Updated guidelines for the recording, evaluation, and genetic improvement of udder health in dairy cattle

J.B. Cole,[1,*] C. Egger-Danner, A.J. Bradley, N. Gengler, B. Heringstad, J.E. Pryce, and K.F. Stock

[1]Animal Genomics and Improvement Laboratory
Agricultural Research Service, USDA
Beltsville, MD 20705-2350

*john.cole@ars.usda.gov

Introduction

- A healthy udder is free from mastitis, which is the most costly disease of dairy cattle (Seegers et al., 2003)
- Udder health has declined in many breeds because of unfavorable correlations with production (Ødegård et al., 2003)
- Poor udder health increases costs, results in higher rates of involuntary culling, decreases revenue, and harms animal welfare
- Genetic selection for improved udder health is an important part of dairy cattle breeding programs (Schutz, 1994; Heringstad et al., 2003)

Existing ICAR guidelines

International Agreement on Recording Practices

SECTION 7.3 - GUIDELINES FOR RECORDING, EVALUATION AND GENETIC IMPROVEMENT OF UDDER HEALTH

7.3.1 General concepts

7.3.1.1 Reader instructions

These guidelines are written in a schematic way. Enumeration is bulleted and important information is shown in text boxes. Important words are printed **bold** in the text.

The aim of these guidelines is to provide dairy cattle breeders involved in breeding programmes with a stepwise decision-support procedure establishing good practices in recording and evaluation of udder health (and correlated traits). These guidelines are prepared such that they can be useful both when a first start to the breeding programme is to be made, or when an existing breeding programme is to be updated. In addition, these guidelines supply basic information for breeders not

What do we want in guidelines?

- Best practices
  - What data should be recorded? Who should collect them? How?
- Concision
  - Include only necessary information
  - Current guidelines are 27 pages…
- Do not repeat work already done!

Udder health phenotypes

Type	Measure[1]	Reference	Type	Measure	Reference
Direct	Clinical mastitis	Bramley et al. (1996)	**Indirect**	Changes in SCC patterns	De Haas et al. (2008)
	Subclinical mastitis	Bramley et al. (1996)		Differential SCC	Schwarz et al. (2011)
Indirect	SCC	Schukken et al. (2003)		Electrical conductivity	Norberg et al. (2004)
	Milkability	Sewalem et al. (2011)		Lactoferrin content	Soyeurt et al. (2012)
	Udder conformation	Nash et al. (2002)		Pathogen-specific mastitis	

[1] The indirect measures listed in italics were added to the revised guidelines.

Phenotype considerations

- Udder health data originate from various sources which differ considerably with respect to information content and specificity
- The data source should be clearly indicated whenever information on udder health status is collected and analyzed
- When data from different sources are combined, these origins must be taken into account

Clinical and subclinical mastitis

- Clinical mastitis results in altered milk composition, and is accompanied by a painful, red, swollen udder (Bramley et al., 1996)
- Subclinical infections do not change the appearance of the milk or the udder, but milk composition is altered
- Subclinical mastitis is most commonly detected based on elevated SCC

Traits – milking speed

- Milking speed data are routinely collected by milking systems and stored in on-farm computer systems
- Genetic correlations of SCS with milking speed generally are moderate and antagonistic
- Selection for faster milking also may reduce risk of mastitis
- Where is the optimum?

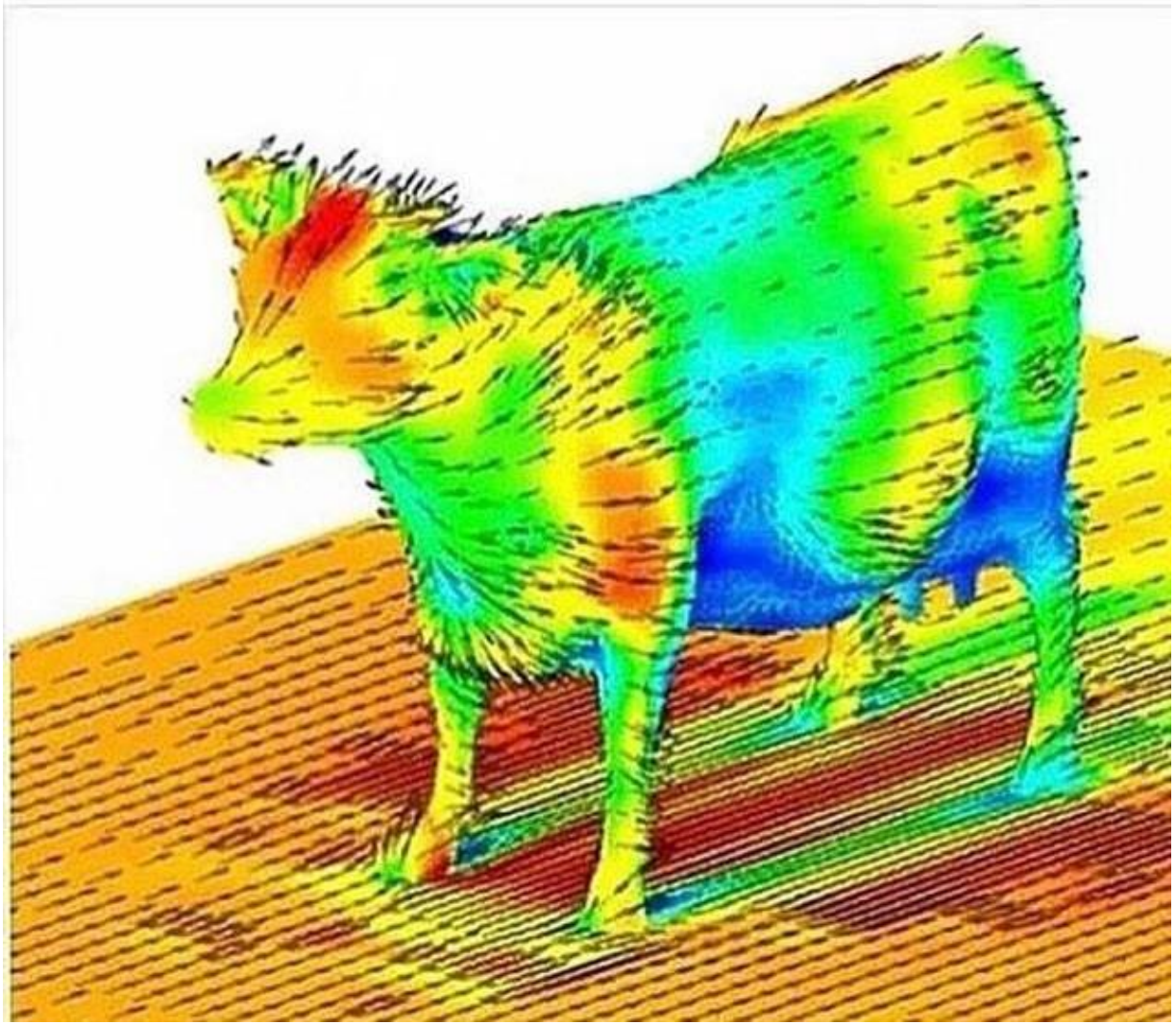
Traits – electrical conductivity

- Electrical conductivity is measured by most modern milking systems
- Cows with mastitis produce milk with increased milk conductivity (Norberg et al., 2004)
- Conductivity measurements at milking can be compared with previous measurements to identify changes consistent with subclinical mastitis

Traits – Lactoferrin content

- Lactoferrin is an iron-binding glycoprotein naturally present in milk.
- It also is released by neutrophils during inflammation, which is consistent with its role in host defense inflammation
- Soyeurt et al. (2012) showed that MIR spectroscopy can cheaply and rapidly predict milk lactoferrin content

New phenotypes are regularly suggested



Applications – Herd management

- Benchmarking supports successful farming
- Comparing cows to herdmates identifies individuals performing beyond expectations
- Cohort summaries permit benchmarking of farms against contemporaries
- Important when milk pricing schemes include differential payment based on milk quality

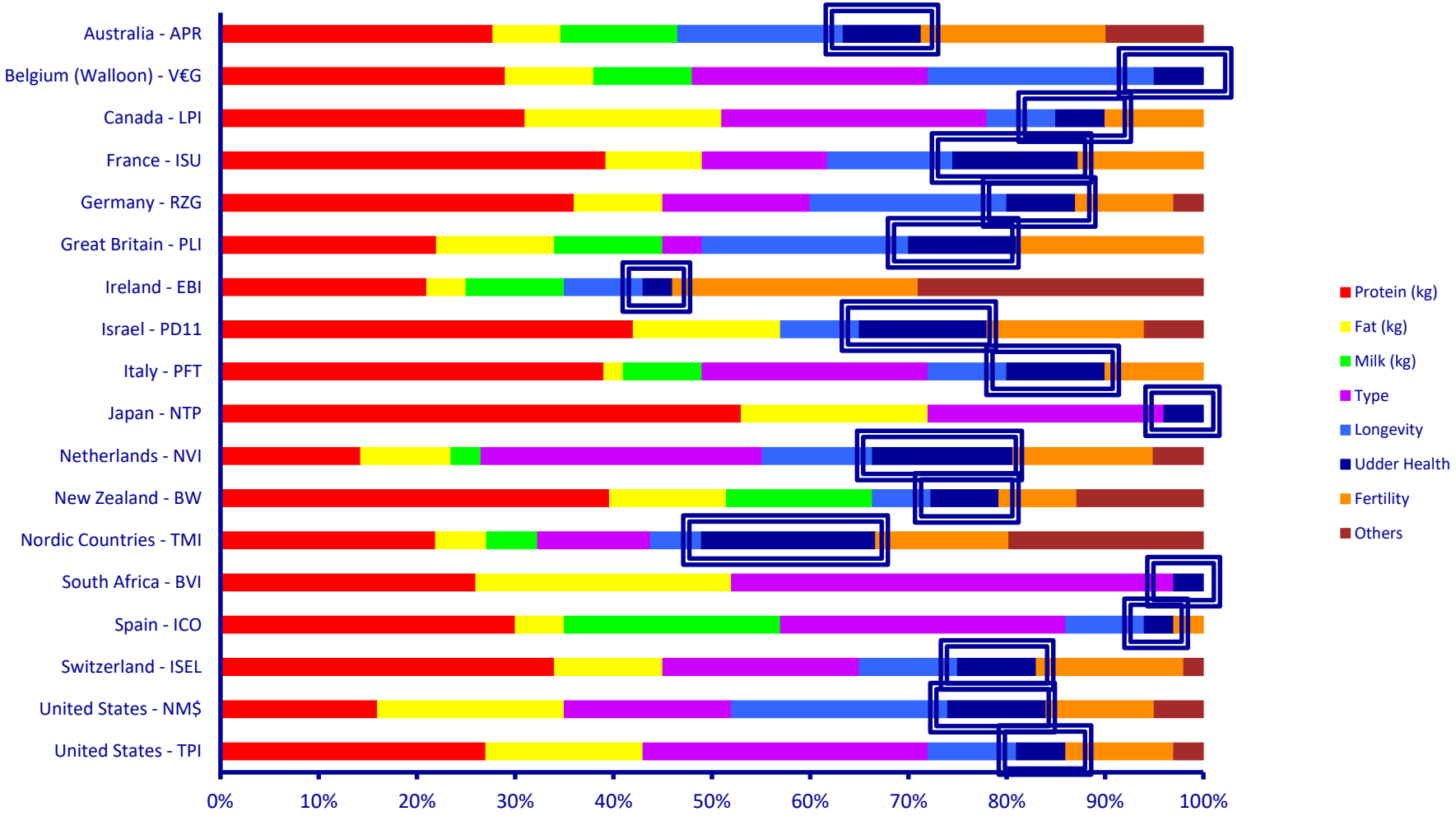
Applications– Population health

- National monitoring programs must meet the demands of authorities, consumers, and producers
- Farmers benefit from increased consumer confidence in safe and responsible food
- Disease surveillance is important to protect integrity of national herds

Applications – Genetic evaluation

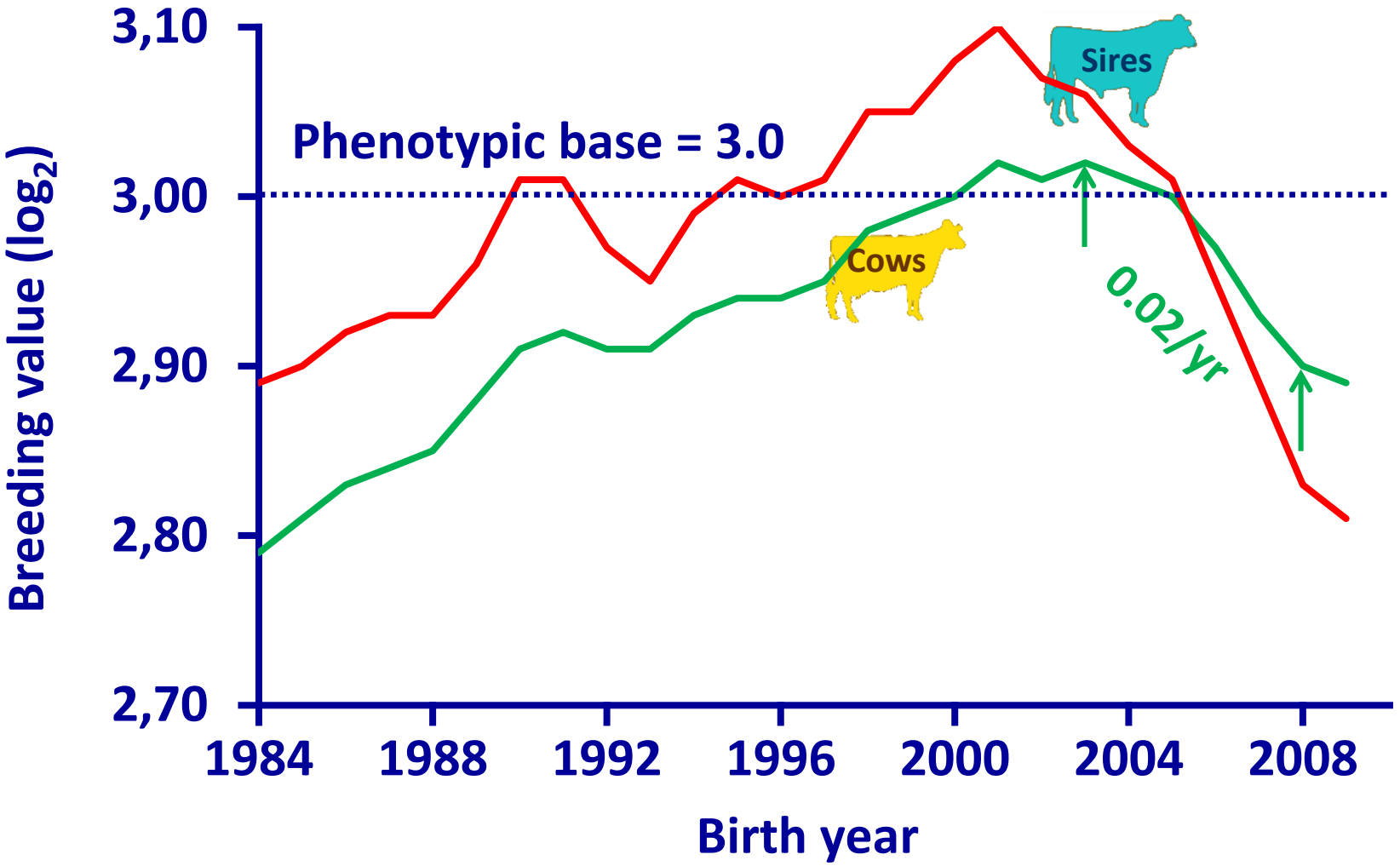
- Breeding values for udder health traits of marketed bulls should be published routinely
- Total merit indices should include an udder health sub-index
- Udder health sub-indices may include both direct and indirect predictors of udder health
- A combination of direct and indirect information maximizes the accuracy of selection

Selection indices include many traits…



Source: Miglior et al. (2012)

Holstein somatic cell score (log_2)



Conclusions

- Udder health guidelines will continue to evolve
  - Technology available for monitoring cow performance will improve
  - More precise phenotypes will become available for lower costs
- The goal remains to provide farmers with tools for making decisions

Affiliations

- C. Egger-Danner, ZuchtData EDV-Dienstleistungen GmbH, Vienna, Austria
- A.J. Bradley,University of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Leicestershire, UK and Quality Milk Management Services Ltd, Cedar Barn, Easton Hill, Easton, Wells, Somerset, UK
- N. Gengler, Agriculture, Bio-engineering and Chemistry Department, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium
- B. Heringstad, Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, Ås, Norway
- J.E. Pryce, Department of Economic Developments, Jobs, Transport and Resources and La Trobe University, Agribio, Bundoora, VIC, Australia
- K.F. Stock, IT Solutions for Animal Production (vit), Verden, Germany

Questions?

FTWG web site:

http://www.icar.org/index.php/technical-bodies/working-groups/functional-traits-working-group/

Holstein and Jersey crossbreds graze on American Farm Land Trust's Cove Mountain Farm in south-central Pennsylvania

Source: ARS Image Gallery, image #K8587-14; photo by Bob Nichols

References - 1

- Bramley, A.J., J.S. Cullor, R.J. Erskine, L.K. Fox, R.J. Harmon, J.S. Hogan, S.C. Nickerson, S.P. Oliver, K.L. Smith, & L.M. Sordillo, 1996. Current concepts of bovine mastitis. Natl. Mastitis Council 37: 1-3.
- de Haas, Y., W. Ouweltjes, J. Ten Napel, J.J. Windig & G. de Jong, 2008. Alternative somatic cell count traits as mastitis indicators for genetic selection. J. Dairy Sci. 91(6): 2501-2511.
- Heringstad, B., R. Rekaya, D. Gianola, G. Klemetsdal & K.A Weigel. 2003. Genetic change for clinical mastitis in Norwegian Cattle: a threshold model analysis. J. Dairy Sci. 86: 369-375.
- Jorani, H., J. Philipsson & J.-C. Mocquot, 2001. Interbull guidelines for national and international genetic evaluation systems in dairy cattle: Introduction. Interbull Bull. 28: 1.

References - 2

- Nash, D.L., G.W. Rogers, J.B. Cooper, G.L. Hargrove & J.F. Keown, 2002. Relationships among severity and duration of clinical mastitis and sire transmitting abilities for somatic cell score, udder type traits, productive life, and protein yield. J. Dairy Sci. 85(5): 1273-1284.
- Norberg, E., H. Hogeveen, I.R. Korsgaard, N.C. Friggens, K.H.M.N. Sloth & P. Løvendahl, 2004. Electrical conductivity of milk: ability to predict mastitis status. J. Dairy Sci. 87(4): 1099-1107.
- Norman, H.D., J.E. Lombard, J.R. Wright, C.A. Kopral, J.M. Rodriguez & R.H. Miller, 2011. Consequence of alternative standards for bulk tank somatic cell count of dairy herds in the United States. J. Dairy Sci. 94(12): 6243-6256.
- Ødegård, J., G. Klemetsdal & B. Heringstad, 2003. Variance components and genetic trend for somatic cell count in Norwegian Cattle. Livest. Prod. Sci. 79(2-3): 135-144.

References - 3

- Parker Gaddis, K.L., J.B. Cole, J.S. Clay & C. Maltecca, 2012. Incidence validation and causal relationship analysis of producer-recorded health event data from on-farm computer systems in the United States. J. Dairy Sci. 95(9): 5422-5435.
- Rivas, A.L., F.W. Quimby, J. Blue & O. Coksaygan, 2001. Longitudinal evaluation of bovine mammary gland health status by somatic cell counting, flow cytometry, and cytology. J. Vet. Diagn. Invest. 13(5): 399-407.
- Schukken, Y.H., D.J. Wilson, F. Welcome, L. Garrison-Tikofsky & R.N. Gonzalez, 2003. Monitoring udder health and milk quality using somatic cell counts. Vet. Res. 34(5): 579-596.
- Schutz, M.M., 1994. Genetic evaluation of somatic cell scores for United States dairy cattle. J. Dairy Sci. 77(7): 2113-2129.

References - 4

- Schwarz, D., U.S. Diesterbeck, S. König, K. Brügemann, K. Schlez, M. Zschöck, W. Wolter & C.P. Czerny, 2011. Flow cytometric differential cell counts in milk for the evaluation of inflammatory reactions in clinically healthy and subclinically infected bovine mammary glands. J. Dairy Sci. 94(10): 5033-44.
- Seegers, H., C. Fourichon & F. Beaudeau, 2003. Production effects related to mastitis and mastitis economics in dairy cattle herds. Vet. Res. 34(5): 475-491.
- Sewalem, A., F. Miglior & G.J. Kistemaker, 2011. Genetic parameters of milking temperament and milking speed in Canadian Holsteins. J. Dairy Sci. 94(1): 512-516.
- Soyeurt, H., C. Bastin, F.G. Colinet, V.R. Arnould, D.P. Berry, E. Wall, F. Dehareng, H.N. Nguyen, P. Dardenne, J. Schefers & J. Vandenplas, 2012. Mid-infrared prediction of lactoferrin content in bovine milk: potential indicator of mastitis. Animal 6(11): 1830-1838.