**Use of Infrared Thermography to Detect the Change in the Body Surface Temperature with Estrus in the Cow**

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Low estrus detection rate has become a major factor that limits reproductive performance in modern dairy cattle. There is a need for a simple and convenient method or tool that might be an aid to detect estrus in cows with silent ovulation. Thermography is a non-invasive technique that transforms surface heat emitted from an object into a pictorial representation. The objective of this study was to determine if thermography could detect the change in body surface temperature with estrus in the cow. A thermal camera (TVS-600, Nippon Avionics Co., Ltd., Japan) was used in this study. Images were recorded onto memory cards, downloaded into a portable laptop computer, and analyzed using an image-processing software program. In a preliminary experiment using two dairy cows, the cows had an elevated surface temperature around the vulva at estrus irrespective of ambient and rectal temperatures, weather, and time of day. Changes in the surface temperature were then quantified as temperature differences (TD), that is, the differences between the maximum temperature on the straight line passing through the right and left ischial tuberosities and the temperature at the right or left ischial tuberosity. For all readings, target areas were scanned approximately 1.5 m from the cow. In Experiment 1, three Japanese Black cycling cows were scanned with the thermal camera daily for 29 days, and TD were recorded. Ovarian dynamics were monitored by rectal palpation and ultrasonography to confirm the day of ovulation. In Experiment 2, PGF2$\alpha$ was given to a total of 17 Holstein-Friesian cows at luteal phase, and two out of the 17 animals that had ovulation without showing any estrous behaviors such as standing, mounting activity or mucus discharge were diagnosed as having silent ovulation. TD were recorded in the two cows, and the day of ovulation was confirmed. In the animals in Experiment 1 and those with silent ovulation in Experiment 2, TD increased above 2.5 and 1.0 degrees Celsius, respectively, during the period between three days before and the day of ovulation, and decreased thereafter. The present study suggests that a single recording of TD by infrared thermography may be utilized for estrus screening in a herd and that daily monitoring of TD may be able to predict the day of ovulation in the cow. In conclusion, use of infrared thermography has the potential to develop a new tool that would improve estrus detection rate in cows with silent ovulation as well as cows showing normal estrus behaviors.

Keywords: infrared thermography, estrus detection, cows, body surface temperature