FOSS

” Challenges in modern dairy farming”

DHI Workshop

Tainan, Taiwan 8 May 2012

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CMT Market Manager, FOSS Denmark

Dedicated Analytical Solutions

Agenda

1. *ICAR sub-committee on milk analysis -a survey*

2. *Introduction to Dairy Herd Improvement*
   - *Global perspective and Denmark*

3. *Challenges in modern dairy farming*
   - *Decease prevention*
     - *Mastitis & Ketosis*
   - *Feeding*
     - *Urea & Fatty Acids Profile*

4. *What can FTIR offer us today and are the potential future parameters?*

5. *Herd Navigator –a proactive Herd Management System*

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Terms of reference

1. Contribute to adequate analytical performance quality for milk recording purposes world wide that does allow valid comparisons between ICAR countries.

2. Monitor the development of reference document and standards on methods of milk analysis and quality assurance in laboratories applicable to milk recording.

3. Maintain a frame for analytical quality assurance of milk testing laboratories through recommendations to ICAR member organisations and an international network of reference laboratories.

4. Monitor the development of instruments for milk analysis of interest for milk recording and equipment related to milk recording analysis (sampling, in-farm analysis, data capture/transfer). In doing so the Group should keep in contact with manufacturers, ICAR Sub-Committees and Working Groups in those areas.

5. Advise ICAR on new developments in the field of analytical methods, analytical quality assurance and milk testing laboratories.

6. Establish and maintain liaisons with international organisations / bodies involved with milk analysis issues dealt by ICAR, in particular IDF and ISO.

ICAR sub-committe on milk analysis

- Membership
  - 11 members (FR, DE, NL, NO, IL, IT, NZ, US, ZA,CY & AR)
  - Observers can attend meetings and give contributions to the work
- Publishing
  - Guidelines for QA in DHI analysis
  - Guidelines for on-farm milk analysis
  - Protocol for the evaluation of milk analysers for approval
  - Analytical methods for milk recording analysis
    - Reference methods
    - Standardized routine methods
    - Analytical instruments
  - Newsletters
- Making questionaires & arranging analytical brainstorm workshops
- Reference Laboratory Network (see next slide)

ICAR Reference Laboratory Network

ICAR Reference Laboratory Network — **Composition and national roles at the date of 12/12/2011** — **41 members**

COUNTRY	TOWN	NAME	NRTO	RMS	MLCC	TLT	IAM	EAMI	RAM	NRCA	DHIA	PAYMENT	Other	Member
ARGENTINA	SAN MARTIN	INTI-CITIL	c	c	c	c	c	c	c	c				+
AUSTRIA	ST MICHAEL	Milchprüfring Sbd									c g x	c g x		+
BELGIUM	MELLE	C.L.O. - Gent / D.V.K.	c	c	c	c	c	c	c	c	c	c		+
BELGIUM	GEMBLOUX	CRAG - DGPA	c	c	c	c	c	c	c	c				+
CANADA	STE ANNE DE BELLEVUE	Valacta		c	c		c	c		c g x	c g x	c g		+
CROATIA	ZAGREB	R.L.M.D.S.	c g x	c g x	c g x	c g x	c g x	c g x	c g x				c g x	+
CYPRUS	NICOSIA	C.M.I.O.									c g x	c g x		+
CZECH REPUBLIC	VIKYROVICE	R.I.C.B.	c	c	c g x	c g x	c g x	c g x	c g x	c			c	+
DENMARK	HOLSTEBRO	Eurofins Steins Lab A/S	c	c	c	c	c	c	c		c	c	c	+
ESTONIA	TARTU	E.A.R.C.		c						c	c	c		+
FINLAND	VALIO	VALIO R&D	c			c	c		c					+
FRANCE	POLIGNY	ACTILAIT / CECALAIT	c g	c g x	c g x	c g x	c g x	c g x	c g x	c g x				+
GERMANY	KIRCHHEIM	Zentrallabor MPR									c g x	c g x		+
GERMANY	BONN	DLQ	c	c		c g x	c g x							+
HUNGARY	GODOLLO	L.P.T. Ltd									c			+
IRELAND	FERMOY	D.P.R.C. Teagasc	c	c	c	c	c	c	c	c				+
ISRAEL	CAESARIA	I.C.B.A.		c g x	c g x		c g x			c	c	c g x		+
ITALY	MACCARESE	AIA-LSL	c s b	c g s b	c g s b		c g s b	c g s b	c g s b	c g s b				+
JAPAN	TOKYO	J.D.T.A.	c	c	c	c	c	c	c	c				+
KOREA	GOYANG SHI	N.A.C.F.			c	c	c							+
LATVIA	RIGA	IFSAHE / SIOR	c	c	c	c	c g	c g	c					+
LATVIA	ULBROKA (RIGA)	Piensaimnieku Laboratorija		c							c g	c g		+
LITHUANIA	KAUNAS	Pieno Tyrimai	c		c	c	c	c		c	c g x	c		+
NETHERLANDS	ZUTPHEN	M.C.S.	c	c		c g x o	c g x o	c g	c g		c g	c g x o		+
NEW ZEALAND	HAMILTON	Tatitrik									c			+
NORWAY	OSLO	TINE R&D		c g	c g	c g	c g	c g	c g					+
POLAND	PRUSZKOW	K.C.H.Z. - Lab Oceny Mleka	c	c						c				+
SLOVAK REPUBLIC	NITRA	R.I.A.P.		c		c	c		c g x					+
SLOVENIA	DOMZALE	Ljubljana University	c	c	c g x	c g x	c g x	c g x	c g x				c	+
SOUTH AFRICA	ELSENBURG	ANPI D.L.		c			c		c					+
SOUTH AFRICA	OLIFANSFONTEIN	N.I.Q.L.			c						c	c		+
SOUTH AFRICA	IRENE	LACTO LAB		c							c			+
SPAIN	SANTANDER	Lab. Agroal. Santander	c g x			c g x	c g x			c g x				+
SWEDEN	JÖNKÖPING	Eurofins Steins Lab AB	c		c	c	c	c			c	c		+
SWITZERLAND	BERN	S.F.R.L.	c g x	c		c	c g x	c g	c g x					+
TUNISIA	SIDI THABET	L.C.P.									c			+
TUNISIA	BEJA	L.C.P.									c			+
UNITED KINGDOM	WOLVERHAMPTON	Direct Lab.		c										+
USA	FAIRLAWN	Eastern Lab Services		c	c	c		c			c	c		+
USA	ITHACA	Dairy One M. A. Lab		c	c				c					+
ZIMBABWE	HARARE	Z.D.S.A.	c			c	c							+
		Number	25	27	21	24	26	19	19	14	19	14	4	41
		Percentage	61	66	51	59	63	46	46	34	46	34	10	100

NRTO = National Ring Test Organiser — RMS = Reference Material Supplier — MLCC = Master Laboratory for Centralised Calibration — TLT = Training in Laboratory Techniques

IAM = Information on Analytical Methods — EAMI = Evaluation of Analytical Methods/Instruments — RAM = Research on Analytical Methods

NRCA = National Regulatory Control of Analyses — DHIA = Dairy Herd Improvement Analyses — Payment = Analyses for milk payment

Membership = Officially nominated by ICAR National Committees — c = cow milk — g = goat milk — x = sheep milk — b = buffalo milk — o = other species

cow milk only — milk of different species

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5. *Herd Navigator –a proactive Herd Management System*

Central Milk Testing –an overview

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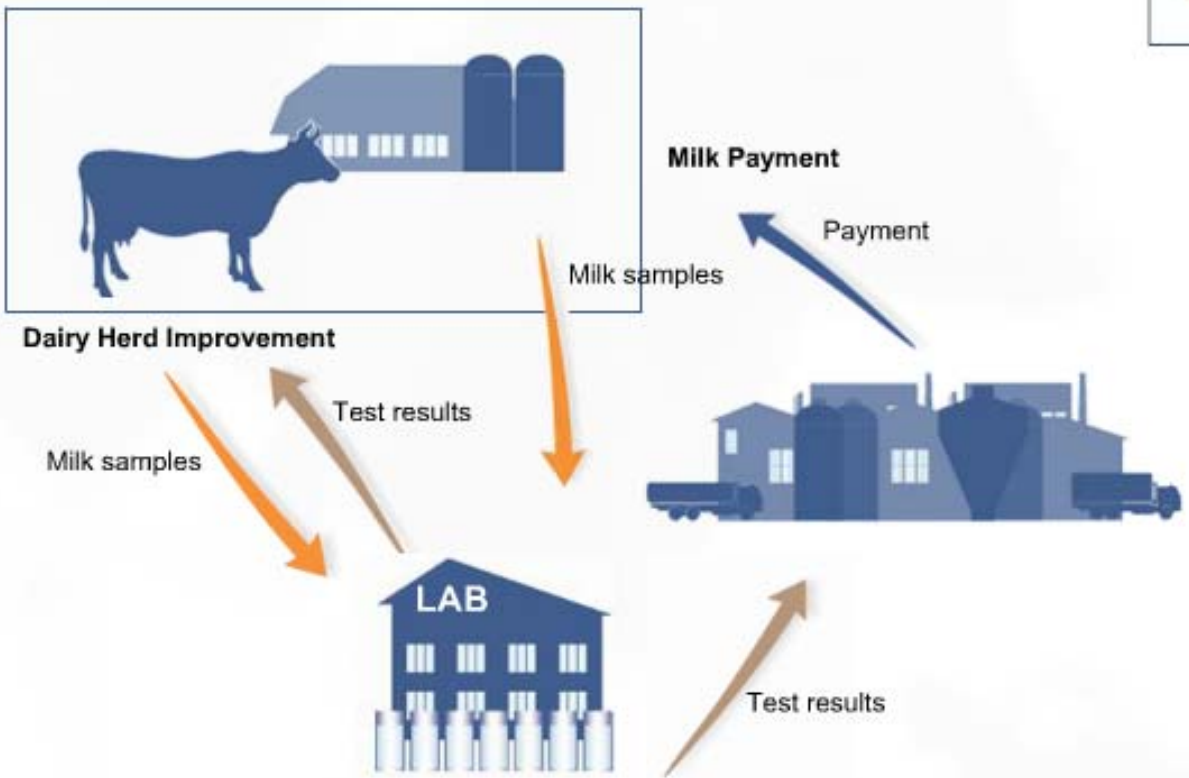
CMT – an overview



- Milk Payment
- Dairy Herd Improvement

Challenges in modern dairy farming

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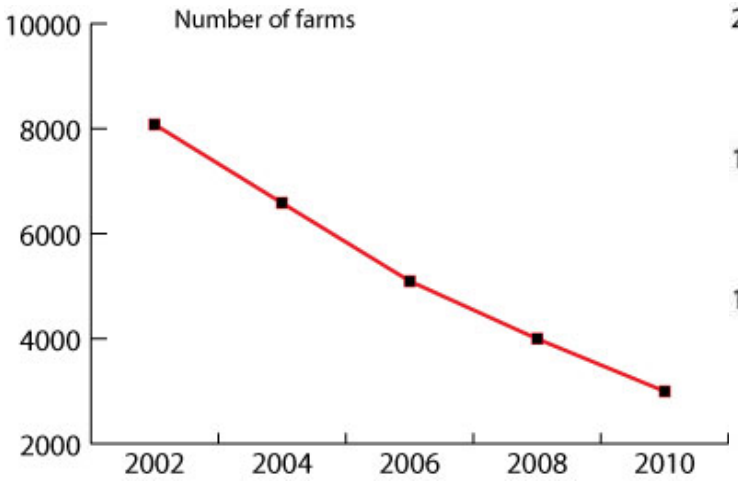
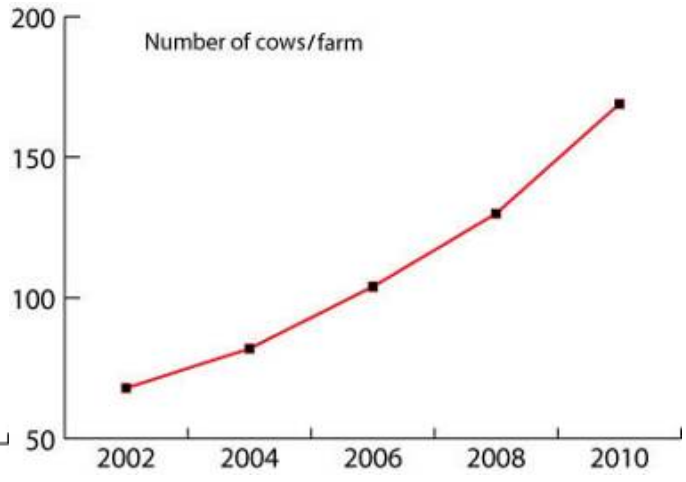
- Staying profitable
  - in spite of declining milk prices
- Ensuring professional and cost-effective farm operation
  - in spite of shortage of qualified labour
- Increasing productivity
  - in spite of stricter demands concerning animal welfare & environmental issues

Source: Danish Cattle Federation Presentation at Trilateral Meeting October 2005





DHI services

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Dairy Herd Improvement

Dairy Herd Improvement Association services

Tools

- Herd books
- Monthly recording of individual cow data
  - Yield
  - Fat, protein, urea, somatic cells
  - Health, insemination, calving
  - Testing typically once a month

Activities

- Advisory services to farmers
- Farm management services
- Breeding programmes
- Mastitis programmes

Effect of Dairy Herd Improvement

Effect of DHI programmes

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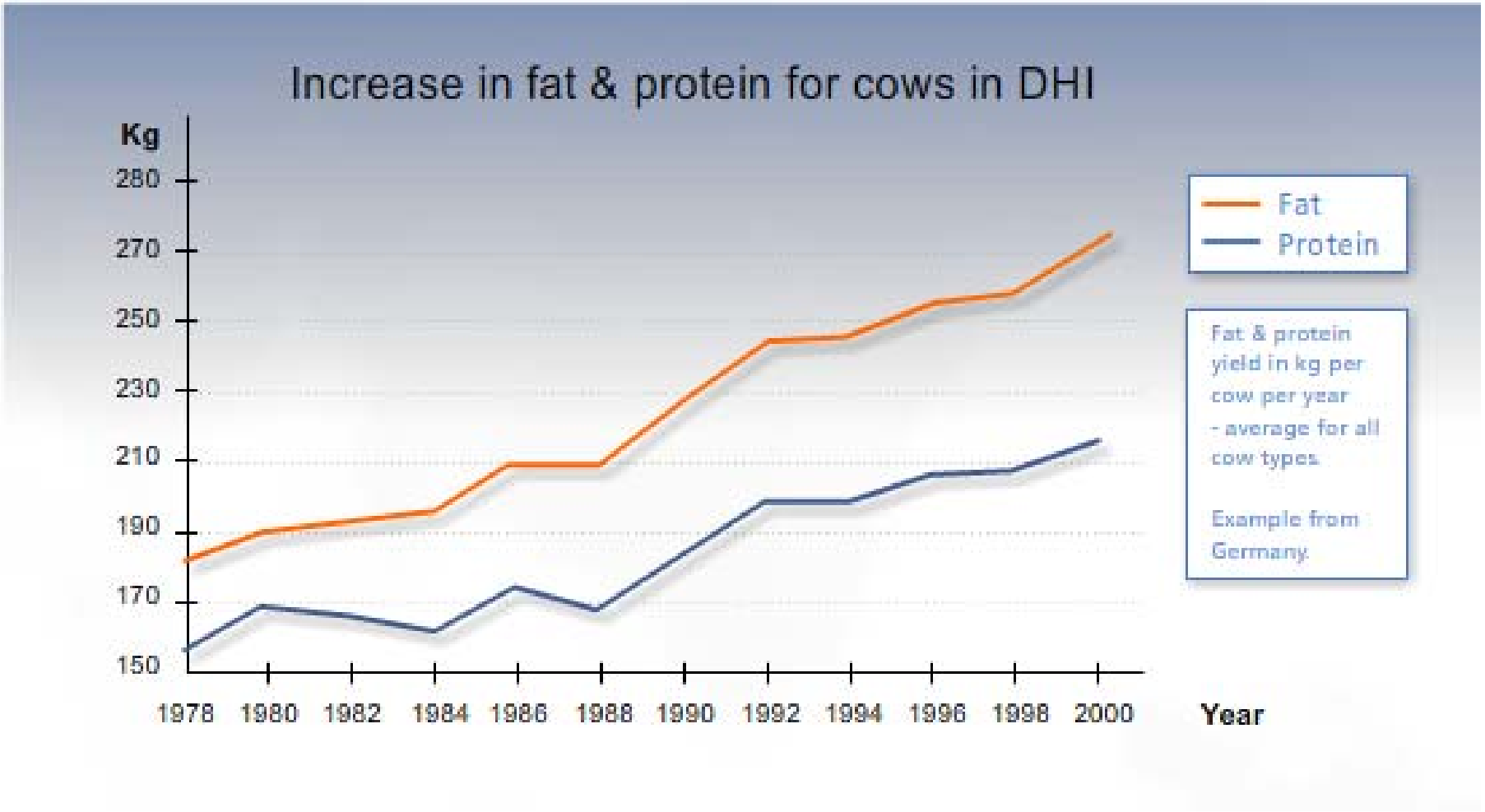
Country	No. of dairy cows	No. of herds	Average cows per herd	Average milk production per cow per year (kg)	% recorded cows in DHI	Milk yield per recorded cow per year (kg)
Australia*	1,700,000	7,953	214	5,414	46%	6,827
Austria	532,735	47,238	11	6,100	74%	6,841
Canada	981,000	13,214	74	8,642	72%	9,768
Chile	476,077	18,522	26	4,845	26%	8,013
Denmark	576,000	4,100	140	8,750	91%	9,079
Finland	287,200	10,920	26	8,349	79%	8,886
France	3,773,000	82,000	46	6,100	66%	8,221
Germany	4,181,679	91,550	45	7,113	84%	8,365
Korea	241,281	6,347	38	8,100	60%	9,500
India	40,000,000	-	< 5	< 1,000	< 0,01%	~ 2,500
Israel	101,393	671	151	11,667	91%	12,968
Japan*	985,200	22,300	44	8,011	58%	10,000
Mexico*	2,153,200	-	-	4,999	4%	-
New Zealand	4,396,675	11,691	376	3,759	64%	3,903
Poland	2,528,827	450,302	6	4,841	24%	7,000
South Africa	540,000	2,713	200	5,190	23%	6,417
USA	9,117,000	53,127	172	9,593	48%	10,218

** 2008 figures, All others are 2010 figures* Source: ***ICAR 2011***

Effect of DHI programmes –ex. Germany



Denmark DHI statistics as per March 2012

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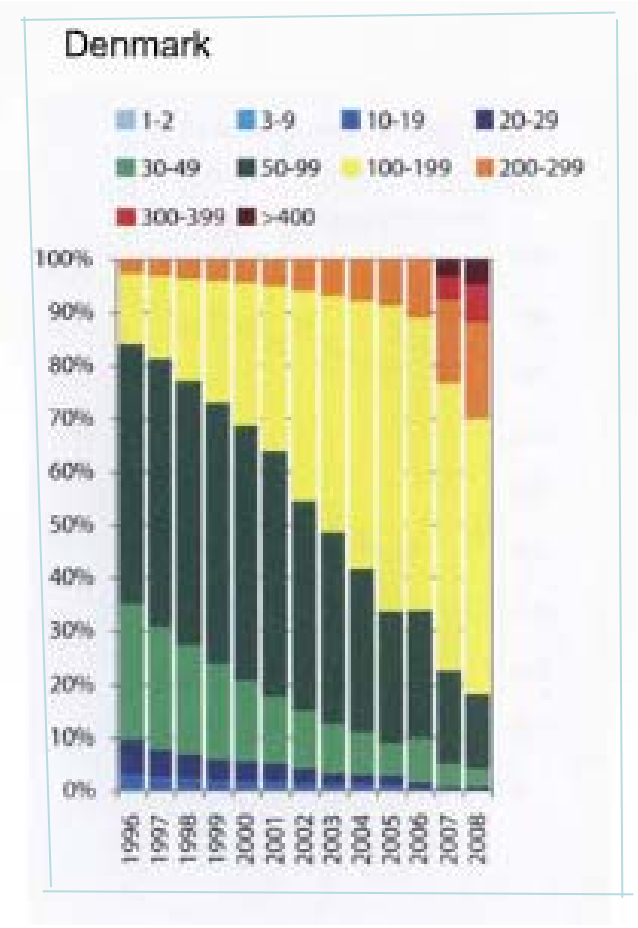
Latest figures from Danish DHI

• Number recorded cows	531.541
• Percentage recorded cows	91%
• Number farms	3.454
• Number of cows per farm	154
• Milk yield (kg)	8.907
• Fat	4,30%
• Protein	3,46%
• No farms > 400.000 SCC	33
• Recorded deceases per cow	1,8
• Recorded no mastitis instances	0,5
• B-control	77%
• A-control	12%
• 6 recordings per year	11%

Development in farm size 1996 -20108



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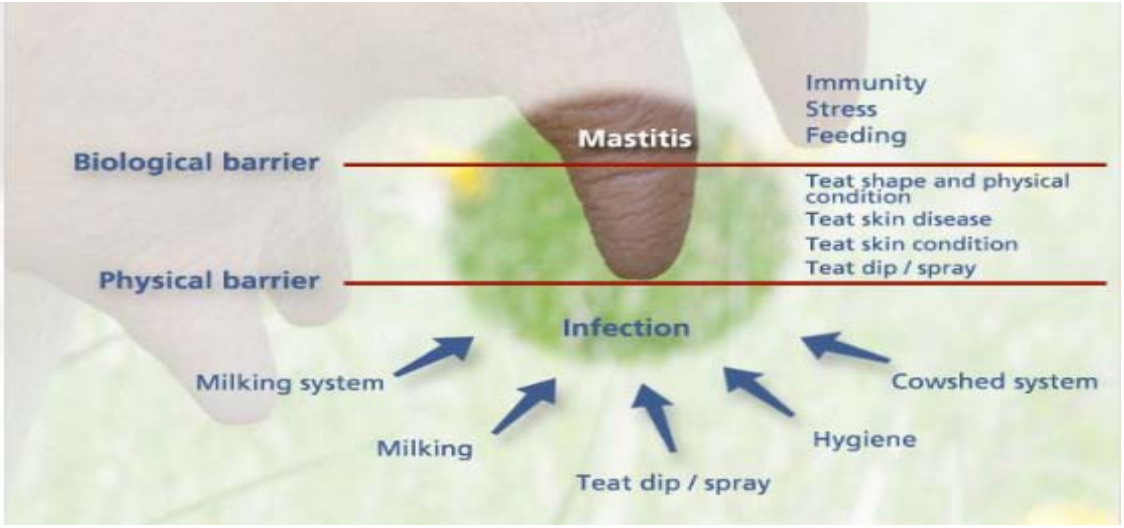
Farmers challenges

What is Mastitis?

- Is an infection of the udder caused by pathogenic bacteria
- In Denmark approx 50% of cows are treated every year
- Many factors are influencing mastitis
- Yield and composition are negatively affected



- Somatic Cell Count is used as a common indicator

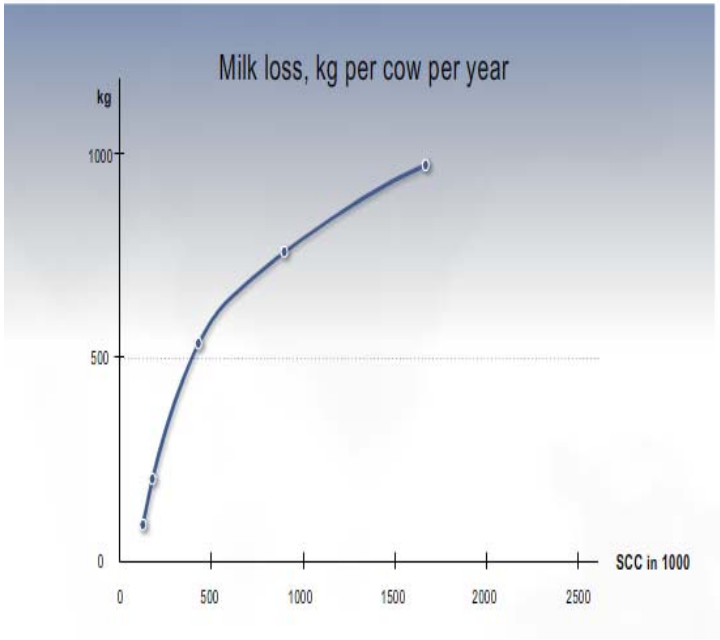
Low	Medium		High
< 200,000	200,000 - 400,000		> 400,000
SOMATIC CELL COUNTS	LOW	MEDIUM	HIGH
Mastitis risk Action	Maintain control measures	Check for chronic cows and corrective measures	Treat subclical mastitis cows

Mastitis consequences

Lower compositional value

Factor	Increase	Decrease	Effect for the Dairy
Fat		⇩	Economy
Free Fatty Acids	⇧		Taste problem
Total casein		⇩	Less cheese yield
Lactose		⇩	Economy
Sodium	⇧		Taste problem
Chloride	⇧		Taste problem
Calcium		⇩	Quality of the product
Lipase	⇧		Taste problem
Bacteria	⇧		Low quality and economy

Lost milk production



Clinical mastitis

- When a cow suffers from clinical mastitis changes in the milk can be seen and often the udder is swollen and the cow may have fever
- In general only a few cows suffer from clinical mastitis
- The farmer is happy! …*but?*

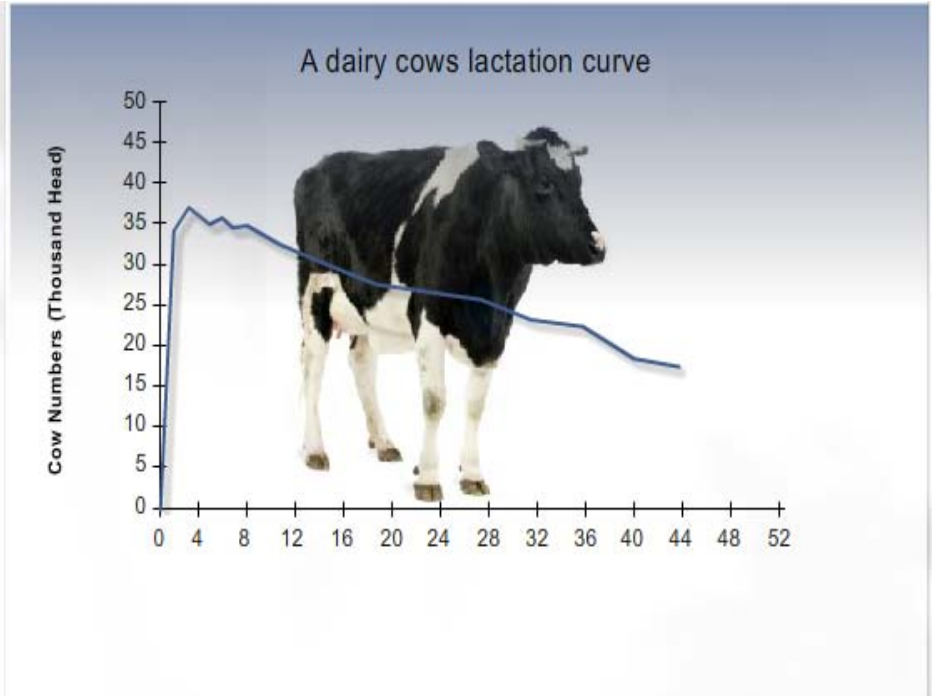
Sub-clinical mastitis

- If the farmer could see the sub-clinical mastitis he would be concerned and take action

- 70% of the total loss of milk production is due to mastitis
- Cost averages EUR 200 per cow per year - or more
- For every cow suffering clinical mastitis, there are 15 – 40 other cows with sub-clinical mastitis

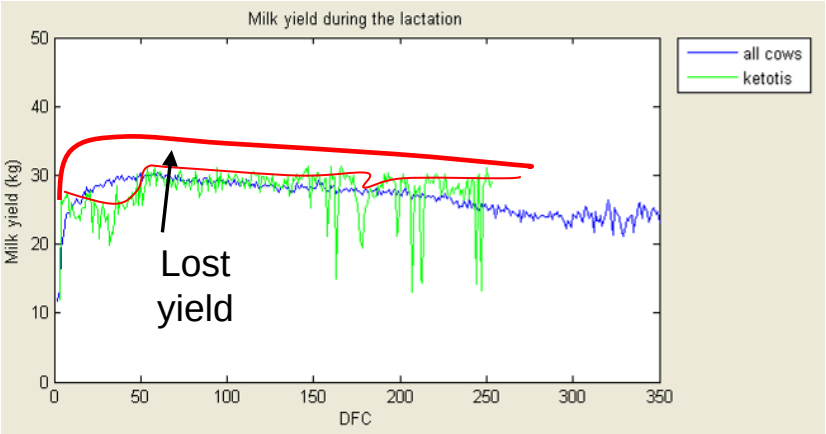
Ketosis, a metabolic disease hitting high yielding dairy cows

- Ketosis occurs when energy output (milk production) is too high compared to energy input (feed intake+ uptake from fat deposits)
- Primary ketosis occurs when too little feed (or too low energy concentration in feed) is offered to the cow.
- Secondary ketosis occurs if the cow stops eating (acidosis or other diseases) while still producing (too much) milk.
- In both cases energy uptake from fat deposits becomes too big, the turnover from fat to glucose in the liver too high, - and hence acetone and Beta Hydroxy Butyrate is excreted as residues.

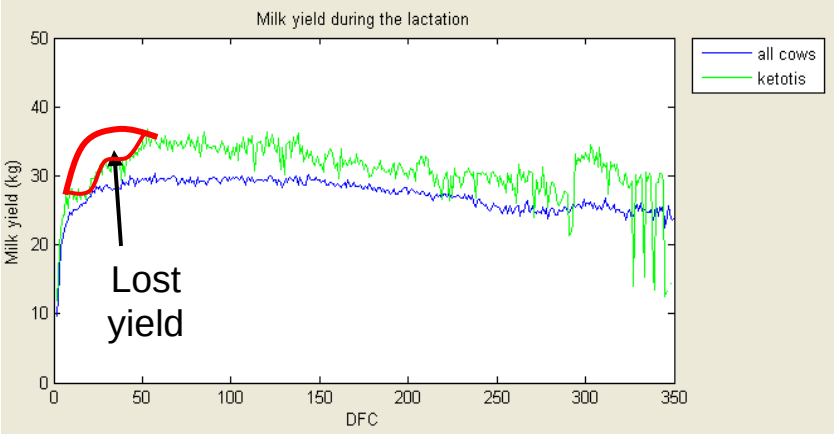


How costly is ketosis?

- Once a ketosis problem is detected in the herd it must be solved on herd level
- Strong requests from the DHI associations has urged FOSS to develop this calibration for MilkoScan FT+.
- Below examples are from two Herd Navigator farms (Lattec).
- We here learned that losses due to subclinical cases losses are bigger than earlier anticipated



Problem solved on cow level

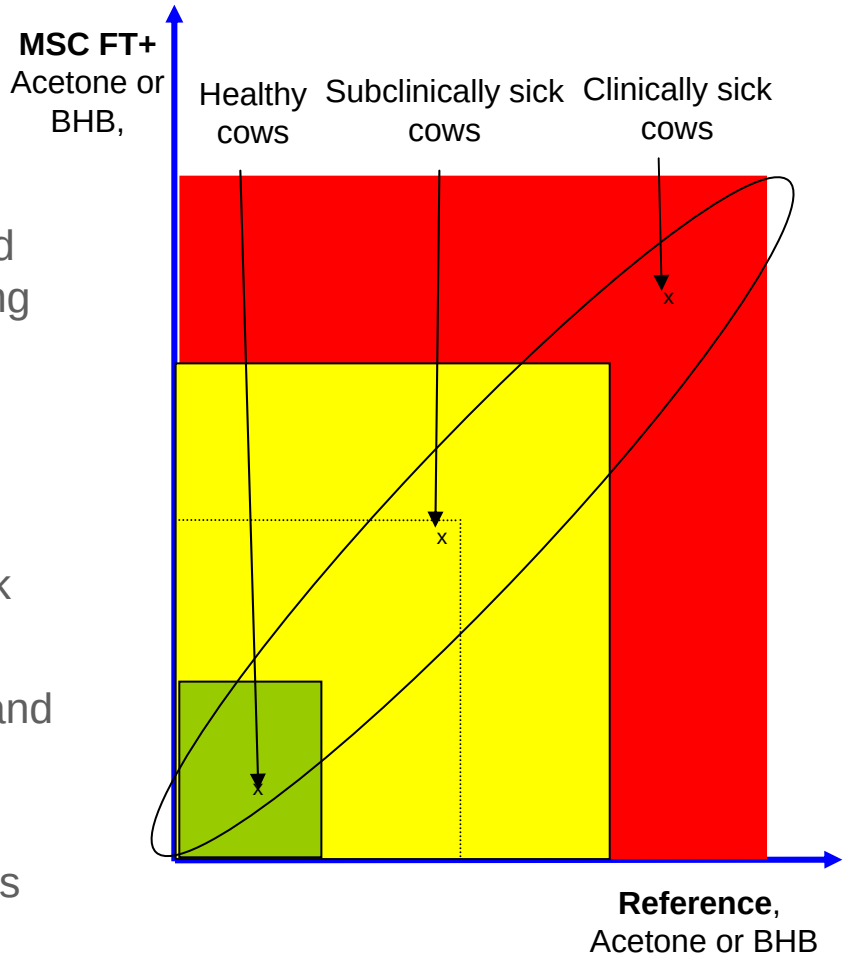


Problem solved on herd level

A ketosis calibration for MilkoScan FT+, - how can it be used?

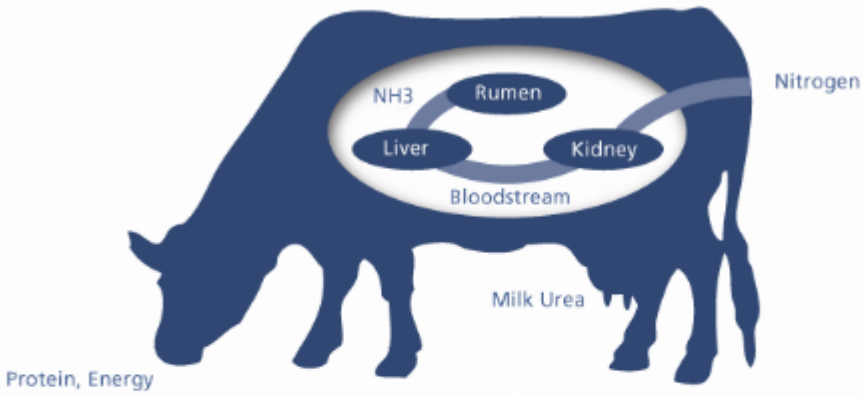
FOSS

- We know that acetone and Beta Hydroxy Butyrate in milk gives info about ketosis in the herd
- All DHI samples can now be screened for ketosis at very low costs (no sorting of samples)!
- The calibration is semi quantitative
  - The prediction model will be grading between healthy and sick
- There is a prediction model for BHB and for acetone
- Advisory service on how to use results must be in place



Optimise feeding by Urea

- It takes energy for cows to synthesise urea for excretion - this reduces the amount of energy available for milk production
- Less available energy may put early lactation cow at increased risk for ketosis
- High levels of urea is toxic to sperm and embryo and can result in infertility and repeat breeding
- High urea levels contribute to environmental contamination due to more urinary excretion of nitrogen



UREA is an end-product of protein metabolism. Protein which is not needed by the cow is broken down into ammonia which is toxic to cells. Ammonia is converted into urea by the liver and enters the blood stream for excretion into the urine. Urea diffuses into all tissues of the body and appears in the milk.

Consequences of over-feeding protein and high concentration of urea

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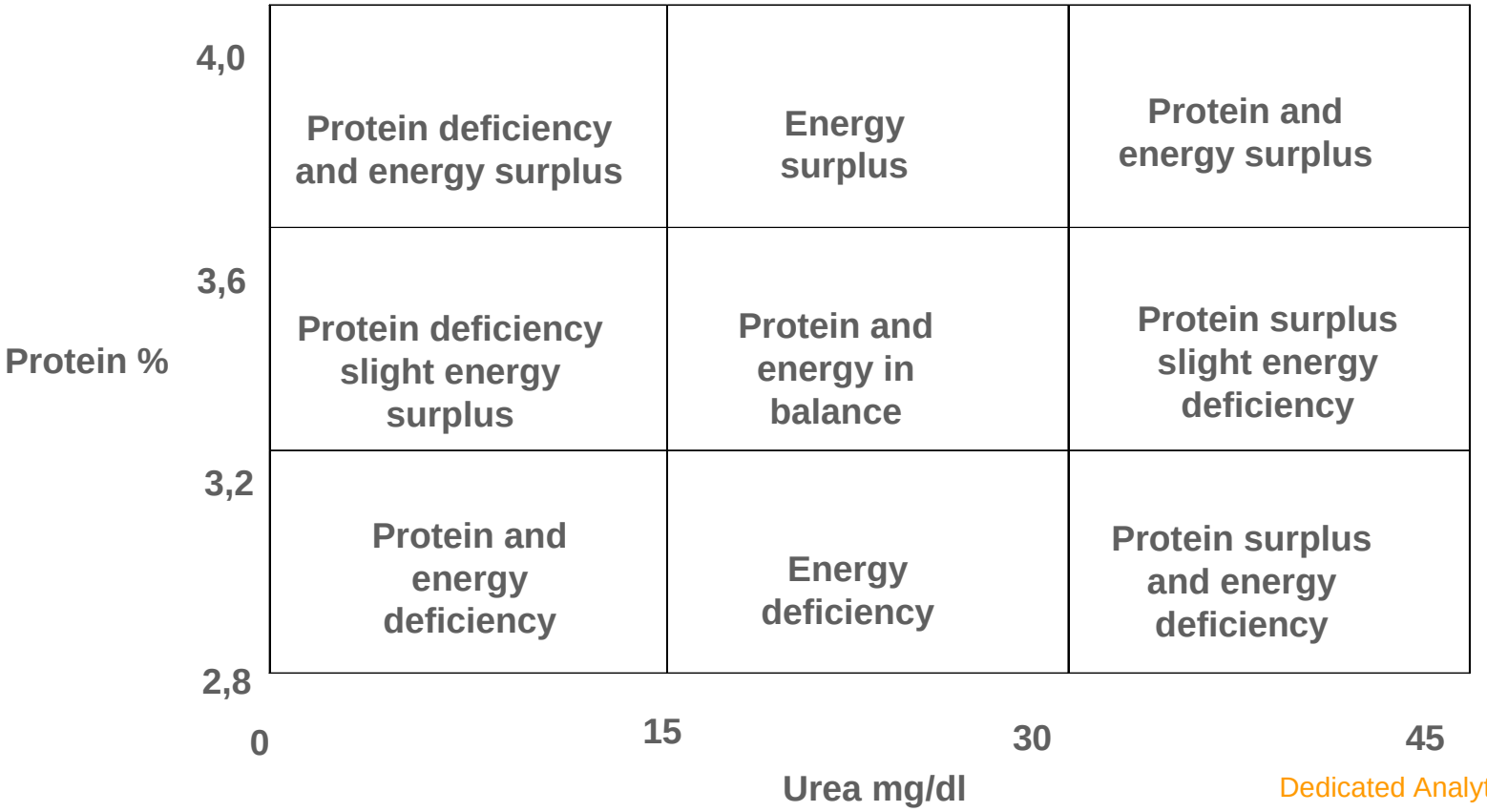
- High urea levels contribute to environmental contamination due to more urinary excretion of nitrogen

Urea information from DHI

When looking at the urea content in the milk an urea level of 15-30 mg/dl is medium balanced and also mean a balanced energy and protein ratio. If there is high urea content of > 30 mg/dl, the cow is fed too much protein. If there is a low level of urea < 15 mg/dl, the cow is fed too little protein.
It is important to look at groups of cows to determine their range and not focus on individual cows.



Urea information from DHI

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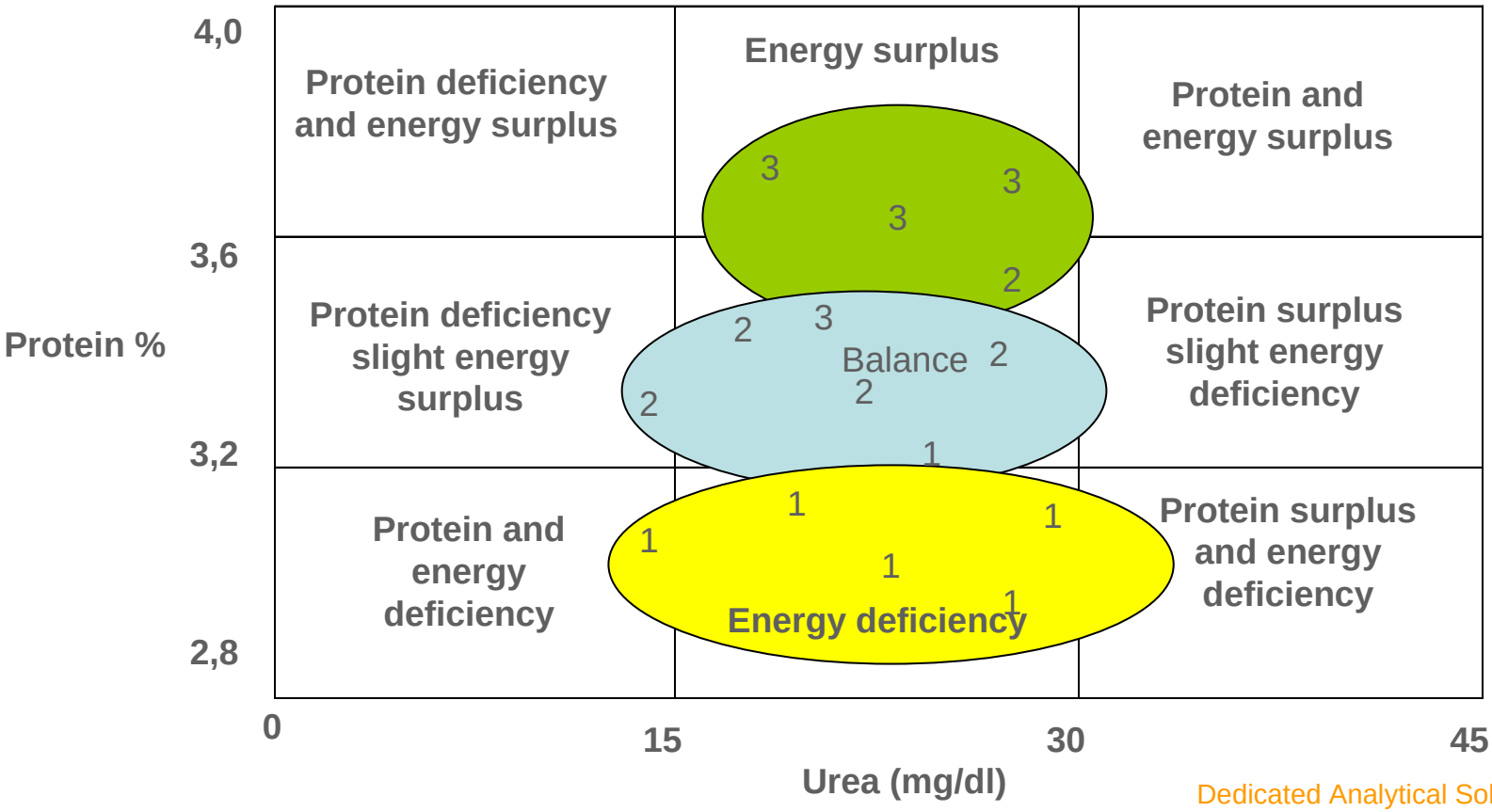
In the figure below, the numbers in the bobbles indicate the following:
1 = Cows with less than 100 lactation days
2 = Cows with 100 - 200 lactation days
3 = Cows with more than 200 lactation days



Why is Fatty Acid Profiling so interesting?

- Fat is not just fat!
- Improved nutritional image of milk
- Potential improvement of cow health and reproduction for the dairy cows
- Potential cut in emission of methane to the atmosphere

All leading to an improved image of milk

- This can be done in two ways:
  - Short term by changes in the feeding
  - Long term by breeding in order to favor a specific fatty acid profile in milk

Will fatty acids become a new payment parameter?

Fatty Acid Profiles, influence on milk composition

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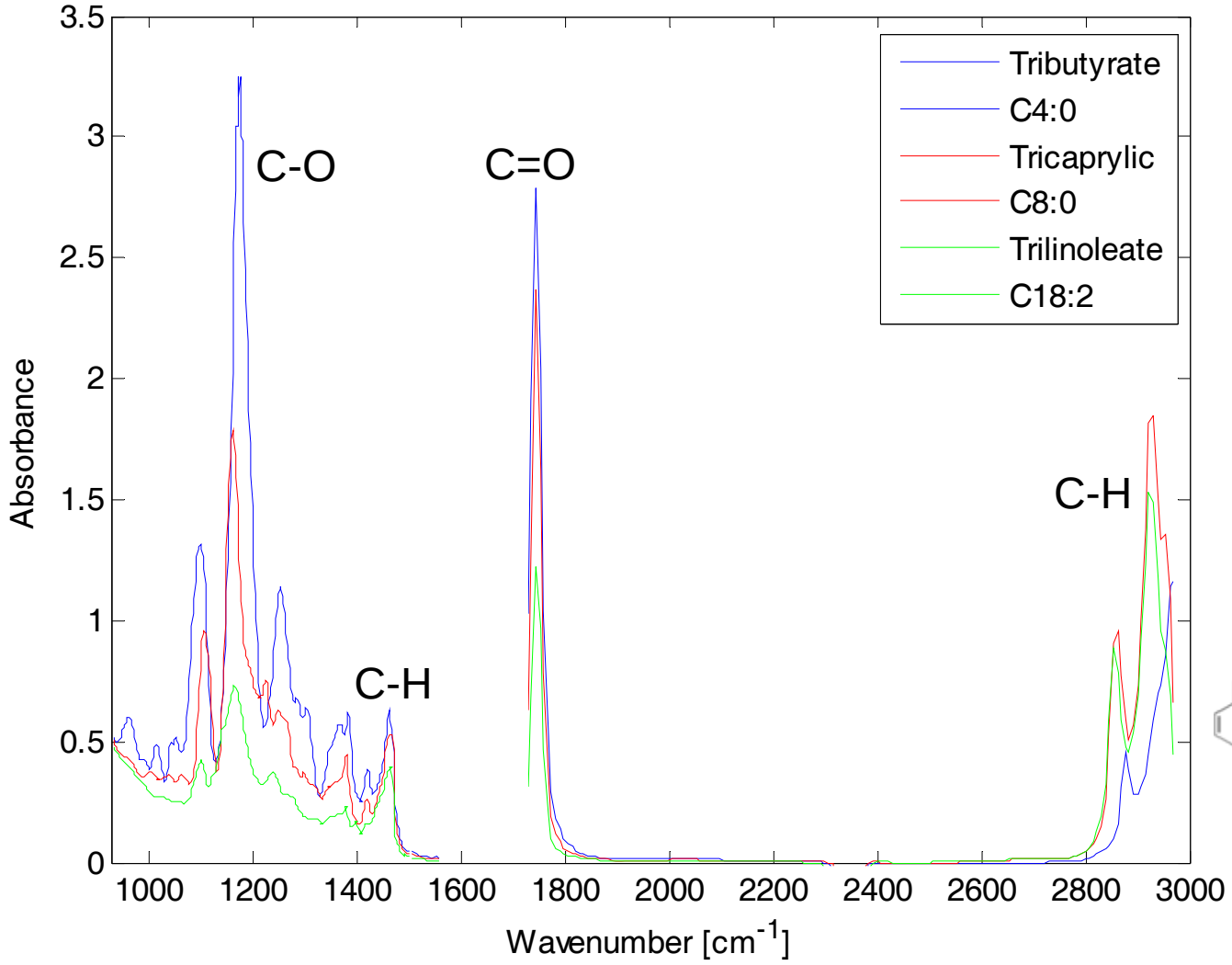
The pioneer:

A Dutch dairy decided to feed the cows with more linseed in order to achieve milk with more unsaturated fatty acids.

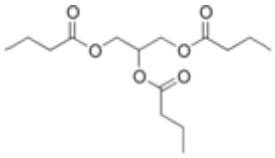
At first: A pilot project with 26 farmers
Later it was extended to 400 dairy farmers supplying 200 million liters of milk

The change in ration results in:
20% more unsaturated Fatty Acids
10% less saturated Fatty Acids
twice the amount of Omega 3

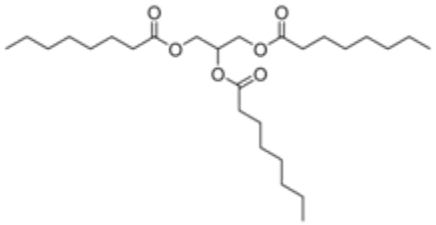
MilkoScan FT+ IR spectra of fat



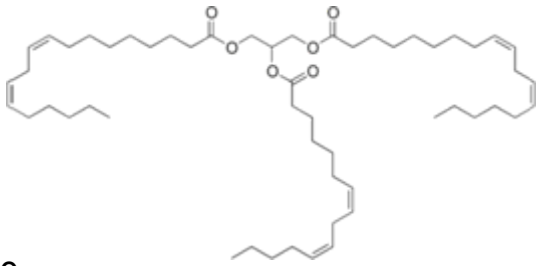
Tributyrate



Tricaprylic



Trilinoleate



MilkoScan FT+ Fatty Acids calibrations - new release

- 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)

- Cis and trans double bonds
  - Trans Fatty Acids

- 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.

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Management tools in the primary production

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The farmer needs analysis on individual cows in order to optimise milk payment, reproduction and to reduce feeding cost and losses due to diseases

- Feeding & management optimisation: fat, protein, urea & fatty acids
- Culling and breeding decisions: fat, protein & SCC
- Disease prevention -mastitis SCC
- Disease prevention -ketosis BHB & Acetone

What can FTIR offer us today?

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- 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

- 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
  - Titratable acidity
  - PH
  - Protein composition
  - But there are many more!

Future challenges and opportunities

- 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?

Agenda

1. *ICAR sub-committee on milk analysis -a survey*

2. *Introduction to Dairy Herd Improvement*
   - *Global perspective and Denmark*

3. *Challenges in modern dairy farming*
   - *Decease prevention*
     - *Mastitis & Ketosis*
   - *Feeding*
     - *Urea & Fatty Acids Profile*

4. *What can FTIR offer us today and are the potential future parameters?*

5. *Herd Navigator –a proactive Herd Management System*

Herd Navigator™

Pro-active Herd Management

Another visionary development from FOSS

DeLaval

We drive progress in milk production

FOSS

We deliver dedicated analytical solutions

lattec

FOSS

Herd Navigator monitors

Focus area	Parameter analysed in milk	Early / on time detection
Reproduction	Progesterone	Heat Silent heat Pregnancy Abortion Cysts Anoestrus
Udder health	LDH – lactate dehydrogenase	Mastitis Subclinical mastitis
Feeding and energy balance	Urea BHB – beta hydroxybutyrate	Feed ration – protein Ketosis Subclinical ketosis Secondary metabolic disorders

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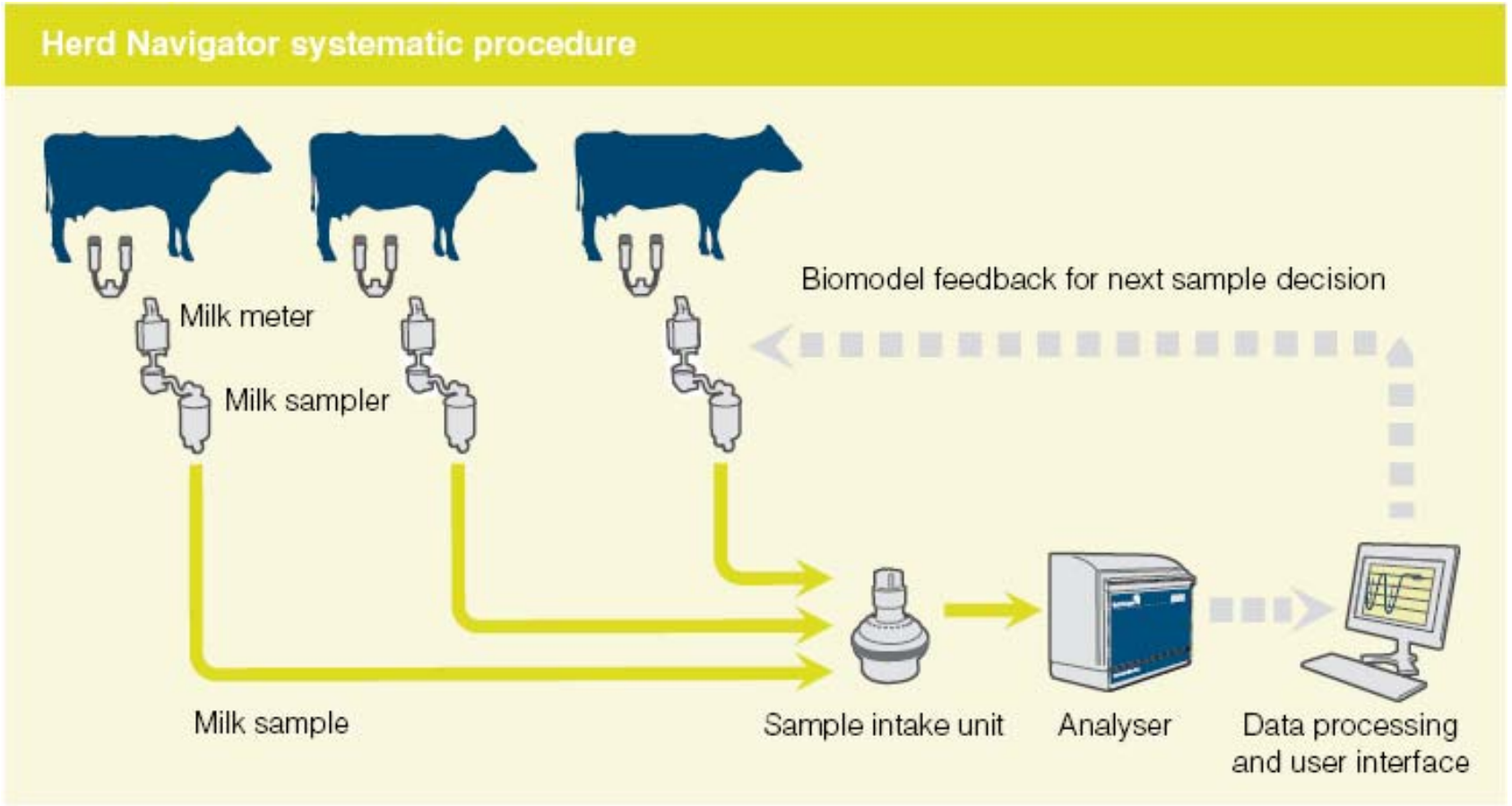
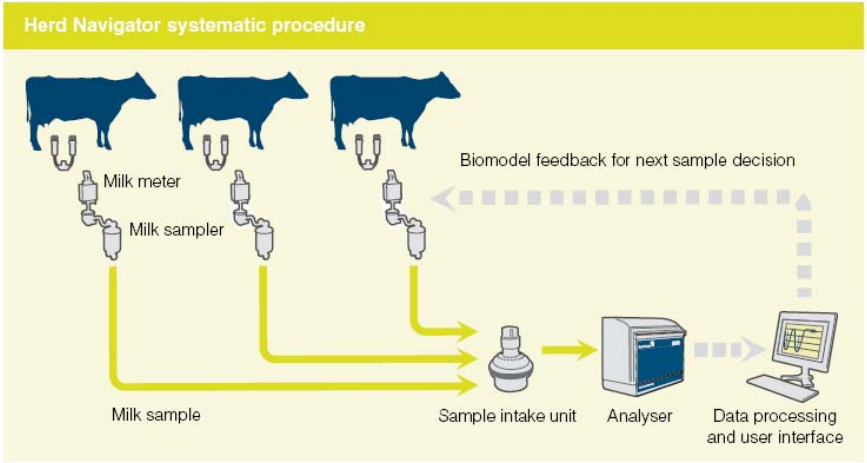
Herd Navigator flowdiagram



Implications for CMT



- Payment samples
  - will still be analysed at CMT
- Cow samples
  - new opportunities
    - Farmer/ veterinarian decides cow(s) to be sampled for special analysis at lab
    - Sample is
      - automatic taken during milking
      - marked electronically
      - send to CMT
  - Central Milk Testing lab analyze samples and provide results to farmer on-line
  - Farmer and veterinarian can independently access the results and decide proper action or treatment

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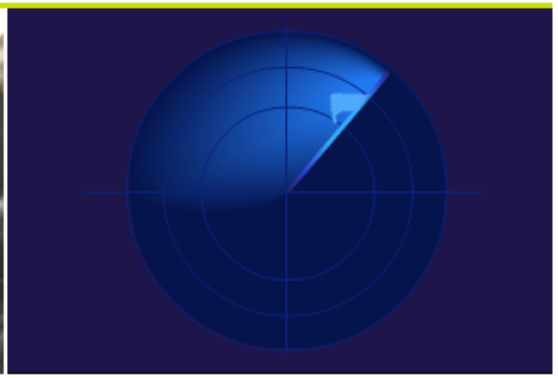
Herd Navigator™

About Herd Navigator | News | Questions & Answers | Contact | Partners



Herd Navigator™ is the future solution for the professional farmer who wants proactive herd management.

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The aim of Herd Navigator is to improve monitoring and intervention and therefore results in reproduction, udder health, feeding and feeding-related conditions.

Monitoring identifies cows which require special attention, and this can save time. At the same time, faster intervention may reduce the number of diseases, save costs and ensure optimal reproduction control. Finally, Herd Navigator can help improve animal welfare and documentation of production.

Herd Navigator is a revolutionary new concept which is being launched in a close and unique enterprise between the partners Dansk Kvæg, DeLaval and FOSS.

Herd Navigator is the winner of the "Gouden Hoof" price.

Herd Navigator is the winner of the "Gouden Hoof" (the golden hoof) price for the most innovative novelty presented on the Agribex 2009 fair in Belgium to be held December 1 to 6 2009

Click here to read more about the Agribex

DeLaval dansk kvæg FOSS

www.herdnavigator.com

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Thank You!

Dedicated Analytical Solutions