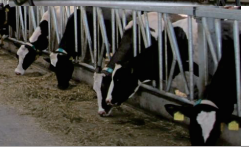
Dedicated Analytical Solutions

GLOBAL EXPERIENCE ON KETOSIS SCREENING BY FTIR TECHNOLOGY

D. Schwarz[1], D.M. Lefebvre[2], H. van den Bijgaart[3], J.-B. Daviere[4], R. van der Linde[5] & S. Kold-Christensen[1]

1 FOSS Denmark
2 valacta Canada
3 Qlip The Netherlands
4 Clasel France
5 CRV The Netherlands



FOSS

Dedicated Analytical Solutions

KETOSIS – THE HIDDEN DISEASE

- Ketosis is a frequently occurring metabolic disease
  - Mainly occurring in the early lactation – severe negative energy balance (NEB)
  - Mobilisation of body fat to compensate NEB → ketone bodies (i.e. acetone (Ac), β-hydroxybutyrate (BHB)) originate and accumulate
  - Major impact on future production, reproduction and overall health of the cow **(e.g., Opsina *et al.*, 2010; Duffield *et al.*, 2009)**
  - Cost per case of ketosis: $300 **(Mc Art *et al.*, 2015)**
- Diagnosis of subclinical ketosis:
  - No visible symptoms – need for measurement of ketone bodies in blood, milk, or urine **(Andersson, 1988)**
  - On-farm solutions: electronic hand-held blood BHB meters; high accuracy but labour-intensive **(Iwersen *et al.*, 2009)**

FOSS

Dedicated Analytical Solutions

SCREENING FOR SUBCLINICAL KETOSIS ON DHI SAMPLES

1999 • Fourier Transformed InfraRed (FTIR): Fast and inexpensive method for ketosis screening by predicting milk Ac **(Hansen, 1999)**

2006 • Joint project of CRV, FOSS and Qlip; development of milk Ac and BHB predictions; appropriate for herd level screening **(de Roos *et al.*, 2007)**

Ketosis screening service on Dairy Herd Improvement (DHI) samples:

2011 • Qlip, CRV and MCC Flanders, the Netherlands and Belgium; • Valacta, Canada

2012 • CLASEL, France

2013 • Polish Breeders Association, Poland; • Eurofins and Danish Cattle Federation, Denmark; • Tokachi DHI, Japan

2014 • CanWest DHI, Canada

2015 • AgSource, US

Under evaluation • DairyOne, US; • ARAL, Italy; • CIS, England; • LIGAL, Spain

Milk Ac and BHB values:
- **sensitivity (69 and 87%)**
- **specificity of 95%**

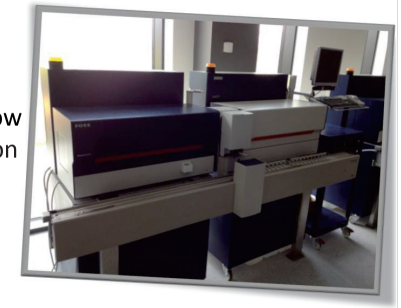
(de Roos *et al.*, 2007; Denis-Robichaud *et al.*, 2014)

FOSS

Dedicated Analytical Solutions

KETOSIS SCREENING – DHI LABORATORY

- Instrument: Milkoscan FT+ (FTIR) with FOSS calibration for Ac and BHB
- Establishment of method:
  - 2,000 milk samples, analysis by a segmented flow analyser and FTIR to build Ac and BHB calibration
- Maintenance of method:
  - Monthly analysis of 100 random samples (pilot milk) by reference method (Skalar)
  - Valacta and CLASEL: Validation of FTIR predictions
  - Qlip: no slope adjustment, no bias setting (original basic calibration established in 2006)



FOSS

Dedicated Analytical Solutions

DHI LABORATORY: CLASSIFICATION AND APPLICATION OF RESULTS

valacta

ACETONE/BHB CONCENTRATION		BHB (mM/l)
HIGH	Treat cow	≥0.2
MEDIUM	Observe cow	≥0.15-<0.20
LOW	No action	<0.15

RISK OF KETOSIS

As ketosis can often be a herd problem, a single alert gives the herd manager a timely warning to examine all early lactation cows.

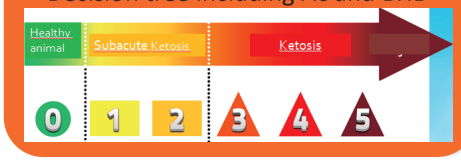
Qlip CRV

Combination of Ac and BHB values with:
- Fat: protein ratio
- Parity
- Month of milk recording

→ Binary (yes/no) score for ketosis for cows with DIM <60 only

CLASEL conseils et services en élevage

Decision tree including Ac and BHB

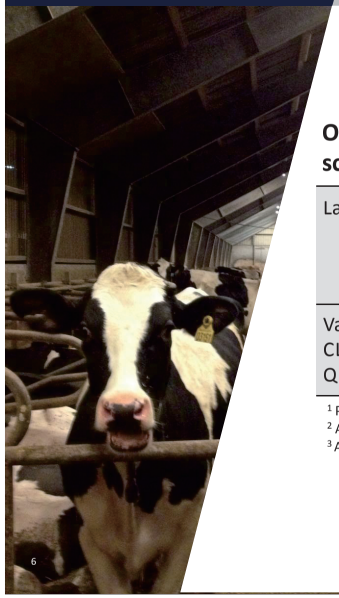


→ Presented for individual animals

FOSS

Dedicated Analytical Solutions

KETOSIS SCREENING IN PRACTISE



Overview on the proportion of samples, farms and cows under ketosis screening from January 1, 2012 to December 31, 2014.

Laboratory	Total number of DHI samples analysed	Proportion of samples with milk BHB analysis (%)	Proportion of farms using ketosis screening (%)	Proportion of cows under ketosis screening (%)
Valacta	7,600,000	54	71[1]	54
CLASEL	9,600,000	100[2]	48	51
Qlip	35,000,000	100[3]	85	90

[1] Proportion of farms that used the service for at least one test-day
[2] Ac and BHB values were predicted for all samples, but reported back to farms enrolled for CetoDetect® only
[3] All milk recording samples; however, just reported back for cows with days in milk<60

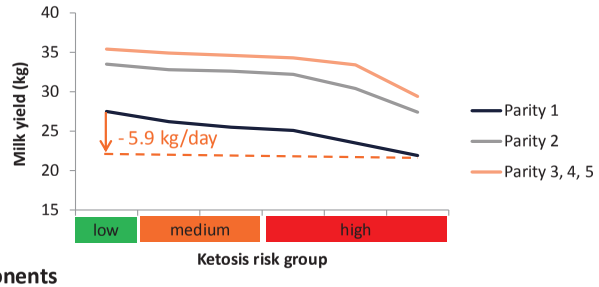
FOSS

Dedicated Analytical Solutions

KETOSIS IMPACTS PRODUCTION

valacta

Average milk yield depending on risk of ketosis



Impacts on Test Day Milk Yield and Components

	Ketosis risk group				
	low	med	high	SE	P
Milk yield (kg/d)	32.5[b]	32.3[b]	30.1[a]	0.2	0.001
Fat (%)	4.10[a]	4.62[b]	5.07[c]	0.02	0.001
Protein(%)	3.25[c]	3.17[a]	3.19[b]	0.01	0.001
Fat:protein ratio	0.82[c]	0.71[b]	0.65[a]	0.01	0.001

CLASEL conseils et services en élevage

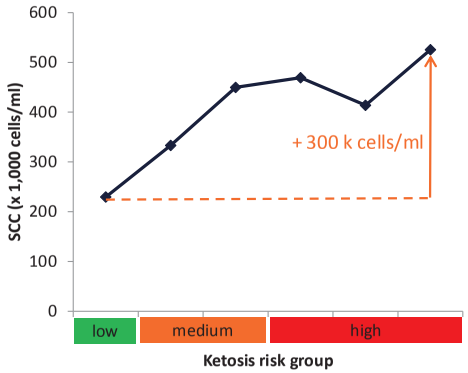
FOSS

Dedicated Analytical Solutions

ASSOCIATION WITH OTHER DISEASES

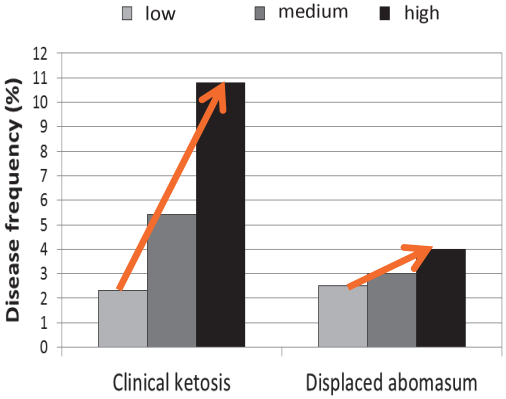
CLASEL conseils et services en élevage

SCC (mastitis) depending on risk of ketosis



valacta

Frequency of clinical ketosis and displaced abomasum depending on the risk of ketosis

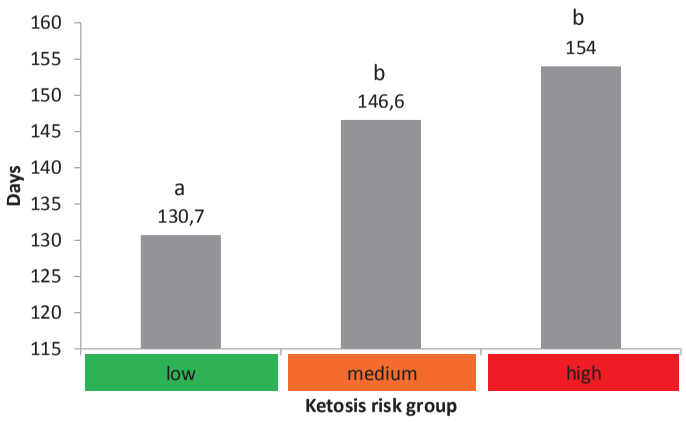


Koeck *et al.*, 2014

FOSS

Dedicated Analytical Solutions

KETOSIS IMPACTS REPRODUCTION

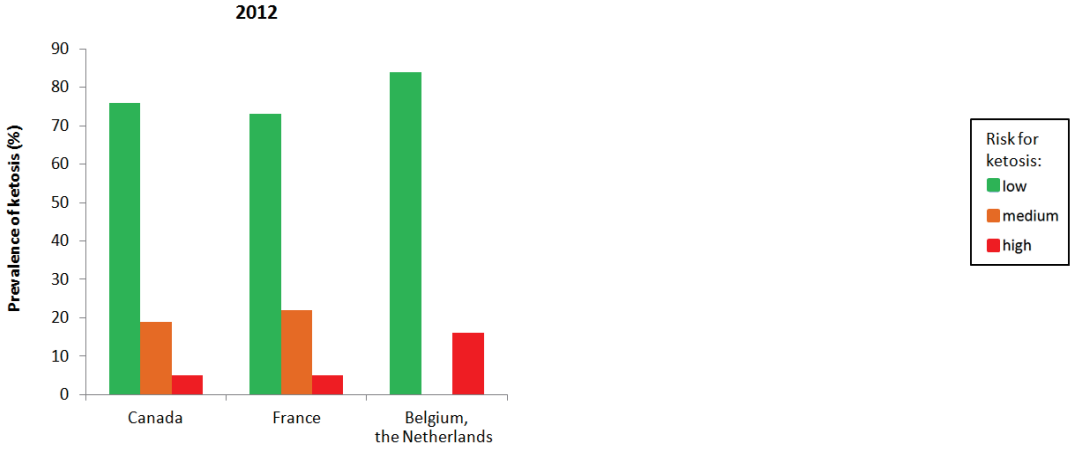


a, b: bars with different letters differ significantly at a level of P <0.001

FOSS

Dedicated Analytical Solutions

DEVELOPMENT OF KETOSIS PREVALENCE OVER TIME

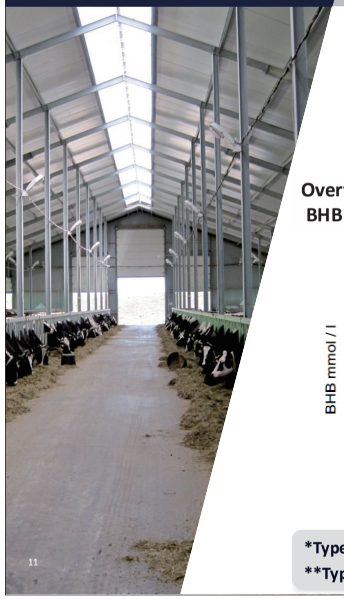


Prevalence of ketosis (low, medium, high risk) in Canada (Valacta), France (CLASEL) and Belgium (region Flanders) and the Netherlands (Qlip) in 2012 and 2014, respectively. Data for Belgium and the Netherlands are expressed as ketosis yes (high risk) or no (low risk).

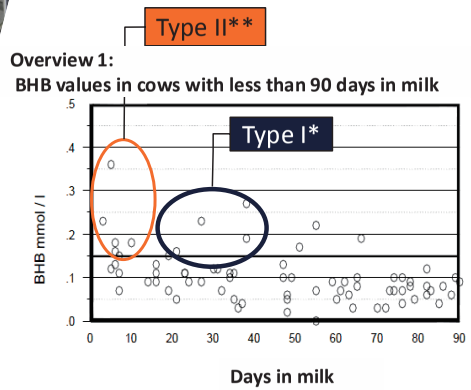
FOSS

Dedicated Analytical Solutions

REAL LIFE EXAMPLE – KETOSIS MANAGEMENT



Herd Results April 2013



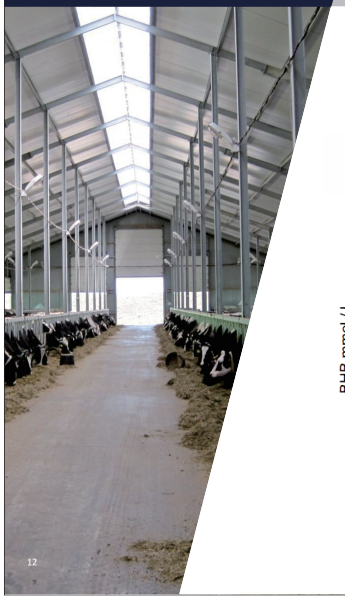
Advisor's suggestion: "Focus first on dry cow (far-off) rations as they obviously bring too much energy."

***Type I** (Fresh cow; Production > Dry matter intake, NEB)
****Type II** (Starts before calving; "fat cow syndrome"; insulin resistance)

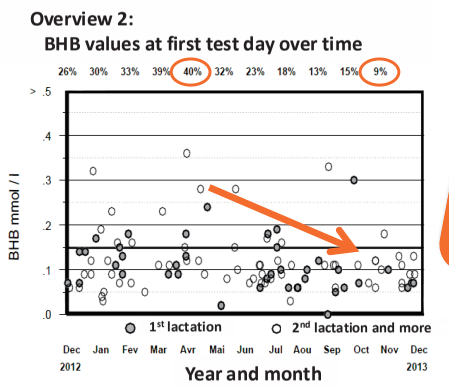
FOSS

Dedicated Analytical Solutions

REAL LIFE EXAMPLE – KETOSIS MANAGEMENT



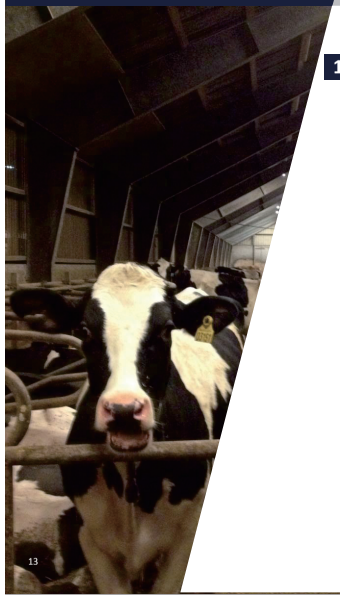
Herd Results December 2013 (8 month later)



→Proportion of cows with high BHB decreased from 40% to less than 10%

FOSS

KETOSIS IMPACTS PROFITABILITY



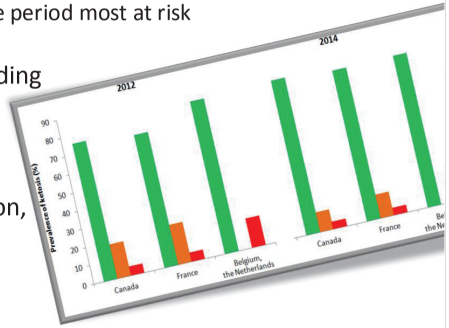
Simulation for a herd with 50 cows

1) Economical losses

a) Milk loss	€
300 l/lactation; ketosis prevalence: 15%; 2.250 l/lactation and herd; 0.33 €/l	750
b) Losses due to associated diseases	

A MESSAGE TO TAKE HOME

- Experience from 3 years of ketosis screening in Canada, France, Belgium and the Netherlands using FTIR technology on regular DHI milk samples:
  - Simple, practical and at low cost for milk producer
  - Elevates awareness of an otherwise undetected problem
  - With monthly testing, not all cows are tested in the period most at risk
- Ketosis screening offers high value to milk recording clients → can help reduce the incidence of the problem
- Development of recommendations for generation, application and interpretation of results



For further information, please do not hesitate to contact: das@foss.dk

REFERENCES

Andersson, L., 1988. Subclinical ketosis in dairy cows. Vet. Clin. North Am. Food Anim. Pract. 4: 233–248.

de Roos, A.P., H.J. van den Bijgaart, J. Horlyk & G. de Jong, 2007. Screening for subclinical ketosis in dairy cattle by Fourier transform infrared spectrometry. J. Dairy Sci. 90: 1761–1766.

Denis-Robichaud, J., J. Dubuc, D. Lefebvre & L. DesCôteaux, 2014. Accuracy of milk ketone bodies from flow-injection analysis for the diagnosis of hyperketonemia in dairy cows. J. Dairy Sci. 97: 3364–3370.

Duffield, T.F., K.D. Lissemore, B.W. McBride & K.E. Leslie, 2009. Impact of hyper-ketonemia in early lactation dairy cows on health and production. J. Dairy Sci. 92: 571–580.

Hansen, P.W., 1999. Screening of dairy cows for ketosis by use of infrared spectroscopy and multivariate calibration. J. Dairy Sci. 82: 2005–2010.

Iwersen, M., U. Falkenberg, R. Voigtsberger, D. Forderung & W. Heuwieser, 2009. Evaluation of an electronic cowside test to detect subclinical ketosis in dairy cows. J. Dairy Sci. 92: 2618–2624.

Johan, M. & J.B. Davière. 2014. Detection of ketosis in dairy cattle by determining infrared milk ketone bodies amount. 39th ICAR Session, Berlin, Germany, 19-23 May 2014.

Koeck, A., J. Jamrozik, F.S. Schenkel, R.K. Moore, D.M. Lefebvre, D.F. Kelton & F. Miglior. 2014. Genetic analysis of milk β-hydroxybutyrate and its association with fat-to-protein ratio, body condition score, clinical ketosis, and displaced abomasum in early first lactation of Canadian Holsteins. J. Dairy Sci. 97: 7286–7292.

McArt, J.A.A., D.V. Nydam & M.W. Overton, 2015. Hyperketonemia in early lactation dairy cattle: A deterministic estimate of component and total cost per case. J. Dairy Sci. 98: 2043–2054.

Oetzel, G.R., 2004. Monitoring and testing dairy herds for metabolic disease. Vet. Clin. North Am. Food Anim. Pract. 20: 651–674.

Ospina, P.A., D.V. Nydam, T.Stokol & T.R. Overton, 2010. Associations of elevated nonesterified fatty acids and β-hydroxybutyrate concentrations with early lactation reproductive performance and milk production in transition dairy cattle in the northeastern United States. J. Dairy Sci. 93: 1596–1603.