Original Research

To Compare the Effect of Different Shade Materials on the Physiological and Biochemical Variables in Buffalo Calves in Summer Season

R. S. D. Barman*, M. K. Chaudhary, R. R. K. Sinha, Anjay, R. K. Verma[1] and D. K. Jha[2]

Department of Livestock Production Management, Bihar Veterinary College, BAU, Sabour, Bhagalpur – 813210, Bihar, INDIA

[1]Department of Veterinary Physiology, R.V.C., Kanke, Ranchi, Jharkhand, INDIA
[2]Department of Animal House, RMRIMS , Agamkauan, Patna, Bihar, INDIA

**.Part of Ph.D.Thesis, Ph.D. Scholor, Deptt.of LPM, BVC, Patna (Bihar)*

***Corresponding author:** barman.ravi@rediffmail.com

Rec. Date:	Aug 28, 2017 15:42
Accept Date:	Apr 25, 2018 18:03
DOI	10.5455/ijlr.20170828034222

Abstract

The present studies was carried out for a period of 120 days during summer season to see the effect of different shade materials on the performance of buffalo calf. Twenty four buffalo calves were selected for study and divided into 4 groups (6 calves in each group). The different groups of calves were studied under different roof materials as followed: asbestos roof (T1), Pre painted CGI Sheet roof (T2), thatch with polythene shading roof (T3): galvanized iron sheet roof (T4). The respiration rate (per minute) at 9:00 AM was 23.31±0.29, 22.76±0.09, 23.00±0.03 and 23.23±0.24 whereas at 2:00 PM was 43.03±0.1.62, 42.35±1.37, 35.00±1.16, 43.40±1.69 for T1, T2, T3 and T4, respectively. The results revealed that the respiration rate of calves at 2:00PM was significantly (P<0.05) higher than respiration rate at 9:00 AM in all the groups throughout the experiment. Respiration rate of T3 showed significant difference from T1, T2 and T3. The rectal temperature at 9:00 AM was 39.57±0.01, 39.76±0.07, 39.26±0.03 and 39.72±0.08 whereas at 2:00 PM was 39.66±0.03, 39.66±0.06, 39.10±0.04 and 39.71±0.04°C for T1, T2, T3, and T4, respectively. The overall rectal temperature of T3 showed significance difference form all other groups. The overall haemoglobin concentration of buffalo calves were 9.42±0.31, 9.62±0.23, 11.02±0.30 and 9.35±0.22 g/dl for T1, T2, T3 and T4 group, respectively. The overall haemoglobin of T3 (11.02±0.30 g/dl) was shown significantly higher (P<0.05) than T1, T2 and T4 during the experiment.

Key words: Biochemical, Buffalo Calves, Different Shade Materials, Physiological, Summer Season

How to cite: Barman, R., Sinha, R., Prasad, A., Verma, R., & Jha, D. (2018). To Compare the Effect of Different Shade Materials on the Physiological and Biochemical Variables in Buffalo Calves in Summer Season. International Journal of Livestock Research, 8(9), 292-304. doi: 10.5455/ijlr.20170828034222

Introduction

India is a tropical climate which is characterized by high temperature and humidity. Extended periods of high ambient temperature coupled with high relative humidity compromise the ability of the dairy calves to dissipate excess body heat. Calves with elevated body temperature exhibit lower DMI and growth with less efficiency, reducing profitability for dairy farms in hot and humid climates. Generally calves are housed in groups in confined outdoor yards during day that leave them expose to high environmental temperatures, which can exceed their ability to dissipate body heat. The ensuing heat stress has important implications for cattle welfare as well as a negative impact on health and production; in extreme cases resulting in death. It has been observed that radiation energy flow on animal is 685 kcal /m²h, but actually only 340 kcal/m²h is from the direct solar radiation and rest is reflected by floor, dust, wall, etc. (Thomas and Sastry, 2007).

To protect young calves from the extremes climate even in the open paddock above the manger is essential during early life. Placing a simple shade over an animal exposed to a hot environment and direct solar radiant energy from the sun cuts the radiant heat load on that animal by about 45% (Blackshaw and Blackshaw, 1994). Solar radiation is a major factor in heat stress and increases heat gain by direct as well as indirect means (Shearer *et al*., 2002). Continued exposure to the direct sun results in loss of body water through evaporation resulting in dryness of skin, increased rectal temperature, respiration and pulse rates, off and cessation of rumination leading to higher calf mortality, poor growth rate during summer (Hemsworth *et al*., 1995). To protect the animals from direct solar radiation in the open paddock, different shade materials are used over the manger. Type of roof material generally decides the micro climate in the underneath covered area. The structure casting the shade should have at least one of the following properties: high reflectivity, low conductivity, low under-surface emissity, correct roof profile (slope) and maximum practical height (Ansell, 1981). Although, many roofing materials available in the market and are in practice, unfortunately, no roofing material has all the properties. Adequate cooling systems in humid climates and less effective than in arid climates and these systems often lack the ability to assist dairy calves in maintaining normal body temperature.

Therefore, the present study was carried out to assess the physiological and biochemical parameters in summer season of buffalo calves housed under different types of roof.

Materials and Methods

The present studies was conducted at ILFC (Instructional Livestock Farm Complex), Bihar Veterinary College, Patna (now comes under Bihar Animal Science University, Patna, Bihar) on twenty four buffalo calves (age group between 25 to 45 days) to compare the effect of different shade materials on the physiological and biochemical variables in buffalo calves during summer season and divided into 4 groups

  DOI 10.5455/ijlr.20170828034222

(6 calves in each group). The different groups of calves were studied under different roof materials as followed:

1. Asbestos roof (T1): commercially available asbestos was used.
2. Pre painted CGI Sheet roof (T2): commercially available pre painted CGI sheet having thickness 0.13 mm to 0.5mm, Zinc coated -60gram/m2-120gram/m2 which is durable, anti-corrosive and excellent water proof.
3. Thatch with polythene shading roof (T3): four inch thick layer of paddy straw fixed to bamboo frame.
4. Galvanized iron sheet roof (T4): commercially available in the market without painted.

Physiological variables such as rectal temperature (RT) was recorded by using digital clinical thermometer and respiratory rates (RR) was counted from a distance by observing flank movements and expressed as counts per minute of calves. These parameters were recorded daily at 9:00 AM and 2:00 PM. Blood from all calves were collected at 0, 15, 30, 45, 60, 75 90 and 120 days of experimental period by puncturing the jugular vein following the aseptic measures. The blood haemoglobin was treated with Drabkin's solution. Ferricyanide from Drabkin's solution converts haemoglobin to methemoglobin which was further converted to cyanmethemoglobin by the action of cyanide. The cyanmethemoglobin has an absorbance, which was proportional to the haemoglobin concentration and expressed in g/dl. The serum biochemical estimation namely glucose, total protein (TP), albumin, globulin and serum enzymatic estimation namely ALP, SGOT and SGPT were estimated as per standard protocols using the kit. The data were analyzed statically following the standard procedure describe by Snedecor and Cochran (1994).

Result and Discussion

The present studies conducted at ILFC (Instructional livestock farm complex), Bihar Veterinary College, Patna on twenty four buffalo calves to compare the effect of different shade materials on the physiological and biochemical variables during summer season (March to June). The physiological variables includes respiration rate, rectal temperature and haemoglobin.

The respiration rate (per minute) during summer season represented in Table 1. The respiration rate (per minute) of buffalo calves at 9:00 AM was 23.31±0.29, 22.76±0.09, 23.00±0.03 and 23.23±0.24 whereas at 2:00 PM was 43.03±0.1.62, 42.35±1.37, 35.00±1.16, 43.40±1.69 for T1, T2, T3 and T4, respectively. The results revealed that the respiration rate of calves at 2:00PM was significantly ($P<0.05$) higher than respiration rate at 9:00 AM in all the groups throughout the experiment. Respiration rate of T3 showed significant difference from T1, T2 and T4. Whereas, there was no significance difference among T1, T2 and T4. The change in respiration rate was observed to be related with discomfort and was noticed that the increase was mainly due to exposure to greater intensity of solar radiation (Das *et al.*, 1997).

  DOI 10.5455/ijlr.20170828034222

Table 1: Mean± SE of respiration rate (per minute) of buffalo calves in summer season

Fortnights	Time	Asbestos Roof (T1)	PPCGI Roof (T2)	Thatch Roof (T3)	GI Sheet Roof (T4)
I	9AM	22.53±0.38	22.53±0.389	22.93±0.79	22.60±0.37
	2PM	38.73±1.02	38.73±1.06	38.07±1.03	38.93±1.05
	Average	30.63±1.59	30.63±1.60	30.50±1.54	30.77±1.61
II	9AM	24.13±0.35	22.93±0.39	23.13±0.49	23.87±0.38
	2PM	47.33±1.24[a]	45.93±1.39[a]	31.87±0.47[b]	47.87±1.12[a]
	Average	35.73±2.25[a]	34.43±2.25[a]	27.50±0.87[b]	35.87±2.30[a]
III	9AM	24.00±0.38	23.00±0.39	23.00±0.49	23.80±0.38
	2PM	47.40±1.19[a]	45.87±1.44[a]	31.93±0.47[b]	47.93±1.07[a]
	Average	35.70±2.26[a]	34.43±2.24[a]	27.47±0.89[b]	35.87±2.31[a]
IV	9AM	24.07±0.38	22.93±0.39	23.07±0.48	23.87±0.38
	2PM	47.27±1.28[a]	46.00±1.37[a]	31.87±0.47[b]	47.73±1.23[a]
	Average	35.67±2.25[a]	34.467±2.25[a]	27.47±0.88[b]	35.80±2.30[a]
V	9AM	24.13±0.35	23.07±0.39	23.13±0.49	23.93±0.38
	2PM	47.33±1.24[a]	46.07±1.33[a]	32.07±0.51[b]	47.93±1.07[a]
	Average	35.73±2.24[a]	34.57±2.24[a]	27.60±0.89[b]	35.93±2.29[a]
VI	9AM	22.53±0.38	22.53±0.38	22.93±0.79	22.60±0.37
	2PM	38.73±1.02	38.73±1.06	38.07±1.03	38.93±1.05
	Average	30.63±1.59	30.63±1.60	30.50±1.54	30.77±1.61
VII	9AM	22.53±0.38	22.53±0.38	22.93±0.79	22.60±0.37
	2PM	38.73±1.02	38.73±1.06	38.07±1.03	38.93±1.05
	Average	30.63±1.59	30.63±1.60	30.50±1.54	30.77±1.61
VIII	9AM	22.53±0.38	22.53±0.38	22.93±0.79	22.60±0.37
	2PM	38.73±1.02	38.73±1.06	38.07±1.03	38.93±1.05
	Average	30.63±1.59	30.63±1.60	30.50±1.54	30.77±1.61
Overall	**9AM**	**23.31±0.29**	**22.76±0.09**	**23.00±0.03**	**23.23±0.24**
	2PM	**43.03±1.62[a]**	**42.35±1.37[a]**	**35.00±1.16[b]**	**43.40±1.69[a]**
Overall		**33.17±0.96**	**32.55±0.73**	**29.00±0.56**	**33.32±0.96**

Means bearing different superscript in a row differ significantly (P<0.05)

At higher temperature the respiration rate was increased rapidly to about 8-10 times of the normal values in calves. The higher respiration rate in T1 and T4 might be attributed to more heat load, which was get rid off by increased pulmonary evaporative cooling through respiratory channel (Gangwar *et al*., 1980). The present finding is also accordance with the observation of Soly and Singh (2001) who reported higher RR during afternoon than morning hr. in crossbred calves during summer season. Schutz *et al*. (2010) concluded increased respiration rate with increase in surrounding heat and observed that this increase was more marked in 2.4m^2 shade/cow and no shade treatments than in the 9.6m^2 shade/cow treatments. These results indicated that cattle use shade to prevent an increase in internal body temperature, but this heat mitigation strategy is only effective if a sufficient amount of shade is provided.

Hosted@www.ijlr.org DOI 10.5455/ijlr.20170828034222

Rectal temperature (^{0}C) during summer season of buffalo calves at 9:00 AM and 2:00 PM are presented in Table 2. Rectal temperature at 9:00 AM was 39.57±0.01, 39.76±0.07, 39.26±0.03 and 39.72±0.08 whereas at 2:00 PM was 39.66±0.03, 39.66±0.06, 39.10±0.04 and 39.71±0.04°C for T1, T2, T3, and T4, respectively.

Table 2: Mean ± SE of rectal temperature (^{0} C) of buffalo calves in summer season

Fortnights	Time	Asbestos Roof (T1)	PPCGI Roof (T2)	Thatch Roof (T3)	GI Sheet Roof (T4)
I	9AM	$39.57±0.13^{ab}$	$39.81±0.09^{a}$	$39.16±0.14^{b}$	$39.79±0.13^{a}$
	2PM	$39.83±0.14^{a}$	$39.93±0.11^{a}$	$39.16±0.14^{b}$	$39.91±0.14^{a}$
	Average	$39.70±0.09^{a}$	$39.87±0.07^{a}$	$39.16±0.10^{b}$	$39.85±0.09^{a}$
II	9AM	$39.54±0.10^{ab}$	$39.79±0.09^{a}$	$39.13±0.14^{b}$	$39.57±0.17^{ab}$
	2PM	$39.57±0.13^{ab}$	$39.81±0.09^{a}$	$39.16±0.14^{b}$	$39.79±0.13^{a}$
	Average	$39.56±0.08^{a}$	$39.80±0.07^{a}$	$39.15±0.10^{b}$	$39.68±0.11^{a}$
III	9AM	$39.60±0.12^{ab}$	$39.85±0.11^{a}$	$39.31±0.14^{b}$	$39.84±0.12^{a}$
	2PM	$39.57±0.13^{ab}$	$39.81±0.09^{a}$	$39.16±0.14^{b}$	$39.79±0.13^{a}$
	Average	$39.59±0.09^{a}$	$39.83±0.07^{a}$	$39.24±0.09^{b}$	$39.81±0.09^{a}$
IV	9AM	$39.60±0.12^{ab}$	$39.85±0.11^{a}$	$39.31±0.14^{b}$	$39.84±0.12^{a}$
	2PM	$39.66±0.09^{a}$	$39.55±0.05^{a}$	$38.92±0.14^{b}$	$39.64±0.14^{a}$
	Average	$39.63±0.08^{a}$	$39.70±0.06^{a}$	$39.12±0.10^{b}$	$39.74±0.09^{a}$
V	9AM	$39.60±0.12^{ab}$	$39.85±0.11^{a}$	$39.31±0.14^{b}$	$39.84±0.12^{a}$
	2PM	$39.66±0.09^{a}$	$39.55±0.05^{a}$	$38.92±0.14^{b}$	$39.64±0.14^{a}$
	Average	$39.63±0.08^{a}$	$39.70±0.06^{a}$	$39.12±0.10^{b}$	$39.74±0.09^{a}$
VI	9AM	$39.60±0.12^{ab}$	$39.85±0.11^{a}$	$39.31±0.14^{b}$	$39.84±0.12^{a}$
	2PM	$39.66±0.09^{a}$	$39.55±0.05^{a}$	$38.92±0.14^{b}$	$39.64±0.14^{a}$
	Average	$39.63±0.08^{a}$	$39.70±0.06^{a}$	$39.12±0.10^{b}$	$39.74±0.09^{a}$
VII	9AM	$39.60±0.12^{ab}$	$39.85±0.11^{a}$	$39.31±0.14^{b}$	$39.84±0.12^{a}$
	2PM	$39.66±0.09^{a}$	$39.55±0.05^{a}$	$38.92±0.14^{b}$	$39.64±0.14^{a}$
	Average	$39.63±0.08^{a}$	$39.70±0.06^{a}$	$39.12±0.10^{b}$	$39.74±0.09^{a}$
VIII	9AM	39.45±0.12	39.28±0.17	39.27±0.13	39.17±0.09
	2PM	$39.66±0.09^{a}$	$39.55±0.05^{a}$	$38.92±0.14^{b}$	$39.64±0.14^{a}$
	Average	$39.56±0.08^{a}$	$39.42±0.09^{a}$	$39.09±0.09^{b}$	$39.41±0.09^{ab}$
Overall	**9AM**	**$39.57±0.01^{a}$**	**$39.76±0.07^{b}$**	**$39.26±0.03^{c}$**	**$39.72±0.08^{ab}$**
	2PM	**$39.66±0.03^{a}$**	**$39.66±0.06^{a}$**	**$39.01±0.04^{b}$**	**$39.71±0.04^{a}$**
Overall		**$39.61±0.02^{a}$**	**$39.71±0.05^{a}$**	**$39.14±0.01^{b}$**	**$39.71±0.05^{a}$**

Means bearing different superscript in a row differ significantly (P<0.05)

The results revealed that the rectal temperature of calves at 2:00 PM was significantly (P<0.05) higher than rectal temperature at 9:00 AM in T1 group. The table showed that the rectal temperature at 9:00AM was higher in T2, T3 and T4 grouped calves whereas at 2:00PM T1 showed the higher (P<0.05) rectal temperature. The overall rectal temperature of T3 showed significance difference form all other groups. Rectal temperature gradually increased, after a period of exposure to the solar radiation. It is considered that the increasing with more then 0.8°C of the mean rectal temperatures the cows are submitted to the heat stress. The significant rise in rectal temperature in T4 followed by T1 grouped calves might be due to heated asbestos and direct solar radiation effect on experimental calves during experimental period. Inability to eliminate excess heat might be the probable reason for rise in rectal temperature. The present finding are in agreement with Tucker *et al.* (2008) who reported that cows provided with more protection (99% shade) from solar radiation as compare to 50% shade and no shade) had lower rectal temperature with higher level of ambient solar radiation. Patil *et al.* (2008) reported significantly (P<0.05) higher differences among the mean values of rectal temperature during summer season under thatch roof (39.49±.05) and under tin shed (39.54±.05), which clearly indicated the inability of the kids housed in tin shed to make up with the higher environmental temperature. Kumar *et al.* (1990) also observed significant difference among thatch roof shed, lite roof and asbestos roof shed during hot summer season. Haemoglobin (g/dl) concentration of buffalo calves during summer season to different shade materials are presented in Table 3.

Table 3: Mean± SE of fortnightly hemoglobin (g/dl) of buffalo calves in summer season

Fortnights	Asbestos Roof (T1)	PPCGI Roof (T2)	Thatch Roof (T3)	GI Sheet Roof (T4)
I	8.50±0.22	8.50±0.43	9.83±0.30	8.33±0.21
II	8.50±0.34	8.83±0.31	10.17±0.54	8.67±0.33
III	8.50±0.22^{a}	9.50±0.56^{ab}	10.33±0.42^{b}	9.50±0.56^{ab}
IV	9.83±0.17	10.17±0.65	10.83±0.31	9.67±0.76
V	9.33±0.21^{a}	9.83±0.75^{ab}	11.33±0.3^{b}	9.17±0.40^{a}
VI	10.17±0.17^{ab}	9.83±0.75^{a}	11.67±0.42^{b}	9.67±0.76^{a}
VII	9.67±0.33^{a}	9.67±0.56^{a}	11.83±0.17^{b}	9.50±0.56^{a}
VIII	10.83±0.40^{ab}	10.50±0.56^{ab}	12.17±0.17^{a}	10.33±0.61^{b}
Overall	**9.42±0.31^{a}**	**9.60±0.23^{a}**	**11.02±0.30^{b}**	**9.35±0.22^{a}**

Means bearing different superscript in a row differ significantly (P<0.05)

The overall haemoglobin concentration of buffalo calves were 9.42±0.31, 9.62±0.23, 11.02±0.30 and 9.35±0.22 g/dl for T1, T2, T3 and T4 group, respectively. The table indicate that haemoglobin of T3 was significant (P<0.05) differ among the groups. The overall haemoglobin of T3 (11.02±0.30 g/dl) was shown significantly higher (P<0.05) than T1, T2 and T4 during the experiment. The lower haemoglobin values may be due to haemodilution, by which more water is transported in the circulatory system for evaporative cooling (Marai *et al.*, 1999). High haemoglobin values are associated with high adaptability to extreme conditions of temperature and it has been suggested that this character might be an index of their superior heat tolerance (Bianca, 1965; Johnson, 1987). The haemoglobin level of calves in all the groups are in accordance with Shrikhande *et al.* (2008) and Rowland's *et al.* (1979) during summer season.

Serum Biochemical Parameters of Buffalo Calves during Summer Season

  DOI 10.5455/ijlr.20170828034222

Glucose

The glucose concentration was estimated by God-POD, End Point Assay and Kinetic Assay method using kit (Span Cogent Diagnostics). In this method glucose oxidase (GOD) oxidises glucose to gluconic acid and hydrogen peroxide. In presence of enzyme peroxidase, released hydrogen peroxide is coupled with phenol and 4-aminoqantipyrine (4-AAP) to form coloured quinoneimine dye. Absorbance of coloured dye is measured at 505 nm and is directly proportional to glucose concentration in the sample. Glucose concentration expressed as mg/dl.

Total Protein (TP)

The total protein (TP) concentration was estimated by modified Biruet method, using the kit (Span Cogent Diagnostics, Surat, Gujrat). In this method, peptide bonds of proteins react with cupric ions in alkaline solution to form a colored chelate, the absorbance of which was measured at 578 nm. The biuret reagents contain sodium potassium tartrate to complex cupric ions and maintain their solubility at alkaline pH. Absorbance data was proportional to protein concentrations and expressed as g/dl.

Albumin

Albumin concentration in serum sample was estimated by Bromocresol Green (BCG) method, using the kit (Span Cogent Diagnostics,Surat, Gujrat). Albumin in serum binds with the dye bromocresol green at pH 3.68 to form a green colored complex, the absorbance of which was measured at 600 nm and expressed in g/dl.

Globulin

Serum globulin concentration was obtained by subtraction of albumin from true protein (TP) and expressed in g/dl. The effect of shade materials on various biochemical parameters viz. glucose, total protein, albumin, and globulin at fortnightly interval are presented in Table 4. The blood glucose values for T1, T2, T3 and T4 were 39.85±0.38, 38.83±0.33, 40.89±0.44 and 38.79±0.25 mg/dl, respectively. The blood glucose values were found to be highest ($P<0.05$) in T3 followed by T1, T2 and T4. However, there was no significant difference could be observed between T1, T2 and T4. Further, level of glucose was relatively less in T2, T4 and T1 group compared to T3, which might be due to increased glucose oxidation (Collier *et al*., 2008). Decreased gluconeogenesis and glycogenolysis were observed in cows during heat stress. The higher level of glucose in T3 group might be due to the fact that they consumed more dry matter when compared to other groups. The present finding is in agreement with the report made by Vijaya Kumar (2005) who concluded that glucose level was significantly more in buffalo heifers treated with sprinkler and fan for reduction of summer stress. Whereas, Bahga *et al*., 2009; Singh *et al*., 2008 found non-significant difference in glucose level in crossbred calves during summer stress.

  DOI 10.5455/ijlr.20170828034222

Table 4: Mean± SE of fortnightly biochemical estimation of buffalo calves in summer season

Fortnights	Asbestos Roof (T1)	PPCGI Roof (T2)	Thatch Roof (T3)	GI Sheet Roof (T4)
Serum Glucose (g/dl)				
I	39.17±1.25	38.17±0.79	40.50±0.99	38.33±0.67
II	40.00±0.93	38.17±0.79	41.00±0.73	38.67±0.80
III	40.83±0.54	39.50±0.34	41.33±0.71	39.33±0.84
IV	41.17±0.40	39.83±0.54	41.83±0.54	39.50±0.34
V	39.17±1.25	38.17±0.79	40.50±0.99	38.33±1.76
VI	37.83±1.35	37.50±0.92	38.17±1.58	37.50±0.76
VII	40.17±0.94	39.50±0.34	42.00±0.86	39.17±1.30
VIII	40.50±1.06	39.83±1.14	41.83±0.94	39.50±0.34
Overall	**39.85±0.38**	**38.83±0.33**	**40.89±0.44**	**38.79±0.25**
Serum Total Protein (g/dl)				
I	6.50±0.22	6.67±0.33	6.83±0.60	6.33±0.33
II	6.83±0.17	6.83±0.31	7.17±0.48	6.67±0.33
III	7.33±0.21	7.17±0.31	7.83±0.31	7.17±0.17
IV	7.33±0.21	7.33±0.33	8.00±0.36	7.33±0.21
V	6.83±0.17	6.67±0.33	7.00±0.52	6.67±0.33
VI	7.83±0.40	7.83±0.17	8.00±0.26	7.67±0.42
VII	6.67±0.33	6.50±0.43	7.00±0.58	6.50±0.34
VIII	7.17±0.17	6.83±0.40	7.83±0.48	6.67±0.33
Overall	**7.06±0.15**	**6.98±0.15**	**7.45±0.18**	**6.87±0.16**
Serum Albumin (g/dl)				
I	3.83±0.40	3.83±0.31	4.50±0.43	3.83±0.31
II	3.83±0.40	3.67±0.42	3.83±0.40	3.50±0.22
III	3.67±0.33	3.17±0.17	3.50±0.34	3.17±0.17
IV	3.83±0.40	4.17±0.31	4.50±0.43	3.83±0.31
V	3.50±0.34	3.50±0.22	3.67±0.33	3.50±0.22
VI	3.83±0.17	3.83±0.17	4.33±0.49	3.83±0.17
VII	3.33±0.21	3.33±0.21	3.67±0.33	3.17±0.17
VIII	4.17±0.31	3.67±0.33	4.17±0.48	3.67±0.21
Overall	**3.75±0.09**	**3.64±0.11**	**4.02±0.14**	**3.56±0.09**
Serum Globulin (g/dl)				
I	2.83±0.48	2.83±0.17	2.67±0.76	2.17±0.31
II	3.00±0.52	3.17±0.31	3.33±0.71	2.67±0.33
III	3.67±0.21	4.00±0.36	4.33±0.21	4.00±0.26
IV	3.00±0.26	3.17±0.17	3.67±0.56	3.17±0.31
V	3.33±0.42	3.33±0.21	3.33±0.56	3.17±0.40
VI	4.00±0.52	4.00±0.26	3.00±0.52	3.83±0.48
VII	3.50±0.43	3.17±0.48	3.83±0.70	3.33±0.42
VIII	2.83±0.48	3.17±0.17	3.67±0.76	3.00±0.45
Overall	**3.29±0.14**	**3.35±0.15**	**3.48±0.18**	**3.17±0.21**

Means bearing different superscript in a row differ significantly (P<0.05)

Total serum protein values were 7.06±0.15, 6.98±0.15, 7.45±0.18 and 6.87±0.16g/dl for T1, T2, T3 and T4, respectively. Total protein did not differ significantly among the groups. The finding is in accordance

DOI 10.5455/ijlr.20170828034222

with the report made by Singh *et al*. (2008) found non-significant difference (P<0.05) in total protein in kids kept in thatch, asbestos, agro-net and under open sky during summer. Bahga (2007), also reported non-significant difference (P<0.05) in total protein of cows, given heat ameliorative measures and control group. Whereas, Vijaya Kumar, (2005) reported significantly (P<0.01) higher total serum protein in buffalo heifers treated with heat ameliorative measures as compared to control group during summer. Shrikhande *et al*. (2008) and Scharf *et al*. (2010) reported higher total serum protein in cattle during higher environmental temperature. The serum albumin values were 3.75±0.09, 3.64±0.11, 4.02±0.14 and 3.56±0.09 g/dl for T1, T2, T3 and T4, respectively. From the table it is clearly evident that the albumin values were non-significant within the groups. However the value was slightly more in T3 as compared to T1, T2 and T4. The present finding accord with Singh *et al*. (2008), who also found non-significant difference in serum albumin of kids kept under different shade. However, Shrikhande *et al*. (2008) reported higher serum albumin (3.30g/dl) in cattle during summer.

The serum globulin values for T1, T2, T3 and T4 were 3.29±0.15, 3.35±0.15, 3.48±0.18 and 3.17±0.21 g/dl, respectively. The results suggested that there was no significant difference in the serum globulin values among the groups. Shrikhande *et al*. (2008); Payne *et al*. (1974) suggested non-significant difference in serum globulin level in cattle during high temperature.

Serum Enzymatic Parameters of Buffalo Calves during Summer Season

Serum Enzymatic Estimation

ALP, SGOT and SGPT were done as per standard protocols using the kit.

ALP (Alkaline Phosphatase)

Serum alkaline Phosphtase was estimated by King and King's method using kit (Span Cogent Diagnostics). Alkaline phosphate from serum converts Phenyl Phosphate to inorganic phosphate and phenol at pH. 10. Phenol so formed reacts in alkaline medium with 4-aminoantipyrine in presence of oxidizing agent potassium ferricynide and forms an orange red colored complex, which can be measured colorimetrically. The colour intensity is proportional to the enzyme activity. ALP expressed as IU/L.

SGOT (Serum Glutamic Oxaloacetic Transminase)

Serum SGOT was estimated by modified Reitman & Frankel's colorimetric-DNPH method (Medsourse Ozone Biomedicals Pvt. Ltd.) expressed as IU/L. SGOT(AST) catalyses the transfer of amino group from Aspartic acid to 2-oxoglutarate to form oxaloacetate and L-Glutamate. The oxaloacetate thus formed reacts with 2, 4 Dinitrophenyl Hydrazine (2,4 DNPH) to NAD. A corresponding hydrazone, brownish red colored complex in an alkaline medium, the color intensity is directly proportional to the SGOT concentration in the serum and is measured photometrically at 505nm or with green filter.

 DOI 10.5455/ijlr.20170828034222

SGPT (Serum Glutamic Pyruvic Transminase)

Serum SGPT was estimated by modified Reitman & Frankel's colorimetric-2, 4-DNPH method (Span Cogent Diagnostics) and was expressed as IU/L. Alanine aminotransferese (ALT) catalyses the transamination of L-alanine and α-ketoglutarate (α-KG) to form pyruvate and L- glutamate. Pyruvate so formed is coupled with 2,4-Dinitrophenyl hydrazine (2,4-DNPH) to form a corresponding hydrazone, brown coloured complex in alkaline medium and this can be measured colorimetrically. The effect of shade materials on three enzymes viz. ALP, SGOT, SGPT at fortnightly interval are presented in Table 5.

Table 5: Mean± SE of fortnightly enzyme estimation of buffalo calves in summer season

Fortnights	Asbestos Roof (T1)	PPCGI Roof (T2)	Thatch Roof (T3)	GI Sheet Roof (T4)
Alkaline Phosphatase (ALP) (IU/L)				
I	132.50±5.70^{a}	136.16±2.00^{a}	119.50±2.78^{b}	137.50±1.70^{a}
II	134.33±1.38^{ab}	140.00±1.29^{a}	124.00±3.60^{b}	141.66±1.66^{a}
III	135.50±4.716^{ab}	140.33±2.60^{a}	124.33±3.24^{b}	140.50±0.50^{a}
IV	120.66±4.58^{ab}	122.66±4.27^{ab}	110.66±2.09^{a}	123.16±1.57^{b}
V	112.50±1.80	113.66±2.04	106.50±4.34	113.16±4.79
VI	127.00±5.04^{ab}	136.16±2.00^{a}	122.83±4.78^{b}	139.00±0.81^{a}
VII	127.83±4.65^{ab}	134.50±2.06^{a}	120.33±3.21^{b}	135.66±1.56^{a}
VIII	132.50±5.70^{a}	137.83±1.64^{a}	118.66±2.57^{b}	139.16±2.71^{a}
Overall	**127.85±2.77^{a}**	**132.66±3.34^{a}**	**118.35±2.28^{b}**	**133.72±3.58^{a}**
Serum Glutamic Oxaloacetic Transaminase (SGOT)				
I	119.16±1.90^{ab}	130.00±2.23^{a}	113.66±1.52^{b}	130.33±3.48^{a}
II	99.16±3.26	101.83±6.64	90.16±2.18	102.16±5.62
III	98.66±4.31^{ab}	108.16±4.93^{ac}	92.50±2.34^{b}	112.33±1.58^{c}
IV	121.50±4.06^{ab}	129.16±2.31^{a}	112.50±2.55^{b}	130.50±4.99^{a}
V	113.66±1.42	115.16±2.19	106.83±4.55	119.33±4.03
VI	118.66±2.21^{a}	120.50±4.79^{a}	96.83±4.43^{b}	121.33±2.51^{a}
VII	118.66±2.21^{a}	122.33±3.47^{a}	99.83±5.71^{b}	122.33±2.98^{a}
VIII	122.50±1.58	118.50±6.48	114.33±1.22	121.50±4.26
Overall	**114.00±3.41^{a}**	**118.20±3.43^{ac}**	**103.33±3.45^{b}**	**119.97±3.28^{c}**
Serum Glutamic Pyruvic Transaminase (SGPT) (IU/L)				
I	24.50±4.08	28.16±2.48	20.33±1.62	29.66±2.20
II	25.83±4.06	28.66±1.78	22.83±1.53	30.66±2.44
III	26.16±3.83	29.33±2.55	23.50±0.71	30.83±1.75
IV	20.66±3.14^{ab}	28.16±2.48^{ab}	18.16±1.30^{a}	30.66±2.44^{b}
V	22.16±2.44^{a}	31.50±3.61^{ab}	21.83±0.79^{a}	33.16±3.02^{b}
VI	30.33±4.08^{ab}	37.83±1.97^{a}	26.66±3.85^{b}	39.33±3.33^{a}
VII	34.50±5.45^{ab}	37.66±3.17^{a}	25.33±3.21^{b}	39.16±3.26^{a}
VIII	22.16±1.99	27.33±2.13	18.66±1.52	27.83±1.88
Overall	**25.79±1.64^{ab}**	**31.08±1.51^{a}**	**22.16±1.07^{b}**	**32.66±1.52^{a}**

Means bearing different superscript in a row differ significantly (P<0.05)

DOI 10.5455/ijlr.20170828034222

Serum alkaline phosphates (ALP) level for T1, T2, T3 and T4 were 127.85±2.77, 132.66±3.34, 118.35±2.28 and 133.72±3.58 IU/L, respectively. The table suggested that ALP was significantly higher (P<0.05) in T4 followed by T1 than T2. However, there was no significant difference between T1, T2 and T4 neither between T1 and T2. Increased in alkaline phosphatase activity due to heat stress under T2 and T4 may be due to alkalosis caused by increased alveolar ventilation and resultant alkalosis (Cunningham, 2002).With regulation of cell division and growth (Swarup *et al*., 1981) Alkaline phosphatase is also involved in maintaining homeostasis and energy generation in animal body (Vashishth *et al*., 1998), which seems to be the reason of higher activity in the present study. The present finding is in agreement with Bahga *et al*. (2007), Kume, (1996). However, Sejian *et al.* (2010) who found a decrease in ALP activity after heat stress. Whereas Nazifi *et al*. (2003) and Bahga *et al*. (2009) reported no significant increase in ALP in response to heat stress.

Serum Glutamic Oxaloacetic Transaminase (SGOT) level were 114.00±3.41, 118.20±3.43, 103.33±3.45, and 119.97±3.28 IU/L for T1, T2, T3 and T4, respectively. The result suggested that there was significantly higher (P<0.05) SGOT level in T4 followed by T2 in comparison to T3 followed by T1. However there was no significant difference between T2 and T4. Whereas significant difference of T3 with all others group. In present study, serum SGOT activity was measured to assist in the overall evaluation of the health status of the calves. The overall value for SGOT falls under the normal range (78-132IU/L) (Radostits, *et al.,* 2007). However, the serum SGOT activity was higher in T4 and T2 grouped calves because of higher temperature inside the shade material which increases the serum SGOT activity in order to compensate the other negative effects of thermal stress on the physiological and biochemical homeostatic mechanisms. Present finding were also accordance with Srinandkumar *et al.* (2003); Calmari *et al*. (2011); Nazifi *et al*. (2003) and Brijesh (2012) as they reported an increase in serum SGOT activity during thermal stress under different situation.

Serum Glutamic Pyruvic Transaminase (SGPT) level for T1, T2, T3, and T4 were 25.79±1.64, 31.08±1.51, 22.16±1.07 and 32.66±1.52, respectively. Serum SGPT was found to be non-significant (P<0.05) between T1, T2 and T4 but T3 has significant (P<0.05) difference with T2 and T4. In present experiment SGPT level falls under normal range (11-40 IU/L) (Radostits *et al.,* 2007). However, serum SGPT level was towards higher side, in T4 followed by T2 which indicate that certain amount of stress to the calves in the shade materials. Nazifi *et al.* (2003) also supported the finding and reported, increased serum SGPT activity at hot temperature as compared to cooler temperatures. Brijesh (2012), reported significantly higher (P<0.05) level of SGPT in heat stress cattle. Marai *et al.* (1997) also observed an increase in serum SGPT activity (179 vs 228 IU/L) in summer as compared to winter in the calves.

  DOI 10.5455/ijlr.20170828034222

Conclusion

The present studies was conducted during summer season to see the effect of different shade materials on the performance of buffalo calves. During summer season provision of thatch roof shade materials provide favorable micro-environment to the buffalo calves by improving the growth and keeping physiological, biochemical and behavioral response in normal range.

References

1. Ansell, R.H. 1981. Extreme heat stress in dairy cattle and its alleviation- A case report: In: Environmental Aspects of Housing for animal Protection. J. A. Clark. Butterworths London, U. K. pp 285-306.
2. Blackshaw, J.K. and Blackshaw, A.W. 1994. Heat stress in cattle and the effect of shade on production and behavior: a review. *Aust. J. Exp. Agric*., 34: 285-295.
3. Bianca, W. (1965). Reviews of the progress of dairy science. Section A. Physiology. Cattle in a hot environment. *J. Dairy Res*., 32: 291-345.
4. Calamari, L., Petrera, F., Abeni, F. and Bertin, G. 2011. Metabolic and hematological profiles in heat stressed lactating dairy cows fed diets supplemented with different selenium sources and doses. *Livest. Sci*., 142: 128-137.
5. Gangwar, P.C., Soni, P.L. and Mehta, S.N. 1980. Effect of environmental cooling on certain physiological and milk ejection responses of buffalo (*Bos bubalis)*. *Indian J. Dietetics.* 17: 302-308.
6. Hemsworth, P.H., Banetta, J.L., Beveridge, L., Matthews, L.R. 1995. The welfare of extensively managed dairy cattle: a review, *Appl. Anim. Behav. Sci*., 42: 161-182.
7. Johnson, H.D. (1987). Bioclimatology and the Adaptation of Livestock. World Animal Science. (H.D. Johnson ed.) Elsevier Science Publ. Co., New York. pp 157.
8. Nazifi, S., Saeb, M., Rowghani, E. and Kaveh, K. 2003. The influences of thermal stress on serum biochemical parameters of Iranian fat-tailed sheep and their correlation with triiodothyronine (T3), thyroxine (T4) and cortisol concentrations. *Comp. Clin. Pathol.*, 12: 135-139.
9. Patil, R.A., Karanjkar, L.M., Jadhav, V.S., Narwade, S.G. 2008. Marathwada Agricultural University, Parbhani (India) Department of Animal Husbandry and Dairy Science. Response in growth of osmanabadi weaned kids to various housing patterns. *Indian J. Anim. Res*., 42: 1.
10. Rowlands, G.J., Little, W., Stark A.J. and Manston, R. 1979. The blood composition of cows in commercial dairy herds and its relationships with season and lactation. *Br. Vet. J*., 135: 64-74.
11. Shrikhande, G.B., Rode, A.M., Pradhan, M.S and Ashiesha, K. 2008. Seasonal effect on the composition of blood in cattle. *Vet. World*., 11:341-342.
12. Snedecor, F.W. and Cochran, W.G. 1994. Stastical Methods (8th ed.). Oxford and IBH Publishing Co., Calcutta.
13. Srikandakumar, A., Johnson, E.H. and Mahgoub, O. 2003. Effect of heat stress on respiratory rate, rectal temperature and blood chemistry in Omani and Australian Merino sheep. *Small Rum. Res*., 49: 193-198.
14. Das, S.K., Upadhyay, R.C. and Madan, M.L. 1997. Changes in skin temperature and physiological reactions in Murrah buffalo during solar exposure in summer. *Asiatic Aust. J. Anim. Sci*., l0: 478-483.
15. Schütz, K. E., Rogers, A. R.,Poulouin, Y. A., Cox, N. R. and Tucker, C. B 2010. The amount of shade influences the behaviour and physiology of dairy cattle. *J. Dairy Sci*., 93:125-233.
16. Sejian, V., Maurya V.P. and Sayeed Naqvi, S.M.K. 2010. Adaptability and growth of Malpura ewes subjected to thermal and nutritional stress. *Trop. Anim. Health Prod*., 42: 1763-1770.
17. Soley, M.J. and Singh, S.V. 2001. 'Physiological and haematological responses of crossbred males under different housing conditions'. M.Sc. Thesis, Dairy Science College, NDRI, Karnal-132001

  DOI 10.5455/ijlr.20170828034222

18. Thomas, C.K. and Sastry, N.S.R. 2007. A text book of Dairy Bovine Production, Kalyani publication pp 14: 97.
19. Tucker, C.B., Rogers, A.R. and Schütz, K.E. 2008. Effect of solar radiation on dairy cattle behaviour, use of shade and body temperature in a pasture-based system. *Appl. Anim. Behav. Sci*., 109: 141-154.
20. Kumar, P., Singh, K. and Sood, S.B. 1990. Effect of micro-environment within different types of sheds on physiological responses in Jamunapari goats in hot semi-arid zone. *Indian J. Anim. Res*., 24:93-100.
21. Kume, S. and Tanabe, S. 1996. Effect of supplemental lactoferrin with ferrous ion on iron status of new born calves. *J. Dairy Sci*., 79: 459-464.
22. Marai, I.F.M., Habeeb, A.A.M. and Farghaly, H.M. 1999. Productive, physiological and biochemical0 changes in imported and locally born Friesian and Holstein lactating cows under hot summer conditions of Egypt. *J. Tropical Anim. Heal. Prod*., 31: 233-243.
23. Collier, R.J., Collier, J.L., Rhoads, R.P. and Baumgard, L.H. 2008. Invited review: Genes involved in the bovine heat stress response. *J. Dairy Sci*., 91: 445-454.
24. Vijayakumar, P. 2005. Effect of thermal stress management on nutritional, physiological and behavioural responses of buffalo heifers. "Ph.D.Thesis" submitted to Deemed University, IVRI Izatnagar, Bareilly (U.P.) India.
25. Bahga, C.S., Sikka, S.S. and Saijpal, S. 2009. Effect of seasonal stress on growth rate and serum enzyme levels in young crossbred calves. *Indian J. Anim. Res*., 43: 288-290.
26. Singh, D.N., Wadhmani, K.S., Arya, J.S., Sarvaiya, N.P. and Patel, A.M. 2008. Effect of blood constitute of ewes during summer in a subtropical climate. *Indian J. Small Rumi*., 14: 252-254.
27. Bahga, C.S. 2007. Effect of Amelioration of heat stress during hot-humid summer on milk yield and blood composition in crossbred cattle. *Indian J. Dairy Sci*., 60: 282-285.
28. Payne, J.M., Rowlands, G.J. and Manston, R. 1974. A statistical appraisal of the results of metabolic tests on 191 herds in the B.V.A./A.D.A.S. joint exercise in animal health and productivity. *Br. Vet. J*., 130: 34-43.
29. Cunningham, J.G. 2002. Textbook of Veterinary Physiology. 3rd ed., W.B. Saunders, Philadelphia, PA.
30. Swarup, G., Cohen, S., Grabers, D.L. 1981. Selective dephosphorilation of proteins containing phosphotyrosine by alkaline phosphatases. *J. Biol. Chem*., 256: 8197-8201.
31. Vashishth, S.N., Kapoor, V., Lall, D. and Kumar, R. (1998). Mineral status and serum alkaline phosphatase activity in lambs fed diets supplemented with fluorine and boron. *Indian Vet J*., 75: 17-21.
32. Radostits, O.M., Gay, C., Hinchcliff, K.W., Constable, P.D. (2007). Appendix-2. Reference laboratory values. Veterinary medicine, A textbook of the diseases of cattle, horses, sheep, pig and goats. Tenth edition. Elsevier, Edinburgh London New York. pp 2049.
33. Brijesh, Y. 2012. Physio-biochemical responses and methane emission during thermal stress in cattle. 'Ph.D. thesis' submitted to Deemed university, IVRI Izatnagar, Bareilly (U.P.).

 DOI 10.5455/ijlr.20170828034222