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Abstract Submission Form

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Preferred presentation Oral

Preferred session Session 2: SC Milk Analysis – New tools to extend the horizon of milk mid-infrared spectrometry

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Title of your paper Predicting dairy cattle heat stress indicators using machine learning and mid infrared spectral data

Insert ABSTRACT text

Heat stress has a negative impact on the well-being and productivity of dairy cows and as well on the profitability of dairy farms. However, the most studies have been conducted in the direction pointing to respiration rate, skin temperature or rectal temperature and milk yield production, and more limited studies have been conducted in relation to the effects of heat stress on milk composition. So far, initial results have been reported in different environments (e.g. Belgium, Tunisia, Germany) based on the mid-infrared (MIR) responses to heat stress in dairy cows. The aim of this study was to investigate the effects of heat

stress from the weather stations to all LKV Baden-Württemberg (LKVBW) farms to a 20 km radius based on all available LKVBW datasets from milk production traits until all predicted milk biomarkers using the MIR spectrum since it is reflecting detailed predicted information from milk samples. The second objective of the study was to underline if there is a difference on heat stress indicators between data from barn weather stations or public weather stations. The meteorological data from the Baden-Württemberg (BW) public weather stations as well barn weather station from MobiMets and Pessl Instruments devices, such as temperature and humidity, were merged with the data set collected by the milk recording organization. Mathematical calculation was used to calculate the temperature-humidity index (THI) values for the daily average, then an average of three days has been taken into link with the farms data based on the day of the milk recording collection, these datasets were link to each animal with the monthly spectral data for each cow from the selected 500 LKVBW farms. The model was created as part of the HappyMoo project using MIR spectral data from Bentley Instruments devices collected in the LKVBW database between the period 2012 and 2019 and external validation was performed on a collected dataset with MIR spectral data between 2020 and 2022. The barn weather data was collected in the Projekt KlimaCO there were MobiMets data from 2020 until 2022 and Pessl Instruments data from 2021 until 2023. The machine learning algorithm was performed in R using the package "glmnet". The spectral data were first standardized using the EMR method and then the first derivative algorithm using the Savitzky-Golay filter was used as preprocessing. It was found that there were differences in the MIR spectra recorded under THI and thermoneutral conditions; certain wavenumbers of the MIR spectrum were answered differently. The THI index was created based on the report between the THI value of the individual cow and the mean THI value of the farm. Then Pearson correlations were calculated based on the THI index and the milk parameters using the "corrplot" library in the R environment. The negative correlation with the THI index concerned milk characteristics such as milk yield: 0.15, lactose: 0. 12, acetate: 0.33, blood NEFA: 0.2 and positive correlations with fat content: 0.59, protein content: 0.40, blood BHB: 0.25, blood glucose: 0.30, blood calcium: 0.21 and fatty acids: 0.35. There were no differences found out between the public weather stations and the barn weather stations. Further analysis is required to identify potential milk-based MIR phenotypes that could be used for herd management and breeding with the aim of identifying resistant animals to heat stress.

Enter keywords MIR, spectral data, heat stress, THI, dairy cattle, welfare