Best practice guide on milking data

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Milk can offer a great deal of information on the health status, reproduction cycle and nutrition of dairy cattle. But how to process this information? And which technologies are currently available for analysing milk?

Milk in itself is a great tool for managing your herd's health, production and fertility. National dairy herd improvement associations and animal health organizations therefore offer many different milk analyses on bulk milk or individual milk samples, such as:

- *Disease testing*: measuring the level of antibodies against Johne's disease, Leptospirosis, Salmonella, BVD, IBR, Q-fever, Neospora, liver fluke, …
- *Pregnancy checks*: by measuring the amount of progesterone or pregnancy associated proteins in milk (PAG)
- *Microbiology*: diagnosis of mastitis, evaluation of selective dry cow treatment
- *Milk quality testing*: measuring the somatic cell count, total bacterial count, coli count freezing point, fat and protein content, …
- *Evaluating the ration:* based on milk urea, fat-protein ratio, ketone bodies, …
- *Genetic evaluation:* based on milking speed, teat morphology..

For now, this guide will focus solely on data collected during the milking process by the farmer with commercial sensor technologies. If you would like more information on national or regional milk testing programs, please consult your local veterinarian.

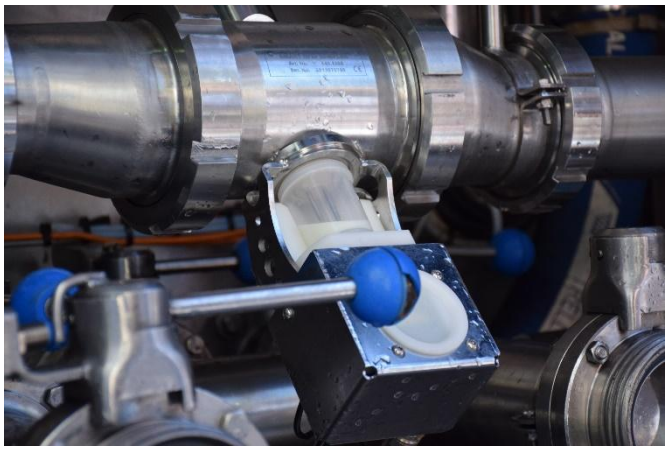

Photo 1. *Taking a bulk milk sample for further analysis during the routine milk collection.*

Milk yield

Recording the daily milk yield is a basic prerequisite for fine-tuning herd management decisions. There are many good reasons for milk recording, such as deciding which cows to breed from, or which ones to cull, calculating the herd's feed rations and identifying health issues. Milk recording can be performed using either milk meters, recording jars or milk flow indicators.

Although there are many different milk meter manufacturers, only meters that are tested and

approved by the International Committee for Animal Recording (known as ICAR) may be applied in Dairy Herd Improvement programs. In that case, the devices also need to be checked and calibrated periodically. A full list of ICAR-certified recording devices can be found here.

Monitoring milk production is essential to manage the herd's productivity and hence profitability. A key concept is the "income over feed cost" (IOFC), which accounts for the income left over after accounting for feed costs. Since feed is a dairy farm's largest expenditure, IOFC – total milk revenue minus feed costs – is an indispensable index to guide decision making. Important inputs are 'daily average milk production', 'the average milk price' as well as 'daily feed costs'.

Milk composition

Milk contains a lot of information on the nutritional and health status of the cow. The milk composition is also a reflection of the cow's breed, age and stage of lactation. Important milk components to keep an eye on include the fat, protein and lactose content.

Fat & protein levels

The milk protein and fat amounts are directly related to the dietary energy supply. An energy deficiency in the feed will inevitably lead to lower proteins levels in the milk. The fat to protein ratio (F:P) is a well-known indicator used to identify cases of **ruminal acidosis** and **ketosis**, a disease that occurs when cows are in a severe state of negative energy balance. In case of ketosis, the protein amount is usually lower than 3.2% (**Table 1**). For more information on metabolic diseases, please check the corresponding best practice guide.

Of course, in addition to being indicators of cow health, fat an protein (and to a smaller degree a lactose) have a direct impact on the farm's income. For more information on how to steer the milk composition to achieve a more favorable milk price, click here.

Table 1. *An overview of factors possibly affecting the composition of milk.*

Indication	Fat	Protein	F:P[1]
Ruminal acidosis	↓		< 1.0
Ketosis	↑	↓	> 1.5
Mastitis	↓ or ↑	↑	
Heat stress	↓	↓	

[1] *Ratio of fat to protein*

Given the natural, daily variations in these milk components (especially the fat content), one individual analysis per month –as is often the case in Dairy Herd Improvement programs- does not suffice to properly evaluate metabolic diseases on a herd level. Automatic in-line monitoring provides a more accurate estimate of the long-term milk composition, even though the reliability of the commercial sensor technologies is inferior compared to laboratory analysis. Therefore, it is crucial that the inline sensors are calibrated routinely (i.e. every 6 months) based on laboratory milk testing.

Urea

Milk urea is a useful tool for identifying herd

problems and improving the protein supply in the ration. When a cow consumes protein, it can be broken down to ammonia in the rumen, which in return is converted to urea in the liver. Excess **protein** consumption can therefore lead to high milk urea levels. When the milk urea levels drop below 175 mg/l, this can point to a protein deficiency. Even values below 200 mg/l require attention when combined with a high fat/protein ratio in milk. The milk urea values, combined with the protein content of the milk, are routinely measured in Dairy Herd Improvement programs to evaluate the dietary energy and protein levels (**Figure 1**).

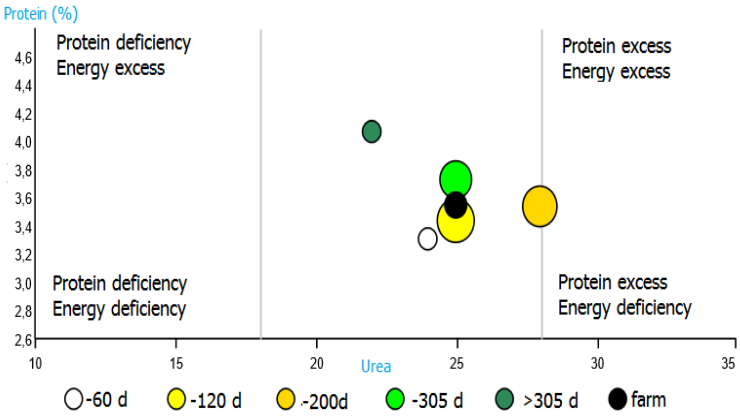

Figure 1. *Milk urea values vs. milk protein levels (%) for different groups of cows, based on their lactation stage (source: CRV).*

However, milk urea values can vary significantly between herds and even within cows. This should be taken into account when interpreting individual milk urea values of cows. Furthermore, these target values differ in pasture-based systems. Milk urea values are typically higher in grazing cattle, without necessarily any detrimental effects on their health.

Lactose

Mastitis causes the lactose content of the milk to decline. However, a lactose measurement in itself is not reliable enough to distinguish cows with mastitis from healthy cows. For more information on automatic mastitis detection, we refer you to the best practice guide on udder health.

Fertility markers

The hormone **progesterone** offers a lot of information about the reproductive stage of the cow. The progesterone level in the milk can be used to determine whether or not a cow…

- … is in heat
- … is not cycling (anestrus)
- … is pregnant
- … needs to be treated for ovarian cysts

Pregnancy can also be diagnosed in the milk by determining the **PAG-levels** (pregnancy-associated glycoproteins). PAG is produced by the placenta starting from 29 days after the (successful) insemination. It is recommended to retest all the cows after 74 days, because of the occurrence of pregnancy loss. It is also important to keep in mind that the PAG levels remain elevated for 60 days after calving. If you test the cow sooner than 60 days, the PAG levels from the previous pregnancy can interfere with the results.

For more information on fertility data, have a look at the best practice guide on reproduction.

Commercial sensor technologies

Below is an overview of the commercially available sensor technologies:

- AfiLab milk: (AfiMilk):

Afimilk, an Israeli company, has developed an near-infrared spectroscopy (NIR) sensor for inline measurements of the protein, fat and lactose content, together with the presence of blood, in individual cow's milk. Since 2010, the sensor is also being marketed by Fullwood as "Crystalab". During milking, the sensor measures these components per 200 mL of milk that passes through the apparatus, and reports the average of multiple measurements.

Photo 2. *The AfiLab milk analyser (source: www.AfiMilk.com)*

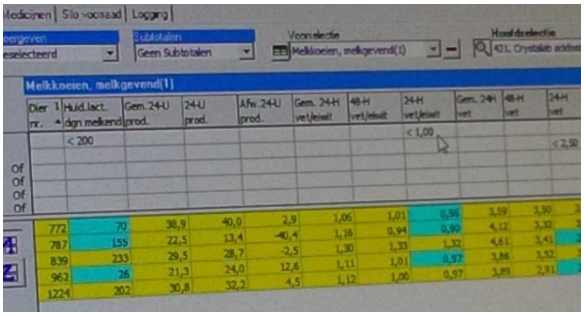

Photo 3. *A list of cows with ruminal acidosis, as diagnosed by the Crystalab, in Fullwood's software Crystal. The user can alter the applied thresholds (i.e. days in milk, fat/protein ratio, and percentage of fat over the last 24h).*

- MQC (Lely):

Lely's MQC unit gives an indication of the somatic cell count, fat, protein, lactose, amount of blood in the milk and the electrical conductivity. It is important to note that the MQC unit does not measure the actual fat and protein percentages!
Individual fat and protein indications are available in the T4C software as an average of the last 5 milkings. Herd averages are based on the individual cow data from the last milking.

- Ekomilk:

The company Ekomilk also offers a manual method for determining fat and protein levels in milk using a benchtop instrument.

- Herd Navigator (DeLaval):

This on-farm system has been designed to detect lactate dehydrogenase (mastitis), beta-hydroxybutyrate (ketosis) and progesterone (heat, pregnancy, infertility). The fully-automated system is available for both conventional milking parlors and milking robots. For cost-effectiveness, the cows are not sampled every milking, but the systems itself decides when the cow should be sampled based on her history and lactation stage. For a behind-the-scenes look at the Herd Navigator™ on a British dairy farm, have a look at this case study.

Checklist

Before investing in an expensive milk analysis system, you should ask yourself the following questions:

- Will you be using the data for dairy herd improvement records?
- Can the data be linked to your regular dairy herd management software?
- Are your cows already equipped with electronic identification?
- Do you have enough background knowledge for handling the data output efficiently, or are you willing to learn it?

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