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Silvopastoral systems attenuate scrotal-testicular thermal gradients in young bulls under tropical conditions

Giovanna Galhardo Ramos[1], Rubens Paes de Arruda[1], Gabriela Novais Azevedo[2], Joedson Dantas Gonçalves[3], Alda Juliana Castro de Sousa[4], Lívia Ferreira Pinho[4], Isabella Rio Feltrin[1], Verônica Schinaider do Amaral Pereira[2], Alexandre Rossetto Garcia[2,4*]

[1]School of Veterinary Medicine and Animal Science, University of São Paulo, Pirassununga, SP, Brazil. [2]Brazilian Agricultural Research Corporation, Embrapa Southeastern Livestock, São Carlos, SP, Brazil. [3]School of Agricultural and Veterinary Sciences, São Paulo State University, Jaboticabal, SP, Brazil. [4]Institute of Veterinary Medicine, Federal University of Pará, Castanhal, PA, Brazil

*e-mail**:** alexandre.garcia@embrapa.br

Livestock production in the tropics exposes animals to high temperatures and direct solar radiation, which can affect homeothermy and scrotal-testicular thermoregulation. It's known that normal gonadal function in bulls depends on maintaining the testicular temperature up to 6°C below the internal body temperature. In turn, the use of silvopastoral systems with planned afforestation aims to promote better microclimatic conditions for grazing animals through the effect of natural shading. Therefore, this study aimed to compare the scrotal-testicular thermal gradients exhibited by young bulls reared in unshaded (NS) or silvopastoral (SPS) production systems. Both production systems consisted of 12 ha of *Urochloa brizantha* (cv BRS Piatã) for intensive rotational grazing, in a tropical altitude region (21°57'42"S, 47°50'28"W). In the SPS, there was a tree component (*Eucalyptus urograndis*) with 84 trees/ha, arranged in an east-west direction, with 30 meters between rows and 4 meters between trees, providing a useful shaded area of 30%. The average reduction in photosynthetically active radiation was 42% compared to the NS system. Forty-six young bulls were used, 22 Nellore (*Bos indicus*) and 24 Canchim (5/8 *Bos taurus* x *3/8 Bos indicus*). Animals of both breeds were uniformly allocated to the NS (8.6±0.1 months; 201.5±5.1 kg BW) and SPS (8.6±0.1 months; 199.7±4.2 kg BW) systems. Animals were evaluated monthly for internal and surface temperatures for twelve months (8 to 19 months of age). Rectal temperature (RT) was measured transrectally using a digital clinical thermometer. Thermographic images were taken with a digital thermal camera (Testo 890-2 kit, Testo AG, Germany) equipped with a 640×480 pixel detector, 42°×32° lens (15 mm), thermal sensitivity <40 mK (<0.04 °C at room temperature), temperature range from -30 to 100 °C, with manual focus option. The adopted emissivity was 0.98. The thermograms were analyzed in the laboratory (IRSoft v.5.0, Testo AG, Germany) using polygons and a freehand tool to delineate the anatomical regions of interest. Data were analyzed using SAS (v. 9.2, SAS Institute Inc., Cary, USA) for the effects of production system (NS and SPS) and time (age, in months) and the interaction of System*Age. The significance level used was 5% (P≤0.05). There was no interaction (System*Age) for RT (P = 0.21), which was only influenced by the production system (NS: 39.5±0.0 vs. SPS: 39.3±0.0; P = 0.03). There was a significant interaction (System*Age) for the RT - proximal testicular pole temperature gradient (P = 0.01), with differences at 14 (NS: 4.6±0.2 vs. SPS: 3.9±0.2 °C), 15 (NS: 4.9±0.2 vs. SPS: 4.3±0.2 °C), 18 (NS: 4.9±0.2 vs. SPS: 4.4±0.2 °C) and 19 (NS: 4.8±0.2 vs. SPS: 4.0±0.1 °C) months of age, with smaller gradients in SPS animals. Similarly, there was an interaction (System*Age) for the RT-distal testicular pole temperature gradient (P = 0.05) with a difference at 13 (NS: 5.5±0.3 vs. SPS: 4.6±0.2 °C) and 14 (NS: 6.0±0.2 vs. SPS: 5.5±0.2 °C) months of age, also with lower values for SPS animals. There was an interaction (System*Age) for RT - temperature of the cauda epididymis gradient (P = 0.05) showing a difference at 13 (NS: 6.6±0.4 vs. SPS: 5.6±0.2 °C), 14 (NS: 7.2±0.2 vs. SPS: 6.5±0.2 °C) and 18 (NS: 7.5±0.2 vs. SPS: 6.8±0.2 °C) months, with the lowest values recorded in animals from the NS system. Similarly, there was an interaction (System*Age) for RT - mean scrotal temperature gradient (P = 0.01), with SPS animals having lower values than NS at 13 (NS: 4.9±0.3 vs. SPS P: 4.3±0.2 °C), 14 (NS S: 5.5±0.1 vs. SPS: 4.8±0.2 °C) and 19 (NS: 5.6±0.2 vs. SPS: 4.8±0.1 °C) months of age. This thermal differentiation in the anatomical regions is essential to ensure adequate spermatogenesis, promoting greater cooling of the scrotal-testicular regions more distal to the animal's body by the countercurrent system originating from the pampiniform plexus. In conclusion, young bulls kept in a silvopastoral system presented lower thermal gradients compared to animals in a non-shaded system, regardless of breed, indicating that these animals, in addition to retaining less thermal energy from the environment, are also less challenged regarding the need to activate thermoregulatory mechanisms to maintain scrotal temperature.

Keywords: Cattle, infrared thermography, thermoregulation, production systems, welfare.

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