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Relationships among enteric methane, body-surface temperature, and body condition score in tropical smallholder dairy cattle

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Abstract

Enteric methane emissions in dairy cattle represent a loss of metabolisable energy, ultimately reducing meat and milk yields. While feed-methane links are well studied, physiological traits such as body energy status and body thermal load remain underexplored. In this context, body condition score (BCS) and body-surface temperature (BST) are relevant indicators of an animal's energy status and the body's physiological response to environmental heat. To address this research gap, data were collected from cows and heifers in 72 smallholder dairy farms across six milk collection zones (MBGs) in Malawi. All farms followed comparable feeding regimens in terms of feed quality and quantity. Data collection took place during the cool-dry and rainy seasons. Methane emissions were measured directly using a Laser Methane Detector (LMD) for at least 6 minutes per animal, while BST was recorded using infrared thermal imaging. BCS were assessed using a standardised 5-point scale (1 = emaciated; 5 = obese), and body weights (BW) were estimated using a standard weighing band for dairy cattle. On-farm temperature and relative humidity were converted into a Temperature Humidity Index (THI). To ensure repeatability, animals were assessed in two time-based groups each day. Data was analysed using linear mixed-effect models, with enteric methane as the dependent variable. Fixed effects included BCS, BST, BW, MBG, and THI, while a random factor accounted for day-specific variations. Results showed a significant effect of BST on methane ($p < 0.05$), probably attributed to individual physiological variations, potentially driven by increased metabolic activity related to thermoregulation. No significant effects were observed for either MBG or THI, and BW was excluded from the final model due to its negligible explanatory value. Estimated marginal means indicated a tendency toward higher methane emissions at optimal BCS values (2.5 and 3; 281.0 ± 22.4) compared to suboptimal BCS levels (2 and 3.5; 241.6 ± 31.6). While not statistically significant, this trend may reflect increased fermentation activity due to higher dry matter intake in animals with optimal BCS. However, additional, potentially impactful factors such as individual farm management are likely, and further analysis is therefore warranted.

Keywords: Body-surface temperature, enteric methane, laser methane detector, thermo imaging

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