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Jyoti Srivastav
Department of Animal Nutrition, Bikaner, Rajasthan, India

Arun Kumar
Department of Livestock Production and Management, College of Veterinary and Animal Sciences, Bikaner, RAJUVAS, Bikaner, Rajasthan, India

Tushar Saxena
Department of Livestock Production and Management, GB Pant University of Agriculture and Technology Pantnagar, Rajasthan, India

Jagriti Srivastav
Department of Livestock Production and Management, College of Veterinary and Animal Sciences, Bikaner, RAJUVAS, Bikaner, Rajasthan, India

Corresponding Author:
Jyoti Srivastav
Department of Animal Nutrition, Bikaner, Rajasthan, India

Impact of different roofing materials on certain physiological parameters of Magra lambs in arid zone of Rajasthan

Jyoti Srivastav, Arun Kumar, Tushar Saxena and Jagriti Srivastav

Abstract
The present study was carried out to observe the impact of different roofing materials on certain physiological parameters of Magra lambs at Livestock Research station Bikaner. Eighteen Magra lambs of 3-4 months of age were randomly divided into three groups T_0 (Control group having tree shed), T_1 (Thatch roof shed), and T_2 (Tin roof shed). All three groups of lambs were managed under a similar system of feeding and other management systems. Physiological parameters *viz*. rectal temperature, respiration rate, heart rate and pulse rate of experimental lambs were measured and recorded data were analyzed. Results indicated significantly (p<0.01) lower rectal temperature and respiration rate in lambs maintained under thatch roof system than T_0 and T_2 groups. Mean values of heart rate and pulse rate in experimental lambs differed non significantly among the treatment groups.

Keywords: Magra lambs, arid zone, Bikaner, Rajasthan

Introduction
Livestock have an important role in enhancement of national income and prosperity of the India. Livestock provide employment to two-third of rural people living in country. Livestock sector shares 4.11% in GDP and 25.6% in total agricultural GDP. The total livestock population of the country is 535.78 million in 2019, among this total sheep population is 74.26 million, increased by 14.1% than previous census (BAHS, 2023). Housing system is considered as one of the most important factor to influence livestock performance in terms of growth, production, health and reproductive efficiency. Roof is an integral part of any housing system also plays a significant role in the animal safety as well as protecting them from adverse climatic conditions. *Ovis aries* do not require huge investment and other inputs on their housing and feeding as it provide meat, milk, skin, wool and manure for sustenance of resource to poor, rural and landless farmers. Sheep in India are mostly reared in open spaces not having suitable housing facilities under an unhygienic and stressful state. Also, no prior planning and designing is done before the construction of sheep shelters. Faulty housing and management practices can be a cause of discomfort leading to poor productivity in farm animals. Roof plays an important role in the determination of the thermal exchanges of the animals **(**Liberati and Zappavigna, 2004) [6]. Sheep exposed to heat stress produce lower live body weight and decreased feed intake efficiency (Maraia *et al*., 2008) [7].

Materials and Methods
The present research study was carried out at Livestock Research Station, Kodemdesar, Bikaner situated at an altitude of 201 meters above the mean sea level in the Thar Desert, about 32 km away from the city of Bikaner in Rajasthan. For the study, Eighteen Magra lambs (male and female) aged of 3 to 4 months, were selected and randomly distributed into 3 experimental groups and provided the following housing condition: T_0 (Control having an open area under tree shade with a sand floor). The shaded area was protected by wire fences. T_1 (Thatch roofed shed) Thatch roof shed was constructed with locally available dry grass (Khimp) fixed on a bamboo frame with a Sand floor. T_2 (Tin roofed shed) has a tin sheet roofed shed with a sand floor. The research study was performed for 90 days duration.

Lambs were kept for an adaptation period of one week before the starting of experiment. All three groups of lambs were managed under similar systems of feeding and other management systems. All the lambs were free from any kind of physiological, anatomical and infectious diseases. Lambs were on grazing for 6 hours daily. Physiological parameters of Magra lambs such as rectal temperature, respiration rate, pulse rate and heart rate were recorded during day time once in week up to completion of work.

Rectal temperature (°F)
Rectal temperature of individual lamb was recorded at weekly interval by using digital clinical thermometer. Rectal temperature was recorded in Fahrenheit (°F).

Respiration rate (breath /per min)
Respiration rate was recorded by counting the flank movements per minute.

Pulse rate (beats/per min)
Pulse rate of individual lamb was measured per minute from femoral artery present at inner side of rear leg.

Heart rate (beats /per min)
Heart rate was measured using the stethoscope, placed on the left side of the chest, just behind the elbow, each sound of the heart was recorded as one beat and recorded as heart rate per min.

Table 1: Experimental design

Sr. No.	Groups	No. of lambs	Roof type
1.	T_0	6	Tree shade
2.	T_1	6	Thatch roof
3.	T_2	6	Tin sheet roof

Statistical analysis
The results of all the experiments were recorded and data obtained were statistically analyzed (Snedecor and Cochran, 1994) [11] for One way Analysis of Variance and Duncan' multiple range tests was conducted to test the significance of difference between mean values.

Result and Discussion
Rectal temperature (°F)
The data of recorded rectal temperature in experimental lambs have been presented in Table 2. Mean value of rectal temperature (°F) were 103.18±0.33, 102.62±0.32 and 102.80±0.37 for T_0, T_1 and T_2, respectively. Significantly higher (p<0.01) value of rectal temperature were recorded in control group T_0 followed by treatment group T_2 and T_1. Higher value of rectal temperature in control group (T_0) might be due to high ambient temperature which increased exposure of solar radiations inside the shed as compared to tin roof house and thatch roof houses.

Table 2: Mean ± S.E values of rectal temperature (°F) in different groups of lambs

Week	(T_0)	(T_1)	(T_2)
1	103.50±0.23	102.81±0.16	102.78±0.38
2	103.05±0.19	102.85±0.25	102.76±0.36
3	103.33±0.47	102.53±0.16	103.35±0.20
4	103.10±0.45	102.68±0.38	102.28±0.47
5	103.50±0.30	102.71±0.27	102.51±0.23
6	103.11±0.28	102.43±0.25	102.30±0.40
7	102.60±0.32	102.38±0.43	102.76±0.50
8	103.66±0.20	102.76±0.26	102.88±0.47
9	104.05±0.08	102.53±0.38	103.50±0.01
10	102.96±0.22	103.55±0.19	102.23±0.31
11	102.86±0.37	102.55±0.21	102.95±0.49
12	103.30±0.22	102.16±0.41	102.91±0.33
13	102.33±0.33	102.16±0.47	103.16±0.30
Average	103.18^{b}±0.33	102.62^{a}±0.32	102.80^{a}±0.37

Means bearing different superscript in a row differ significantly (p<0.01)

Present findings are similar with the findings of Khongdee *et al.* (2010) [5], Kamal (2013) [4], Patil *et al.* (2014) [8]. However these findings are in disagreement with Yazdani and Gupta (2000) [12] in calves and Bhatt *et al.* (2005) [2] in sheep.

Respiration rate (breaths/min): The recorded Respiration rate of lambs under different roof system has been presented in Table 3.Results revealed that lambs kept under thatch roof (T_1) had significantly lower (p<0.01) respiration rate than lambs kept under tin roofing (T_2) and tree shade. However respiration rate in all groups was higher than normal, probably due to high environment temperature during day time in summer season. Low respiration rate in T_1 group as compare to other groups might be due to lower thermal stress inside shed. The change in respiration rate was increased due to exposure with solar radiation which could be related with uncomfortable condition of animal. The respiratory process helps to the animals to get rid off heat load of body by increased pulmonary evaporating loss.

Table 3: Mean ± S.E. values of Respiration rate (breaths/min) of lambs in different groups of lambs

Week	(T_0)	(T_1)	(T_2)
1	39.50±0.50	32.16±1.04	36.33±0.91
2	39.16±0.54	36.33±1.11	36.38±0.86
3	38.83±1.53	35.66±1.54	36.94±0.95
4	39.00±1.26	36.33±1.11	36.77±0.89
5	38.66±0.61	35.50±1.45	36.94±0.79
6	38.66±1.58	34.66±0.76	37.88±0.82
7	36.66±1.05	34.16±1.86	35.66±0.91
8	38.00±0.51	35.16±1.64	36.88±0.75
9	36.83±1.51	33.50±1.23	35.11±0.90
10	36.16±1.55	34.66±1.49	35.83±0.80
11	36.83±1.64	34.00±1.34	35.77±1.00
12	38.33±0.55	34.66±1.49	36.27±0.72
13	29.66±1.25	29.83±0.87	30.22±0.79
Average	37.41^{c}±0.41	34.35^{a}±0.39	35.92^{b}±0.26

Means bearing different superscript in a row differ significantly (p<0.01)

Similar findings of study were observed with findings of Yazdani and Gupta (2000) [12], Pennisi *et al.* (2010) [9] and Patil *et al.* (2014) [8] in cattle.

Heart rate (beats/min): The data of heart rate recorded during experimental period have been presented in Table 4. Overall mean value of heart rate for group T_0, T_1, T_2 were 78.08±0.66, 76.30±0.51, 76.30±1.86, respectively. The results indicated that the average value of heart rate for T_0 group was numerically higher than T_1 and T_2 groups but the difference was non- significant.

Table 4: Mean ± S.E. values of Heart rate (beats/min) of lambs in different groups of lambs

Week	(T_0)	(T_1)	(T_2)
1	77.00±1.12	75.66±1.56	74.83±1.44
2	76.83±2.92	76.00±1.87	73.33±1.30
3	76.16±2.42	79.16±1.66	77.33±2.48
4	77.83±0.79	75.00±1.71	78.33±2.70
5	79.16±3.34	73.83±1.83	73.50±1.52
6	79.16±2.18	76.50±1.89	75.00±1.69
7	77.83±2.72	73.83±1.22	73.66±1.64
8	78.50±3.70	79.16±2.54	78.50±0.99
9	77.16±2.24	76.16±2.46	75.66±2.56
10	79.50±2.37	75.33±1.56	79.50±2.56
11	78.16±2.13	75.33±1.02	77.66±1.68
12	78.33±3.14	78.00±2.79	77.50±2.43
13	78.50±2.51	78.00±1.46	77.16±1.86
Average	78.08±0.66	76.30±0.51	76.30± 1.86

Pulse rate (beats/min): The average mean value of pulse rate in group T_0, T_1 and T_2 were 76±0.51, 76.55±0.51, 75.87±0.49, respectively. Results revealed that average pulse rate of lambs were non significantly (p>0.05) affected by different roofing system.

Present findings of study were similar with the findings of Shivaji (2017) [13] in kids, Findings were in disagreement with Patil *et al.* (2014) [8].

Table 5: Mean ±S.E. values of Pulse rate (beats/min) of lambs in different groups of lambs

Week	(T_0)	(T_1)	(T_2)
1	76.00±1.29	78.00±1.93	73.00±0.77
2	75.16±1.99	73.83±1.40	74.66±1.96
3	75.66±1.02	74.50±1.72	75.16±2.40
4	74.66±2.15	77.16±1.51	75.33±2.21
5	76.50±2.01	77.66±2.10	74.83±2.30
6	75.83±2.91	75.33±2.24	74.33±1.47
7	75.83±1.57	76.33±2.12	76.66±1.72
8	76.33±1.70	75.83±2.34	74.83±1.51
9	78.66±1.20	75.66±1.80	75.33±1.52
10	76.33±2.38	77.50±1.14	78.16±2.05
11	79.66±2.56	77.50±2.09	78.00±1.77
12	75.83±1.24	80.16±1.66	77.33±1.14
13	78.00±2.01	75.66±2.02	78.66±1.96
Average	76.50 ±0.51	76.55 ± 0.51	75.87 ± 0.49

Conclusion

Present study revealed that, thatch roof can be used as beneficial and economic roofing material as it protected lambs from extreme heat stress in harsh climatic condition of arid zone in Rajasthan during the summer season. Thatch roof prevented direct and indirect solar radiations and created more comfortable micro environment inside the shed which results in better growth performance as compared to tin sheet and tree. Lambs kept under tree had high physiological values which indicate that tree alone was insufficient to protect lambs from adverse climatic condition.

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