Friday, March 1, 2024

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 Improving taste and flavor in dairy product through milk analysis of free fatty by Mid-infrared (MIR) spectrometry.

Insert ABSTRACT text

The dairy sector deals with a recurring issue: a taste alteration due to degradation of fat, commonly called lipolysis. Lipolysis happens after the milking, through the physical shocks induced by freezing, pumping, transfer and storage of the milk. Physical break of fat globules makes triglycerides accessible to enzymes and degraded into free fatty acids (FFA). Among them, the volatile short chain FFA lead to organoleptic issues through undesired tastes.
An easy quantification of these individual short chain FFA, responsible of taste alteration, is very difficult. Historically, the lipolysis was quantified with the BDI methods by the measurement of the fat acidity. On the other hand, the analysis of a wide range of FFA is now possible by Gas Chromatography coupled with tandem mass spectrometer (GC-MS/MS). This analysis is time consuming, expensive and difficult to apply for routine analysis on a large set of samples. In order to bring a new way of preventive and corrective action for dairies and farmers, this project aims to develop predictive models based on milk mid Infrared

spectroscopy (FT-MIR) to quantify FFA.
For this purpose, milk samples from 4 different countries were collected and analyzed by MIR spectroscopy as well as GC-MS/MS. The different models provided moderate R^2 for long-chain FFA and relatively low R^2 for short-chain FFA. Indeed, most of short chain FFA were under the limit of quantification. The lack of short-chain FFA concentration was solved by testing different methods of mechanical induction of lipolysis without interfering with the MIR spectrum. Among them, time milk homogenization has demonstrated a clear increase of short chain FFA value leading to better predictive models. More than 750 analyses were performed (including classical and mechanically induced lipolysis samples) to setup this model. Five different machine learning algorithm (principal component regression (PCR), partial least square regression (PLS), Kernel ridge regression (KRR), Elastic-Net Regression (ENR) and Support Vector machine Regression (SVMR)) were performed for each free fatty acid on the entire dataset. These different algorithms exhibit for each free fatty acid different performances. R^2v ranged from 0.4 to 0.8 depending on the considered FFA (C4 to C18).
In order to unravel the practical use of these models, a large-scale modelling approach was applied on a Luxembourg spectral database of 1,159,559 spectra between January 2019 and December 2021.
This large-scale analysis has produced some interesting conclusions. One of the most interesting is that these forecasts show a clear differentiation of FFA between summer and winter. Indeed, farms are more likely to be confronted with lipolysis during winter.

Enter keywords Milk, Mid-Infrared, Free Fatty acid, machine learning