine, F, TDS, Ca, Mg, SiO_2, Cu, Mn, SO_4, NO_3, Zn, C_6H_5OH, alkalinity ($CaCO_3$), alkalinity (P), Total Hardness ($CaCO_3$), As, Cyanide, Na, Pb, Cr_6, Total Choroform Count, Test for E.coli, Specific Conductivity.

Objective:-3

To assess the effect of mineral mixture supplementation on growth and physiological adaptability of Malpura ewes subject to heat stress.

THI in Shed condition during study period

S. No	Weak	THI	
		Morning	Afternoon
1	Weak-1	25.97	33.63
2	Weak-2	20.88	29.87
3	Weak-3	22.03	30.42

THI in Climate chamber during study period

Chamber THI (42^0C)	35.42

Reference :- Marai *et. al.*, 2007

The experiment conducted during the month of September for 21 days. Twenty one healthy adult Malpura ewes were used and were randomly divided into three group viz. GI (Control; n=7), GII (Heat Stress; n=7) and GIII (Heat Stress + Mineral Supplementation; n=7). The control (GI) animals were maintained under shed, while heat stress (GII) and heat stress + mineral supplementation(GIII) animals were subject to heat stress by exposing them at 42^0C for 6 hours per day between 10:00 h and 16:00 h in climatic chamber. This experimental procedure was fallowed during experimental period of 21 days. Body weight, Body condition score, Physiological response, and Blood collection was carried out at weekly interval.

Mineral Mixture Composition per Kg diet: Zinc Sulphate 164.0 mg, Colbalt sulphate 0.95 mg, Chromium acetate 1.2g, Selenium chloride 0.1mg, and Vitamin E 40.0 mg. Dose: 20gm/Kg body weight

Parameter studied:-

Body Weight (BW), Body Condition Score (BCS), Respiration Rate (RR), Pulse Rate (PR), Rectal Temperature (RT), Feed and Water Intake, Estrus Percentage, Esturs Duration, Hemoglobin (Hb), Packed Cell Volume (PCV), Plasma Glucose, Urea BUN, Total Plasma Cholesterol, T_3 and T_4, Cortisol, Estradiol and Progestron.

Figure 3: Animals exposed to heat stress in chamber

Objective:-4

To assess the efficiency of indigenously devised bamboo dome structure as cold protection device and to observe its effects on adaptive capability of Malpura lambs during winter season.

The study was conducted with the primary objective to assess the efficiency of indigenously devised bamboo dome structure as cold protection device and to observe its effects on adaptive capability of Malpura lambs during winter season. The study was conducted in 16 Malpura lambs of one month old. The lambs were randomly dived into 2 groups of 8 animals each viz., GI (Cold protected; n=8) and GII (Cold exposed; n= 8). GI lambs were protected with help of bamboo dome structure while GII lambs were kept on the shed with all four sides open. The study was conducted for a period of 5 weeks. Blood collection was carried out at weekly interval.

Figure 4: Lambs housed under bamboo dome structure covered with gunny bags

Figure 5: Picture showing lambs inside the bamboo dome structure

Parameter studied:-

Body Weight (BW), Respiration Rate (RR), Pulse Rate (PR), Rectal Temperature (RT), Skin temperature, Hemoglobin (Hb), Packed Cell Volume (PCV), Plasma Glucose, T_3 and T_4, and Cortisol

Objective:- 5

Molecular characterization of HSP70 gene in sheep

1. PCR Condition used for amplification of HSP 70 gene.
   a. 94°C for 5min- Initial Denaturation
   b. 94°C for 1min- Denaturation
   c. 48°C for 45 sec-Annealing
   d. 72°C for 1min- Synthesis
   e. Go to 2 , 35 Cycles
   f. 72°C for 10 min – Final Extension

2. Primers used for in –vitro amplification of DNA

   5'ATGGCGAAAAACATGGCTATC 3' (FP)

   5'CTAATCCACCTCCTCAAT 3' (RP)

Results

Objective 1:-

Table 1: Effect of heat stress on RR (breaths/Min), PR (beats/Min), RT (^oF) and SR ($g/m^2/h$) of Malpura ewes

Items	RR (Morning)	RR (Afternoon)	PR (Morning)	PR (Afternoon)	RT (Morning)	RT (Afternoon)	SR (Afternoon)
μ±SE	35.92 ±0.94	94.21 ±1.44	57.74 ±0.63	70.95 ±0.58	100.72 ±0.48	101.63 ±0.61	106.54 ±7.16
Group	*	**	NS	**	*	NS	NS
Control	38.36	74.70	57.86	67.98	100.82	101.96	99.18
Heat Stress	33.48	113.73	57.62	73.92	100.63	101.30	113.90

Pooled SE for treatment	±1.33	±2.04	±0.89	±0.82	±0.07	±0.86	±10.13
Week	**	**	**	**	*	NS	**
1	21.25	56.75	57.42	68.83	100.67	101.98	113.42
2	27.67	82.08	48.58	73.08	100.46	98.08	165.07
3	40.08	109.04	64.33	80.00	101.03	102.44	91.64
4	38.25	99.17	55.92	71.33	100.53	102.71	27.40
5	46.25	117.96	62.50	70.04	100.82	102.06	106.62
6	37.25	121.58	58.25	68.17	100.56	102.33	134.34
7	40.25	72.92	57.17	65.17	101.02	101.84	107.30
Pooled SE for Week	±2.49	±3.81	±1.66	±1.53	±0.13	±1.62	±18.95
Group*Week	NS	**	NS	**	NS	NS	NS

RR- respiration rate; PR-pulse rate; RT-rectal temperature; SR-sweating rate
μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01) and NS- Non-Significant

Table 2: Effect of heat stress on Body Weight, BCS and ADG of Malpura ewes

Items	**BW (Kg)**	**BCS**	**ADG (g)**
μ±SE	38.76	2.91	-43.51
	±0.26	±0.03	±14.23
Group	NS	**	NS
Control	39.09	3.13	-35.83
Heat Stress	38.44	2.69	-51.20
Pooled SE for treatment	±0.37	±0.05	±20.13
Week	**NS**	****	****
1	40.26	3.44	-187.50
2	38.60	2.68	-124.11
3	37.82	2.65	140.75
4	38.80	2.68	-57.12
5	38.60	2.79	33.91

6	38.83	2.83	-67.00
7	38.44	3.27	
Pooled SE for week	±0.70	±0.09	±34.86
Group*Week	**NS**	**NS**	**NS**

BW: Body Weight, BCS: Body Condition Score and ADG: Average Daily Gain
μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01) and NS- Non-Significant

Table 3: Effect of heat stress on Feed and Water Intake of Malpura ewes

Items	**Feed Intake (DMI gm/w^.75/day)**	**Water Intake (Lt/DMI Kg/day)**
μ±SE	53.23 ±0.42	5.70 ±0.04
Group	**	**
Control	57.42	4.24
Heat Stress	49.04	7.15
Pooled SE for treatment	±0.59	±0.06
Week	**	**
1	43.66	6.92
2	49.44	6.38
3	54.55	5.37
4	54.34	5.45
5	56.92	5.66
6	60.49	4.40
Pooled SE for week	±1.02	±0.11
Group*Week	*	**

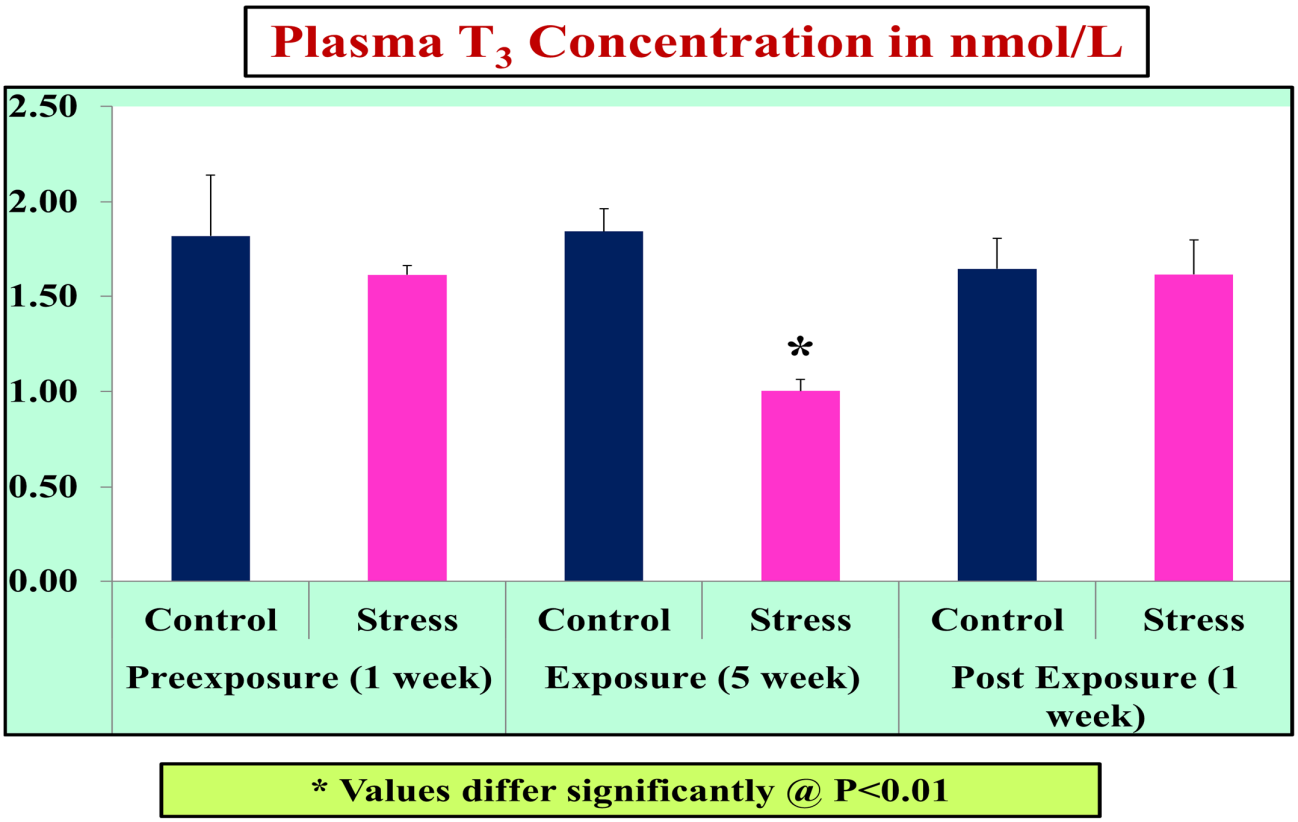
DMI: Dry Mater Intake
μ indicates the overall mean for the parameter. * (P<0.05) and ** (P<0.01), NS- Non-Significant

Table 4: Effect of heat stress on Hb and PCV concentrations of Malpura ewes

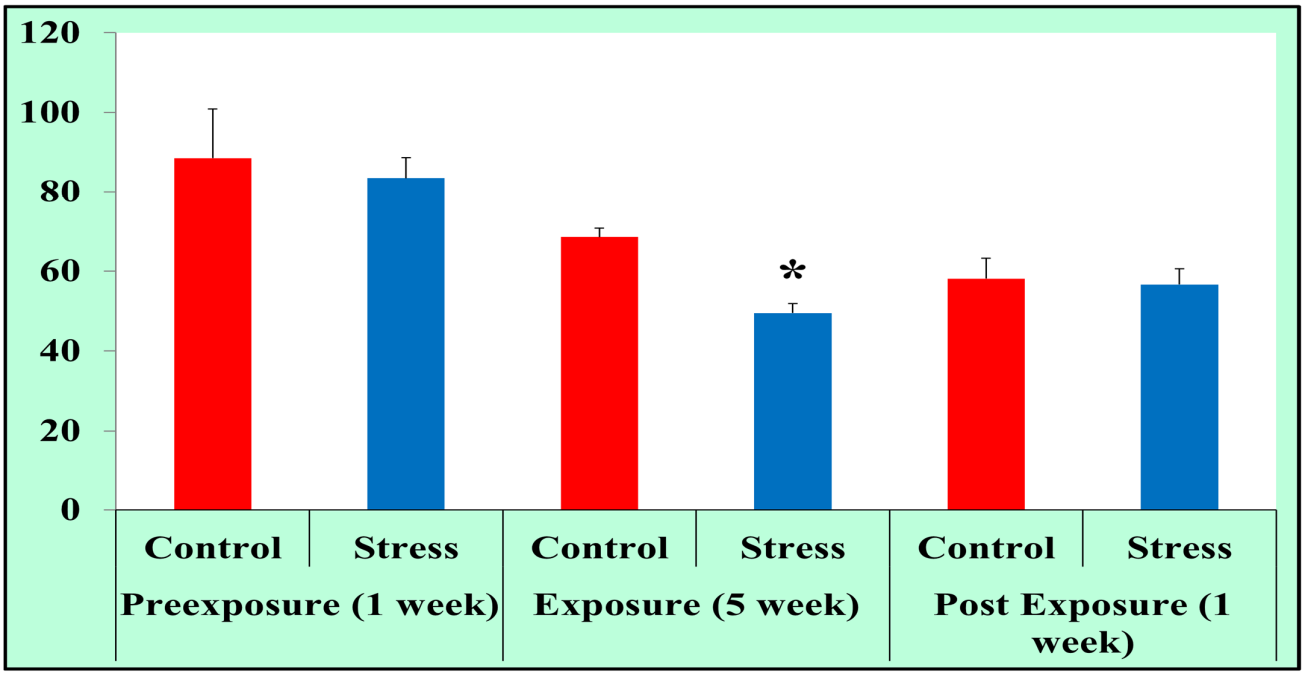
Items	**Hb (g/dl)**	**PCV (%)**
μ±SE	9.27 ±0.10	35.27 ±0.60
Group	**NS**	**
Control	9.13	32.90
Heat Stress	9.33	37.63
Pooled SE for treatment	±0.13	±0.85
Week	**	**
1	12.14	38.24
2	11.79	36.99

3	11.11	30.30
4	8.35	40.03
5	7.87	34.74
6	6.13	32.96
7	7.24	33.62
Pooled SE for Week	±0.25	±1.60
Group*Week	**NS**	*

μ indicates the overall mean for the parameter. * (P<0.05) and ** (P<0.01), NS- Non-Significant

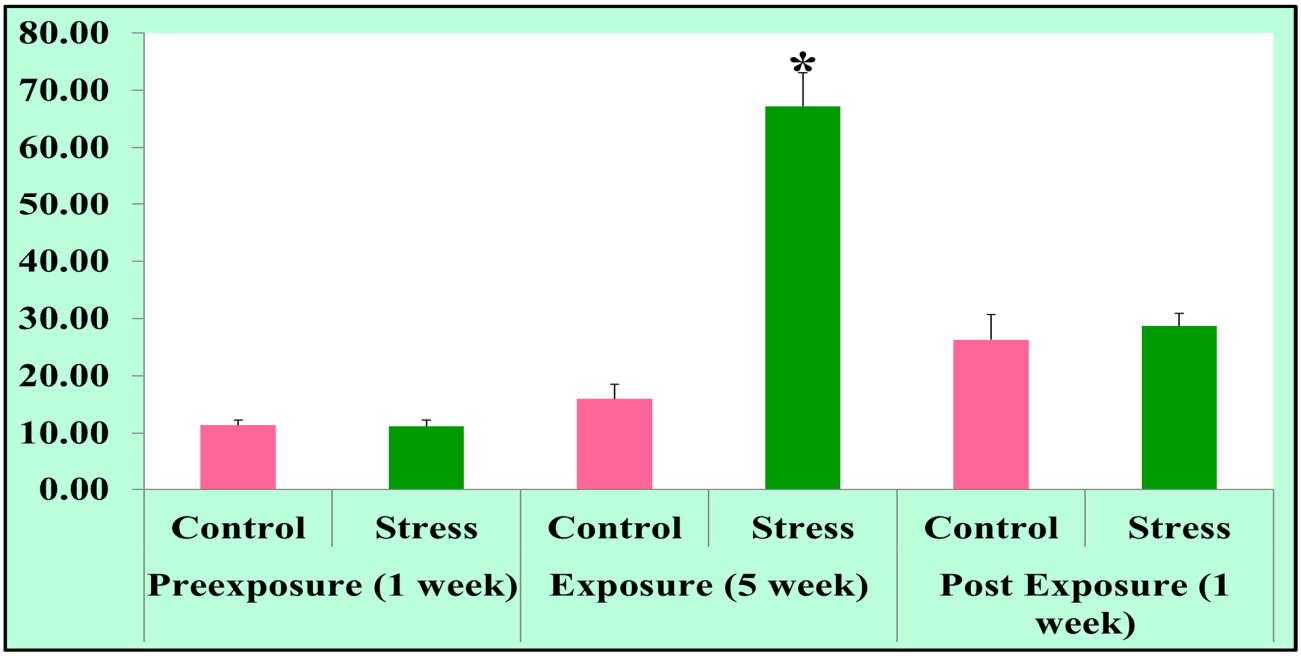


Plasma T_4 Concentration in nmol/L



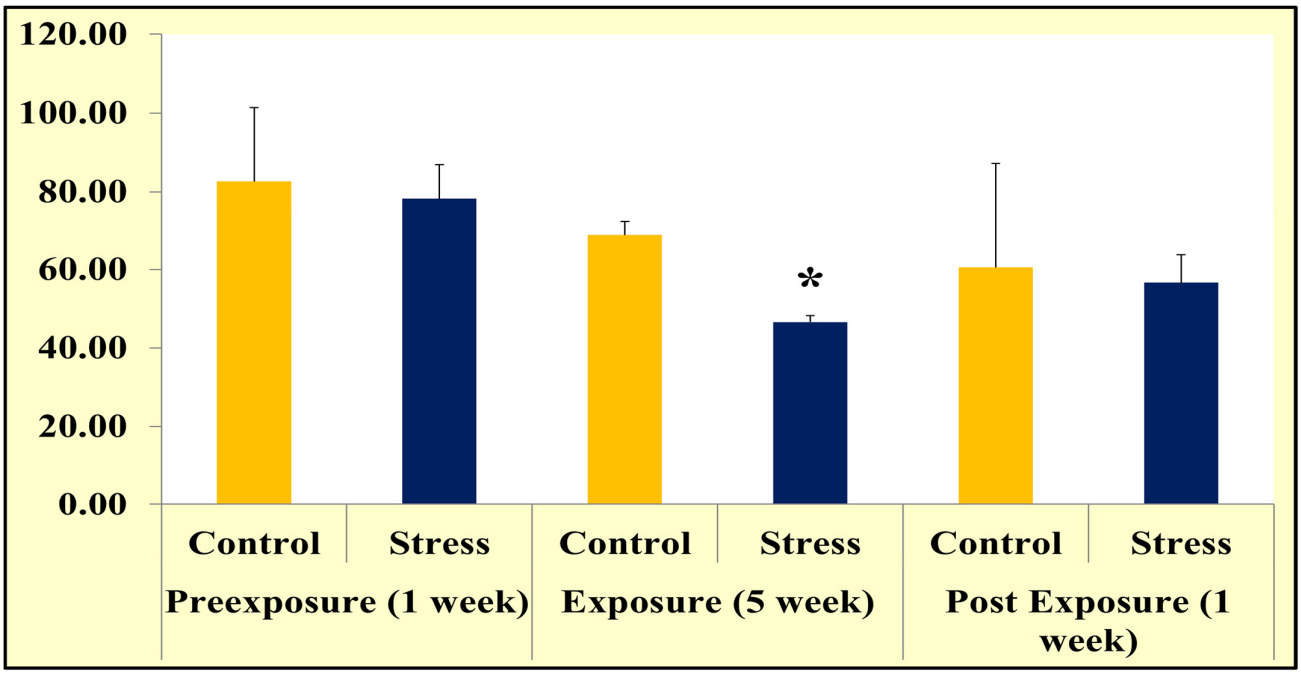
* Values differ significantly @ P<0.01

Plasma Cortisol Concentration in nmol/L



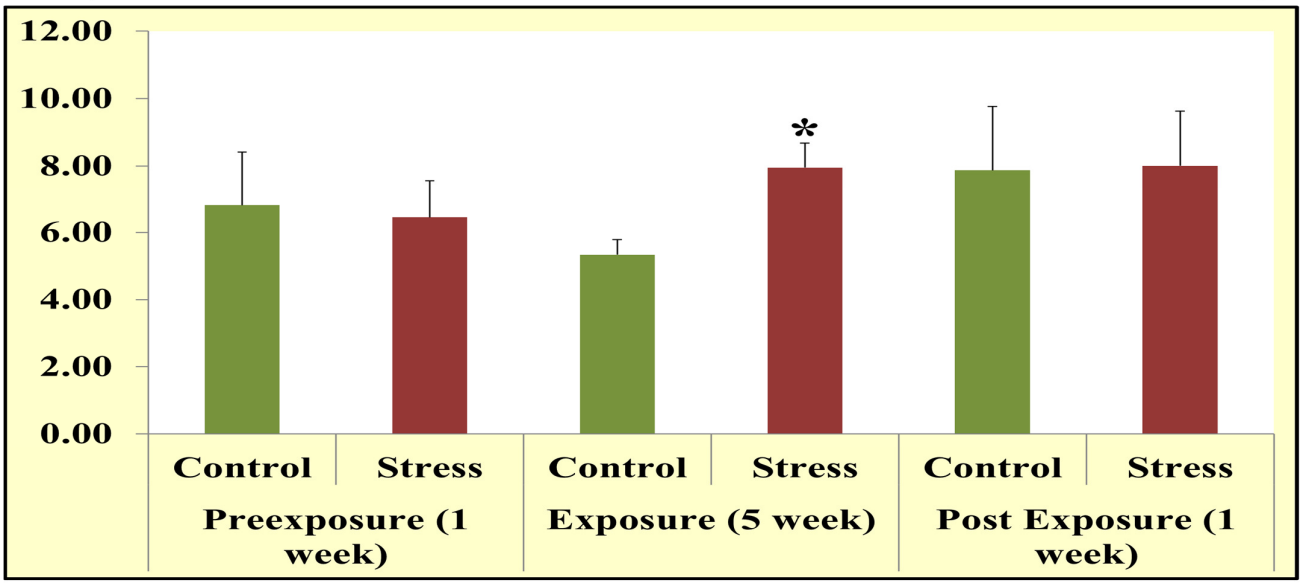
* Values differ significantly @ P<0.01

Plasma Estradiol Concentration in pg/ml



* Values differ significantly @ P<0.05

Plasma Progesterone Concentration in ng/ml



* Values differ significantly @ P<0.05

Conclusion:-

The study establishes the adaptive capability of Malpura ewes to summer season by altering their feeding behavior and physiological responses. This is reflected on the low feed intake, high water intake and significant differences in the physiological responses in heat stressed ewes. Further, the study proved that heat stress during summer season is detrimental to reproductive performance and this is evident from the significant ($P < 0.05$) changes in the reproductive hormone levels in these ewes.

Physiologically the animals showed recovery efficiency within a week period of time. This is evident from the non significant changes in all physiological measurements between control and stress groups. Further, the results show that Malpura ewes were able to recover their reproductive efficiency within a week time.

Although the animals showed signs of recovery from the heat stress within 7 days post exposure, still the values of stress hormone is significantly higher indicating more time period is required to completely recover from heat stress under hot semi-arid environment.

Results of Objective 2:-

Water Quality of Tonk district (Sample No. 25)

Parameters within maximum limits
pH, Cl, Sulphate, Total hardness, Na, Fe, Color, Ca, Mg, Total dissolved solids
Parameters which are nil
Residual free Chlorine, Cu, Phenolic compound, Arsenic, Zn, Cr

Parameters	Maximum limits	Mean ± SE
Specific conductivity	300-700 µ siem/cm	1802±200.6
Silica	0.01 mg/l	8.42±0.74
Fluoride	1 mg/l	1.45±0.08
Total Coli form Count	10	21.97±1.84
Odour	Unobjectionable	56 %
Alkalinity	200 mg/l	344.0±32.32
Maganese	0.1 mg/l	0.126 (n=1)
Nitrate	45 mg/l	60.52±5.2
Lead	0.05 mg/l	0.00342±0.00062 (n=18)
Turbidity	5	8.82±2.38
Cyanide	0.05 mg/l	0.0339±0.0059 (n=3)
E. Coli	Absent	Present (n=2)

Water Quality of Bhilwara district (Sample No. 25)

Parameters within maximum limits
pH, Chloride, Fluoride, Sulphate, Na, Fe, Color, Calcium
Parameters which are nil
Residual free Chlorine, Cu, Mn, Zn, Cr, E. Coli

Parameters	Maximum limits	Mean ± SE
Specific conductivity	300-700 µ siem/cm	1326±217.3
Silica	0.01 mg/l	5.62±0.80
Total dissolved solids	500 mg/l	861.9±126.9
Total Coli form Count	10	17.7±1.99
Odour	Unobjectionable	83 %
Alkalinity	200 mg/l	326.8±35.01
Magnesium	30 mg/l	40.33±5.58
Nitrate	45 mg/l	52.01±5.7
Total hardness	300 mg/l	336.0±43.1
Turbidity	5	9.61±2.58
Phenolic compound	0.001 mg/l	0.0549 (n=1)
Arsenic		0.126 (n=1)
Cyanide	0.05 mg/l	0.0514 (n=1)
Lead	0.05 mg/l	0.265 (n=1)

Water Quality of Jodhpur district (Sample No. 19)

Parameters within maximum limits
pH, Sulphate, Nitrate, Mg, Na, Fluoride, Fe, Color, turbidity, Total dissolved solids
Parameters which are nil
Residual free Chlorine, Lead, Cu, Mn, Phenolic compound, Arsenic, Cyanide, Zn, Cr, E. Coli

Parameters	Maximum limits	Mean ± SE
Specific conductivity	300-700 µ siemens/cm	1569±237.7
Silica	0.01 mg/l	4.92±0.88
Chloride	250 mg/l	330.2±61.7
Total Coli form Count	10	15.0±2.18
Odour	Unobjectionable	84 %
Alkalinity	200 mg/l	238.5±38.29
Total hardness	300 mg/l	341.1±47.1
Calcium	75 mg/l	77.31±10.0

Water Quality of Bikaner district (Sample No. 19)

Parameters within maximum limits

pH, Chloride, Sulphate, Nitrate, Total hardness, Ca, Mg, Na, Fluoride, Fe, Color, turbidity, alkalinity

Parameters which are nil

Residual free Chlorine, Cu, Mn, Phenolic compound, Arsenic, Cyanide, Zn, Cr, E. Coli

Parameters	Maximum limits	Mean ± SE
Specific conductivity	300-700 µ siemens/cm	8905±230.3
Silica	0.01 mg/l	4.03±0.85
Total Dissolved Solids	500 mg /l	597.2±134.5
Total Coli form Count	10	16.55±2.11
Odour	Unobjectionable	79 %
Lead	0.05 mg/l	0.365 (n=1)

Water Quality of Jalor district (Sample No. 21)

Parameters within maximum limits

pH, Sulphate, Nitrate, Mg, Na, Fe, Color, turbidity, Total hardness, Calcium & Total dissolved solids.

Parameters which are nil

Residual free Chlorine, Lead, Cu, Mn, Phenolic compound, Arsenic, Cyanide, Zn, Cr & E.Coli.

Parameters	Maximum limits	Mean ± SE
Specific conductivity	300-700 µ siemens/cm	1609±219.0
Silica	0.01 mg/l	2.74±0.81
Chloride	250 mg/l	364.2±56.9
Total Coli form Count	10	15.1±2.01
Odor	Unobjectionable	90 %
Alkalinity	200 mg/l	247.5±35.27
Fluoride	1 mg/l	1.26±0.09

Comparison of Primary data with Secondary data for Water Quality Parameters:-

Parameters	Max. limits	Primary data (n=107)	Secondary data (n=107)
pH	6.5-8.5	7.66±0.35 [a]	8.18±0.41 [b]
Specific conductivity	300-700 µ seim/cm	1409±160.5 [a]	2405±185.9 [b]
Chloride	250 mg/l	255.65±46.2 [a]	464.12±53.5 [b]
Sulphate	200 mg/l	100.94±13.8 [a]	201.56±15.9 [b]
Magnesium	30 mg/l	27.17±4.2 [a]	50.51±4.9 [b]
Sodium	200 mg/l	100.58±26.9 [a]	425.26±31.2 [b]
Fluoride	1 mg/l	0.94±0.1 [a]	1.56±0.1 [b]
Iron	0.3 mg/l	0.042±0.06 [a]	0.49±0.07 [b]
Silica	0.01 mg/l	5.12±0.8 [a]	25.18±0.9 [b]
Total dissolved solids	500 mg/l	889.4±101.7 [a]	1563±117.8 [b]
Nitrate	45 mg/l	46.07±10.1 [a]	85.88±11.7 [b]
Total hardness	300 mg/l	258.33±29.5	342.01±34.15
Calcium	75 mg/l	56.26±6.1	53.8±7.1

Effect of source of water on its quality parameters:-

Parameters	Max. limits	Ground water* (n=71)	Surface water** (n=36)
pH	6.5-8.5	7.68±0.05	7.61±0.07
Specific conductivity	300-700 µ seim/cm	1518±132.97	1301±185.42
Chloride	250 mg/l	305.4±33.6 [a]	162.7±46.9 [b]
Sulphate	200 mg/l	120.3±14.2 [a]	65.1±19.9 [b]
Total hardness	300 mg/l	275.1±24.3	229.9±33.9
Calcium	75 mg/l	60.6±5.1	48.1±7.1
Magnesium	30 mg/l	29.7±3.1	23.7±4.4
Sodium	200 mg/l	113.6±12.7	89.1±17.8
Fluoride	1 mg/l	1.02±0.07	0.87±0.60
Total dissolved solids	500 mg/l	984.8±74.6	743.8±104.1
Alkalinity	200 mg/l	269.6±21.6	238.6±30.1
Color	5	0.16±0.15 [a]	1.57±0.21 [b]
Odor	Unobjectionable	93%	50%
Turbidity	5	3.25±1.33 [a]	12.63±1.86 [b]
Total suspended Solids	-	17.23±4.86 [a]	70.05±6.78 [b]
Total coli form count	10	14.96±1.07 [a]	22.64±1.49 [b]
Silica	0.01 mg/l	3.84±0.43 [a]	8.18±0.60 [b]
Nitrate	45 mg/l	40.63±3.05 [a]	59.89±4.26 [b]
Iron	0.3 mg/l	0.036±0.01	0.057±0.01

Lead	0.05 mg/l	0.00253±0.0055 (n=7)	0.0518±0.033 (n=13)
Cyanide	0.05 mg/l	Nil	0.0383±0.005 (n=4)
E. Coli	Absent	Absent	Present (n=2)
Manganese	0.1 mg/l	Nil	0.126 (n=1)
Arsenic	-	Nil	0.0549 (n=1)
Phenolic compound	0.001 mg/l	Nil	0.126 (n=1)

Residual free chlorine, Copper, Zinc, Chromium : Nil

***Ground water** : Tube well, Hand pump, Well

****Surface water** : Pond, Canal, River, Dam

Conclusions

The water samples from different sources available for livestock were analyzed from 4 districts of Rajasthan and found that specific conductivity, chloride magnesium, sodium, silica and total solids were above the range of maximum limits permissible. In addition, calcium was lower than the permissible range.

Results of Objective 3:-

Table 1: Effect of heat stress and mineral mixture supplementation on RR (breaths/Min), PR (beats/Min), RT (°F) and SR (g/m^2/h) of Malpura ewes

Items	RR (Morning)	RR (Afternoon)	PR (Morning)	PR (Afternoon)	RT (Morning)	RT (Afternoon)	SR (Afternoon)
μ±SE	25.786 ±0.586	82.655 ±2.064	60.429 ±1.163	75.036 ±1.030	100.092 ±0.055	102.281 ±0.042	60.840 ±8.584
Group	NS	**	NS	NS	NS	**	NS
Control	26.071^{a}	41.929^{c}	58.500^{a}	71.893^{b}	100.118^{a}	101.786^{b}	72.443^{a}
Heat Stress	26.286^{a}	108.893^{a}	62.214^{a}	76.000^{ab}	100.079^{a}	102.432^{a}	51.894^{a}
Mineral Supplementation	25.00^{a}	97.143^{b}	60.571^{a}	77.214^{a}	100.079^{a}	102.625^{a}	58.182^{a}
Pooled SE for treatment	±1.015	±3.575	±2.014	±1.783	±0.095	±0.73	±14.868
Day	**	**	*	**	**	**	**
0	24.095^{b}	43.905^{b}	53.619^{c}	67.714^{b}	99.929^{bc}	101.481^{c}	145.184^{b}
7	23.429^{b}	102.000^{a}	58.286^{cb}	77.571^{a}	100.233^{ab}	102.810^{a}	34.035^{a}
14	30.857^{a}	91.190^{a}	65.238^{a}	75.524^{a}	100.386^{a}	102.457^{b}	33.451^{a}
21	24.762^{b}	93.524^{a}	64.571^{ab}	79.333^{a}	99.819^{c}	102.376^{b}	30.689^{a}

Pooled SE for Day	±1.172	±4.128	±2.325	±2.059	±0.110	±0.084	±17.168
Group*Day	**NS**	**	**NS**	**NS**	**NS**	*	**NS**

RR- respiration rate; PR-pulse rate; RT-rectal temperature; SR-sweating rate

μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant; Means with similar superscript do not differ significantly (P>0.05) from each other.

Table 2: Effect of heat stress and mineral mixture supplementation on Body Weight and BCS of Malpura ewes

Items	**BW (Kg)**	**BCS**
μ±SE	33.462 ±0.136	3.155 ±0.036
Group	**NS**	*
Control	33.565[a]	3.143[ab]
Heat Stress	33.368[a]	3.018[b]
Mineral Supplementation	33.454[a]	3.304[a]
Pooled SE for treatment	±0.236	±0.062
Day	**	**
0	31.971[c]	2.762[c]
7	33.881[ab]	3.214[b]
14	33.571[b]	3.190[b]
21	34.424[a]	3.452[a]
Pooled SE for week	±0.272	±0.072
Group*Day	**NS**	**NS**

BW: Body weight, BCS: Body Condition Score

μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant; Means with similar superscript do not differ significantly (P>0.05) from each other

Table 3: Effect of heat stress and mineral mixture supplementation on Feed, Water Intake of Malpura ewes

Items	**Feed Intake (DMI gm/w^.75/day)**	**Water Intake (Lt/DMI Kg/day)**
μ±SE	65.457 ±1.012	3.041 ±0.043
Group	**	**
Control	87.050[a]	2.429[c]
Heat Stress	46.575[c]	3.681[a]
Mineral supplementation	62.745[b]	3.014[b]
Pooled SE for treatment	±1.753	±0.074
Day	*	*
7	61.842[b]	2.900[b]
14	67.179[a]	3.076[ab]
21	67.349[a]	3.148[a]

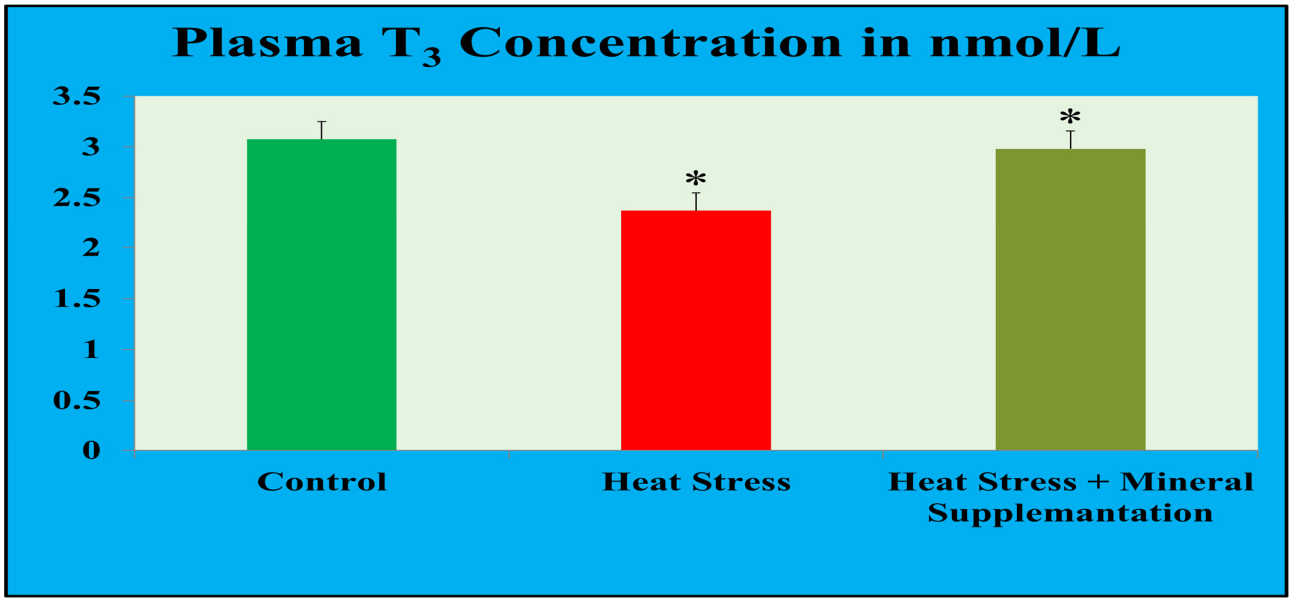
Pooled SE for week	±1.753	±0.074
Group*Day	**	**

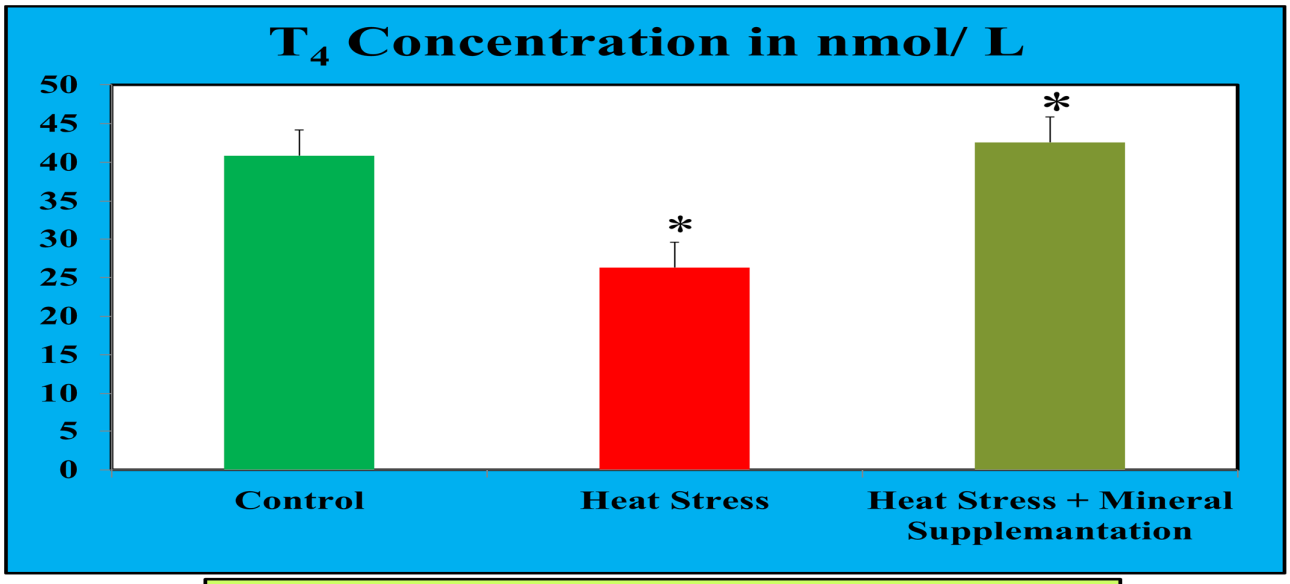
DMI: Dry Mater Intake; μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01) and NS- Non-Significant; Means with similar superscript do not differ significantly (P>0.05) from each other.

Table 4: Effect of heat stress and mineral mixture supplementation on Glucose, Hemoglobin and Packed Cell Volume of Malpura ewes.

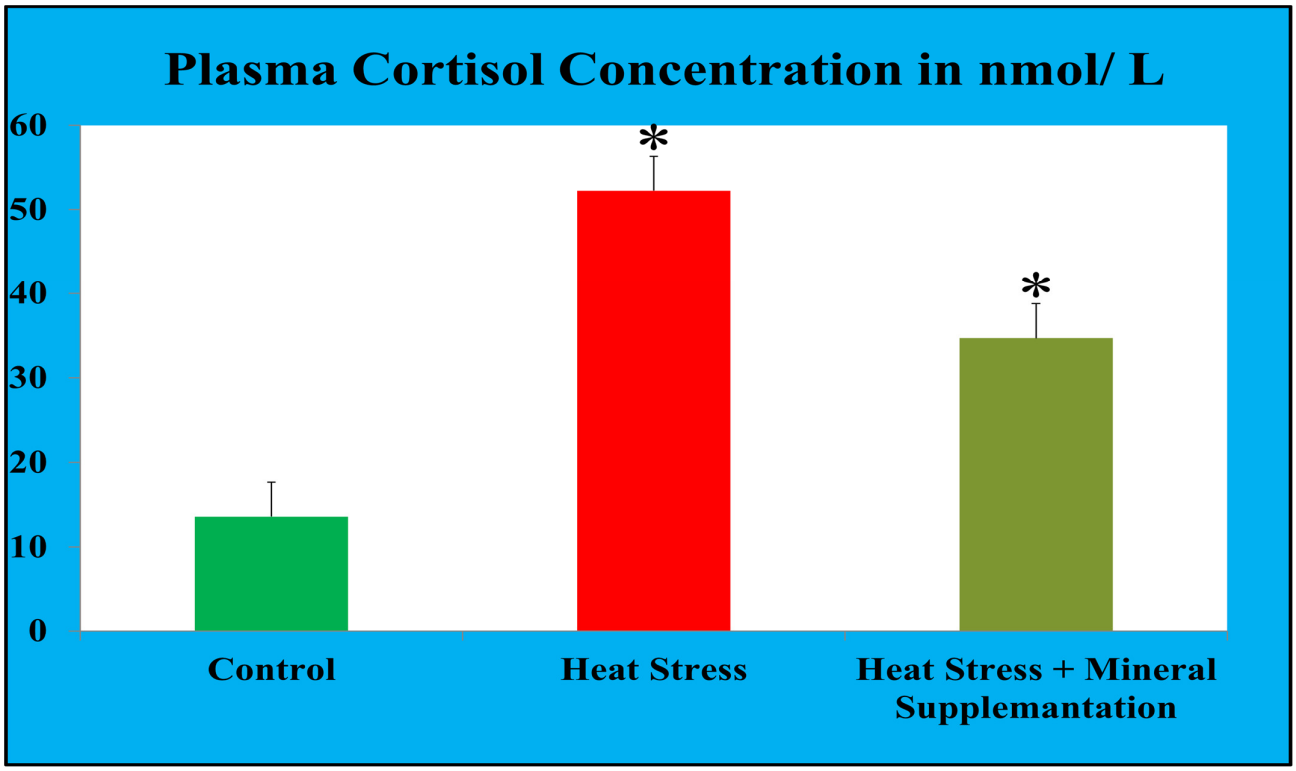
Items	**Glucose (ml/dL)**	**Hb (g%)**	**PCV (%)**
μ±SE	61.516 ±0.667	9.920 ±0.105	35.700 ±0.136
Group	**	**	**
Control	65.548^{a}	9.68^{b}	34.335^{b}
Heat Stress	58.181^{b}	10.641^{a}	38.478^{a}
Mineral Supplementation	60.819^{b}	9.432^{b}	34.289^{b}
Pooled SE for treatment	±1.155	±0.181	±0.994
Day	**	NS	NS
0	66.607^{a}	9.620^{b}	33.782^{a}
7	62.367^{b}	$9.794^{a\,b}$	35.327^{a}
14	61.843^{b}	$9.942^{a\,b}$	36.952^{a}
21	55.247^{c}	10.321^{a}	36.740^{a}
Pooled SE for week	±1.333	±0.209	±1.148
Group*Day	**	NS	*

μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant; Means with similar superscript do not differ significantly (P>0.05) from each other.

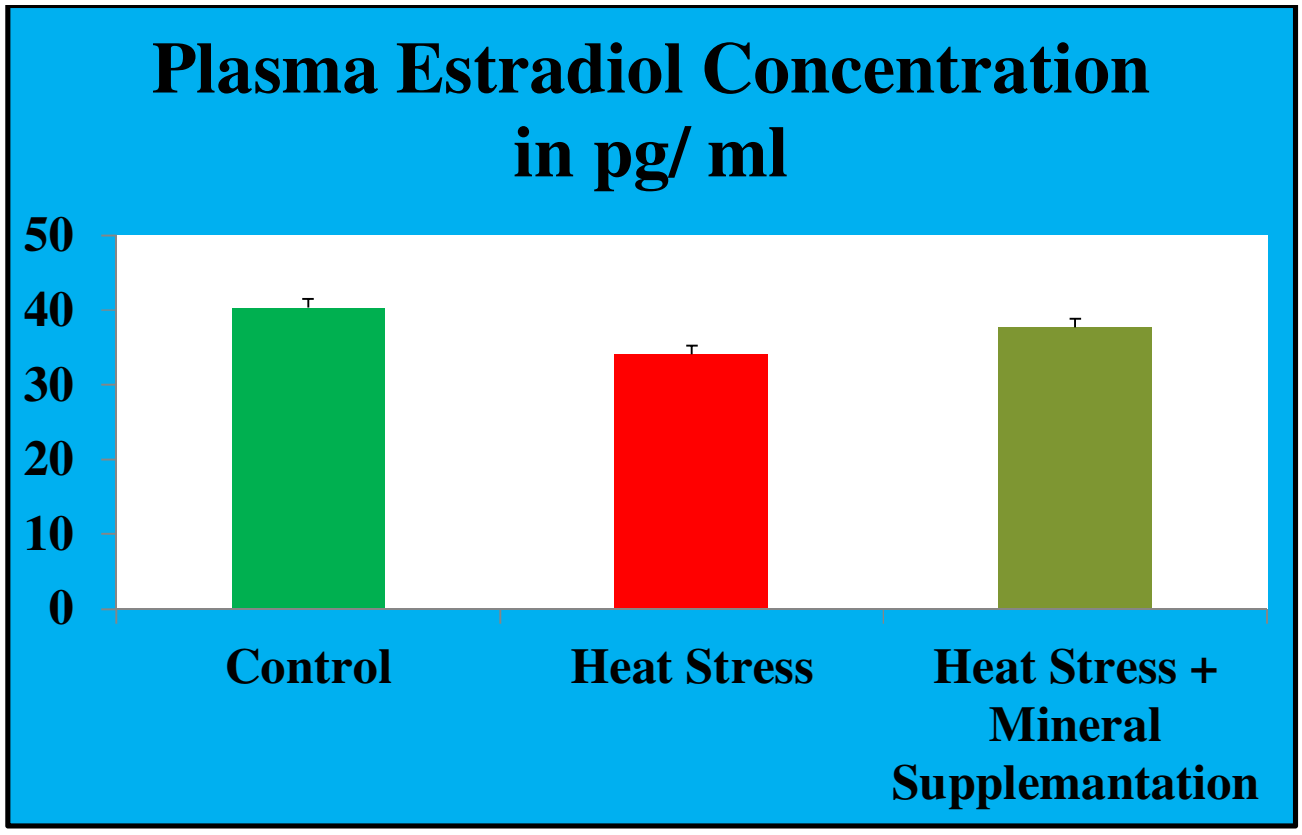


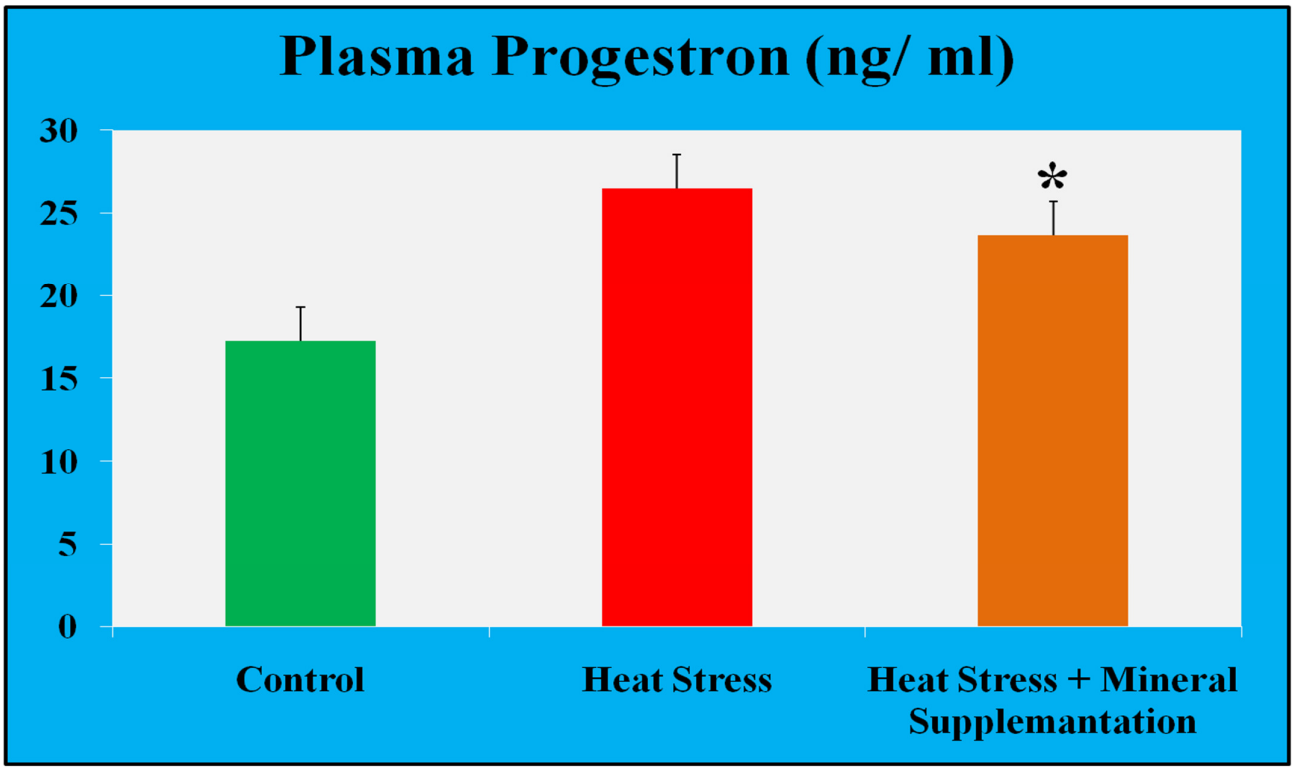


*** Values differ significantly @ P<0.01**



*** Values differ significantly @ P<0.01**





* Values differ significantly @ P<0.05

Conclusion:-

Heat stress affected the feed intake, water intake, physiological responses, blood biochemical and endocrine responses. This shows that Malpura ewes posses the capability to adapt to hot semi-arid environment. Further, the results from the study prove that the adverse effect of heat stress on the productive and reproductive efficiency of Malpura ewes was reduced considerably by mineral mixture supplementation. This shows the protective effect of mineral mixture to relieve heat stress in Malpura ewes.

Results of Objective 4:-

Table 1: Effect of cold protection on BW (kg) RR (breaths/Min), PR (beats/Min), RT (^{o}F) and ST (^{0}C) of Malpura lambs

Items	BW	RR (Morning)	RR (Afternoon)	PR (Morning)	PR (Afternoon)	RT (Morning)	RT (Afternoon)	ST (Morning)	ST (Afternoon)
μ±SE	11.372	48.231	51.938	87.425	108.550	102.378	102.860	31.389	34.562
	±0.539	±1.189	±1.860	±1.989	±1.729	±0.116	±0.057	±0.388	±0.263
Group	NS	**	*	NS	**	NS	**	NS	NS
Cold Protected	10.800	52.225	47.475	88.400	103.900	102.410	102.708	31.923	34.385
Cold Exposed	11.945	44.200	56.400	86.450	113.200	102.345	103.013	30.855	34.740
Pooled SE for treatment	±0.762	±1.681	±1.681	±2.813	±2.445	±0.163	±0.864	±0.548	±0.372
Week	NS	**	NS	NS	*	NS	**	**	**
0	9.475	49.875	51.562	78.375	114.375	102.125	103.312	29.069	37.575
1	10.494	65.250	53.875	92.625	106.500	102.694	102.881	29.225	34.963
2	11.063	38.562	43.125	87.000	98.000	102.250	102.569	33.294	35.694

3	12.300	44.500	53.750	85.000	111.250	102.488	102.731	33.212	28.050
4	13.531	42.875	57.375	93.625	112.625	102.331	102.806	32.144	36.531
Pooled SE for Week	±1.205	±2.658	±4.160	±4.448	±3.866	±0.258	±.127	±0.867	±0.588
Group*Week	NS	NS	NS	NS	NS	NS	NS	NS	NS

μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant

Table 2: Effect of cold protection on cortisol (n mol/L), T_3 (n mol/L) and T_4 (n mol/L) concentrations

Items	**Cortisol**	**T3**	**T4**
μ±SE	16.536 ±0.668	4.801 ±0.170	60.387 ±3.442
Group	**	**	*
Cold Protected	12.082	4.039	51.852
Cold Exposed	20.989	5.564	68.922
Pooled SE for treatment	±0.944	±0.241	±4.868
Week	*	NS	NS
1	12.233	4.727	59.339
2	18.306	4.713	65.542
3	16.870	5.092	65.390
4	18.239	4.773	56.803
5	17.030	4.703	54.860
Pooled SE for Week	±1.493	±0.380	±7.697
Group*Week	NS	NS	NS

of Malpura lambs

μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant

Table 3: Effect of cold protection on Hb and PCV concentrations of Malpura Lambs

Items	**Glucose** (g/dl)	**Hb** **(g%)**	**PCV** (%)
μ±SE	93.217 ±2.336	10.901 ±0.267	47.254 ±1.185
Group	NS	**	**
Cold Protected	90.883	10.189	43.924
Cold Exposed	95.551	11.613	50.583
Pooled SE for treatment	±3.304	±0.378	±1.676
Week	**	*	*
0	109.436	10.469	49.639
1	97.699	11.425	40.299
2	92.765	9.427	45.092
3	82.826	11.309	52.617
4	83.357	11.875	48.620
Pooled SE for Week	±5.223	±0.598	±2.649
Group*Week	NS	NS	NS

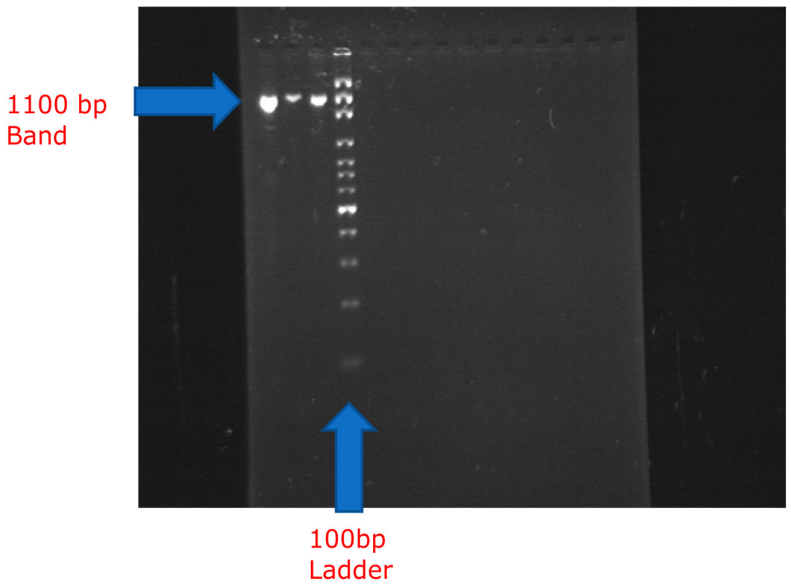
μ indicates the overall mean for the parameter. * (P<0.05), ** (P<0.01), NS- Non-Significant

Conclusions:-

The results from the study proves that the indigenously developed bamboo dome structure were able to protect the lambs from the cold stress. This is evident from the significant reduction in level of stress hormone cortisol and significant lowering of metabolic hormones as compared to cold exposed group indicating that they are not relying on increasing their metabolic rate to counter cold stress.

Results of Objective 5:-

- A product of 1100bp fragment was amplified specifically which was resolved on horizontal gel electrophoresis on 1 % Agarose gel
- The specific bands were excised from the gel and sent for sequencing after purifying the DNA using gel extraction kit
- Amplification of HSP 70 Gene of Sheep



Amplification of HSP 70 Gene of Sheep

Summary of Achievements:

- Severity of heat stress (Solar radiation: 42- 46^{0}C) was established in Malpura ewes on productive and reproductive parameters. Malpura ewes showed signs of recovery from heat stress within a period of one week.
- The water samples from different sources available for livestock were analyzed from 4 districts (water dark zone) of Rajasthan and found that specific conductivity, chloride magnesium, sodium, silica and total solids were above the range of maximum limits permissible. In addition, calcium was lower than the permissible range.
- Effect of heat stress on the productive and reproductive efficiency of Malpura ewes was reduced considerably by mineral mixture supplementation (Mineral Mixture Composition per Kg diet: Zinc Sulphate 164.0 mg, Colbalt sulphate 0.95 mg, Chromium acetate 1.2g, Selenium chloride 0.1mg, and Vitamin E 40.0 mg. Dose: 20gm/Kg body weight). This shows the protective effect of mineral mixture to relieve heat stress in Malpura ewes.
- The indigenously developed bamboo dome structure (Inside: 19.33°C; Outside: 9.25°C; Difference: 10.08°C) was able to provide better protection from cold stress to lambs.
- Amplification of HSP 70 gene of sheep was established.

Procurement of Equipments:-

Name of the Equipment	Status of Procurement	Estimated Cost/ Budget allocated (Rs. in lakhs)	Actual Cost
1. Laparoscope	Purchased	13,00,000/=	15,39,429/=
2. Beta Counter		25,00,000/=	
3. Blood Chemistry Auto-analyser	Purchased	8,10,000/=	6,62,720/=
4. Ultra-Low Temperature Refrigerator (Deep freezer)	In Process	1,90,000/=	5,00,000/=
Total=		**48,00,000/=**	**27,02,149**

Status of works, if any : No

Budget details:-

Head	1st Release		2nd Release		Cumulative		
A. Recurring Contingency	**Released**	**Expend.**	**Released**	**Expend.**	**Released**	**Expend.**	**%**
I. Operational expenses (Labour, skilled staff, POL, Supplies etc.,) Contractual services etc.,	0.02	-	19.0	14,35,313	19.02	14,35,313	-
II. TA	0	0	4.0	1,31,008	4.0	1,31,008	-
III. HRD	0	0					
Total (A)	**2000**	**-**	**23,00,000**	**15,66,321**	**23,02,000**	**15,66,321**	**68.04%**
B. Non Recurring Contingency			-	-			-
I. Equipment	46,10,000	22,02,150	-	-	46,10,000	22,02,150	-
II. Equipment costing less than Rs. 5 Lakhs	1,90,000	0	-	-	1,90,000	0	-
III. Information Technology	1,50,000	1,40,250	-	**-**	1,50,000	1,40,250	**-**
C. Inst. Charge		-	-	-		-	-
Total (B)	**49,50,000**	**23,42,400**	**0**	**0**	**49,50,000**	**23,42,400**	**47.32%**
D. Total (A+B)	**49,52,000**	**23,42,400**	**23,00,000**	**15,66,321**	**72,52,000**	**39,08,721**	**53.9%**

HRD Program conducted, if any: **No**

Training/Symposia attended:

1. Participated in **National Stakeholders consultation on climate change platform at CRIDA**, Hyderabad between 18-21 September 2011 (V. Sejian and S.M.K. Naqvi).
2. Participated in **XX Annual conference of Society of Animal Physiologist of India** (SAPI) and International Symposium on "Advances in Physiologic Research for Sustainable Development of Livestock and Poultry Production" organized by Department of Veterinary Physiology, WBUAFS, 37, Kshudiram Bose Sarani, Belgachia, Kolkata between 2-4 November 2011 (V.Sejian and Anoop Kumar Singh).
3. Participated in National seminar on "**Prospects and retrospect of small ruminants and rabbit production: contribution to socio-economic security**" organized by **Indian Society for Sheep and Goat Production and Utilization** (ISSGPU) in association with Central Wool development Board at Jaipur between 7-9 December 2011 (S.M.K.Naqvi, V.Sejian, Anoop Kumar Singh and Rajni Chhetri).

Publication/ Patents : 4

Publication:-

1. Singh, A.K., Sejian, V and Naqvi, S.M.K (2011). Effect of mineral mixture supplementation on growth and physiological adaptability of Malpura ewes subjected to heat stress. In: Prospects and retrospect of small ruminants and rabbit production: contribution to socio-economic security" organized by Indian Society for Sheep and Goat Production and Utilization in association with Central Wool development Board at Jaipur between 7-9 December 2011, pp 98-99.
2. Rajni, C., Sejian, V and Naqvi, S.M.K (2011). Comparative study on the endocrine responses during pre exposure, exposure and post exposure period of heat stress under hot semi-arid environment. In: Prospects and retrospect of small ruminants and rabbit production: contribution to socio-economic security" organized by Indian Society for Sheep and Goat Production and Utilization in association with Central Wool development Board at Jaipur between 7-9 December 2011, pp 100.
3. Rajni, C., Sejian, V and Naqvi, S.M.K (2011).Effect of summer season on the growth and reproductive performance of Malpura ewes under semi-arid tropical environment. In: XX Annual conference of Society of Animal Physiologist of India (SAPI) and International

Symposium on "Advances in Physiologic Research for Sustainable Development of Livestock and Poultry Production" organized by Department of Veterinary Physiology, WBUAFS, 37, Kshudiram Bose Sarani, Belgachia, Kolkata between 2-4 November 2011, pp 134.

4. Singh, A.K., Rajni, C., Sejian, V and Naqvi, S.M.K (2011). Effect of summer season on the adaptive capability of Malpura ewes under semi-arid tropical environment. In: XX Annual conference of Society of Animal Physiologist of India (SAPI) and International Symposium on "Advances in Physiologic Research for Sustainable Development of Livestock and Poultry Production" organized by Department of Veterinary Physiology, WBUAFS, 37, Kshudiram Bose Sarani, Belgachia, Kolkata between 2-4 November 2011, pp 156.

Any other information : NA