

# Evaluation of thermal imaging for detection of subclinical mastitis at the quarter level.

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## INTRODUCTION

Automated measurement of udder surface temperature to identify subclinical mastitis in individual quarters in cows during milking, could be an important contributor to the control of subclinical mastitis incidence and associated bulk tank somatic cell count in the dairy herd.

## OBJECTIVE

The goal was to investigate the efficacy of measuring udder surface temperature using a thermal camera as a tool for diagnosing subclinical mastitis at the quarter level in dairy cows under field conditions.

## MATERIALS AND METHODS

- ▶ **Farm 1:** 33 cows without any clinical disease.
- ▶ **Farm 2:** 6 cows without any clinical disease.
- ▶ Images were collected using a commercial handheld infrared thermal camera (FLIR E5, FLIR) from 72 quarters in the milking parlor (**Figure 1**).
- ▶ Milk samples were aseptically collected at the same time and somatic cells were counted by BactoCount IBCm (Bentley Instruments Inc., MN, USA).
- ▶ The threshold of  $200 \times 10^3$  cells/mL of somatic cell count was adopted to classify subclinical mastitis and healthy quarter and bacteriological examinations (gold standard) were performed to confirm the infection of quarters.

A single measurement of udder skin surface temperature by a thermal camera at the quarter level was not reliably diagnosing subclinical mastitis compared to bacteriological culturing. Maybe repeated measures of udder skin temperature in time would increase sensitivity and specificity.

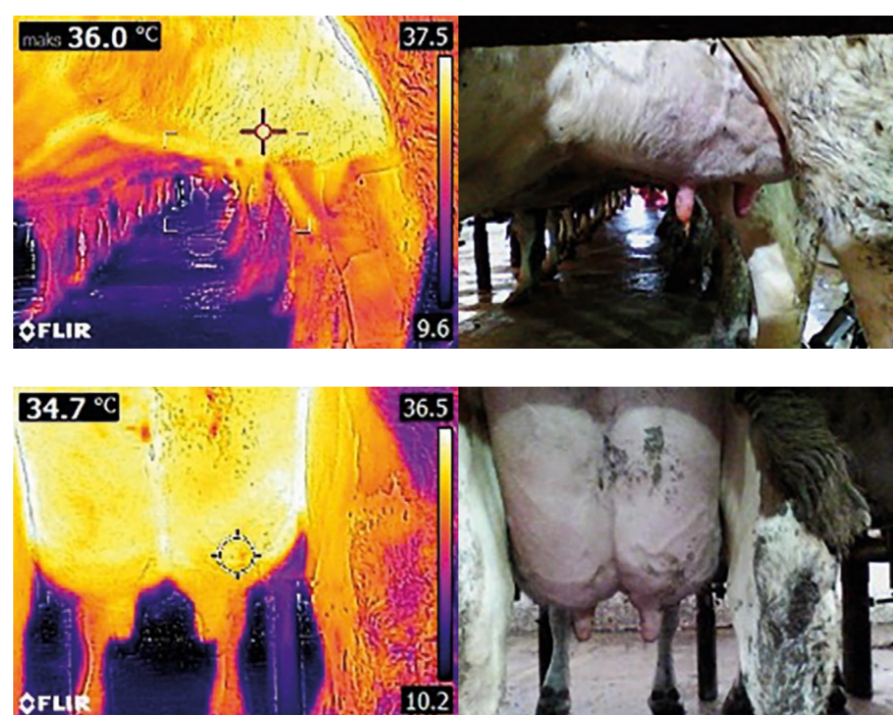


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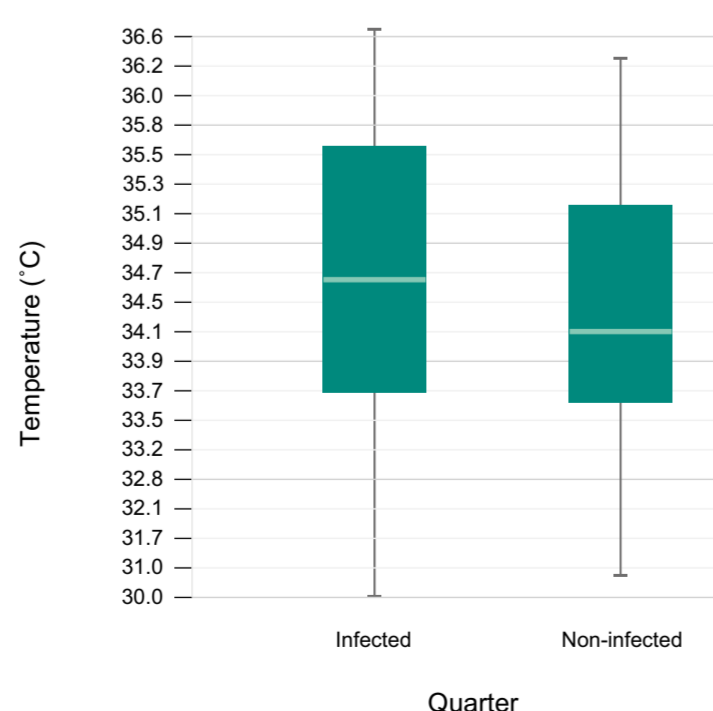
## RESULTS

- ▶ Mean udder surface temperature was similar between quarters being either below ( $n=49$ ;  $34.33 \pm 0.23^\circ\text{C}$ ) or above ( $n=17$ ;  $34.51 \pm 0.31^\circ\text{C}$ ) the somatic cell count threshold of 200,000 cells/mL ( $p=0.676$ ; **Figure 2**).
- ▶ Infected ( $n=41$ ;  $34.52 \pm 0.24^\circ\text{C}$ ) and non-infected quarters ( $n=26$ ;  $34.14 \pm 0.29^\circ\text{C}$ ) determined by bacteriological culture, had similar surface temperatures ( $p=0.311$ ; **Figure 3**).
- ▶ Sensitivity and specificity were 69.23% and 46.34% ( $p=0.692$ ;  $\text{AUC}=0.538$ ) according to the bacteriological examination (gold standard), respectively (**Figure 4**).

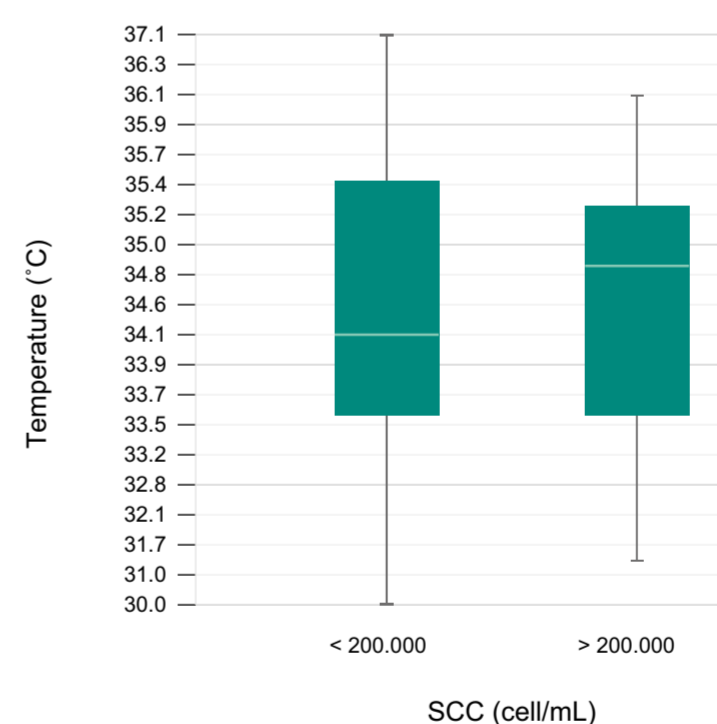
**FIGURE 1.** Examples of measurements of udder surface temperature with a thermal camera.



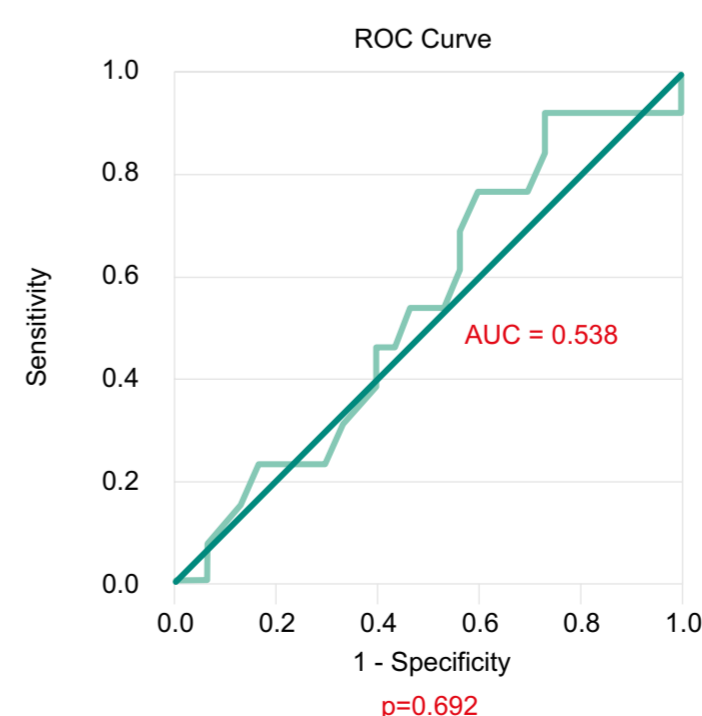
**FIGURE 3.** Comparison of mean quarter udder skin surface temperature to quarter bacteriological examination.



**FIGURE 2.** Comparison of quarter mean udder skin surface temperature to quarter SCC category of  $> 200\text{k}$  cells/mL (infected) or  $< 200\text{k}$  cells/mL (uninfected).



**FIGURE 4.** Sensitivity and specificity of thermal imaging to identify infection status according to the bacteriological examination.



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