

AGENDA

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- ▶ Infrared analysis of milk
- ▶ Mid infrared spectroscopy
 - ▶ Measurement of minor components
 - ▶ Targeted and non-targeted analyses
- ▶ A vision of future applications

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RECENT ADVANCES IN FTIR

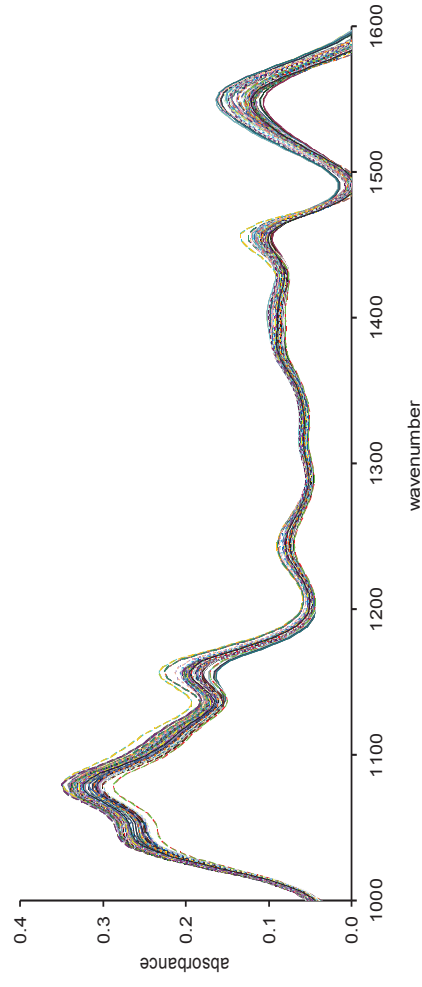
DHI Seminar TLRI, Taiwan 15 October 2015
Steen Kold-Christensen, International Market Manager, FOSS, Denmark



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MID IR SPECTRA OF LIQUID MILK

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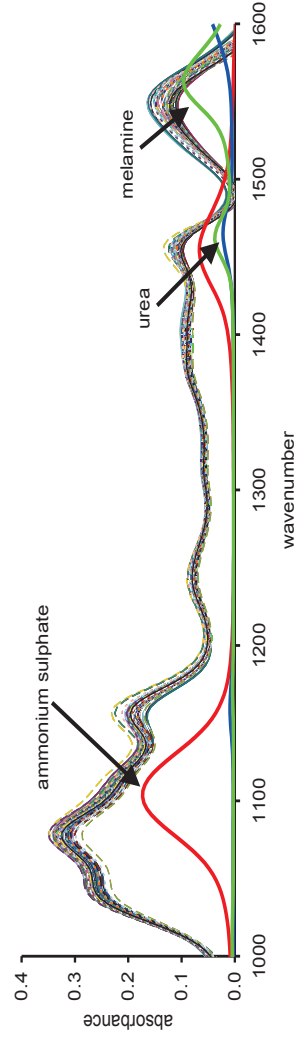


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MILK ADULTERATION

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WHAT CAN FT-IR OFFER US TODAY?

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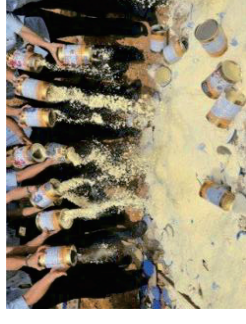
- ▶ **MIR** spectroscopy has since 1970's offered rapid analysis of main constituents
 - ▶ fat, protein, lactose, solids & solids-non-fat
- ▶ **FT-IR** spectroscopy is the state-of-the-art method for acquiring MIR spectra analyzing:
 - ▶ Conventional parameters
 - ▶ fat, protein (true & crude), casein, lactose, solids, urea, citric acid, free fatty acids, PH, FPD
 - ▶ New parameters
 - ▶ Fatty Acids Profiling
 - ▶ Ketosis screening (BHB and Acetone)
 - ▶ Adulterants Screening

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THE USE OF TARGETED & UNTARGETED CALIBRATION MODELS

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- ▶ Melamine crisis (2008) with contaminated milk powder
- ▶ Liquid milk deliberately adulterated for economic gain
- ▶ Collaborative project between Fonterra, Arla and FOSS
- ▶ Resulted in development of targeted and untargeted models for detecting milk adulteration at economic levels
- ▶ In 2014 we have released FTIR models using abnormal spectrum module (ASM) as well as targeted models for specific adulterants

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FOSS COMMITMENT IN TESTING AGAINST MILK ADULTERATION

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- ▶ FOSS started in the nineties with Infrared analysis against simple and known adulterants. Such as tests for screening for added water.
- ▶ As the adulteration schemes became more complex FOSS developed new tools for making screening models against unknown adulterants.
- ▶ Today we offer "out of the box" screening model against abnormalities in the milk as well as offering many targeted calibrations against specific adulterants.
- ▶ Within 30 sec the dairy plant can screen the milk for any unknown adulterants or analyze for well-known adulterants such as Melamine or CIP agent by means of infrared analyzers

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MILK ADULTERATION

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- ▶ Milk quality is tested before unloading. But milk adulteration is rarely tested at the platform.
- ▶ Milk Adulteration is a growing problem.
- ▶ Adulteration can be deliberate or caused by accident.

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SCREENING FOR MILK ADULTERATION

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Unintentional deviations

Caused by accidents or failures.

- ▶ Agent in the cows feed that is transported on to the milk
- ▶ Cleaning agent
- ▶ Water

Intentional deviations

Driven by economic gains:

- ▶ amount (weight and/or volume)
- ▶ milk fat content
- ▶ milk protein content
- ▶ dry matter content
- ▶ the total bacterial counts and somatic cell counts



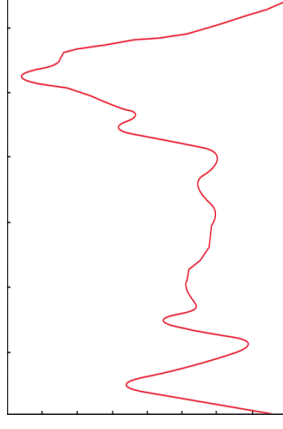
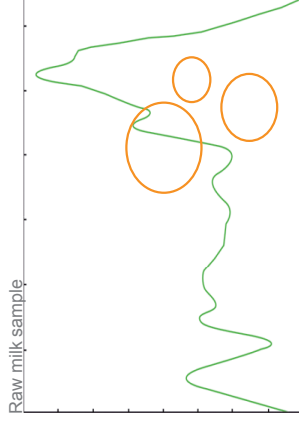
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NORMAL VS ABNORMAL SPECTRUM

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- ▶ FTIR spectra from natural raw milk samples is a unique finger print of normal milk



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UNTARGETED SCREENING MODEL

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- ▶ You can screen all milk samples against abnormalities. It will not tell you what is in the milk only if it is normal milk or not.
- ▶ Advantages untargeted model allows you screening for an unlimited number of unknown potential adulterants within 10 - 30 sec.

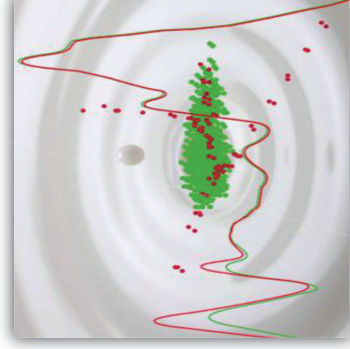


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READY TO USE MODEL FOR THE MILKOSCAN FT1

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- ▶ Ready to use model to screen against abnormal milk in raw cow milk.
- ▶ Before starting the screening of your milk you need to consider;
 - ▶ Number of false positive and negative results
 - ▶ How to make confirmatory tests
 - ▶ What to do with the milk in the truck



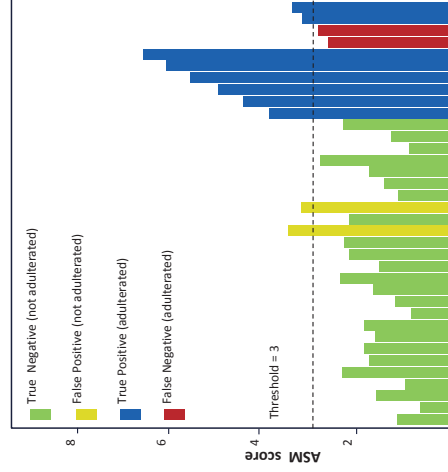
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NUMBER OF FALSE POSITIVE AND NEGATIVE RESULTS

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- ▶ The output from the model is an ASM Score.
- ▶ If $ASM\ score > threshold$, the new sample is classified as abnormal



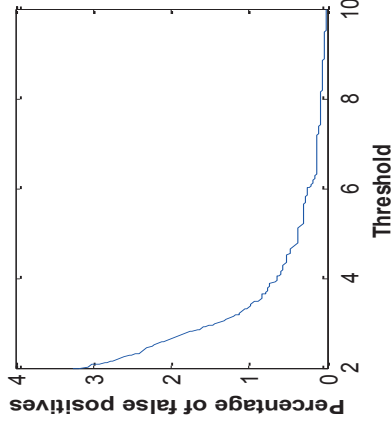
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NUMBER OF FALSE POSITIVE AND NEGATIVE RESULTS

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- ▶ The graph shows the effect of changing the threshold in the model.
- ▶ A threshold on 3 corresponds to a false positive rate of 1.5% whereas a threshold on 5 corresponds to a false positive rate of 0.4%.



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WHAT CAN BE SCREENED AGAINST WITH THE UNTARGETED MODEL?

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- ▶ The table shows the Limit of Detection for the adulterants which could be detected as abnormal by the model.
- ▶ The LoD's correspond to a threshold of 3.

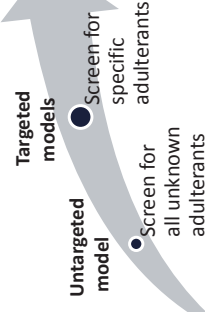
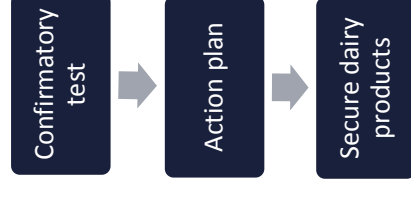
Adulterant	LoD	LoD Adulterant	LoD	LoD Adulterant	LoD
Allantoin	300 ppm	Cyanuric acid	170 ppm	Sodium bicarbonate	400 ppm
Amidourea	500 ppm	Cyromazine	300 ppm	Sodium hydroxide	0.06 %
Aminotriazine	800 ppm	Dicyandiamide	300 ppm	Sodium nitrite	200 ppm
Ammonium nitrate	200 ppm	Formaldehyde	400 ppm	Thiourea	500 ppm
Ammonium sulphate	300 ppm	Hydroxyproline	900 ppm	Triuret	800 ppm
Biuret	600 ppm	Maltodextrine	1100 ppm	3-aminotriazole	1100 ppm
CIP agent	1%	Melamine	300 ppm	4-aminotriazole	1400 ppm

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SECURITY SCREENING IN 30 SECONDS

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Rapid inexpensive screening of your milk

FOSS GOODPRODUCT - A STRONG VISION



GoodProduct™

Tools to secure an effective and safe supply chain

