Some investigations about the better use of the DCC device of DeLaval

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Abstract

The DeLaval Company now markets in France a specific device called the " DeLaval cell counter DCC" which measures Somatic Cells count (SCC) in the parlour during milking whenever the farmer wants in order to help him to improve udder health of cows. Three experiments were carried out, 2 at the experimental farm of Derval (44-France) and one in 10 commercial farms.

At the experimental farm, 3 groups of 8 cows with different SCC levels were made up. During 5 consecutive days, milk samples of the chosen cows were taken during 4 fractions of milking such as : first squirts of milk (SQ1), second squirts of milk after the preparation of the udder (SQ2), total milk (MK) and after removing the unit (AFTMK) compared with data got in the specific interprofessionnal laboratory (LAB) as used in the milk recording conditions.

The third experiment was performed in commercial farms. DCC measurements were done at three levels of milk in the bulk tank and compared with the LAB results.

The DCC device is able to accurately measure SCC in milk. Very high and significant correlations between results from the lab and SCC given by the DCC at different studied moments during milking were noticed.
The more representative data got from the DCC related to those given by the laboratory are coming from samples taken from the second squirts of milk or from the total milking. Samples taken after milking are always higher than the ones just mentioned and similar to those taken from the first squirts of milk.

When using the DCC, only one sample can be analysed whenever the duration of milking; it gives a good idea of the SCC analysed in the laboratory. However, this only data is not compulsorily the best view of the real infectious status of the animal. That means that when a cow is considered as infected or doubtful, other SCC should be got considering in the same time other parameters as udder conditions (colour, temperature), milk production, behaviour, etc.

In practice, the easier part of milk to be analysed with the DCC seems to be taken from the first squirts of milk, but a specific diagram should be used in order to get an accurate estimation of SCC if analysed in the laboratory. Using this diagram could be interesting because the conclusion on the real infectious status of the animal can be deducted from tools usually used by technicians, veterinarians or farmers themselves.

When using the DCC for controlling SCC in the bulk tank samples can be taken everywhere in the milk.

Contents

Introduction

Somatic cells count (SCC) is one of the main parameter used by farmers to manage udder health of their cows. Traditionally, SCC is part of results given by milk recording once a month.

The DeLaval company now markets in France a specific device called "DCC" as "DeLaval Cells Counter" which can give this type of information in the parlour during milking whenever the farmer wants and needs to get more investigation in order to improve udder health of cows.

DeLaval asked the Institut de l'Elevage to make some investigations farm in order to determine:

1. The evolution of SCC measured by the DCC in the different milking fractions : strict foremilk (2-3 first squirts), second squirts (after preparation of the udder, total milk (from the sampler of the milk meter) and after milking (after detachment). The goal of this study was to conclude on the best time during milking to take the more representative sample to be analysed with the DCC ,

2. Evolution of SCC between milking sessions : evolution morning/evening milking and during 5 consecutives days. The goal of this study was to conclude on the number of milking sessions during which it would be necessary to take samples analysed with the DCC, in order to get the best information about the infectious status of the udder.

3. Evolution of SCC to the level in bulk tank according where the sample is taken in commercial farms. The goal of this study was to conclude to the more representative level of sampling in the bulk tank when farmers want to investigate SCC in their bulk tank with the DCC.

Experiments 1 and 2

Experiments 1 and 2 were carried out at the experimental Farm of DERVAL- France), in which a herd of 85 dairy cows is kept. Average milk yield is around 9500 kg per cow and per year. Tests were done in the DeLaval double 5, 10 units herringbone milking parlour of the farm.
Measurements in bulk tanks were done in commercial farms in the surroundings of the experimental and at the experimental farm.

Material and methods

First of all, 3 milk samples were taken with the sampler of the milk meter during the week prior the beginning in order to get the more accurate health status of the cows of the experimental farm in getting information about individual SCC for each cow. Three previous results of milk recording were also involved in this research.

Among all cows of the herd:

- 8 of them were chosen with a high level of cells: more than 800000 cells/ml during the above mentioned recordings,
- 8 were chosen with a number of cells: between 300000 cells/ml and 800000 cells/ml ,
- and 8 were chosen with a low level of cells less than 300000 cells/ml.

Experiments 1 and 2 were performed in the meantime as described following :

during 5 consecutive days at every milking sessions (from Monday morning milking until Friday evening milking), milk samples of the chosen cows were taken during 4 fractions of milking such as :

- before attachment of the cluster
    - 1- three squirts of strict foremilk of each quarters were hand taken just after the cows entered on the platform, before washing the udder. The milk was mixed into a vial similar to the one used by the local Milk Recording Organization which was identified and then stocked in a specific box. After milking, the milk was analysed with the DCC.

      (these measurements will be called SQ1 in the report)

    - 2- three squirts of milk of each quarters were hand taken just after the udder was washed and dry. The milk was mixed into a vial similar to the one used by the local Milk Recording Organization which was identified and then stocked in a specific box. Just after milking, the milk was analysed with the DCC.

      (these measurements will be called SQ2 in the report)

- during milking: milk samplers of the milk meter of the milking installation were connected and at the end of milking, two representative samples of milk were hand taken from the milk meter sampler : one of at least 30 ml was poured into a vial, identified, stocked in another vial and after milking the box was introduced in a fridge before being sent to the laboratory in a refrigerated box. Analysis were made in the inter-professional laboratory "CINTERLIV" in Chateaugiron (35–France)

  (these measurements will be called LAB in the report)

  In the meantime, another sample was taken and poured into another vial, identified and stocked in a specific box. Milk was analysed with the DCC after milking.

  (these measurements will be called MK in the report)

- after detachment of cluster, two or three squirts of each quarters of milk were again hand taken, mixed into a vial, identified and stocked in a specific box. Milk was analysed with the SCC after milking.

  (these measurements will be called AFTMK in the report)

Experiment 3

Material and methods

In 10 different farms, samples were hand taken in three levels of the bulk tank after at least two milking (morning and evening). Measurements were done in bulk tank with milk of an equal number of morning and evening milking sessions. In addition, the bulk tank of the experimental farm was twice investigated. Results were added to those of the commercial farms.

Samples were taken a three different levels: a the top, mid level and at the base of the stocked milk. A part of the milk was poured into a vial, identified, stocked in a refrigerated box and sent to the laboratory for analyse. Another part of the sample was poured in another vial and immediately analysed with the DCC.

Analyse of results and statistical treatments

Results of experiments 1 and 2 were analysed together. Raw data LAB and MK in number of SCC/ml were just plotted in order to have an idea of the relationship between these two results.
Because the distribution of SCC was not normal, a logarithmic transformation of raw data was undertaken and controlled for its normality (UNIVARIATE procedure of SAS) and statistical treatments of these transformed data were done with SAS (GLM, REG and CORR Procedures)

Because of the small number of farms involved in experiment 3, no specific statistical treatment was done.

Results

Experiments 1 and 2

1- Information about the 3 groups of studied cows

As mentioned in the paragraph "Material and methods", 3 groups of 8 cows with different individual SCC status of the udder were done.

Main information about theses 3 groups are indicated in table 1. Cows were introduced in each of the 3 groups referring to their average SCC of 6 controls as mentioned previously (3 official milk recordings and 3 additional recordings during the last month before the beginning of the experimentation). The 6 controls were done, analysed and computed, on October 6, November 2, December 1, 2004 and January 3, 10 and 18 respectively.

Table 1. The different studied cows

Nb cow	group	Nb lactation	Average number of SCC * 1000
3119	1	4	26
3130	1	3	93
3159	1	3	27
3171	1	2	34
3179	1	2	97
3181	1	2	38
3183	1	2	64
3185	1	2	40
3187	1	2	37
Average SCC of the group (standard deviation)			54 (28)
743	2	7	393
3127	2	3	289
3138	2	3	211
3142	2	3	377
3168	2	2	394
3175	2	2	167
3189	2	2	111
3228	2	1	114
Average SCC of the group (standard deviation)			257 (122)
3149	3	3	415
3047	3	5	717
3070	3	4	623
3073	3	5	906
3145	3	3	622
3163	3	3	1364
3191	3	1	670
Average SCC of the group (standard deviation)			1021 (791)

2- The logarithmic transformation and the statistical treatments

Because the distribution of the results was not normal a logarithmic transformation was undertaken in order to render normal the distribution and to statistically treated the results as usual. The transformed data was called "Logcell"

Then an analyse of variance was done with all data in order to test if significant differences could be seen in results, between milking sessions (morning and evening) (milking effect), between recorded days (day 1 until day 5) (day effect) and between the different time or phase of milking when sample was taken (SQ1, SQ2, MK, LAB and AFTMK) (phase effect); in addition the interactions day*phase and milking*phase where tested in order to determine if data from the DCC were influenced or not with these controlled parameters. The group effect was not tested because they were different by definition of the experimental design.

The mathematical model could be written as followed :

$$Logcell = cow_{(1,\ 2,3,\ldots,24)} + day_{(1,\ 2,\ldots,5)} + milking_{(1,\ 2)} + phase_{(1,\ 2,\ldots,5)} + day*phase_{(1,\ 2,\ldots,16)} + milking*phase_{(1,\ 2,\ldots,4)} + \varepsilon.$$

It explained 83% of the variance

Because of a marked milking effect, showing that results were not similar whether the morning or the evening milking was considered, similar analyses of variance, without the controlled parameter "milking" and the interaction milking*phase were undertaken. Then, the mathematical model could be written as followed :

$$Logcell = cow_{(1, 2,3,\ldots,24)} + day_{(1, 2,\ldots,5)} + phase_{(1, 2,\ldots,5)} + day*phase_{(1, 2,\ldots,16)} + \varepsilon.$$

It explained 81 up to 86% of the variance considering the evening or the morning session.

Finally, others analyses of variance were done for each group of cows and for morning and evening milking in order to see if the phase and day effects were similar or not in each group and for each milking. The mathematical model was the same than the last one.

After each analyse of variance showing a significant different between the studied parameters, a test of comparison of means (Newman and Keuls), was done in order to determine the statistical differences of the results (Logcell) for each parameter.

3- Results

4.1. Results related to all data

Table 2 shows the average Logcell and SCC in each group during the whole experimentation. This table illustrates that the 3 groups were also quite different as they were constructed before the experimentation. This result renders licit the different analyses on the different groups.

Table 2. Logcells means and average SCC (geometric mean) for the 3 groups during the whole experimentation

Group	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)
1	399	4.718	0.358	52304
2	400	5.331	0.413	217193
3	397	5.856	0.492	718167

First, the analyse of variance shows a cow effect. This effect was not analysed because it is obvious that results are different for each cow.

Secondly, a milking effect is noticed showing that results are different at morning and at evening milking (table 3).

Table 3. Results in morning and evening milking sessions.

Milking	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
morning	598	5.251	0.619	178381
evening	598	5.350	0.635	224114

* = geometric mean

This results demonstrate that it is necessary to make a separate statistical treatment for the two milking sessions.

Testing the day effect was very important because it was one of the main question : how many milking a user has to take into account in order to get a good and accurate overview of the real infectious status of a given cow?

General statistical treatment on all data show a marked day effect. Table 4 illustrates that the effect is only due to day 5 which is quite different than results of the other days, and on the contrary, there is no statistical differences noticed between results from day 1 until day 4.

Table 4. Day effect on all transformed data

Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
1	240	5.317 [a]	0.602	207491
2	239	5.326 [a]	0.639	212060
3	239	5.314 [a]	0.629	206153
4	238	5.313 [a]	0.623	205821
5	240	5.234 [b]	0.652	171269

Values with different letters within the same column indicate significant differences (P<0.05)
* = geometric mean

Table 5, show the main results when comparing these different moments of sampling during milking.

Table 5. Phase effect on all transformed data

Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
LAB	240	5.227 [b]	0.543	168861
SQ1	240	5.455 [a]	0.669	285391
SQ2	238	5.202 [b]	0.674	159415
MK	240	5.146 [c]	0.594	139978
AFTMK	238	5.474 [a]	0.594	297591

Values with different letters within the same column indicate significant differences (P<0.05)
* = geometric mean

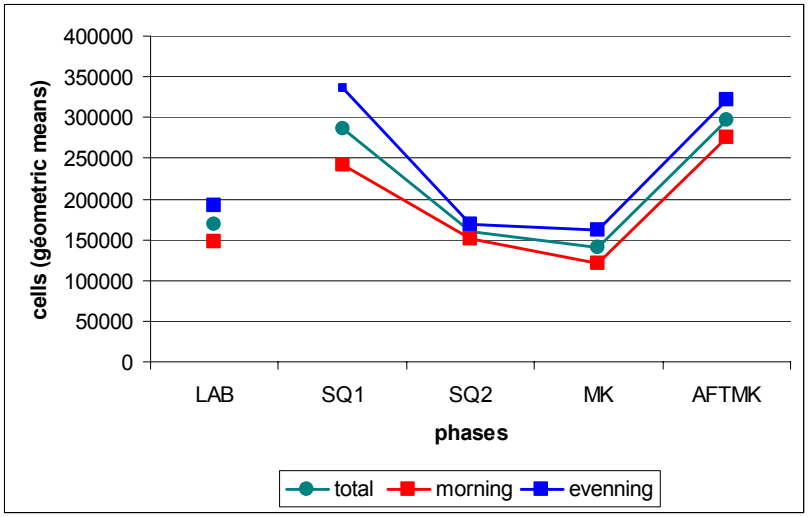
Table 5 shows that :

1- measurements done with the DCC on milk from the whole milking (MK) are slightly lower than the laboratory results (LAB),
2- the highest results and significantly different from the other are noticed in samples SQ1 and AFTMK,
3- laboratory results and SQ2 samples are not significantly different.

These results are confirmed when plotted on a graph (graph 1), which shows that the more representatives data compared to the LAB data are those obtained when analysing milk from the second squirts of milk after the preparation of the udder (SQ2).

In addition no significant inter-actions day*phase and milking*phase is noticed, showing that the phase results are similar every day and at every milking.

Graph 1. SCC (geometric means) of the different phases measured with the DCC compared to the laboratory results



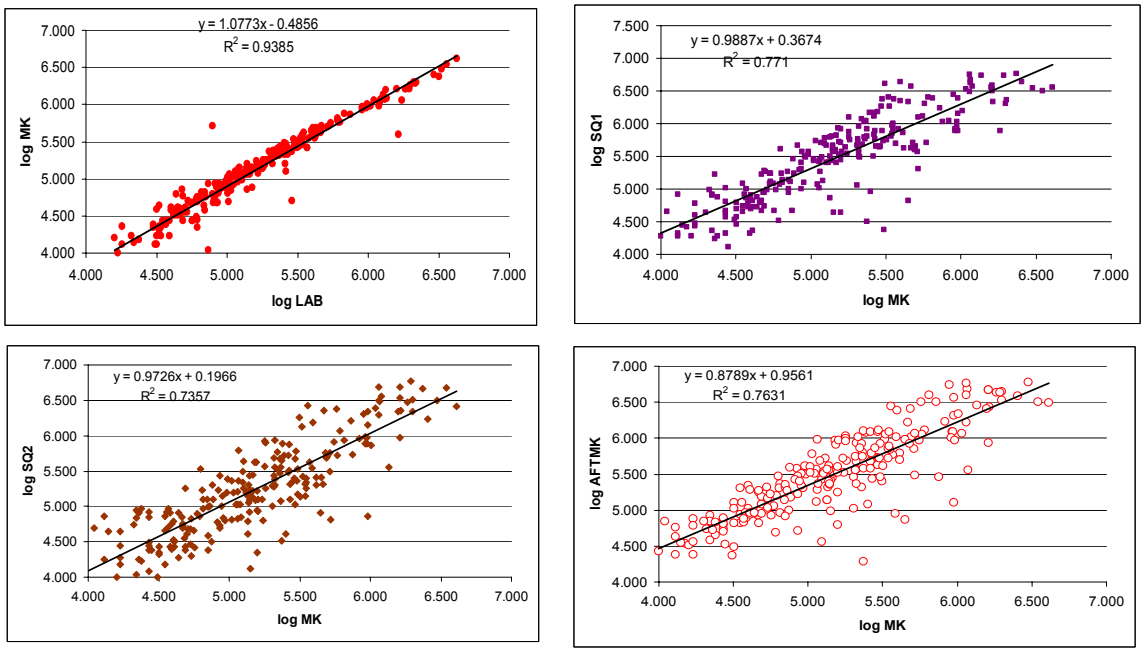
Despite, some differences are noticed between the different values (transformed data), all of them are linked with a very strong linear relationship (table 6).

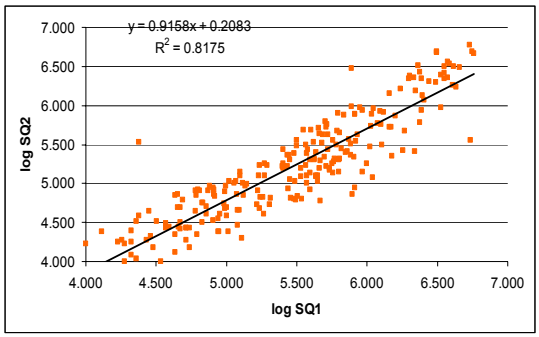
Table 6. Correlations between the different values according to the moment of sampling

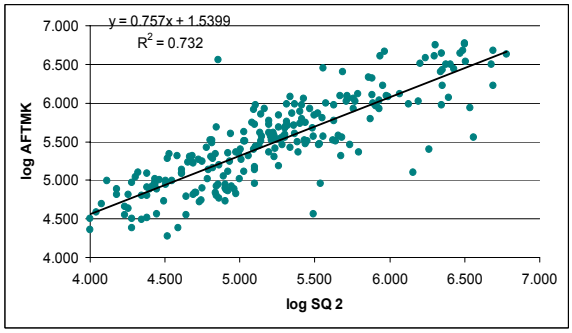
	LAB	SQ1	SQ2	MK	AFTMK
LAB	1.00	0.87	0.86	0.97	0.86
SQ1	0.87	1.00	0.90	0.88	0.88
SQ2	0.86	0.90	1.00	0.85	0.86
MK	0.97	0.88	0.85	1.00	0.87
AFTMK	0.86	0.88	0.86	0.87	1.00

The correlations are confirmed when plotted the different values to each other, as we can see on some examples given on graph 2.

Graph 2. Relationship between different results







4.2. Morning and evening milking sessions

The same treatment as described for all data was done for each morning and milking sessions.
Table 7 shows the average Logcell and SCC in each group during the two studied milking sessions and confirms that the 3 groups were also quite different as they were constructed before the experimentation. Results in the morning are always lower than in the evening due to more milk at the morning milking.

Table 7. Means Logcells and average SCC (geometric mean) for the 3 groups at the morning and the evening sessions

	Group	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)
Morning	1	199	4.655	0.322	45215
	2	200	5.298	0.403	198458
	3	199	5.801	0.477	632222
Evening	1	200	4.781	0.380	60459
	2	200	5.364	0.420	231047
	3	198	5.912	0.503	816322

The statistical analysis shows a day effect, but only in the evening, and at the limit in the morning (F= 0.0584). Even if we have not exactly the same position of the 4 first days, in both sessions, the one which is quite different than the others is always the 5th, confirming what was found when testing all data together. Table 8 gives the main results for both morning and evening milking sessions. The analyse does not show any statistical difference in the inter-action- day*phase demonstrating that phases results for are similar every studied day.

Table 8. Day effect for both morning and evening milking sessions

Milking	Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	1	120	5.244[a]	0.565	175444
	2	119	5.251[ab]	0.635	178221
	3	120	5.268[ab]	0.625	185472
	4	119	5.295[ab]	0.625	197260
	5	120	5.199[b]	0.651	158019
Evening	1	120	5.390[a]	0.631	245386
	2	120	5.401[a]	0.637	251965
	3	119	5.360[a]	0.632	229345
	4	119	5.332[ab]	0.624	214758
	5	120	5.269[b]	0.652	185631

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

* = geometric mean

We can conclude this analyse in two directions :

1- taking one sample at a given milking has a high probability to be representative of SCC status of the animal,
2- comparison of results must be made only by considering the same type of milking : morning or evening.

Finally, testing the phase effect on both morning and milking session shows a similar results than noticed when working with all data, as shown on table 9.

Table 9. Phase effect for both morning and evening milking sessions

Milking	Phase	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	LAB	120	5.171[b]	0.528	148286
	SQ1	119	5.384[a]	0.665	242127
	SQ2	119	5.180[b]	0.654	151254
	MK	120	5.084[c]	0.600	121284
	AFTMK	119	5.439[a]	0.576	274838
Evening	LAB	120	5.284[b]	0.536	192291
	SQ1	120	5.527[a]	0.668	370077
	SQ2	119	5.225[b]	0.695	168010
	MK	120	5.208[b]	0.584	161551
	AFTMK	119	5.508[a]	0.613	322226

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

* = geometric mean

Separate statistical treatments of the morning and evening milking sessions lead to the same conclusion as when working with all data :

1- measurements done with the DCC on milk from the whole milking are always slightly lower than the laboratory results in the morning and in the evening. These results are significantly different in the morning but not in the evening, but their classification is similar.
2- the highest results and significantly different from the other are noticed in samples SQ1 and AFTMK at both milking sessions,
3- laboratory results and SQ2 samples are not significantly different.
4- This analyse confirms than the most consistent DCC measurements with those given by the laboratory are the second squirts of milk taken after the preparation of the udder (SQ2), whatever milking is considered.

4.3. Results within the three groups of cows

Similar statistical treatments were done within each group of cows differing by their number of SCC, in order to see if results can be influenced by the SCC level itself.

a. Group 1 : low SCC

Table 10 gives the day effect in group 1 with low SCC.

In the morning session, the day effect is just close to the limit of 5% (F=0.053), but in the evening session, no day effect is noticed.

Referring to the morning session, the classification is similar to the one noticed when considering results all cows together, showing that there is no particular influence of the SCC on the DCC measurements.

Table 10. Day effect in group 1

Milking	Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	1	40	4.655[ab]	0.354	45188
	2	40	4.639[ab]	0.322	43512
	3	40	4.671[ab]	0.338	46938
	4	39	4.716[a]	0.289	51985
	5	40	4.597[b]	0.310	39527
Evening	1	40	4.757[a]	0.349	57141
	2	40	4.836[a]	0.339	68519
	3	40	4.821[a]	0.372	66201
	4	40	4.799[a]	0.355	62958
	5	40	4.694[a]	0.470	49503

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

*= geometric mean

Table 11 shows the phase effect in group 1.

Table 11. Phase effect in group 1

Milking	Phase	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	LAB	40	4.658[b]	0.213	45547
	SQ1	40	4.710[b]	0.301	51282
	SQ2	40	4.580[c]	0.355	38004
	MK	39	4.474[d]	0.323	29772
	AFTMK	40	4.852[a]	0.287	71200
Evening	LAB	40	4.810[a]	0.331	64643
	SQ1	40	4.868[a]	0.386	73861
	SQ2	40	4.615[b]	0.370	41169
	MK	40	4.686[b]	0.413	48551
	AFTMK	40	4.928[a]	0.316	84646

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

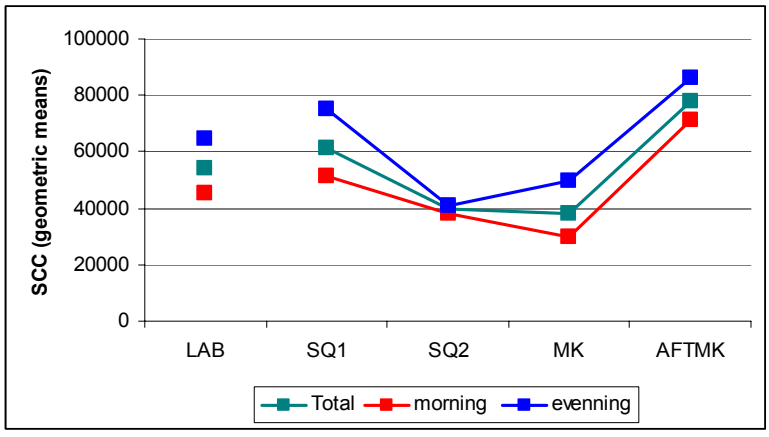
* = geometric mean

Once more, we find a similar classification of the phases within the group 1 than the one mentioned with all morning and evening data, as followed :

1- SQ1 and AFTMK have the highest DCC values,
2- SQ2 and MK are similar or close to each other,
3- MK is always lower than the LAB data.

Graph 3 shows the evolution of SCC of the different tested phases with the DCC compared with results of the laboratory.

Graph 3 : SCC (geometric means) of the different phases measured with the DCC compared to the laboratory results for the group of cows with low level of cells (Group 1)



b- <u>Group 2 : medium SCC</u>

Table 12 gives the day effect within group 2 for the morning and the evening milking.

For both morning and evening milking, the statistical treatment shows a day effect.

In the morning milking, the only significant difference is noticed on the 5th day as mentioned when figuring all transformed data. Every SCC (geometric means) are located around 200000 and 225000 during the four fist days, and only decrease up to 150000 the 5th day.

Statistically speaking, in the evening milking, the situation is more complicated, but the classification of the days is quite similar. Nevertheless, we can observe that SCC (geometric means) and obviously Logcell decrease from day 1 until day 5. That means that in case of SCC close to the 300000 limit, it should be advisable to get one or two measurements more at one or two consecutive similar milking, in order to ensure that the animal can be infected or not.

Table 12. Day effect in group 2

Milking	Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	1	40	5.351[a]	0.350	224640
	2	40	5.328[a]	0.463	213064
	3	40	5.331[a]	0.371	214133
	4	40	5.301[a]	0.359	199801
	5	40	5.177[b]	0.456	150337
Evening	1	40	5.471[a]	0.458	295660
	2	40	5.414[ab]	0.437	259335
	3	40	5.366[abc]	0.419	232547
	4	40	5.305[bc]	0.387	202112
	5	40	5.263[c]	0.382	182702

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

*= geometric mean

Table 13 shows the phase effect in group 2.

Table 13. Phase effect in group 2

Milking	Phase	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	LAB	40	5.193[b]	0.306	155789
	SQ1	40	5.446[a]	0.457	279422
	SQ2	40	5.179[b]	0.441	151213
	MK	40	5.140[b]	0.322	138011
	AFTMK	40	5.530[a]	0.317	338881
Evening	LAB	40	5.302[b]	0.324	200377
	SQ1	40	5.564[a]	0.461	366127
	SQ2	40	5.201[b]	0.446	158795
	MK	40	5.242[b]	0.361	174518
	AFTMK	40	5.510 [a]	0.980	323848

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

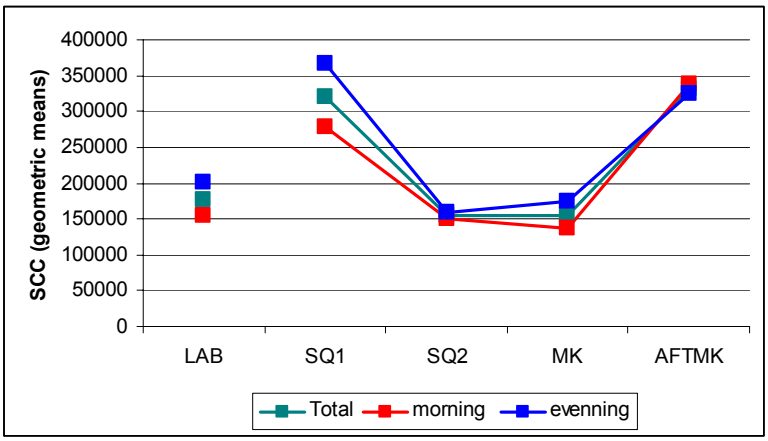
* = geometric mean

Results are approximately similar in the morning and in the evening and also similar to those mentioned with all data.

For the medium SCC group transformed data are statistically similar for LAB, SK and MK, and higher but equivalent to each other for SQ1 and AFTMK.
Referring to SCC (geometric means), we can notice the same evolution and the trend for the DCC data (MK) to be slightly lower than those given by the laboratory. However, on the contrary of results showed with all data, there is no significant difference between MK and LAB.

Graph 4 shows the evolution of SCC of the different tested phases with the DCC compared with results of the laboratory.

Graph 4 : SCC (geometric means) of the different phases measured with the DCC compared to the laboratory results for the group of cows with medium level of cells (Group 2)



c- Group 3 : high SCC

Table 14 gives the day effect within group 3 for the morning and the evening milking.

Table 12. Day effect in group 3

Milking	Day	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	1	40	5.726[a]	0.349	532003
	2	39	5.799[a]	0.463	630190
	3	40	5.803[a]	0.528	634774
	4	40	5.854[a]	0.561	714771
	5	40	5.822[a]	0.469	663986
Evening	1	40	5.942[a]	0.390	874594
	2	40	5.954[a]	0.540	900210
	3	39	5.908[a]	0.553	808666
	4	39	5.906[a]	0.536	804549
	5	40	5.849[a]	0.499	707251

Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

*= geometric mean

The statistical treatment doesn't show any significant differences between days in the morning and in the evening milking. That is an evidence, that with high SCC only one measurement with the DCC leads to the conclusion that the cow is likely drastically infected and a strong and action from the milker is rapidly necessary.

Table 15 shows the phase effect in group 3.

Table 15. Phase effect in group 3

Milking	Phase	N	Mean Logcell	Standard deviation	Average SCC (cells/ml)*
Morning	LAB	40	5.662[b]	0.441	459513
	SQ1	40	5.996[a]	0.442	990600
	SQ2	40	5.765[b]	0.513	581714
	MK	40	5.638[b]	0.437	434199
	AFTMK	39	5.947[a]	0.453	885959
Evening	LAB	40	5.739[bc]	0.468	548934
	SQ1	40	6.148[a]	0.397	1407474
	SQ2	39	5.877[b]	0.573	753283
	MK	40	5.697[c]	0.461	497637
	AFTMK	39	6.101[a]	0.448	1262877

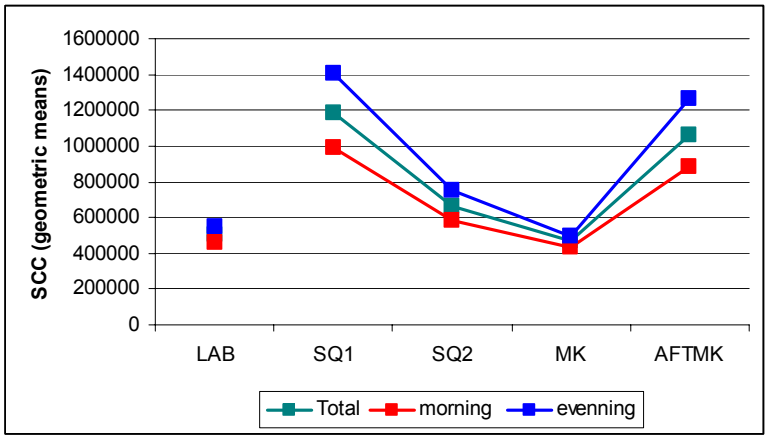
Values with different letters within the same column for each milking session indicate significant differences (P<0.05)

* = geometric mean

We can notice a very similar classification of the different studied phases. Cows with high SCC also show good relationship between SQ2, LAB and MK, and when using the DCC device, the most representative data compared to those from the laboratory are the second squirts of milk sample after the preparation of the udder.

Graph 5 shows the evolution of SCC of the different tested phases with the DCC compared with results of the laboratory.

Graph 5 : SCC (geometric means) of the different phases measured with the DCC compared to the laboratory results for the group of cows with high level of cells (Group 3)



Experiment 3.

How using the DCC to measure SCC in the bulk ?

In 10 farms and twice in the experimental farm, 2 samples were hand taken, one for DCC measurements and one to be analysed for SCC in the laboratory at three levels in the bulk tank: at the top, in the middle and at the base of the tank, as described in paragraph "Material and methods".. The milk was sampled as it was when the technician arrived on the farm. Sometimes the milk was just steered, sometimes not depending on the farm.

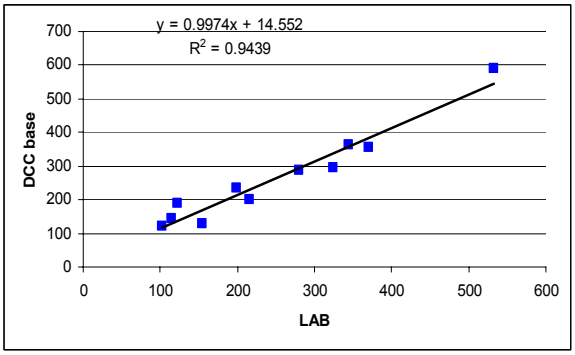
Results of DCC measurements and laboratory values at different levels in the bulk tank can be seen on table 16.

Table 16. Results of measurements at different levels in the bulk tank

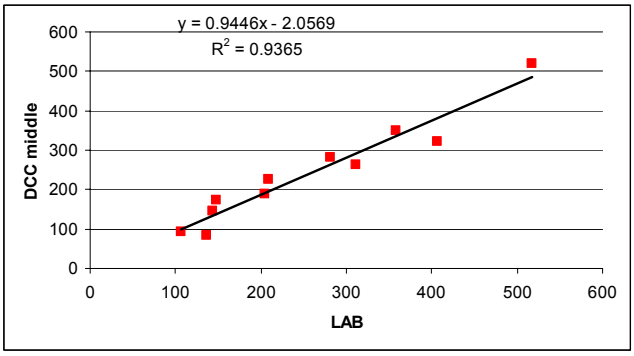
Farm	Base		Middle		Top	
	DCC	lab	DCC	lab	DCC	lab
1	190	122			184	116
2	236	199	226	209	261	215
3	130	154	173	148	157	156
4	289	280	281	281	306	290
5	200	216	188	205	183	225
6			82	137	87	110
7	356	370	323	406	364	424
8	362	345	349	359		
9	144	115	144	143	139	129
10	295	324	263	312	295	326
11	122	103	94	106	100	106
12	589	532	521	517	517	553

Graph 6 shows a good correlation between the LAB results and DCC results whatever level of milk in the bulk tank is considered. Correlations are 0.97 between LAB and base, middle and top of the bulk tank.

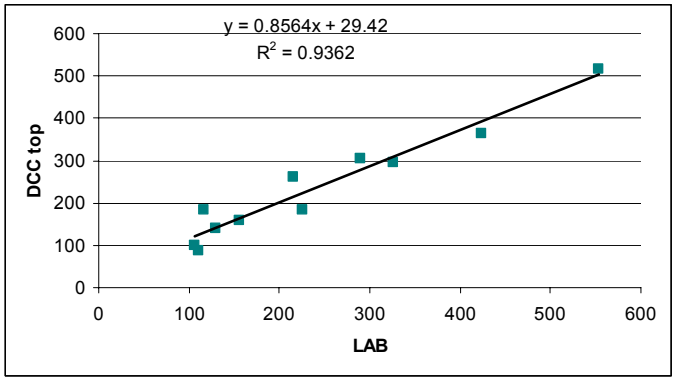
Graph 6. Correlations between LAB and DCC in relation with the DCC measurement level



(a) base



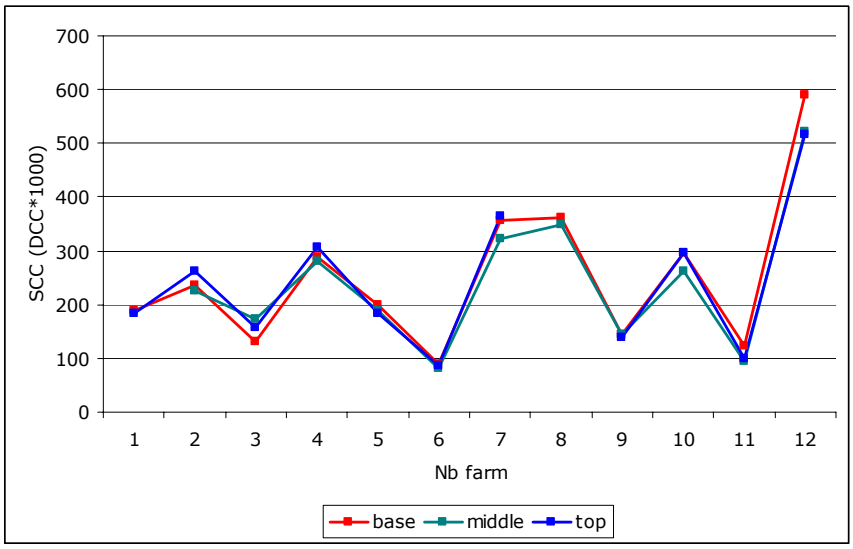
(b) middle



(c) top

Because SCC values measured with the DCC in the different farms were of the same magnitude, we are able to present graph 7 which shows the different measurements at different levels of milk in the bulk tank in the studied farms. This graph doesn't show any difference between the 3 levels. That means that sampling milk in the bulk tank for DCC measurement can be done everywhere in the bulk tank.

Graph 7. SCC measured with the DCC at 3 levels of milk in the bulk tank



Discussion

The different studies carried out with the DeLaval DCC device show a good representativeness of the measurements in relation to the classical measurements in the specific laboratory. These results are totally in accordance with those presented by Ruegg and al (2005) who didn't find any significant differences between the $\log_{10}$SCC and the $\log_{10}$DCC of quarter milk samples and a significant correlation of 0.92 between these two parameters. Our measurements on composite milk at different times of milking leads to similar correlation levels : from 0.86 up to 0.97, depending on the moment of the measurements.

It should be conclude that the DeLaval DCC is able to accurately measure SCC in milk.

Because we do not find any large day effect, only the 5th day was significantly different, and data are, in average, lower than during the 4 previous days, we also can conclude that only one measurement with the DCC is necessary to get a data which is representative of SCC result analysed in a specific laboratory. However, when the result given by the DCC, especially one of the most representative of the laboratory data (MK or SQ2), is close to the limit from which it can considered than a cow is infected, it should be preferable to make one (or two) measurements more during similar milking sessions (morning or evening), in order to confirm the first result.

Finally, the main important problem is to chose the right moment during milking for taking a sample for the determination of SCC in the milk. Results of our study show that there are very good correlations between SCC (LAB) and DCC data, with SQ2 and MK. That means that when using the DCC in practice an operator can get a very good representativeness of the SCC analysed in the laboratory with SQ2 and MK.

However it is always possible to use MK if no milk sampler are not installed on each unit because MK samples cannot be easily taken nor analysed. If it is decided to work with SQ2 samples, that means than the farmer has also to remove the first squirts, obviously, without taking sample, but the total work induced by removing the first squirts, then the second squirts and identifying the samples before analysed could be time consuming, especially when the farmer decides to control a large number of cows.

Taking samples after milking (AFTMK) could be a solution, but three main drawbacks appeared during the study :

- the first one was higher SCC than those got when sampling in SQ2, MK and than the LAB results,
- the second and the main important is that in some cases, it was very difficult to get one drop of milk from one or two quarters, because the cow was completely milked. That means that in certain cases, data obtained from these samples are not representative of the milk of the cow. Obviously, this can be avoided in increasing the milk flow rate at the switch point level of the automatic cluster remover (if a such device is existing on the milking installation),
- the last one is that is also time consuming and can be forgotten because the farmers used disinfecting udders just after the ACR has removed the cluster.

Finally, it appears that what is apparently easier in practice is to take a sample from the first squirts of milk, but we have seen than SQ1 results are higher than those got when sampling in SQ2, MK and very similar that results got after milking (AFTMK). People involved in the DCC use in the experimental farm think that sampling SQ1 seems to be easier, more natural and less time consuming. The main problem is still the comparison of SCC got at that time with the tools usually used on the field as SCC got from the laboratory.

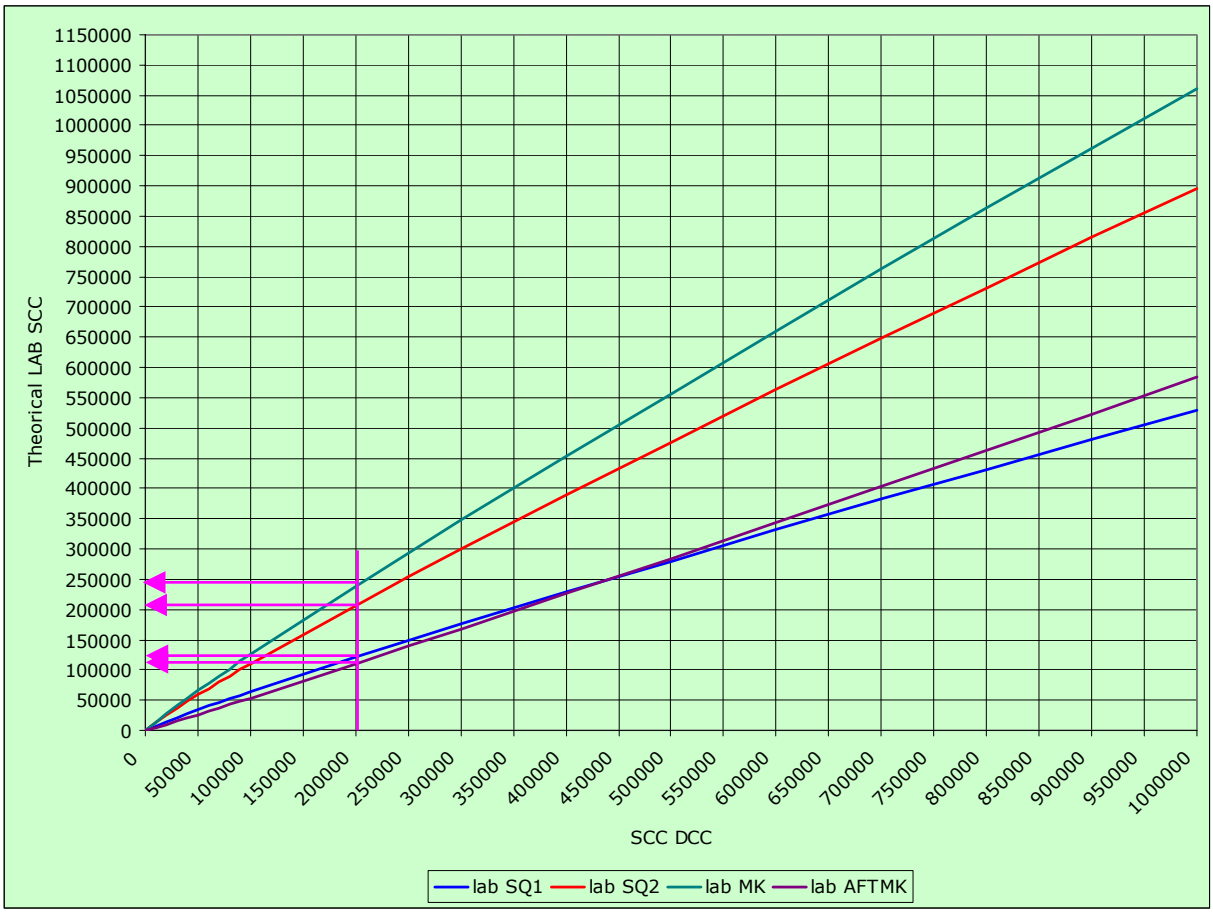
In order to help people in this way, using the high correlation between the different results got during the study and the calculated equations of the regressions lines which has a R^2 of 0.73-0.77, we have made two diagrams from which it is possible to get a more accurate estimation of what the result of the laboratory should be when an operator get a data from the DCC. These diagrams must be considered as an example only available with data got from the laboratory where SCC analysis where made (inter-professional laboratory in Chateaugiron (35-France), because results can vary from one laboratory to another one.

Graph 8 is the diagram which can be used from 0 up to 1000000 cells/ml, and the diagram 2 (graph 9) could be used up to 4000000 cells/ml.

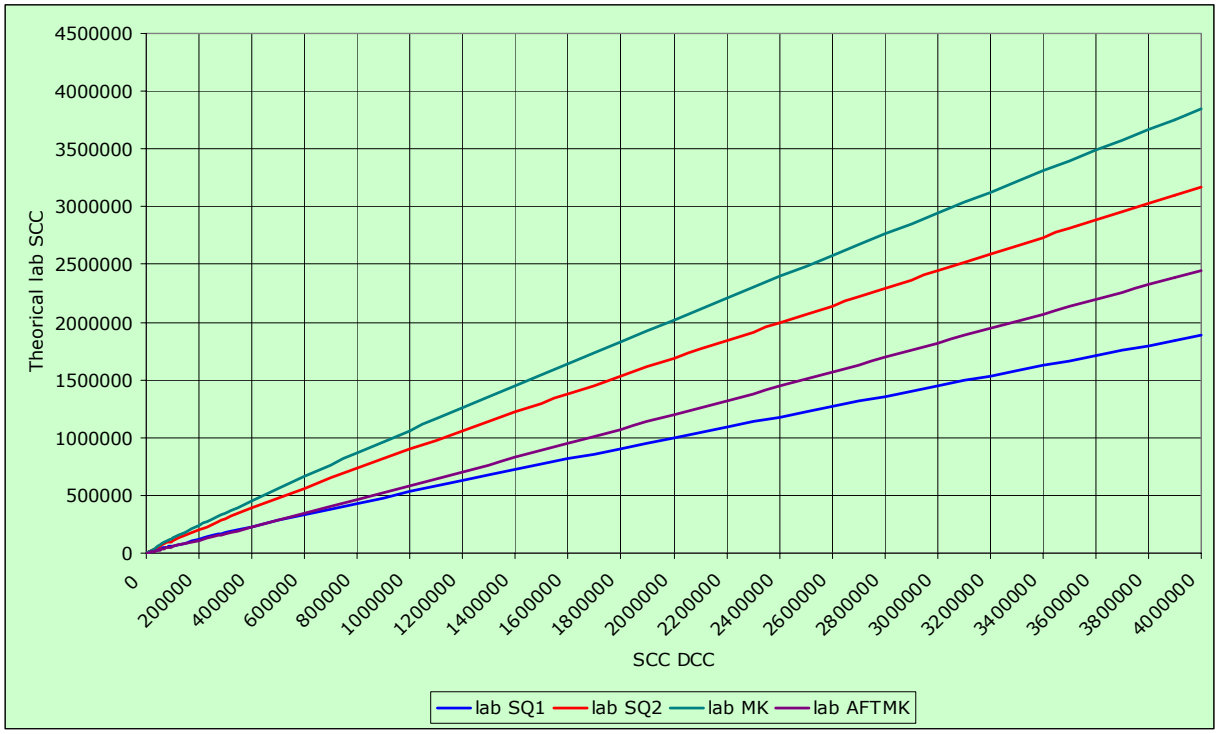
How to use these diagrams? Each of them have 4 lines corresponding at the time of sampling during milking : SQ1 (blue line), SQ2 (red line), MK (green line) and AFTMK (purple line). The X-axis corresponds to SCC got from the DCC within the 4 studied critical times. Then tracing a vertical line from this value, it intersects the line corresponding at the time when sampling at a good estimation of the results which would be get if the sample is analysed in the laboratory.

For example, if a DCC data is 200000 cells/ml, this value corresponds to an estimated lab data of 120000 cells/ml for a SQ1 sample, 205000 cells/ml in for a SQ2 sample, 240000 cells/ml for a MK sample and 110000 cells/ml for a AFTMK sample (graph 8). These different values can be read on the y-Axis.

Graph 8. Example of diagram 1 for data between 0 and 1000000 cells



Graph 9. Example of diagram 2 for data between 0 and 4000000 cells



Finally, using the DCC for checking SCC in the bulk tank could be easy : the level of milk where the sample is taken is not important and steering or not milk before sampling seems to be of a minor importance.

Conclusion

The DCC device is able to accurately measure SCC in milk. Very high and significant correlations between results from the lab and SCC given by the DCC at different moment during milking (first and second squirts of milk, milk from the sampler of the milk meter and samples taken just after milking).

When using the DCC, only one sample can be analysed whenever the duration of milking; it gives a good idea of the SCC analysed in a specific laboratory.

The more representative data got from the DCC related to those given by the laboratory are coming from samples taken from the second squirts of milk or from the sampler of the milk meter. Samples taken after milking are always higher than the ones just mentioned and similar to those taken from the first squirts of milk. Sometimes, it is difficult to get milk from quarters after milking.

When using the DCC for controlling SCC in the bulk tank samples can be taken everywhere in the milk.

References

Ruegg, P., L., Hulland C. and Rieth B., 2005. Performance or the Direct Counter used on Milk Samples obtained from fresh cows. Proceedings of the 44th annual NMC meeting, January 16-19, 2005, Orlando, Florida, USA.