51ª Reunião Anual da Sociedade Brasileira de ZOOTECNIA
BARRA DOS COQUEIROS - SERGIPE - BRASIL - 2014

Quantification of heat loss by radiation in Pantaneiro horses using infrared thermography

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The Pantaneiro horse is a breed adapted to environmental conditions found in the Brazilian Pantanal. These horses are required to work cattle during the greater part of the day, generally in a hot and humid environment. In these conditions, the animals produce high heat loads that need to be dissipated to maintain homeostasis. In mammals, heat is dissipate through radiation, conduction, convection and evaporation. Sensible heat loss (radiation and convection) is dependent of the thermal gradient between the skin and environment temperature, whose flow can be evaluated by infrared thermography (IRT), a non-invasive technique with several applications for research on mammals. Thus, this study aimed to quantify heat loss by radiation (Qr) in Pantaneiro horses submitted to different gaits and environment temperatures in the Pantanal. Five treatments (gaits) were assigned randomly in a five by five Latin-square design. The gait examined were walk, trot, gallop, extended trot and run as well as at rest. Ten castrated males were evaluated, two in each treatment. The tests were performed during the hottest time of the day (between 9.00 and 11:00) on a 1000 m long grass track, which they ran twice (total of 2.000 m), during four days consecutives. Velocity was calculated from distance and time in km h^{-1}. Heart rate (HR) in beats per minute was measured using a stethoscope, and respiratory rates (RR) in breaths per minute counting flank movements. Rectal temperature (RT) was taken using a mercury thermometer placed against the rectal wall of the animal for two minutes. Environmental temperatures were measured at the time of the measurements on the horses. All horses were scanned from the same side at an angle (90°) and distance (2.0 m) using an infrared camera (FLIR i-series) before and after the test. Images were analyzed using QuickReport© software. Average superficial temperatures taken at four body regions (forearm, groin, rump and nostril) were calculated registering 10 points in each region. Heat radiated (W/m^2) was calculated for each body region of the horse by method derived from Stefan–Boltzmann's law using the equation: $Qr = \epsilon\sigma (Ts4-Ta4)$, where: Qr = heat loss by radiation (W); ϵ = emissivity of 0.95; s = Stefan Boltzmann Constant (5.67 10-8 W m^{-2} K^{-4}); Ts = horse surface temperature (°K), and Ta = air temperature (°K). The body surface area was not considered in the calculation. Statistical analysis were performed using GLM procedure of SAS including the effects of ambient temperature, velocity x ambient temperature interaction as well as linear and quadratic effects of velocity. There was a significant quadratic effect ($P<0.05$) of velocity on Qr of forearm and groin with positive regression, howeve, the regression was negative for nostril. There was also a significant effect of velocity on RR, probably indicating a velocity limiar of heat loss by Qr through the nostril, thus, the body must rely on respiratory mechanisms for heat loss when the velocity increases. Infrared thermography analysis has proven to be a reliable technique to quantify heat loss by radiation in horses.

Keywords: animal genetic resources, exercise physiology, precision technology, thermoregulation

Acknowledgments: Embrapa, INCT-Pecuaria (MCT/CNPq/FAPEMIG) and UnB.