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**BEHAVIORAL AND TECHNOLOGICAL APPROACHES FOR ASSESSING THERMAL STRESS
ADAPTATION IN LAYING HENS**

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Abstract: This review summarizes the various methods used to evaluate poultry behaviour under thermal stress, highlighting their importance for improving animal welfare, production performance, product quality, and environmental management. An extensive literature search was carried out on laying hens, thermal stress, and welfare-related aspects, emphasizing behavioural indicators, physiological responses, production traits, and management factors associated with adaptation to severe thermal conditions. Several observational methods were evaluated, including naturalistic observation, photographic documentation, continuous monitoring, time sampling, and focal animal studies. Infrared thermography was pointing out for its non-invasive technique to monitor body temperature. Despite their high costs and technological challenges, modern technologies for monitoring, recording, and assessing poultry behaviors are essential for an efficient farm management, as they contribute to the prevention of production losses and facilitate timely interventions by farmers.

Introduction

Poultry are vulnerable to thermal stress due to the absence of functional sweat glands, high core body temperature, and rapid metabolic rate. Extreme temperatures—both high and low—reduce egg production, impair growth, and cause meat quality defects (PSE & DFD meat). Thermal stress drives physiological, metabolic, and genetic changes affecting skeletal muscle growth, protein synthesis, and fat accumulation—ultimately threatening industry sustainability.

Research methodology

Scopus, PubMed,
Web of Science, ScienceDirect

124 relevant papers identified
73 articles selected
52 citations included

Key focus areas

behavioral observation techniques
monitoring technologies,
thermal stress responses
methodological limitations

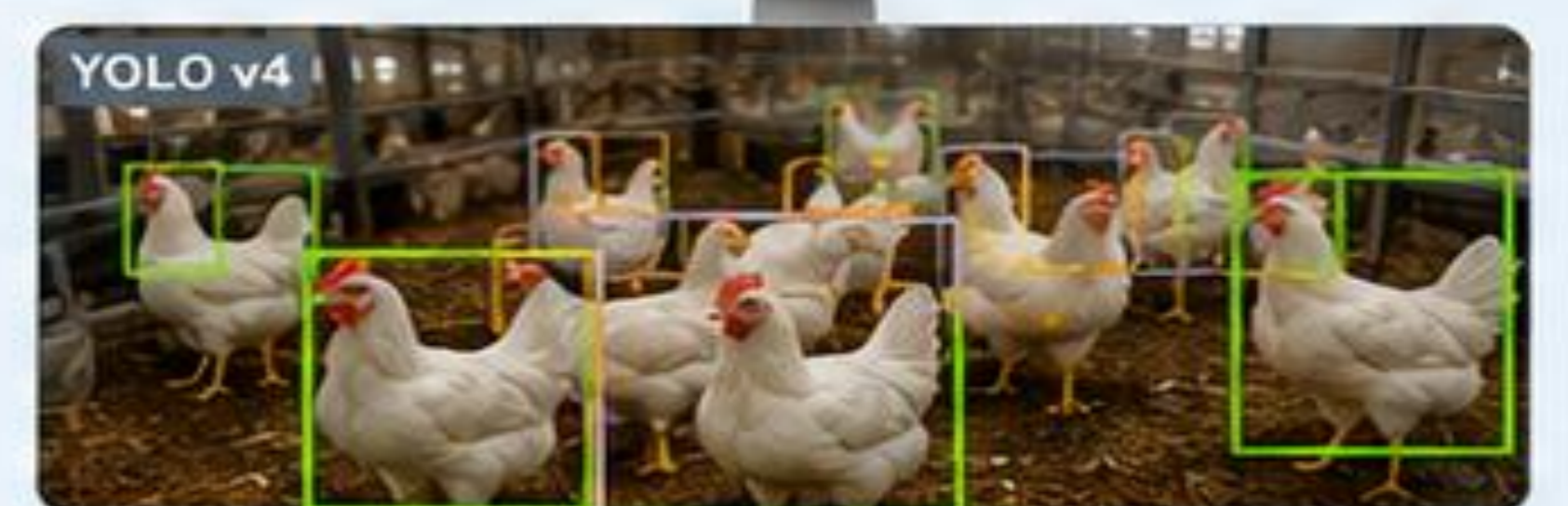
Results and discussions

Monitoring Technologies

- Video & Automated Systems**
Real-time monitoring and automated behavior analytics.
- Ceiling-mounted Video Cameras**
Wide-area coverage for continuous observation.
- Scan Sampling + Video**
Periodic scans supported by video recordings.
- Low-cost Camera + YOLO v4**
Cost-effective detection of hens and behaviors.
- Acoustic/Vocalization Analysis**
Audio monitoring of flock sounds.
- SVM model detecting alarm, squawk & gavel calls**
Classifies calls to detect stress-related vocalizations.

Behavioral Samples Techniques (Altmann, 1974)

- Focal animal sampling
- Scan sampling
- Ad libitum sampling
- Continuous recording
- One-zero sampling
- Video observation

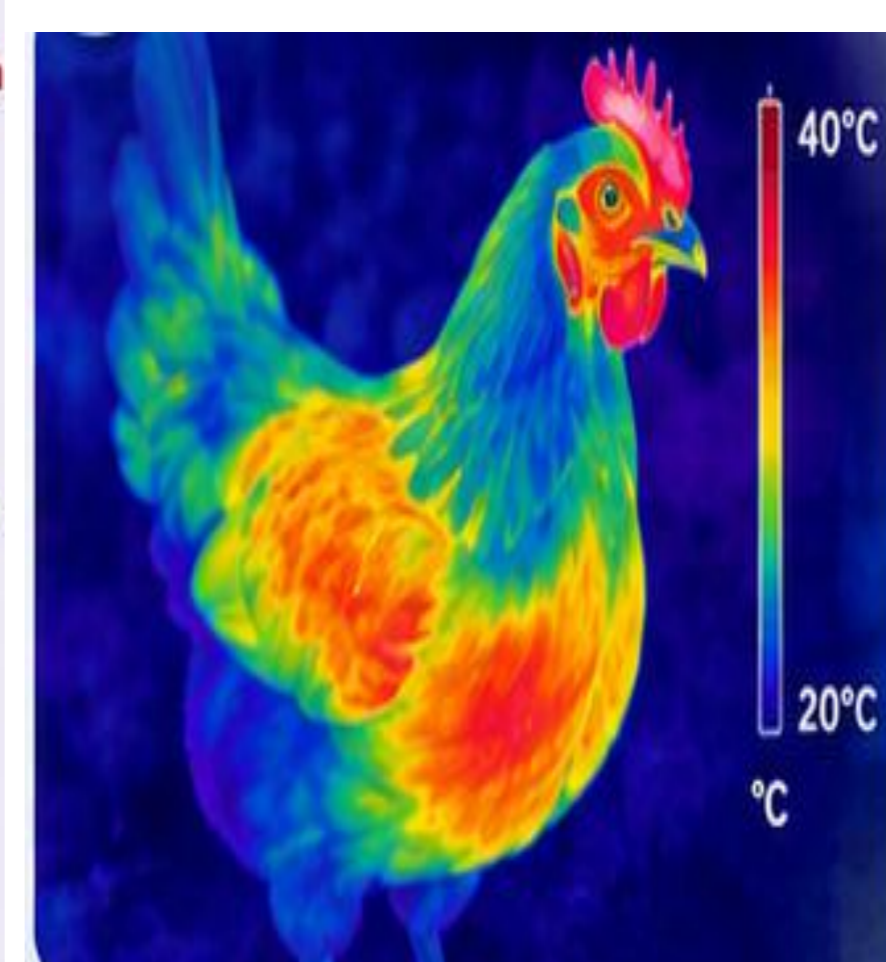


AI & Computer Vision



Deep Learning Detection Models
Performance of models for heat stress detection in laying hens.

Infrared Thermography (IRT)



- Non-invasive Surface Temperature**
IRT measures heat emission from body surfaces without contact.
- Detects vasoconstriction/vasodilation patterns**
Linked to stress responses.
- Strongly correlates with cloacal temperature and physiological state.**

Conclusions

Regular behavioral monitoring, supported by video analysis, AI/IRT, acoustic tools, enables early and non-invasive detection of thermal stress in hens, improving welfare and reducing economic losses for farmers.

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