DISEASE DIAGNOSED AND DESCRIBED BY NIRS

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The mammary gland is made up of remarkably sensitive tissue, which has the capability of producing a large volume of secretion, milk, under normal or healthy conditions. When bacteria enter the gland and establish an infection (mastitis), inflammation is initiated accompanied by an influx of white cells from the blood stream, by altered secretory function, and changes in the volume and composition of secretion. Cell numbers in milk are closely associated with inflammation and udder health. These somatic cell counts (SCC) are accepted as the international standard measurement of milk quality in dairy and for mastitis diagnosis. NIR Spectra of unhomogenised composite milk samples from14 cows (healthy and mastitic), 7days after parturition and during the next 30 days of lactation were measured. Different multivariate analysis techniques were used to diagnose the disease at very early stage and determine how the spectral properties of milk vary with its composition and animal health.

PLS model for prediction of somatic cell count (SCC) based on NIR milk spectra was made. The best accuracy of determination for the 1100-2500nm range was found using smoothed absorbance data and 10 PLS factors. The standard error of prediction for independent validation set of samples was 0.382, correlation coefficient 0.854 and the variation coefficient 7.63%. It has been found that SCC determination by NIR milk spectra was indirect and based on the related changes in milk composition. From the spectral changes, we learned that when mastitis occurred, the most significant factors that simultaneously influenced milk spectra were alteration of milk proteins and changes in ionic concentration of milk. It was consistent with the results we obtained further when applied 2DCOS.

Two-dimensional correlation analysis of NIR milk spectra was done to assess the changes in milk composition, which occur when somatic cell count (SCC) levels vary. The synchronous correlation map revealed that when SCC increases, protein levels increase while water and lactose levels decrease. Results from the analysis of the asynchronous plot indicated that changes in water and fat absorptions occur before other milk components. In addition, the technique was used to assess the changes in milk during a period when SCC levels do not vary appreciably. Results indicated that milk components are in equilibrium and no appreciable change in a given component was seen with respect to another. This was found in both healthy and mastitic animals. However, milk components were found to vary with SCC content regardless of the range considered. This important finding demonstrates that 2-D correlation analysis may be used to track even subtle changes in milk composition in individual cows.

To find out the right threshold for SCC when used for mastitis diagnosis at cow level, classification of milk samples was performed using soft independent modeling of class analogy (SIMCA) and different spectral data pretreatment. Two levels of SCC - 200 000 cells/ml and 300 000 cells/ml, respectively, were set up and compared as thresholds to discriminate between healthy and mastitic cows. The best detection accuracy was found with 200 000 cells/ml as threshold for mastitis and smoothed absorbance data: - 98% of the milk samples in the calibration set and 87% of the samples in the independent test set were correctly classified. When the spectral information was studied it was found that the successful mastitis diagnosis was based on reviling the spectral changes related to the corresponding changes in milk composition.

NIRS combined with different ways of spectral data mining can provide faster and nondestructive alternative to current methods for mastitis diagnosis and a new inside into disease understanding at molecular level.