Agenda

1. *DHI Global Trends*
   - *FOSS track record*
   - *Challenges in modern dairy farming*
   - *Dairy Herd Improvement in Denmark and global perspective*
   - *Benchmarking Denmark and Taiwan*

2. *Healthy Dairy Products*
   - *Fatty Acids Profile for improved healthy dairy products*
   - *Free Fatty Acids – for milk quality*
   - *Future perspectives*

Fatty Acids Profile

Why is Fatty Acid profile interesting:

- Consumers want to get the right fat from their diet
  - The fat should be unsaturated rather than saturated
  - High cholesterol levels causes heart diseases
- The **dairies** need to offer **value added products** to stay profitable
- Improved nutritional image of milk

The Fatty Acid profile can be used for:

- Payment analysis of milk according to:
  - Unsaturated fatty acids
  - Saturated fatty acids
- The farmers can use the results to optimize the feed of the dairy herd regarding target amounts of unsaturated fatty acids in the raw milk
  - Short term by changes in the feeding
  - Long term by breeding in order to favor a specific fatty acid profile in milk

Good fats and bad fats

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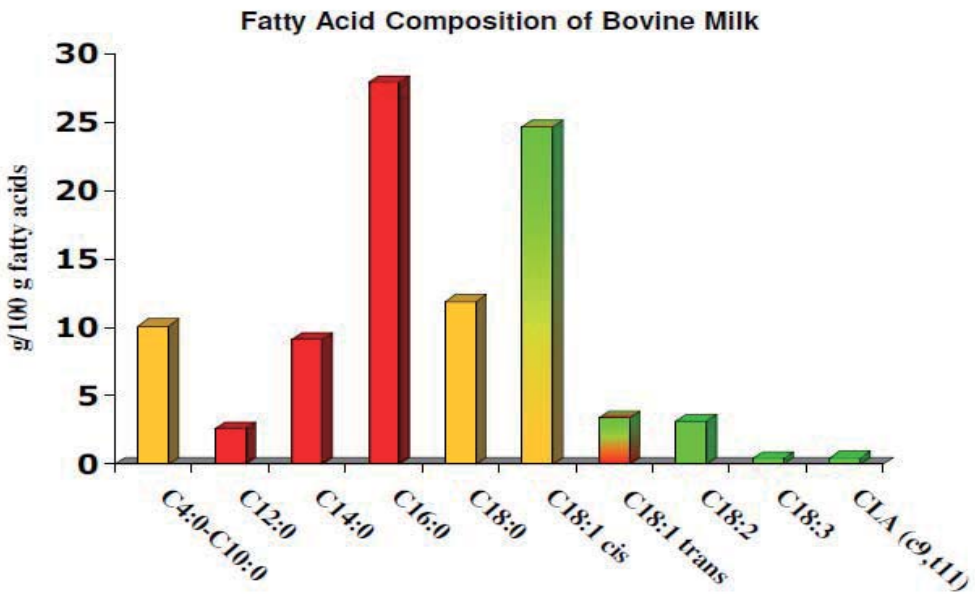

Source: Professor Andy Salter, University of Nottingham

Factors driving fatty acid profiles in milk

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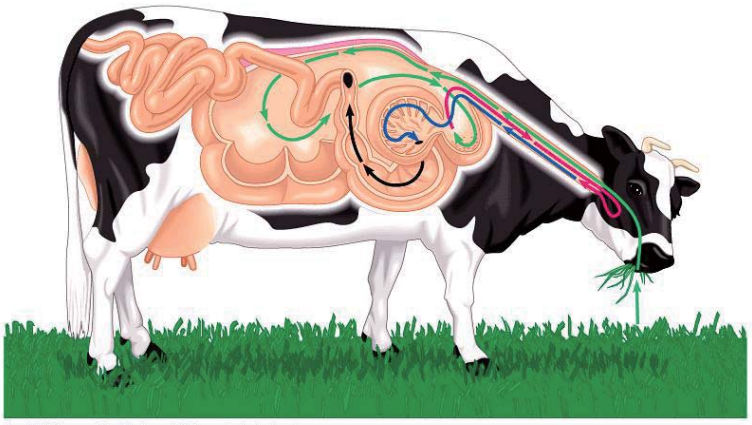
1. Ration
2. Body fat mobilisation
3. Genetics



International Dairy Federation

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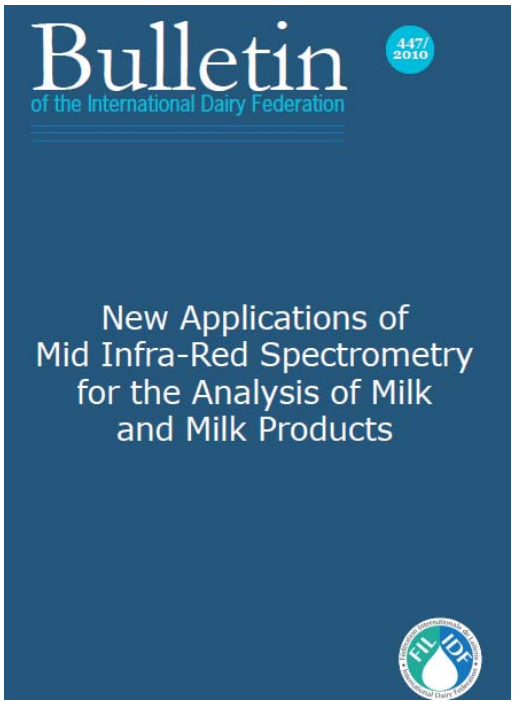
- **Published December 2010**
- **Analysis of results gained using different equipment in 11 different laboratories across Europe**
- **Assessment of accuracy, reproducibility and repeatability**



Great Britain has taken the lead

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MARKS & SPENCER

Launched in July 2011

Delivering:
- 6% less saturated fat
- 84 tonnes of saturated fat removed from its customers diets each year
- Improved cow health and welfare (?)

MilkoScan FT+ Fatty Acids calibrations

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- Chain length
  - Short Chain Fatty Acids (SCFA): C4 + C6 + C8 + C10
  - Medium Chain Fatty Acids (MCFA): C12 + C14 + C16
  - Long Chain Fatty Acids (LCFA): C18
- Degree of unsaturation
  - Saturated Fatty Acids (SFA)
  - Mono Unsaturated Fatty Acids (MUFA)
  - Poly Unsaturated Fatty Acids (PUFA)

- Major fatty acids
  - C14:0
  - C16:0
  - C18:0
  - C18:1 total

Based on samples from 4 countries and validated on samples from 5 countries
Ring trial including 7 laboratories for GC analysis.

Type of Fatty Acids		Features
Short Chain Fatty Acids (SCFA) (saturated only)	C4:0 – C10:0	**13-15%** of total fatty acids in milk. Present in milk products only Positive properties only found , - no negative reported Positive influence on body weight, cholesterol in blood and cancer
Medium Chain Fatty Acids (MCFA) (saturated only)	C12:0 –C16:0	**35-45%** of total fatty acids in milk (many plant products are higher May lead to increased risk of cardiovascular diseases. Only malicious if consumed in excess amounts
Long Chain Fatty Acids (LCFA) (saturated only)	> C16:0	**10 – 15%** of total fatty acids in milk Neutral influence on cardiovascular diseases No negative impact on human nutrition >C18 used in nervous structures

Table 1: Features and benefits of the short, medium and long chained saturated fatty acid in human diet, according to presentation from Professor Philippe Legrand Un. Of Rennes.

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FFA in dairy products and suppliers milk

Free Fatty Acids is the result of "Lipolysis", which is an enzymatic process in the milk

Problems caused by higher FFA levels:

- Rancidity in high-fat dairy products i.e. butter, cream
  (FFA has a rancid and soapy taste and smell)
- High levels of FFA influences the shelf life
  (i.e. reduced shelf life of milk powder products)
- Affects/reduce cheese yield
  (FFA is not included in the coagulum)

Why test suppliers milk:

- Farmers, who deliver milk with high FFA, can be helped to correct the problem
- Raw milk with high FFA levels cannot be "repaired", the damage is done, and the enzymatic process continues
- The milk industry faces increasing competition, and must have more and more knowledge and control over the raw material ("Chain Management")

FFA influenced and maintained by:

- Adversely affect the flavour and quality of milk dairy products

Free Fatty Acids are influenced by:

- The mechanic treatment of the milk (milking machine design)
- Installation and operation
- The general hygiene/bacterial status of the milk
- Physiological status of the cow (stage of lactation, diseases, composition of fodder, seasonality etc.
- Milk handling on the farm and in the factory

Low FFA can be maintained:

- by well designed and monitored milking machines and bulk tanks
- by consistent balanced cow diets
- and by proper drying-off procedures

FFA Calibration and benefits with MilkoScan FT+

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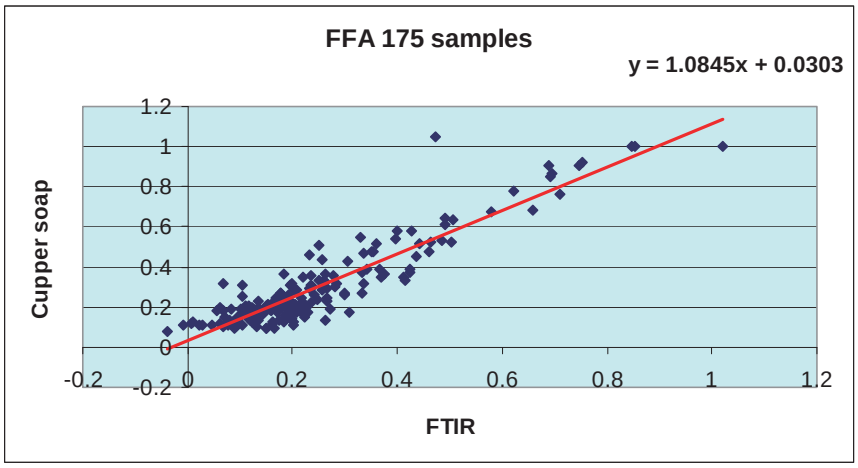
MilkoScan FT+ can be an excellent method for FFA-screening by:

- Reducing analysis costs
- Giving high test frequency and thereby a much better overall picture of FFA levels
- Saved time and costs if using BDI or cupper soap method today

Relatively few of the collected milk samples have elevated FFA levels, and cost per FFA positive sample is thus high. Unless an inexpensive and efficient screening method is used.



- Normal concentration of FFA in raw milk “ab farm” is < 0.7 mmol FFA / 100g Fat
- Sound cow’s milk contains ~0.5 mmol FFA/100 g Fat
- FFA > 1 mmol FFA / 100g Fat is considered abnormally high / ‘defective’

Countries measuring Free Fatty Acid

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FFA is today measured in:

- **The Netherlands**
- **Norway**
- **France**
- **Belgium**
- Japan
- Italy
- UK
- Canada
- USA
- Denmark
- Spain
- Brazil
- The Czech Republic

} FFA included in Payment Scheme

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What can FTIR offer us today?

- Mid-Infrared (MIR) spectroscopy has been available since the 1970's as a rapid method for routine measurements of the main constituents in milk (fat, protein, carbohydrates)

- Fourier Transform Infrared (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, freezing point depression

  - New parameters
    - Fatty acids
    - Ketosis screening (BHB and acetone)
    - Abnormal Milk Screening

Potential new parameters

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- Many research projects are actively researching new parameters from FT-IR:
  - CRA-W, Agramir, Phénofinlait, OptiMIR, Robust Milk, University Padova and many more
  - FOSS are involved in some of above projects and in several other projects with key customers
- Numerous publications are available
- Some of the new potential parameters are
  - Milk coagulation properties
  - Pregnancy confirmation
  - Protein composition
  - But there are many more!

Future challenges and opportunities

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- We have already covered measurements where an easy ”copy-and-paste” of a reference method to FT-IR is possible
  - It now becomes more challenging – but not impossible to develop new parameters based on what FT-IR is capable of
  - Sometimes the uncertainty of the reference method is the problem
- Accuracy is not necessarily everything
  - Classification only requires good accuracy close to the classification limit
  - Semi-quantitative models are possible for low concentration constituents
- Combine FT-IR with other analytical info
- Learning from Herd Navigator
- Combine with other relevant herd management
- information?
- Looking at trends by following the individual cow?
- More frequent samples?

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Thank You!

Dedicated Analytical Solutions