Submission

Monitoring the pregnancy status of dairy cows using mid-infrared spectra of milk collected from milk recording

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Optimal fertility in dairy cattle is a major concern for farmers to ensure a sustainable milk production. Confirmation and monitoring of pregnancy are crucial to avoid extended number of days open and therefore increased production costs. Optimal monitoring of pregnancy has to be of sufficient accuracy but also easy to organize and as cheap as possible. Hence, the use of information directly collected in the context of milk recording programs, and especially the mid-infrared (MIR) spectra of milk, can be useful to develop a (pre-)screening tool. The MIR spectroscopy is a rapid, non-invasive and inexpensive method which is widely and routinely used by milk labs to provide a prediction of milk composition. This study aims to investigate the opportunities to use directly the MIR spectra as an indicator of the pregnancy status of a given cow. MIR spectra and population records (e.g., animal identification, calving dates, insemination dates) from milk recording programs of the Walloon Region in Belgium over the last 3 years have been used. The method is based on the comparison of the observed spectrum for a cow at a certain day with the expected spectrum of the same animal at the same day in milk if this cow was open. The resulting residual spectra (i.e., difference between observed and expected spectra) are therefore the result of all effects which were not taking account in the modeling of the expected spectra such as the pregnancy status. Residual spectra are then used to build a predictive logistic equation to discriminate pregnancy. The obtained equation is finally validated on a testing dataset randomly selected from the original database. A total of 258,131 spectra from open cows have been used to perform modelling of all expected spectra of the whole database. Then, a total amount of 419,912 residual spectra have been obtained. Afterwards, 317,816 residual spectra have been selected as training dataset to build the predictive logistic equation. The testing dataset included 102,096 residual spectra (46,305 from open cows and 55,791 from pregnant cows). On the testing dataset the average error rate was 18.1%. 84.4% of data belonging to open cows were correctly identified as open and 79.8% of the pregnant cows were correctly identified as pregnant. These results showed a high potential for providing a surveillance tool of the pregnancy status of a given cow at a given day using directly the MIR spectra of milk. Finally, these results and methodologies will be tested and implemented on real conditions, using a pilot farm network, in order to improve the usefulness of the tool to (pre-)screening status of pregnancy.

Keywords:
mid-infrared spectra

surveillance
pregnancy

Session 3
Oral