

Heat stress : matching climate, health and animal activity data to improve dairy cows' welfare management

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Introduction

The KLIMACO project aims to build up and support climate resilience in livestock farming in the Upper Rhine region. Adaptation strategies to cope with climate change will be implemented. The health and animal welfare group is working on strategies and recommendations for livestock farmers to face heat stress and prevent risks. The goal of the study is to combine data from different sources. A global overview of thermal stress origin and issues on dairy cows has to be developed.

Material and methods

The study is currently running in 16 farms in the Upper Rhine region (Figure 1). All farms are equipped with a MoBiMet device from the Climability Design project¹ (Mobile BioMeteorology, Figure 2) and Pessl instruments² (Figure 3). Since summer 2021, the barn THI (Temperature Humidity Index) is calculated every 5 minutes by the MoBiMet. The continuously calculated barn THI are compared to outdoor THI, using daily average THI from independent weather station^{3,4} (Figure 1). The THI equation⁵ used is the following : $(1.8 * \text{Temperature}) + 32 - (0.55 - (0.0055 * \text{Relative Humidity})) * ((1.8 * \text{Temperature}) - 26)$. Since July 2022, milk samples are done for each lactating cow one to two times a week in four alsacian farms. Conventional milk analysis and spectral analysis are performed.

Finally, the data from the SESAM⁶ tracking system developed in a previous project to continuously monitor walking, standing, lying, eating and ruminating activities of dairy cows will be used. The aim is to detect changing behaviour in dairy cows' activities when thermal stress issues are occurring.

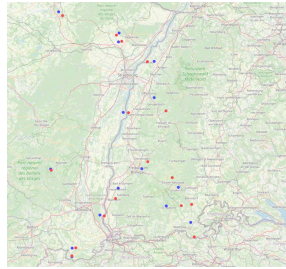


Figure 1 : Location of the barn weather stations (Barn THI, blue points) and of the independent weather stations (Outdoor THI, red points)



Figure 2 : MoBiMet (Mobile BioMeteorology device)



Figure 3 : Pessl Instruments devices

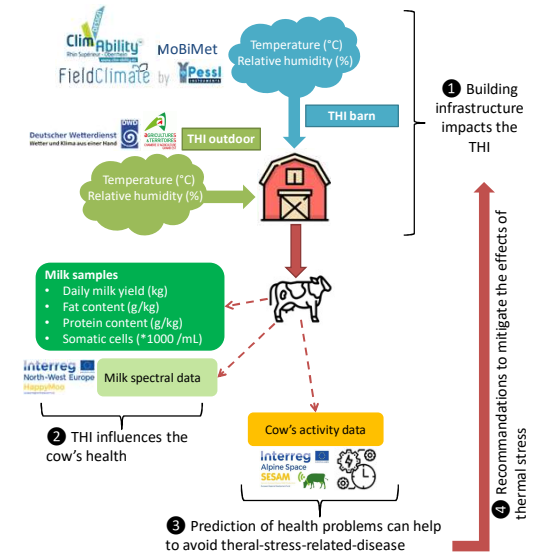


Figure 4 : Process and objectives to mitigate thermal stress of dairy cows in the Upper Rhine region (THI: Temperature Humidity Index, MoBiMet: Mobile BioMeteorology, ① Research hypotheses)

First results and discussion

The outdoor THI has a positive impact on the barn THI (p-value <0,05). The relative humidity calculated by the MoBiMet seems to be overestimated, leading to an higher calculated THI. To verify this assumption, Pessl instruments were installed in July 2022. The different records measured by the two devices will be compared. If the assumption is verified, a corrective equation will be developed to get a corrected THI from the MoBiMet.

The outdoor THI impacts negatively the milk yield. When the THI goes up by 1 point, 137 (± 0,39) g milk is lost. For example, for the same relative humidity (60%), at 20°C, the cow does not suffer from heat stress, but reaching a temperature of 30°C, the cow suffers from strong heat stress. In this case, the THI goes from 66 to 80 points; meaning a loss of 1,9 kg milk/cow/day.

Synchronise the activity data from the SESAM tracking system with climate data could be an answer to predict health issues (Figure 5).

Table 1 : Influence of the outdoor THI on milk yield and milk quality

	Milk yield (kg)	Fat content (g/kg)	Protein content (g/kg)	Somatic cells count (*1000/mL)
Mean	12,8	41,2	31,9	363
Median	12,1	40,9	32,2	97
Outdoor THI p-value	0,00042	0,141	0,016	< 2.e ⁻¹⁶

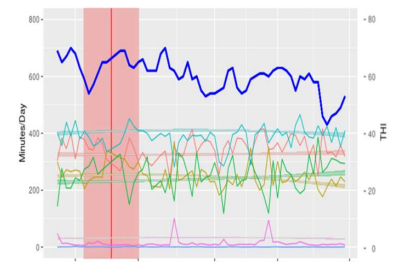


Figure 5 : THI impacts on cow's activity and behaviour (data from the SESAM tracking system, 2021). The highlighted red indicates the occurrence of a mastitis

Conclusion and perspectives

The goal was first to evaluate the delta THI ($\Delta\text{THI} = \text{Barn THI} - \text{Outdoor THI}$) to assess the capacity of the building to reduce (or emphasize) heat stress. To date, due to data transfer issues, the difference between barn and outdoor THI could not be measured. Meanwhile, to go further in the understanding of heat stress issues origin, a complementary survey will be carry out. Modifications in animal diet, water and pasture management and building's infrastructure during thermal stress will be monitored. Thanks to the equation developed through the HappyMoo⁷ project, the THI felt by each cow will be estimated. This THI will be compared to the barn THI. The aim is to identify which type of cow are the most robust to cope with heat stress.

Finally, the synchronisation of climate, health and animal activity data through statistical analysis still have to be done.

References

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