From new milk-testing parameters to new DHI services. The view of an instrument manufacturer

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Abstract

FOSS has a long history in developing analytical solutions and introducing new parameters to the industry. The objective of this study is to provide an overview on the implementation of new milk-testing parameters in practise and how they can become new DHI services that can be offered and utilised by the dairy industry. Specifically, examples on quality assurance as well as the actual practical application for the parameters differential somatic cell count (DSCC), beta hydroxybutyrate (BHB) and acetone (i.e. ketosis screening), and fatty acid profiling, respectively, will be presented.

Mastitis is still the most costly disease in dairy farming. DSCC represents the proportion of specific immune cells (neutrophils (PMN) and lymphocytes vs. macrophages) and thus provides more information about the actual udder health status of dairy cows. The results of a recently concluded study clearly demonstrate that the test performance (i.e. sensitivity) for identification of mastitis increases applying the combination of DSCC and SCC as compared to SCC alone. This, in turn, opens up the possibility to develop new tools for improved management of mastitis such as more targeted mastitis screening as well as selective dry cow therapy, which are both currently tested under practical conditions.

Ketosis is a costly metabolic disorder, which usually occurs in dairy cows during the early lactation period when energy demands for milk production exceed energy intake. Milk BHB and acetone in regularly available DHI samples can be predicted using Fourier transform infrared (FTIR) technology. Quality assurance procedures for ensuring generation of reliable data have been developed and documented. The application of the data is different among DHI laboratories/organisations. While ketosis screening services are based on milk BHB results only in some countries, the data is incorporated in decision trees in other countries.

The milk fatty acid profile contains a lot of information about the processing properties of milk as well as the nutritional status of dairy cows. Various different practical applications and quality assurance tools are used around the world.

In conclusion, milk samples harbour a lot of information and, besides the traditional parameters, new tools as well as services that can be offered to the dairy industry help to increase the value of milk testing. However, dairy farmers and farm advisors are rather in need of meaningful information than in need of raw data. It is therefore clearly in the interest of FOSS to share global experiences on new parameters as well as actively participate and contribute to the development of new milk-testing based DHI services.

Keywords: milk analysis, mastitis, ketosis, fatty acid profile

Introduction

Production related diseases in dairy cows (e.g. mastitis, ketosis) often remain undetected or untreated given their subclinical character and thus cause significant economic losses to dairy farmers as well as adversely impact animal welfare.

Mastitis, the inflammation and/or infection of a cow's udder typically caused by bacteria, is still causing tremendous losses of •32 billion to the dairy industry worldwide and thus the most costly disease in milk production (Seegers *et al*., 2003; Halasa *et al*., 2007).

Ketosis, a metabolic disorder in high yielding dairy cows, where energy demands exceed energy intake is another issue causing significant economic losses on dairy farms nowadays. The incidence of ketosis has been estimated to be 25-60% in dairy herds with costs of •260 per case (Mc Art *et al*., 2013, 2015; Mahrt *et al*., 2015).

Milk samples on individual cow and herd level are available regularly through dairy herd improvement (DHI) and payment testing, respectively, and it is thus convenient to utilise such readily available samples for determining more parameters than SCC, fat, protein, and lactose.

The objective of this study is to provide an overview on the implementation of new milk-testing parameters in practise (particularly through DHI testing) and how they can become new DHI services that can be offered and utilised by the dairy industry.

Mastitis

Somatic Cell Count (SCC), representing the total number of cells in milk, is a well-accepted and broadly used indicator for mastitis and milk quality (e.g. Schukken *et al*., 2003). Since its introduction in the 1970s the regular and inexpensive determination of SCC on individual cow level as well as the implementation of incentives in terms milk prices depending on the actual quality of milk (e.g. SCC level) have contributed significantly to the improvement of udder health. Data from the Netherlands illustrate this positive development: average bulk tank SCC dropped from 600,000 cells/ml in 1971 to 200,000 cells/ml in 2002 (Figure 1).

Differential Somatic Cell Count (DSCC) is a new parameter indicating the percentage of individual immune cells (i.e. PMN combined with lymphocytes) in milk (Damm *et al*., 2017; Schwarz, 2017a). DSCC is known to increase significantly as a results intramammary infection (i.e. mastitis) as described elsewhere (Schwarz *et al*., 2018; Wall *et al*., 2018).

The combination of SCC and DSCC leads to an improvement in the identification of mastitis cases through DHI testing (unpublished data). This, in turn, can serve as basis for improved mastitis management in the frame of DHI testing and as a result to further improvements regarding udder health on dairy farms.

Besides providing the industry with innovative analytical solutions, FOSS actively helps in the establishment of SCC for improving milk quality in developing countries by sharing best practises etc. in dedicated seminars. Furthermore, the implementation of (new) services for mastitis management based on SCC (and DSCC) is performed in close cooperation with the industry.

Ketosis

Milk beta-hydroxybutyrate (BHB) and acetone can be predicted from milk samples and used as indicators for ketosis. The possibility of using DHI samples and FTIR

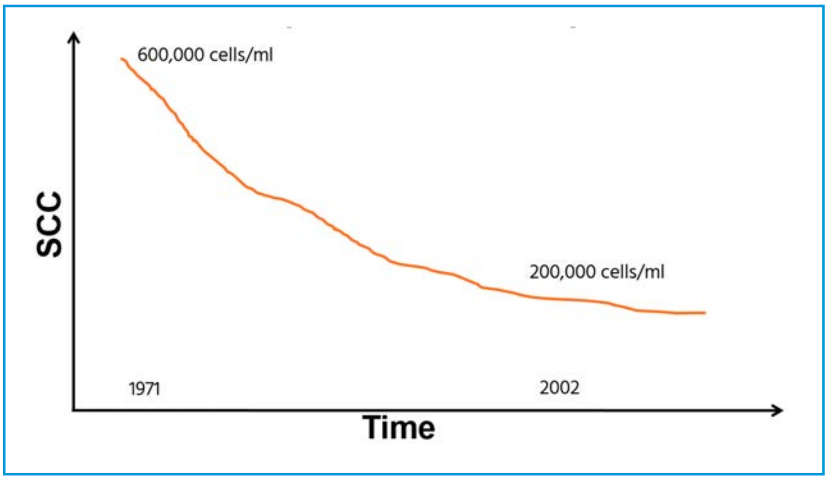

Figure 1. Development of average bulk tank SCC over time based on data from the Netherlands (according to Sampimon et al., 2005)

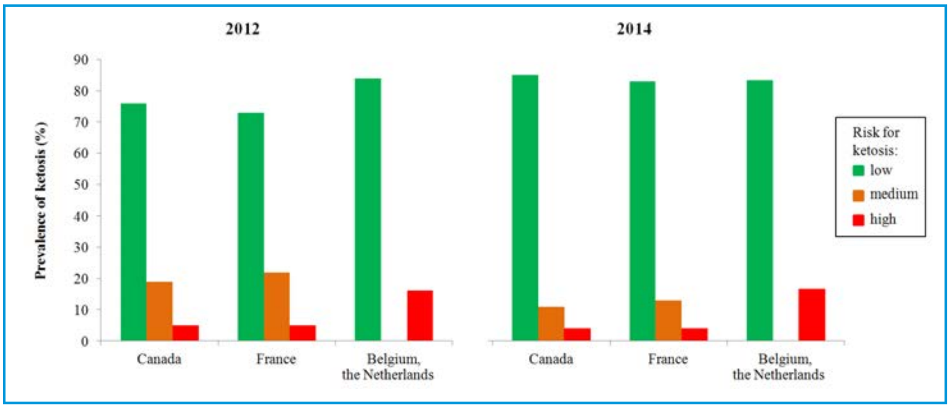

Figure 2. Prevalence of ketosis (low, medium, high risk) in Canada (Valacta), France (CLASEL) and Belgium (region Flanders) and the Netherlands (Qlip and CRV) in 2012 (left) and 2014 (right), respectively. Data for Belgium and the Netherlands are expressed as ketosis yes (high risk) or no (low risk).

technology for herd level ketosis screening with good values for sensitivity and specificity has been described elsewhere (de Roos *et al.*, 2007; Denis-Robichaud *et al.*, 2014).

Best practise cases on quality assurance procedures in laboratories (Schwarz *et al.*, 2015; Schwarz, 2017b; IDF, 2019) as well as the practical application of milk BHB and acetone results were described in various publications (e.g. Santschi *et al.*, 2016; Renaud *et al.*, 2019). Briefly, it is a practical and highly-valuable service that can be offered through DHI testing to help reducing the incidence of ketosis (Figure 2).

FOSS has documented best practise cases from around the world and, e.g., contributed to respective activities within IDF (preparation of IDF Bulletin on new IR applications). In close cooperation with the industry in terms of implementing ketosis screening as a new milk-testing service, FOSS is working on making ketosis screening available to more dairy farms worldwide.

Other applications

The milk fatty acid profile contains a lot of information about the processing properties of milk as well as the nutritional status of dairy cow.

Milk fatty acids can be determined differently, e.g. according to the degree of saturation, the chain length, and their origin (FOSS application notes 64 and 5465). While the focus of working with milk fatty acid profiles was mainly on improving dairy products (e.g. elevated content of unsaturated fatty acids) in the past, work in more recent years was rather focused on utilising the results for improving the nutrition of dairy cows (e.g. Jensen, 2002; Palmquist, 2006).

FOSS is actively involved in the development of quality assurance procedures to secure the reliability of the generated milk fatty acid data. Beyond that, various activities regarding the development of actual practical applications of milk fatty acid results are currently running. Any new developments will be shared in dedicated seminars.

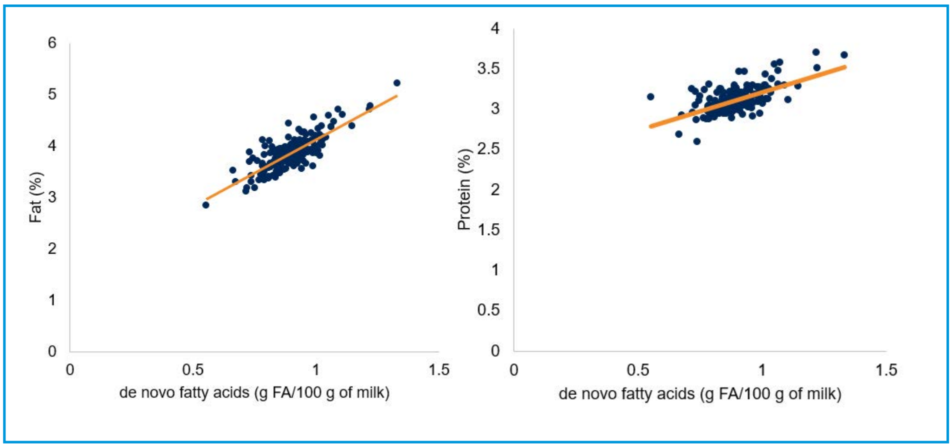

Figure 3. Exemplary data describing the interrelation between the de novo fatty acid content and milk fat (left) and milk protein (right), respectively.

Conclusions

Milk samples harbour a lot of information and, besides the traditional parameters (i.e. SCC, fat, protein, lactose), FOSS has developed new innovative parameters serving as basis for new services that can be offered to the dairy industry and help to increase the value of milk testing. However, dairy farmers and farm advisors etc. are rather in need of meaningful information than in need of raw data. Hence, it is clearly in the interest of FOSS to support the industry by sharing global experiences/best practise cases on the application of new parameters (e.g. through dedicated seminars) as well as actively participate and contribute to the development of new milk-testing based services.

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Wall, S.K., O. Wellnitz, R. Bruckmaier & D. Schwarz. 2018. Differential somatic cell count in milk before, during, and after artificially induced immune reactions of the mammary gland. J. Dairy Sci. 101:5362–5373.Fig 2. Interrelation between the de novo fatty acid content and milk fat (top) and milk protein (bottom), respectively.