

A review study on environmental heat stress and heat load management in the dairy cattle under climate change ⁽¹⁾

Chia-Jung Lee ⁽²⁾⁽³⁾ and Yi-Chun Lin ⁽³⁾⁽⁴⁾

Received: Jul. 31, 2023; Accepted: Dec. 8, 2023

Abstract

According to the investigation report by the Intergovernmental Panel on Climate Change (IPCC) , it is estimated that the average earth surface temperature will rise by 1.5°C in the next 30 years. The temperature increase in mid-latitude regions could reach approximately 3°C, while in high-latitude regions, it could reach 4.5° C. Heat stress has become one of the most significant challenges in the dairy industry. High dry-bulb temperature, humidity, radiation, and low air movement in the environment create a heat stress environment for cows. Environmental heat stress affects the behavior and physiology of dairy cows, leading to a decrease in milk production, energy imbalance, increased risk of hoof diseases and reproductive disorders, and even cow mortality. The heat balance state exhibited by cows, influenced by environmental conditions, exposure time, individual factors, and breeds, can be described by the term "heat load," which more accurately defines and describes the heat balance status of cows. Cows exhibit similar physiological responses when subjected to high heat stress environments or high heat load conditions, including increased respiration rate, heart rate, body temperature, and water intake, as well as decreased feed intake, activity, and lying behavior. When environmental indicators exceed threshold values, cows' physiological responses will vary to different degrees. Different regions, cattle breeds, and production stages have different heat load thresholds. Both single indicators such as temperature or wind speed and composite indicators can be used to assess the impact of heat stress severity on cows. There are two main methods to reduce heat load in cows' bodies: reducing heat production and accelerating heat dissipation. Under climate change, a detailed understanding of various responses and adaptability of dairy cows during heat stress environments is beneficial for developing strategies that enhance cows' heat tolerance while maintaining productivity. Through breeding, heat adaptation in dairy cows can be fundamentally improved. Combined with cow-centered heat balance management measures, optimal strategies for environmentally sustainable management can be sought.

Key Words: heat stress, heat load, climate change, heat balance management.

(1) Contribution No. 2773 from Taiwan Livestock Research Institute (TLRI), Ministry of Agriculture (MOA).

(2) Livestock Management Division, MOA-TLRI, Tainan 71246, Taiwan R. O. C.

(3) National Chung Hsing University 40227, Taiwan, R. O. C.

(4) Corresponding author, E-mail: ycl2019@nchu.edu.tw