Practical applications to improve udder health: a pathogen-specific approach

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Abstract

Due to advancing technology on dairy farms, data integration is becoming increasingly important with regard to professional herd management. The aim of this study was to develop pathogen-specific udder health evaluations to upgrade the web-based udder health program and allow a proactive improvement of udder health in Austrian dairy herds. Investigations were preceded by data harmonization and the integration of the results of bacteriological milk cultures from laboratories into the Central Austrian Cattle Database. Udder health status can be assessed using various factors. In this study, test-day somatic cell count records, the veterinarian-reported diagnoses of acute and chronic mastitis, as well as the results of milk sample cultures, were combined. Research and development was based on data collected during an observational study conducted in cooperation with 250 farms, 17 veterinarians, 6 milk laboratories and research institutions.

Almost 6,900 quarter milk samples collected from lactating dairy cows with (suspected) udder health problems were available. Pathogen-specific udder health reports on individual cows, current and previous herd infection reports, and parameters allowing benchmarking both within and across herds were developed and subsequently displayed in clearly arranged charts. Such evaluations provide vital information on farm-specific pattern(s) of pathogens annually or even over a predefined period of time. In addition, the combination of bacteriological data and routinely-recorded animal production and health data provide details on period(s) of risk of infection as well as the cow group(s) at risk.

The pathogen-specific program allows a step-by-step analysis of animal and herd udder health status. Management issues and possible reservoirs of infection can therefore be identified more easily and eliminated at an earlier stage. Assessing the infection status of the udder, by means of milk culture results, can assist in decision-making processes leading to more precise control and prevention measures to improve udder health. One of the main challenges regarding this tool is the availability of quarter milk samples on a regular basis to ensure good quality and a high informative value of the evaluations.

Apart from supporting management decisions, results of bacteriological milk cultures may also be used in genetic evaluations of udder health. Thus, practitioners need to be motivated and trained accordingly in order to achieve sufficient data availability. The more information available, the more targeted a treatment can be: this tool could,

therefore, play a crucial role in the prudent use of antimicrobials on dairy farms. Results are in routine use in the herd management program within the Central Cattle Database in Austria and Germany (RDV) to assist veterinarians and farmers.

Keywords: pathogen-specific, culture milk samples, udder health, herd management, preventive control.

Introduction

In the field of udder health, where good herd management is essential, a web-based udder health module is available for farmers and veterinarians in Austria. Up to now, it was based on test-day SCC and veterinary diagnoses. An assessment of needs regarding data use in dairy farming in Austria showed that the electronic availability of the results of bacteriological testing of milk samples from laboratories was a particularly high priority for both farmers and veterinarians (Perner *et al*. 2016; Weissensteiner *et al*. 2018). A standardised diagnostic code for results of bacteriological milk analyses has been developed and an interface for data exchange between the central cattle database (RDV) and milk laboratories was established while taking international state-of-the-art field research into account (Obritzhauser *et al*., 2019). These efforts ensure well-prepared and harmonised data. Obtaining causative pathogens by sending milk samples for culture to external laboratories gives more detailed information for mastitis diagnostics and enables treatment specific to the pathogen involved (Cha *et al*. 2016). Therefore, the objective of this study was to develop an udder health management tool to be made available to dairy farmers and herd veterinarians in Austria considering pathogen information.

Material and method

Data collection took place within the framework of the ADDA project "ADvancement of Dairying in Austria" between 1 October 2015 and 30 September 2016 in which a total of 250 farms, 17 veterinarians and six laboratories participated. A total of 6,892 quarter milk samples collected from 1,382 lactating cows with (suspected) udder health problems from over 200 farms were available for the investigations. In most cases, all four udder quarters, even healthy quarters, were sampled. Approximately 450 samples had to be discarded because of contamination, sour milk, or empty or broken tubes. In the majority of the milk samples analysed (72.2%), no pathogens could be detected. A total of 1,533 (22.2%) samples were culture positive. Among the most common bacteria were *CNS, Staphylococcus aureus, Streptococcus uberis, Streptococcus dysgalactia* and other *Streptococci, E. coli* and other *Enterobacteriaceae.* Data were analysed at cow and quarter level and merged with calving, lactation and udder health data, such as mastitis diagnosis and test-day somatic cell counts.

Results and discussion

Examples of pathogen- specific evaluations for udder health herd management

Selected results used for a pathogen-specific udder health herd management tool are presented below. Based on some examples, the intended use and the informative value of the evaluations are described. They are intended to assist in answering questions such as: Which mastitis pathogens can be found predominantly (leading bacteria) at farm level? How many of the cows being sampled demonstrate symptoms of infection? Can infections be assigned to a particular cattle group? What is the most likely path of infection? Where is the main source of infection? Does the infection incidence and situation change over time?

Pathogen-specific udder health reports on individual cows

Figure 1 shows an example of a daily individual cow report covering production, reproduction and health data, complemented by the date of milk sampling and the bacteriological culture result at quarter level. In the example given, the cow was infected by the pathogen *Staphylococcus aureus* in both hind udder quarters. No pathogens have been found on the fore udder quarters. The linkage with other animal data stored in the RDV also enables us to determine the stage of lactation in days at the time of sampling.

Data storage in this kind of format allows results to be assessed online at any time and repeatedly by farmers and their veterinarian(s). This comprehensive animal-specific view helps to analyse the situation more rapidly, identify chronically infected animals with poor prognosis, assisting veterinarians in selecting an appropriate therapy, and dry off strategy.

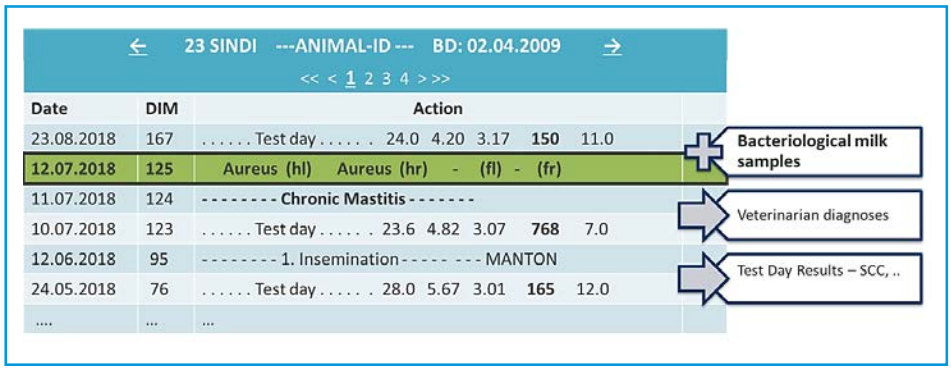

Figure 1. Report at individual cow level based on current and historic pathogen-specific and further udder health information.

Report on farm-specific pattern of pathogen

Figure 2 shows an example of a summary of the pathogen spectrum in the herd. The report is intended to show which pathogens are responsible for the majority of infections in a defined period. Ideally, a leading pathogen can be identified. The pattern of pathogen is always herd-specific as it only considers pathogens sampled from milk at this specific farm. The frequencies of pathogens sampled are displayed in the bar chart with decreasing frequency from left to right. By showing the number of cows with at least one positive culture sample for the specific pathogen, the extent of infected cows in the herd can also be assessed.

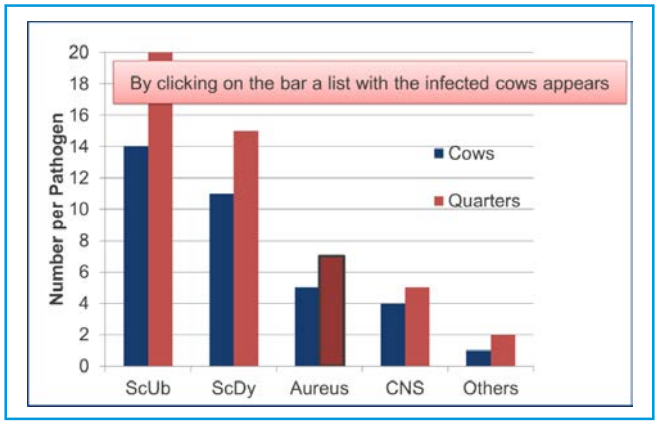

Figure 2. Report on farm-specific pattern of pathogen annually or over a predefined period of time.

The number of infected quarters for these cows is shown in the second bar. If a leading pathogen can be identified, an appropriate pathogen-specific therapy and prevention concept can be developed in consultation with a veterinarian.

Herd report 2 - Pattern of pathogen per lactation

Figure 3 shows an example of the summary of the pathogen spectrum per lactation in the herd. The combination of bacteriological data and routinely recorded animal identification, production and health data may facilitate the detection of period(s) of risk of infection as well as the cow group(s) at risk, amongst other things.

As there may be pathogen-specific differences in first or higher lactating cows, the same report can be displayed separating cows per pathogen by lactation number. Once the cow group-at-risk is known, deficiencies in certain areas (e.g. hygiene in the calving box, milking hygiene, feeding, management at drying off) might be identified.

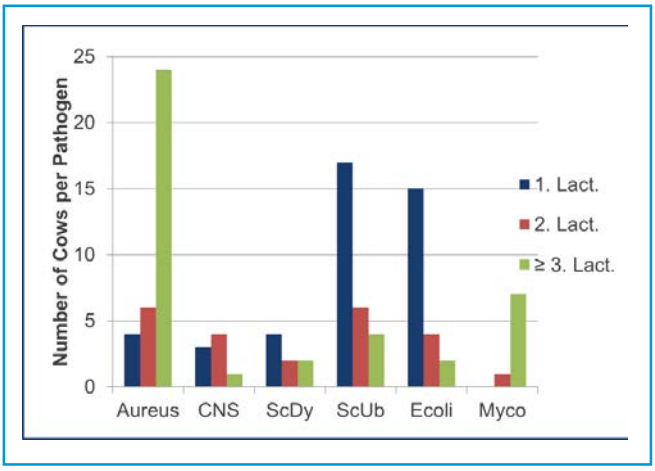

Figure 3. Example of annual herd report - Pattern of pathogens per lactation (1st, 2nd, and 3rd or higher).

		contagious pathogens						environmental pathogens			
		MYCO	SCAG	AUREUS	SCDY	CNS	SCUB	ECOLI	ENBA	STREP	OTHER
Farm current state	Nr. of Cows	0	0	7	5	3	3	4	0	2	1
Farm previous year	Nr. of Cows	4	0	16	12	4	7	6	1	3	2

Figure 4. Reservoir of infection given in number of cows per pathogen. Example of herd management report which shows the pathogen occurrence from culture positive milk samples expressed in number of infected (at least once) cows per pathogen over a period of 12 months.

Figure 4. Reservoir of infection given in number of cows per pathogen. Example of herd management report which shows the pathogen occurrence from culture positive milk samples expressed in number of infected (at least once) cows per pathogen over a period of 12 months.

Herd report – Reservoir of infection

Figure 4 shows an example of the pattern of pathogens on a farm when dividing the pathogens into their reservoir of infection. The detection of the reservoir of infection may provide information on management mistakes. The frequency of pathogens may give more insight into the possible reasons for occurrence of udder health problems. The pathogen groups differ in their way of transmission and require different preventive and control measures. Line two ("farm previous year") illustrates the pattern of pathogens from the year before. This might be beneficial to farmers in allowing them to check the effect of implemented management strategies/ steps.

Conclusions

The pathogen-specific program allows a step-by-step analysis of animal and herd udder health status. By integrating the results of bacteriological culture milk samples into the existing udder health tool, management issues and possible reservoirs of infection can be identified more easily and therefore eliminated at an earlier stage. Assessing the infection status of the udder, by means of milk culture results, can assist in decision-making processes leading to more precise control and prevention measures to improve udder health. This tool, which now allows a more comprehensive picture of udder health in dairy cows, could play a crucial role in the prudent use of antimicrobials. Professional udder health management with targeted use of antimicrobials is vital in times of increasing antimicrobial resistance. Within the D4Dairy project, further research will focus on of the harmonisation of sensitivity testing of antimicrobials and the development of targeted dry-off strategies (Obritzhauser *et al.* 2019).

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Abbreviations

MYCO = *Mycoplasma* spp, SCAG = *Streptococcus agalactiae*, AUREUS = *Staphylococcus aureus*; SCDY = *Streptococcus dysgalactiae*, CNS = Coagulase-negative *staphylococci*. SCUb = *Streptococcus uberis*, ECOLI = *Escherichia coli*, ENBA = *Enterobacteria* spp, STREP = *Streptococci* spp, others = pathogens not listed separately, hl/hr/fl/fr = hind/front left/right