Usefulness of standard milk components for monitoring udder health

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Summary

With respect to upcoming devices for on-farm analysis of milk it was evaluated, whether milk components, being object of standard milk analysis, could be used as indicators of udder health. As to be deducted from several publications it was found that variations of lactose content were corresponding in a rather stable way with variations of somatic cell count. It therefore can be concluded that this component, beyond electrical conductivity of milk, could be useful for monitoring udder health at on-farm level.

Key words: *Milk components, udder health, on-farm milk analysis*

Introduction

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 SCHLIMME and BUCHHEIM (1995) , is one of the osmotic relevant components of milk. When, due to an infection by pathogens (LERCHE, 1966; TOLLE, in: GRAVERT, 1983), its production is inhibited, mineral substrates, mainly containing sodium and chloride, are entering the milk, stabilising the osmotic pressure of the mammary gland, but also increasing the electrical conductivity of milk. It therefore is obvious that, beyond somatic cell count, not only electrical conductivity but also lactose may be an indicator for detecting disturbances in the mammary gland (TOLLE, in: GRAVERT, 1983), 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. That system, prototypes of which were tested for some time at several departments in France, is using near infrared parameters for milk analysis. So it is able to evaluate with good accuracy standard milk components, like fat, protein and lactose, but it does not provide direct information on somatic cell counts 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, Braunschweig, from a group of 15 cows over a whole lactation about 2200 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 < 200 000 cells/ml (1666 samples), 200 000 – 500 000 cells/ml (296 samples), > 500 000 cells/ml (209 samples). For each parameter, included into the experiments, the coefficient of correlation to SCC was calculated.

Results

The average milk yield per cow over the whole lactation varied between 15,1 and 15,3 kg at various SCC levels (Tab. 1). As to be expected, there was an obvious negative correlation between milk yield and week of lactation, but no influence of this parameter on level of SCC was to be found.

Average electrical conductivity increased from 5,6 mS/cm at a SCC of <200 000/ml to 5,9 mS/cm at 200 000-500 000 somatic cells/ml up to 6,4 mS/cm at >500 000 somatic cells/ml. Significant positive correlation to SCC was found for this parameter at all levels of SCC.

As to be deducted 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 1. Survey of monitored parameters at foremilk samples.

Parameter	SCC (* 1000/ml)					
	< 200		200 - 500		> 500	
	Average	SD	Average	SD	Average	SD
Yield (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
Cond. (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 2 gives a survey of the correlation of evaluated parameters to SCC. It can be seen that for all classes of SCC there was found an interaction between SCC and lactose which in all classes is beyond the limit of $p<1\%$ (>0,08 for SCC below 200 000/ml, >0,18 for the other classes).

Data included into table 2 indicate that also other parameters 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 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 suspected that colour of milk also may be affected by species of pathogens being present in the mammary gland.

Table 2. Survey of correlation of monitored parameters with SCC.

Parameter	SCC (* 1000/ml)		
	< 200	200 - 500	> 500
Yield (kg)	0,001	0,021	-0,097
Cond. (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

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 can 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 that milk component at low cell counts may be of special interest for herd management.

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