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**Original Article****Infrared thermography as a non invasive tool for goat**

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**Abstract**

The use of infrared thermography (IRT) as a method to identify diseases in animals has prospective opportunities. IRT is a non-invasive diagnostic tool that uses infrared radiation to capture images of an object's temperature. This technology can be used to detect health issues in goats by identifying variations in their body temperature. Its ability to assess temperature distribution remotely since it doesn't require direct physical contact with the surface being monitored is one of its main advantages. Some common health issues in goats that can be detected using IRT include mastitis (inflammation of the mammary gland), foot rot (infection of the hoof), and pneumonia (inflammation of the lungs). IRT can also be used to monitor the overall health of a herd and detect outbreaks of infectious diseases. Overall, infrared thermography is a valuable tool for detecting health issues in goats and can ensure the well-being of these animals.

**Keywords:** Infrared thermography, Mastitis, Non-invasive

**Introduction**

Infrared thermography (IRT) is a non-invasive diagnostic tool that uses infrared radiation to capture images of an object's temperature. This technology can be used to detect health issues in goats by identifying variations in their body temperature. IRT is a new, easy-to-use, non-invasive device that provides visual images of animals while measuring body surface temperature without causing any radiation (Sorokoet *al.*, 2014; Mazur and Eugeniusz-Herbut, 2006; Kuncet *al.*, 2007). According to the Stefan-Boltzmann equation, all objects emit infrared radiation via conduction, convection, and radiation in proportion to their temperature (Poikalainen *et al.*, 2012). This technology has been used in veterinary medicine for several years to diagnose various health conditions in different animals, including goats.

Infrared thermography in goats involves using a thermal camera to capture images of the goat's body surface temperature. The camera detects the differences in temperature that are invisible to the naked eye and creates a visual map of the temperature distribution across the goat's body. This technique is particularly useful for detecting early signs of health issues, such as inflammation, infection, or injuries. When an area of the body is affected by an abnormal condition, such as inflammation, the affected area typically shows an increase in temperature due to increased blood flow to the area. In contrast, an area affected by a decreased blood supply, such as a wound, may show a decrease in temperature. Infrared thermography can be used to diagnose a range of health conditions in goats, including mastitis, foot rot, pneumonia, and arthritis. It can also be used to monitor the general health of a herd, identify the best time for breeding, and even detect pregnancy in female goats. In conclusion, infrared thermography is a valuable diagnostic tool for identifying and monitoring health conditions in goats. It provides a non-invasive and quick method of detecting early signs of disease, allowing for early intervention and treatment.

**Why there is need for infrared thermography?**

There are several reasons why infrared thermography is necessary in veterinary medicine, particularly in the diagnosis and treatment of health issues in goats.

Firstly, infrared thermography is a non-invasive imaging technique that does not require physical contact with the animal, making it a stress-free and safe method of diagnosis. Unlike other diagnostic methods, such as taking a blood sample or performing a biopsy, infrared thermography

does not require any invasive procedures, making it less painful and more comfortable for the animal.

Secondly, infrared thermography is a quick and efficient diagnostic tool that allows for the early detection of health issues. Infrared images can detect temperature variations on the surface of the animal's skin, even before the animal shows visible signs of illness or injury. This early detection enables prompt diagnosis and treatment, leading to better health outcomes for the animal.

Thirdly, infrared thermography is a cost-effective diagnostic tool. It provides a non-invasive and quick diagnosis of health issues, which means that farmers and veterinarians can identify health issues early, reducing the need for expensive and time-consuming treatments later on.

Finally, infrared thermography can be used to monitor the overall health of a herd and detect outbreaks of infectious diseases. This early detection enables farmers to take prompt action to prevent the spread of the disease, reducing the risk of illness and death in the herd.

In research pertaining to the health and welfare of farm animals, infrared thermography (IRT) has a wide range of possible applications (Stewart *et al.*, 2005; Mcmanuset *et al.*, 2016).

#### **Applications of IRT in goats:**

- **Early detection of mastitis:** Infrared thermography can detect early signs of mastitis, a common health issue in lactating goats. There have been speculations about using infrared thermography (IRT) to measure the temperature of the udder's surface and utilize that information to diagnose mastitis (Berry *et al.* 2003). Mastitis is characterized by inflammation of the mammary gland, which results in increased temperature in the affected gland. IRT can detect this increased temperature before other visible symptoms appear, allowing for early diagnosis and treatment.
- **Detection of hoof and leg issues:** Goats with hoof and leg issues, such as foot rot or arthritis, often show an increase in temperature in the affected area. IRT can detect this increased temperature, allowing for early diagnosis and treatment of the condition.
- Laminitis, according to Bargalet *et al.* (1992), is an aseptic foot inflammation that causes a rise in hoof temperature.
- **Monitoring of pregnant goats:** Infrared thermography can be used to monitor pregnant goats by detecting changes in body temperature during pregnancy. The increase in temperature in the udder and abdominal region can indicate pregnancy, and the subsequent decrease in temperature can indicate the onset of labor.
- **Monitoring of heat stress:** Homeostatic responses that are generally occurred due to heat stress in goats include the increase in respiration rate, body temperature, and water consumption as well as the reduction in food intake (Gupta *et al.* 2013; Caulfield *et al.* 2014). IRT can detect temperature variations on the goat's skin, allowing farmers to monitor and manage heat stress in their goats.
- **Monitoring of overall herd health:** Infrared thermography can be used to monitor the overall health of a goat herd. By detecting early signs of illness or injury, farmers and veterinarians can take prompt action to prevent the spread of disease and ensure the health and wellbeing of the entire herd.

#### **Points to be considered while performing IRT in goats:**

- **Prepare the goat:** The goat should be brought to a quiet, well-ventilated area and allowed to acclimate to the environment for at least 15 minutes before testing. The goat should be clean and dry, with no hair covering the areas of interest.
- **Set up the infrared camera:** The infrared camera should be set up and calibrated according to the manufacturer's instructions. The camera should be positioned at the appropriate distance from the goat, typically between 1-2 meters, and at a perpendicular angle to the area of interest.
- **Capture the images:** The camera operator should take a series of images of the areas of interest, such as the udder or other parts of the body. The images should be taken from different angles to ensure accurate and comprehensive coverage.
- **Analyze the images:** The images should be analyzed using software provided with the infrared camera or specialized veterinary software. The software can help identify areas of temperature differences and provide quantitative information about the thermal status of the goat.
- **Interpret the results:** The results of the infrared thermography should be interpreted by a veterinarian or other qualified professional. The results can be used to identify areas of heat loss, inflammation, or other abnormalities that may indicate underlying health issues.

#### **Precautions for IRT**

- **Prepare the goat properly:** Before starting the IRT, ensure that the goat is clean, dry, and not wearing any clothing or accessories that could interfere with the imaging. The goat should also be calm and relaxed to avoid any unnecessary movements that could affect the accuracy of the results.
- **Avoid external factors:** Ensure that there is no external heat source, such as sunlight or heaters, near the goat or the imaging area. This can cause inaccurate readings and affect the results.
- **Position the camera correctly:** Ensure that the infrared camera is positioned correctly and perpendicular to the area being imaged. If the camera is not positioned properly, it can result in inaccurate readings.
- **Be aware of environmental factors:** Environmental factors such as drafts or cold temperatures can also affect the accuracy of the IRT results. Ensure that the testing area is draft-free and at a stable temperature to ensure accurate results.
- **Follow safety protocols:** Always follow safety protocols while handling the infrared camera. Ensure that the camera is not damaged or broken, and always use it according to the manufacturer's instructions.
- **Interpret the results carefully:** IRT results should always be interpreted by a trained veterinarian or other qualified professional. This can help avoid misinterpretation of the results and ensure that appropriate actions are taken based on the findings.
- By following these precautions, IRT can be a valuable tool for assessing the thermal status of goats and detecting early signs of health issues.

## Conclusion

Infrared thermography (IRT) is a non-invasive diagnostic tool that has become increasingly popular in recent years for assessing the thermal status of animals. *Capra hircus*, or domestic goats, have been shown to benefit from the use of IRT in various applications, such as detecting mastitis, monitoring lameness, and assessing overall health. Regular IRT monitoring can help detect early signs of health issues and prevent the spread of contagious diseases. However, there are certain limitations and precautions to be considered when using IRT in goats. Factors such as environmental temperature, hair coat thickness, and animal movement can affect the accuracy of IRT results. Proper preparation of the goat and camera, avoidance of external heat sources, and interpretation of results by a trained professional are crucial in obtaining accurate and reliable results from IRT in goats. Further research and standardization of IRT protocols in goats can help maximize its effectiveness as a diagnostic tool and promote its wider adoption in the veterinary field.

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