From science to practice – improved udder health with the German project milchQplus

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Abstract

The aim of the nationwide project milchQplus is to improve the udder health status on German dairy farms. For this purpose, additional key figures are to be implemented by the 12 German milk recording organisations in their dairy herd improvement reports reaching about 53,000 dairy farmers monthly. These key figures are calculated from data produced by the normal milk recording of the individual cows and allow an assessment of the health status of the bovine mammary gland at herd level. Particularly, they give a picture of existing udder diseases, the duration of udder diseases as well as new udder diseases, always presented as a proportion of the whole herd. Most importantly, these values are objectively measurable figures, thus, they can make a valuable contribution to a strategic optimisation of the udder health management on farm. They allow continuous monitoring of udder health at herd level and act as an early warning system for mastitis problems at herd level. Additionally, they can be used to set realistic development targets as well as to control the effectiveness of improvements made.
Furthermore, it is well known that the communication between the stakeholders involved in the farm plays an essential role in advancing udder health. Within the project this is considered in two ways: Firstly, workshops are carried out for consultants and milk recording personnel to raise their technical expertise with focus on the key figures as well as to improve their general communication skills. Secondly, in 2013 and 2014 dairy farmers, veterinarians and farm consultants across Germany have been interviewed on their experiences with and views on improving mammary gland health. Based on the results of these interviews a strategy will be developed to implement the project results such that a sustainable optimisation of the udder health status in practice is achieved.

Keywords: udder health, mastitis, key figures, early warning system, communication

Introduction

More than 3.6 million cows are milk recorded in Germany and more than 70% of these are registered in the herd book. This makes Germany having the largest active cow population in the European Union and even one of the largest worldwide. In Germany approximately 53,000 dairy farmers out of the total 80,000 are currently joined to one of the 12 regional

dairy herd improvement (DHI) organisations. Thus, active farms are keeping on average 69 cows producing about 8,221 kg milk per head per year (ADR, 2013).

A highly heterogeneous agricultural structure stands behind these figures. Small family operated farms with an average herd size of 43 cows can be found in the South of Germany. Bigger, still family operated farms with an average of 84 cows are located in the North-West, whereas cows are kept in large scale dairy operations with an average of 274 animals per herd in Eastern Germany (ADR, 2013). Despite the structural differences the overall developments in the German dairy industry in the last decades have been similar. On the one hand many farms, mainly smaller ones, shut down, e.g. 35,000 farms since 2003; on the other hand the remaining farms increased their herd size rapidly, resulting in the total number of dairy cows in Germany staying relatively constant over the years. These structural changes were accompanied by improvements in herd management tools, animal husbandry facilities, milking technologies, and feeding systems. This led also to an increase in the annual milk yield per cow, which increased for example from 7,355 kg in 2003 to 8,221 kg in 2013 in the milk recorded herds (ADR, 2003, ADR, 2013).

In 2013, the average German dairy cow started milk production at an age of 28.2 months and left the herd again at an age of 64.8 months, thus, having a productive life span of just over three years (ADR, 2013). While the fourth lactation is considered to be the most productive one, only 21 to 25% of cows, depending on breed, reach that lactation number (Vit, 2012). Udder diseases represented the second most common reason for cows being culled in Germany in 2013 with a proportion of 14.3% (ADR, 2013). Moreover, analysis of random samples in North Germany revealed that every second cow is affected once by clinical mastitis per lactation (Krömker, 2007). This causes direct economic losses due to acute milk reduction as well as due to the disposal of antibiotic milk. Additional economic losses occur from milk not even produced caused by long term tissue damage to the gland, additional labour, higher replacement rates, and veterinary costs. Surprisingly, despite the technical improvements on the farm and the increased annual milk yield per cow over the last years, udder health did not improve in the same period of time. In fact, the average somatic cell count (SCC) even exhibited a slight upwards trend over the last years (ADR, 2002, until ADR, 2013).

If a more sustainable milk production is to be achieved the optimisation of udder health needs to be prioritised. This in turn will lead to improved animal welfare *per se*, a longer productive life span at an improved health status, i.e. a higher production efficiency, reduction in usage of antibiotics and less milk losses. Obviously, this optimisation of udder health requires comprehensive management skills and technical knowledge by the dairy farmer. However, often the focus has been laid on the health status of individual cows, while the udder health status at herd level and management routines affecting the whole herd have been neglected. A strategic approach is required.

It is well known that communication between the stakeholders plays a vital role in improving udder health. Consulting is a complex process. The reasons for its failure can be manifold. Udder health can be improved sustainably if, in general, consultants pursue a more preventative approach and if the farmer’s personal needs for communication as well as technical knowledge are taken into account.

MilchQplus project background

MilchQplus is a three year project having started in May 2012. Partners of the project are the German Association for Performance and Quality Testing (DLQ) and the microbiology group at the University of Applied Sciences and Arts Hannover. The DLQ is the umbrella

organisation of 12 milk recording organisations, two associations for raw milk testing, and one organisation providing IT solutions for animal production. Through its member organisations the DLQ has direct contact to the 53,000 German dairy farmers participating in milk recording. This unique network enables easy and fast transfer of scientific and technical knowledge resulting from this project into the dairy practice.

Key figures for udder health

Mastitis is a multifactorial disease. Therefore, the complexity of udder health can only be encountered and solved successfully by a strategic approach. MilchQplus developed new key figures which allow an assessment of the health status of the bovine mammary gland at herd level (Figure 1). While they are based on the SCC results of the individual cows standardly available from the monthly milk recording, these key figures give a picture of existing udder infections, the duration of udder infections as well as new udder infections of the whole herd.

The SCC is commonly used to assess the health status of the udder. The composition of the leucocytes which make up the vast majority of the somatic cells found in milk alters during the course of an infection (Schwarz *et al*., 2011). Also the concentration of other inflammation parameters in milk changes at the same time (Hamann, 2001). These studies showed that the changes were already significant at or below a SCC of 100,000 cells/ml. Also the recommendations of the German Veterinary Medical Society (DVG, 2012) to differentiate between healthy and diseased mammary glands work along a cut-off value of SCC of 100,000 cells/ml. Therefore, milchQplus uses a SCC of 100,000 cells/ml as an orientation value to distinguish between cows with a healthy udder and cows exhibiting a disturbed mammary gland health. A SCC greater than 100,000 cells/ml does not immediately imply a necessity to treat or even to cull this animal. Instead this orientation value is applied such that the key figures function as an early warning system for udder health problems in the herd. Only if such problems are recognised early appropriate measures can also be taken at an early stage in order to reduce incidence and prevalence of mastitis.

In detail these key figures are: (1) The proportion of cows with healthy udders as defined by a composite milk somatic cell count $\leq$ 100.000 cells/ml on the current herd test day. If the proportion of cows with healthy udders is too low measures are required to reduce the chance of new infections during lactation. (2) The rate of chronically diseased cows with poor cure prospects. This comprises cows which repeatedly exhibited a SCC > 700,000 cells/ml. A high rate provides indication of the spread of cow associated microorganisms in the herd and a possibly inadequate cure rate in the dry period. This figure might also simply identify cows worth considering culling. (3) The rate of newly diseased animals during lactation. A high rate of new infections in the lactation period since the last herd test, i.e. cows shifting from SCC $\leq$ 100,000 cells/ml to > 100,000 cells/ml, reflects current management problems or seasonality effects. If this issue is counteracted successfully this key figure will respond quickly. Besides the calendar date, these new infections can also be depicted according to days in milk pointing to stages of lactation of concern. (4) The rate of newly infected animals together with the (5) the rate of healed animals during the dry period reflect the state of the dry cow management. Low healing rates in the dry period after the application of antibiotic dry cow therapy reveals a high number of reinfections, so that actions to counteract new infections are required. Finally, (6) the rate of heifer mastitis is determined. Too many heifers with an elevated SCC at the first herd test also indicate a problem within this special animal group and causes need to be clarified.

milchQplus Key Figures	Description	Period	Average /Top Farms
(1) Proportion of cows with healthy udders	Proportion of animals with ≤ 100,000 somatic cells/ml of all lactating animals at the current milk recording.	Current milk recording	50% / 76%
Categories of somatic cells	Proportion of animals with SCC ≤ 100,000 (= key figure 1) SCC > 100,000 and ≤ 200,000 SCC > 200,000 and < 400,000 SCC ≥ 400,000	Current milk recording	
(2) Proportion of chronically diseased animals with poor cure prospects	Proportion of animals with > 700,000 somatic cells/ml each in the last three milk recordings of all currently lactating animals.	Current milk recording	5% / < 1%
(3) New infection rate during lactation	Proportion of animals with > 100,000 somatic cells/ml in the current milk recording of all those animals with ≤ 100,000 somatic cells/ml in the previous milk recording.	Current milk recording	21% / 9%
(4) New infection rate in the dry period	Proportion of animals with > 100,000 somatic cells/ml in the first milk recording after calving of all those animals with ≤ 100,000 somatic cells/ml in the last milk recording before drying off.	Moving annual average	28% / 16%
(5) Cure rate in the dry period	Proportion of animals with ≤ 100,000 somatic cells/ml in the first milk recording after calving of all those animals with > 100,000 somatic cells/ml in the last milk recording before drying off.	Moving annual average	50% / 77%
(6) Rate of heifer mastitis	Proportion of heifers with > 100,000 somatic cells/ml in the first milk recording after calving out of all heifers calved in one year.	Moving annual average	41% / 18%

Figure 1. Overview of milchQplus-key figures describing the udder health status of the herd. Values for the key figures are from random samples of average and top farms in North Germany (Volling, 2011).

MilchQplus will bring these key figures via the DLQ member organisations into the reports, which farmers receive monthly with the results of the milk recording, either in printed or digital form for a better monitoring system.

Furthermore, benchmarking figures will be provided for each key figure on these DHI reports allowing a comparison with top farms. For this purpose the top 25% of farms ranked according to their average herd SCC at the last milk recording are selected within a region. From these farms an average value for each key figure is calculated and presented. These benchmarking figures will be updated at least on a monthly basis. A comparison with figures from their own region instead of figures sourced from the literature (Volling, 2011) was considered as a stronger motivator for farmers to change operations.

Communication between stakeholders

One further goal of milchQplus is to improve the communication between the stakeholders involved in the farm. Starting in 2013 workshops have been carried out for consultants and milk recording personnel. Content of the first part of the workshop was to raise awareness for the importance of a strategic approach combined with an early warning system to tackle mastitis problems, and how these milchQplus key figures can contribute to such a strategic approach. This technical knowledge was followed by a communication session in the second part. This communication session supported the participants to identify their own personally preferred role in the consulting process. Different kinds of attitudes by farmers to cooperate and to accept new knowledge were presented which are helpful to consider when establishing a trusting relationship. Finally, this session was completed by some basic rules on successful communication.

Secondly, in 2013 and 2014 milchQplus team members have been interviewing dairy farmers, veterinarians and farm consultants across Germany. Dairy farmers were selected by a continuously low SCC in their herds accompanied by an above average milk yield per animal. The differing agricultural structures in Germany were reflected in farms selected. The main aims of the interviews with farmers were to investigate what motivates them, how they perceive mastitis on their farm and how they view the risk factors for mastitis. Veterinarians were chosen for interview if they practised veterinary herd health management on dairy farms. Farm consultants were selected if they had long term experience on dairy farms. The interviews with veterinarians and consultants served to verify the results from the interviews with the farmers. They were asked on their own views on risk factors and on their opinion how farmers might judge these risk factors. Similarly, their thoughts on how to motivate a farmer were enquired. The evaluation of these interviews is still in progress. Based on the results of these interviews a strategy will be developed to further contribute to a sustainable optimisation of the udder health status in practice.

Cell differentiation

As mentioned above the composition of the somatic cells varies with stage of mammary gland infection. A flow-cytometry method for differentiation of somatic cells in raw milk as an innovative diagnostic tool for the identification of cases of chronically incurable mastitis is developed within the scope of the milchQplus project. The results may help to estimate the prognosis and may give information about the potential prospect of an antibiotic therapy for mastitis. In a second step, a high-throughput method will be developed for cell differentiation in DHI samples. Cell differentiation data implemented in DHI reports will support dairy farmers, veterinarians and consultants to make evidence-based therapy or culling decisions. This feature completes the objectives of the project.

Conclusion

In order to achieve an improved udder health, the complexity of udder health needs to be solved by a strategic approach. The key figures to be introduced by milchQplus form a valuable tool for this management challenge on a dairy farm. The key figures are both indicators and measurable parameters directly related to udder health. They function as an early warning system for mastitis problems at herd level by revealing the current udder health status, the duration of existing udder infections and the time of new infections in the herd. Benchmarking figures derived from top farms in the region help farmers to assess their own herd situation as well as act as motivator. Thus, these key figures can also be used to set realistic goals for the development of the udder health in the herd as well as to control the effectiveness of improvement and treatment measures taken.

Communication is a crucial part if udder health is to become a success story. Farm consultants and veterinarians are in charge of establishing a trusting relationship with the farmer and of bringing forward the idea of preventing rather than treating mastitis. Risk factors need to be analysed and communicated appropriately. Similarly, a catalogue of measures will only be accepted and implemented if it is tailored and communicated according to the needs of the farmer and his willingness for change.

The unique network backing milchQplus which reaches from a university institute over the DLQ umbrella organisation to all German milk recording organisations allows an immediate contact to the majority of German dairy farmers. Hence, the scientific and technical knowledge gained in milchQplus can directly find its way into the dairy practise.

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List of References

ADR, 2003 - ADR, 2013. Rinderproduktion in Deutschland. Annual Reports. Edition 2003 to 2013. Arbeitsgemeinschaft Deutscher Rinderzüchter e.V. (German Cattle Breeders‘ Association), Bonn, Germany.

German Veterinary Medical Society, 2012. Bekämpfungsrelevante Aspekte der Mastitis des Rindes als Bestandsproblem. In: Leitlinien Bekämpfung der Mastitis des Rindes als Bestandsproblem. German Veterinary Medical Society (editor), DVG Service, Gießen, Germany, p 21-27.

Hamann, J., 2001. Relationship between somatic cell count and milk composition. Proceedings of the Animal Health Conference, IDF World Dairy Summit 2001, Bulletin of the IDF No. 372: 56-59.

Krömker, V., 2007. Euterkrankheiten. In: Kurzes Lehrbuch Milchkunde und Milchhygiene, V. Krömker (editor), Parey in MVS Medizinverlage, Stuttgart, Germany, p 47-74.

Schwarz D., U.S. Diesterbeck, S. König, K. Brügemann, K. Schlez, M. Zschöck, W. Wolter & C.P. Czerny, 2011. Microscopic differential cell counts in milk for the evaluation of inflammatory reactions in clinically healthy and subclinically infected bovine mammary glands. J. Dairy Sci. 78: 448–455.

Vit, 2012. Trends Fakten Zahlen 2012. Edition 2012. Vereinigte Informationssystem Tierhaltung w.V., Verden, Germany.

Volling O., 2011. Eutergesundheitsmanagement in Milchviehherden mit sehr niedrigem Herdensammelmilchzellgehalt in Niedersachsen. PhD Thesis, Göttingen University, Germany.

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