Detection of clinical mastitis in automatic milking systems

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Summary

The objective of this paper was to determine state-of-the-art ability of AMS to detect abnormal milk or clinical mastitis. Five different models of AMS were tested in six herds and sampled for 13 to 48 hours to find at least 10 cow milkings with abnormal milk and 50 cow milkings with normal milk. Due to the short sampling periods, the CMT-score of the foremilk was used to identify and support classification of abnormal and normal milk. Cows and quarters with a CMT-score >3 and no clots on a 0.1 mm filter were omitted from the calculations.

The current AMS models have systems to produce alarm lists of cows whose milk should be checked for abnormalities, but these systems are not intended for automatic diversion of milk at present. This should be taken into account when evaluating the current systems. The sensitivity of the detection for the six herds varied from 13 to 50% when calculated for the actual milking, from 22 to 100% for the test days, and from 43 to 100% when calculated for the previous week. Specificities for the same time periods were found to be 87-100%, 85-100%, and 35-100%, respectively. At present, the sensitivities and specificities are generally too low for automatic diversion of abnormal milk, and it seems that most of the models could benefit from application of more sophisticated algorithms.

Key words: *Automatic milking systems, clinical mastitis, sensitivity, specificity*

Introduction

Automatic milking systems (AMS) mainly base detection of cows with mastitis on the measurement of milk conductivity. The conductivity of the milk increases in quarters with subclinical and clinical mastitis and comparisons between the four quarters and maybe inclusion of historical data make it possible to detect mastitic quarters. However, being mastitic is not a steady condition because infected quarters may have high and fluctuating SCC and a varying excretion of bacteria. The foremilk may occasionally or never show clinical signs and the milk yield of the infected quarter may be reduced. The automatic detection systems do not divert abnormal milk automatically at present but produce an alarm list, which

herds with more than 100 cows we expected to be able to find at least 10 cow milkings with abnormal milk from at least five different cows. One herd was selected for each of the AMS models 1 to 4 and two herds for no. 5. The models are kept anonymous in the tables. Only one of the AMS models was equipped with a colour sensor to automatically divert milk with blood.

Data were collected from the five AMS models present in Denmark, i.e. DeLaval VMS, Fullwood Merlin, Gascoigne Melotte, Insentec Galaxy, and Lely Astronaut. The six selected herds were sampled for various numbers of hours from 13 to 48 and at least 50 cows with normal milk were sampled twice in each herd. Cows were foremilked in the milking box just before the automatic milking. Foremilking was done into a four-chambered strip cup with 0.1 mm filters mounted at the outlet, a CMT-scoring plate collecting the foremilk from each quarter. Visual scoring was done during foremilking. A small amount of water was run through the filters to remove foam before the visual inspection of the filters. CMT-scoring was also done immediately after foremilking. Two consecutive milkings without clots on the filter, no visual abnormality, and low CMT-score were needed to classify cows and quarters as normal whereas any milking with clots on the filter and a CMT-score >3 was rated as abnormal. The remaining unclassified cows and quarters were either omitted (first milking but otherwise normal) or discarded (CMT-score >3 or visually changed in colour but no clots on the filter).

Sampling was carried out in the six herds for a time period of 13 to 48 hours and resulted in collection of foremilk scorings of 169 to 623 cow milkings (Table 1). A large percentage of the samples were omitted, especially in the herds with a short sampling time. About 5 to 15% of the cow milkings were discarded because the CMT-score was 4 or 5 or they were visually changed in colour but with no clots on the filter. The number of cow milkings with normal milk was from 47 and up and the number of cow milkings with abnormal milk was from 4 to 18.

All herds had an alarm list based on conductivity and the results are presented in Table 2. The number of discarded samples that appeared on the alarm lists varied. One to five cow milkings with abnormal milk matched directly the alarm based on conductivity and 2 to 13 did not.

Table 3 presents the sensitivities and specificities calculated for the actual milkings, the test days, and the previous week (including the test day). Sensitivities were generally low for the actual milking and increased when looking at a longer time span. Specificities were generally high at the actual milking and dropped when looking at a full week. Herd 5 had the lowest specificity for the actual milking but it turned out that sensors were not calibrated sufficiently. Consequently, the specificity was very low when looking at the alarm list for a week. It could be speculated that the relatively high numbers of abnormal cow milkings found in Herd

as the main source of information for mastitis detection (de Mol and Woldt, 2001). Some of the systems may obviously benefit from adopting and implementing such calculation models.

References

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Table 1. Number of cows and milkings in the tested herds.

				Hours of	No. of cow milkings					Quarters	
Model	Herd	AMU	Cows	sampling	Total	Drop	Discard	Normal	Abn.	Normal	Abn.
1	1	2	79	48	350	89	46	206	9	936	9
2	2	3	145	13	222	113	35	56	18	256	22
3	3	4	116	13	178	90	21	61	6	243	6
4	4	2	100	14	192	104	26	47	15	227	15
5	5	2	105	16	169	102	7	54	6	223	6
5	6	3	184	36	623	184	69	366	4	1526	7