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Infrared Thermography to Estimate Thermal Comfort in Meat Sheep

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Introduction

Heat stress is one of the main limiting factors in the performance of sheep in tropical regions, particularly when associated with high humidity and inadequate facilities.

Infrared thermography (IT) is a tool that allows determining the temperature distribution on surfaces and investigating heat transfer processes. Moreover, it is a non- invasive diagnosis technique to measure surface temperature that indicates thermoregulation physiological events as well as assesses the animal's thermal stress (BROWN-BRANDL et al., 2013).

Adverse climate conditions directly impact thermal comfort and animal production. Therefore, this study aimed to verify whether infrared thermography can be used to identify animals experiencing thermal stress due to heat.

Material and Methods

The research was carried out in the sheep farming sector of the Federal Institute of Pará (IFPA) in the city of Castanhal, PA, Brazil. 18 crossbred (Dorper x Santa Inês) sheep whose mean weight was 30 ± 2 kg were used. The animals were confined in a 6 m x 32 m barn oriented in the east-west axis featuring 3.0 m high ceiling and concrete columns 4 m apart that supported wooden trusses. The barn was covered in fiber cement tiles.

To the left of the barn, common bamboo (*B. vulgaris* Vittata) clumps were planted, which were used as a sanitary barrier and decreased the incidence of direct sunlight, thus creating a mild microclimate by the barn's left wall.

The Hobo H8 Onset® data loggers were installed in the barn to monitor the environmental variables of air temperature (AT) and relative humidity (RH) every 15 min. The temperature and humidity index (THI) was determined according to the equation proposed by Thom (1959).

An infrared camera (T650-FLIR®) set to emissivity coefficient of 0.95 was employed to measure the animals' surface temperature at different sites of the body. In all collections, the camera was placed at a standardized distance (4 m from the animal and 1.5m from the ground) to better focus and photograph the animals' right side (axilla, stifle, foreskin, eye, and lip) (Figure 1).

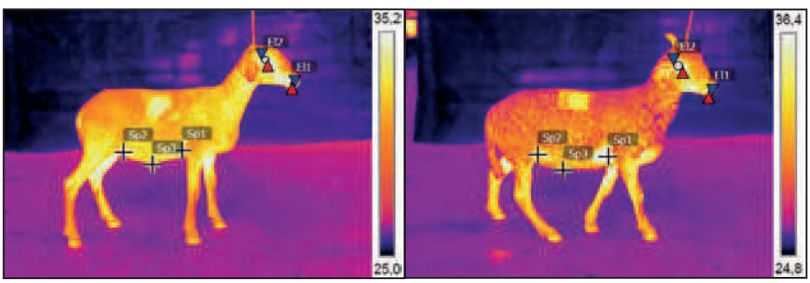

Figure 1: Thermal images highlighting the body sites analyzed.

A completely randomized spli-split-plot experimental design with six treatments and three repetitions was employed with environment (natural shade and no shade) as the plot and period of the day (5-6 AM, 1-2 PM, and 7-8 PM) in the split-plot. The periods were chosen from prior observations of the prevailing climate conditions so that one caused greater thermal discomfort than the others, thus leading to changes in behavioral patterns that could be detected.

Analysis of variance was used for the statistical analysis of the variables and Tukey's test at 5% significance was used to compare the means.

Results and Conclusions

During the experimental period, the values calculated were 24.04 ± 0.17, 29.26 ± 1.36 and 25.46 ± 0.16 for AT; 95.55 ± 0.87, 78.43 ± 4.73 and 90.92 ± 1.66 for RH; 74.84 ± 0.34, 81.40 ± 1.5 and 76.83 ± 0.23 for THI for the periods of 5-6 AM, 1-2 PM, and 7-8 PM, respectively.

The analysis of the temperatures in the periods shows that they were within the thermal comfort range, which is around 30 °C. However, RH values above the recommended were observed, between 40 and 70%, which indicates difficulties in exchanging heat with the surroundings (BAÊTA AND SOUSA, 1997). In the period between 5 and 6 AM, the animals were under comfort situation, however, the indices between 1 and 2 PM and between 8 and 9 PM indicated alert situation, suggesting thermal stress condition according to the THI (BAÊTA AND SOUSA, 1997).

The analysis of variance showed no significant difference ($P>0.05$) for stifle, eye, and lip between the two environments. Temperature increased around the axilla of the animals in the environment with no shade since part of the process to maintain homeothermy occurs by increasing blood flow to the body surface through vasodilation (SILVA, 2000).

Thus, IT of the axilla and foreskin region enables identifying animals under thermal stress by heat. An effect ($P<0.05$) was observed for all periods, with the highest means observed between 1 and 2 PM (Table 1).

Table 1. Mean temperature values (°C) of the sheep (axilla, stifle, foreskin, eye, and lip) under different climate conditions measured by thermographic images.

Environment	Periods			Mean
	5-6 AM	1-2 PM	7-8 PM	
		Axilla		
No shade	34.98±1.17	36.83±0.80	36.24±0.97	36.57A
Shade	35.00±1.16	37.87±0.62	36.83±0.69	36.02B
Mean	34.99c	37.35a	36.53b	
		Stifle		
No shade	35.18±1.21	36.83±0.93	35.91±0.86	35.97A
Shade	35.19±1.18	37.22±0.69	35.05±5.34	35.82A
Mean	35.18b	37.02a	35.49b	
		Foreskin		
No shade	33.55±0.87	36.37±0.75	33.72±0.86	35.3A
Shade	34.06±1.01	36.57±0.85	35.27±0.82	34.55B
Mean	33.81c	36.47a	34.5b	
		Eye		
No shade	34.35±1.07	37.03±0.34	36.33±0.35	36.10A
Shade	34.25±0.83	37.3±0.44	36.74±0.30	35.91A
Mean	34.30c	37.16a	36.54b	
		Lip		
No shade	32.61±1.30	36.29±0.34	34.99±0.90	34.92A
Shade	33.24±0.85	36.55±0.50	34.97±0.49	34.62A
Mean	32.92c	36.42a	34.98b	

Means followed by the same small letters on the same row and by the same capital letters in the same column do not differ according to Tukey's test at 5% probability.

The use of infrared thermography proved sensitive to detect differences in the animals' skin temperature and, thereby, to identify an indicator of thermal stress due to heat. The behavior of body surface temperatures in the axilla and foreskin was shown to be important in sheep homeothermy.

References

BAÊTA, F.C.; SOUZA, C.F. Ambiência em edificações rurais – **Conforto animal**. Viçosa: UFV, 1997, 246p.

BROWN-BRANDL, T.M.; EIGENBERG, R.A.; PURSWELL, J.L. Using thermal imaging as a method of investigating thermal thresholds in finishing pigs. **Biosystems Engineering** , Londres, v.114, n.3, p.327-333, 2013.

SILVA, R.G. **Introdução à bioclimatologia animal.** 1.ed. São Paulo: Nobel, 2000. 286p.

THOM, E. C. The disconfort index. **Weatherwise**, v.12, p.57-59, 1959.