Raw milk testing, – today and in the future!

Present status

Testing of raw milk, not yet pasteurized and standardized or in other ways processed is usually done for three purposes.

1. To assist the milk producers on the farms to optimize their production for quality as well as for quantity, usually done on monthly milk recording samples from individual cows.
2. To assist the milk purchasers and milk producers to settle the quality and payment of the milk. Here bulk tank samples, often collected at every milk collection, are analyzed.
3. To determine the quality of the milk and the health status of the herd.

In most established milk markets the analyses for above purposes are carried out by neutral inter professional laboratories. A considerable centralization constantly takes place within this area, resulting in rather few very large laboratories in most countries. In countries like the Netherlands, Sweden, Denmark and New Zealand by far most, if not all, samples are analyzed in one lab. In countries like France and Germany there is one laboratory per department/Bundesland.

The number of samples per lab is very high. With 1.6 million dairy cows in the Netherlands, the Dutch lab analyzing 90% of all samples receives 1 million milk recording samples and approximately 200,000 bulk tank samples per month. So the level of automation in these labs is already high and steadily increasing, and this too allows more flexible sampling schemes in the lab.

The increasing level of automation, is due to the use of belts for sample transportation, robot solutions and barcode or RFID tags on the vials etc. This means very little manual handling of the samples between registration of the sample and until it leaves the laboratory often as waste for a biogas plant or similar.

Future challenges, for milk producers and for the milk testing laboratories.

For those milk testing labs situated in the so-called milk belt in Europe, a more or less constant number of cows in their region can be foreseen now the milk quotas are gone, whereas the herd sizes will increase resulting in fewer herds in total.

The larger herds lead to an increasing demand for new tools within herd management. Tools where the herd manager is able to monitor his herd via his mobile phone or in front of his PC, based on various automatic registrations carried out on his cows in the barn. The registrations may arise from analyses on milk from his cows, information gathered during the milking session or on pedometers, cameras etc in the barn. A tough competition takes place between companies providing such solutions.
Until now, analyses made on the monthly milk recording samples have provided the herd manager with valuable information to manage his herd. About feeding as well as health and lately also reproductive parameters. However, on-farm solutions analyzing milk, such as Herd Navigator, as well as other solutions installed in the parlor or in the barn are increasing competition within the herd management field. If, in the future, on-farm milk analyses can be carried out at competitive prices, or if the key parameters for efficient herd management such as udder health, reproduction etc can be predicted without analyzing the milk, then the demand for milk recording will decrease.

One feature that would enable increased benefits of analyzing on milk recording samples would be changes in the sampling scheme. Today, samples analyzed at maximum every 4-5 weeks throughout the lactation. It would be more useful if cows were sampled much more frequently at the beginning of lactation, not in the mid lactation and then once before being dried off. This requires an automated solution in the milking parlor to sample relevant cows, including ID on the vial etc, thereby ensuring automatic feedback to the herd management system on analytical results. It is possible to develop such a solution, especially for herds milked in milking parlors, rotaries and with automatic milking systems! However, the relevant question is, who has an interest in developing such a solution? Can the sale of such a solution compete with the sale of a total herd management solution based on on-farm parameters for a company like Delaval or GEA? Instead, it might rather be a task for the biggest stakeholder to such a solution, the farmers organized in ICAR, to drive the development of such a solution in order to make it happen!

**Comparability across borders?**

When dairies become bigger and more international, they will have members selling them milk in more countries. This requires a system for uniform payment across borders for the same milk quality! And thereby leads to a demand for comparability of the analysis results across borders!

At present, all labs are joining proficiency schemes and ring trials in order to ensure comparable results within their own country. Such ring trials also do take place across borders, especially between reference labs and for reference methods, but less for routine methods. However, in the future, it will be more important to systematically ensure comparability and uniform results across borders. A very large percentage of the total payment for raw milk is based on the content of fat and protein in the milk; billions of Euros are paid to the farmers based on the analyses of these constituents. Therefore even small systematic differences will cause big biases in the payment between markets.

Another important example of this cross border challenge is the situation for total bacteria count in milk. In the EU today, all milk must have a total bacteria count below 100,000 Colony Forming Units/ml in order to fulfil the EU regulation (853/2004). And almost all farmers are paid according to the content of CFU/ml in their milk. However, hardly any laboratories analyzing total bacteria count in raw milk use a routine method counting bacteria in CFU/ml. Instead, the instruments count Individual Bacteria Count/ml. Therefore, in order to monitor the EU hygiene directive and in order to grade the milk, all countries or regions have established local conversion tables to convert the analyzed IBC/ml into CFU/ml. For different historical and practical reasons these conversion tables are not uniform across borders.

International Dairy Federation is presently working on a solution for this. One solution could be to agree to one uniform/average conversion table for all EU countries. Another more useful and cost efficient solution would be, to use the unit counted by the routine
Antimicrobials in raw milk

There are limits for the acceptable content of antimicrobials in milk worldwide, often referred to as Maximum Residue Levels (MRL). In the EU the MRL for penicillin G in milk is 4 ppb and similar limits have been defined for all other antibiotics in use. Sampling takes place on bulk tank level, but in principle the MRL limit must be met in any milk sample taken in a herd, also on single cow level! Therefore some dairies support farmers to test on cow level, before milk from a treated cow is recommenced. Other dairies choose to sanction milk detected positive, also if it is below the MRL - the so called zero tolerance approach. This approach poses very high demands to the test procedure used. Especially because the sensitivity of available methods in the market constantly increases and for certain antibiotics is far below the MRL.

None of the commercially available analytical solutions in the market at present is able to meet all MRL limits, - see table 1, but many are able to go significantly lower than MRL for specific antibiotics. This leaves us with a dilemma; do we want to accept a detected content below the MRL, but positive, in milk from the bulk tank? At the same time it leaves us with the challenge to make sure that the positive result is caused by antibiotics and not by presence of for instance natural inhibitors such as lactoferrin or lysozyme, which is more likely to happen at the lower concentrations it is becoming possible to detect! From practical experience from various labs, lowering the sensitivity from approx.

200,000 IBC/ml corresponds to almost 80,000 CFU/ml in country B whereas it corresponds to approximately 30,000 CFU/ml in country D

methods. It is more precise, repeatable and much more useful in assisting the herd manager further to improve the milk quality.
He also indicated that a calibration for NEFA (non-esterified fatty acids) in blood (signaling a high mobilization of body fat) can be made on milk. NEFA is commonly used in research projects to give information on energy balance. Dr Barbano is presently investigating which management procedures are related to the increased production seen in the herds with high de novo fatty acids in milk.

A common denominator for these new potential parameters is, that a reference method used in milk with traditional wet chemistry probably cannot be established. The full milk MIR spectra, and thereby a wide range of information hidden all over the spectra is used, and this cannot be analyzed by traditional chemical methods. Another thing in common is that all these parameters are relevant mainly in early lactation. So more frequent sampling in early lactation will increase benefits.

Most of these calibrations, or rather models, can benefit further from additional information which is usually present in the herd management database. If combining the information found in the spectra with lactation stage and number, previous diseases registered for the animal breeding data etc then predictions probably can be further improved.

Conclusions:
There is a big potential for development of solutions that can assist the dairy farmer and the dairy industry to further optimize the amount and quality of the milk production. Some of these solutions will be present and be used in the barn only, others involve analyses of milk from the herd and the cows in the existing milk laboratories.

To fully benefit from some of the parameters presently under development it would be very useful to be able to optimize the sampling scheme for milk recording and make it more flexible. However, this demands development of automatic sampling systems, which can ease the sampling process, especially as the herd size is still increasing. The driver of the development of such a device may well have to be the farmers and their milk recording organizations, as the present companies within the business may see a better business case in further development of the on-farm market. The consequence of this may be, that the main providers of solutions to the large inter professional laboratories may lose business too if activities are moved to the dairy farms.

Another challenge to handle, in order to fully implement some of the new parameters, is the question of reference analyses. Traditional chemical analyses in milk, or even in blood, may not be possible to develop, and this is necessary to establish a traditional calibration. This challenges the demand for monitoring of performance and for comparability between labs and across borders in new ways!

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Food safety regulations based on sound science

Activities and Targets of the Global Harmonization Initiative (GHI)

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Differences in food safety regulations result in needless destruction of safe food in a world where a billion people have very little or none. Food products that meet regulatory requirements and are, therefore, designated safe in one country might be confiscated across a border to protect the citizens against a perceived health hazard. Sometimes, such differences are created on purpose to block imports for economic advantage. Because of uncertainties about whether a new product, ingredient or a product produced using a novel processing technology comply with the interpretation of local food laws, companies that operate internationally hesitate to invest in introduction or development. Thus, differences in regulations amongst countries affect, on the one hand, food security and, on the other hand, hamper international trade and innovation [1].