Dieter Ordolff, Kiel

Usefulness of Standard Milk Components for Monitoring Udder Health

In conjunction with upcoming devices for on-farm analysis, tests were conducted to determine if milk components monitored by standard milk analysis could be used as indicators for udder health. As could be expected from several publications, variations in lactose content corresponded analogously to variations in the somatic cell count. Therefore, it can be concluded that this component, in addition to the electrical conductivity of the milk, could be useful for monitoring udder health on the farm level.

Data about milk components, to be found in every protocol of standard milk analyses, mainly are related to fat, protein and lactose. All these components are useful for herd management purposes, e.g. optimisation of cow feeding. Lactose, originating from the synthetic activity of the mammary gland, as mentioned e.g. by [3], is one of the osmotic relevant components of milk. When, due to an infection by pathogens [1, 2], it's production is inhibited, mineral substrates, mainly containing sodium and chloride, enter the milk, stabilise the osmotic pressure of the mammary gland but also increase the electrical conductivity of milk. It therefore is obvious that, beyond somatic cell count, not only electrical conductivity but also the lactose content may be an indicator for detecting disturbances in the mammary gland [1], if data are available with short delay.

In recent years at least one research project (France Contrôle Laitier, France) was indicating upcoming facilities for on-farm-milk analysis, which not only would reduce the amount of samples to be stabilised and transported to central laboratories, but also would produce a rapid feedback to the farmer, improving the efficiency of herd management. This system, prototypes of which were tested for some time at several departments in France, uses near infrared parameters for milk analysis. So it is able to evaluate with good accuracy the contents of standard milk components, like fat, protein and lactose, but it does not provide direct information on somatic cell count of milk samples.

It therefore was investigated to what extent standard milk components would be useful for monitoring udder health. Furthermore, spectroscopic parameters of samples were evaluated according to the standard CIE-l*a*b*. Electrical conductivity, commonly used as an indicator of udder health, also was recorded.

Experiments

At the experimental station of FAL at Braunschweig (Germany), from a group of 15 cows over a whole lactation about 2500 foremilk samples were taken by quarter. Standard milk analyses were done in the central laboratory of the local milk recording organisation.

Analytical results were classified according to three levels of somatic cell count (SCC), representing <200000 cells/ml (1966 samples), 200000 to 500000 cells/ml (329 samples), and >500000 cells/ml (250 samples). For each parameter, included within the experiments, the coefficient of correlation to SCC was calculated.

Results

The average daily yield per cow over the whole lactation varied between 15.1 kg and 15.3 kg at various SCC levels (*Table 1*). As to be expected, there was an obvious negative correlation between milk yield and week of lactation, but no interaction of this parameter with the level of SCC was to be found.

Average electrical conductivity increased from 5.6 mS/cm at a SCC of <200000/ml to 5.9 mS/cm at 200000 to 500000 somatic cells/ml and up to 6.4 mS/cm at >500000 so-

Parameter	SCC (• 1000/ml)					
	< 200		200 - 500		> 500	
	Average	SD	Average	SD	Average	SD
Yield/day (kg)	15,1	4,0	15,3	4,4	15,2	4,4
SCC (• 1000/ml)	45,0	48,0	320,9	82,2	1440,4	2102,2
Conductivity (mS/cm)	5,6	0,3	5,9	0,5	6,4	0,7
Fat (%)	1,5	0,7	1,7	0,7	1,9	0,9
Protein (%)	3,4	0,3	3,4	0,3	3,4	0,3
Lactose (%)	4,9	0,2	4,6	0,3	4,3	0,5
Luminance	69,3	2,4	67,8	2,6	67,3	2,7
red/green	-2,6	0,4	-2,7	0,5	-2,5	0,5
yellow/blue	-1,0	1,4	-1,7	1,7	-1,4	1,8

Table 1: Monitored parameters at foremilk samples

Prof. Dr. agr. habil. Dieter Ordolff is member of the scientific staff of the Institute for process engineering and farm building research (FAL), Bundesallee 50, D 38116 Braunschweig and of the Institute for Chemistry and Technology, Fed. Res. Ctre. for Nutrition and Food, Location Kiel, Hermann-Weigmann-Str.1, D24103 Kiel; e-mail: *dieter.ordolff@bfel.de*

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Parameter	SCC (• 1000/ml)		
	< 200	200 - 500	> 500
Yield (kg)	0,001	0,021	-0,097
Conductivity (mS/cm)	0,227	0,245	0,223
Fat (%)	0,062	0,072	0,192
Protein (%)	0,044	-0,116	0,478
Lactose (%)	-0,318	-0,265	-0,329
Luminance	-0,158	-0,124	-0,066
red/green	-0,128	-0,006	0,283
yellow/blue	-0,087	-0,033	0,344

Table 2: Correlation of monitored parameters with SCC

matic cells/ml. Significant positive correlation to SCC was found for this parameter at all levels of SCC.

As to be concluded from earlier investigations, a standard milk component, clearly interacting with SCC at all three levels, was lactose. The average concentration varied from 4.9% at the SCC-level <200 000/ml to 4.6% at 200 000/ml to 500 000/ml and down to 4.3% at the level >500 000/ml.

Table 2 gives a survey of the correlation of evaluated parameters to SCC. For all classes of SCC was found a significant interaction between SCC and lactose ($p < 1\%$).

Data included in table 2 indicate that other parameters also were affected by SCC. As to be expected, electrical conductivity in average behaved in a rather constant way. In the class >500 000 cells/ml protein was also reacting rather clearly on variation of SCC. Spectroscopic parameters, however, did not behave in a uniform way. While luminance was negatively correlated with SCC especially at lower classes, the parameters red/green and yellow/blue were shifting in a clear direction, towards red and yellow, only above 500 000 somatic cells/ml.

An additional cow specific evaluation of data has shown that, especially at cell counts below 200 000/ml, lactose content was correlated to SCC at least at a level comparable with electrical conductivity. The behaviour of spectroscopic parameters in cow specific samples was less constant. They produced most sensitive reaction at the lowest and the highest classes of SCC. Of course it should be taken into account that colour of milk also may be affected by species of pathogens being present in the mammary gland.

Conclusions

Besides direct counting of somatic cells, which already is possible at on-farm conditions, and monitoring electrical conductivity of milk, to be regarded as an indirect parameter, also lactose content of milk may be useful for evaluating udder health. It will not require additional technical input as soon as on-farm analysis of milk components will be available. The sensitivity of this milk component at low cell counts may be of special interest for herd management.

Literature

Books are marked by •

[1] • *Gravert, H.O.* (Ed): Die Milch. Verlag Eugen Ulmer, Stuttgart, 1983

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[3] • *Schlimme, E. und W. Buchheim*: Milch und ihre Inhaltsstoffe. Verlag Th. Mann, Gelsenkirchen, 1995