Differential Cell Count as a Biomarker for Mastitis Screening – A Review

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Abstract

Currently, programmes for monitoring udder health in the frame of dairy herd improvement (DHI) testing are based on the analysis of somatic cell counts (SCC). However, mastitis remains the most prevalent and costly disease in the dairy cattle industry worldwide. Approximately 70 to 80% of the losses are caused by the subclinical form of the disease. Besides causing substantial economic damages, mastitis adversely affects dairy cow welfare. Hence, new biomarkers, that allow a more accurate monitoring and detection of mastitis, in particular of the subclinical form, are needed. The primary objective of this study is to provide a review of literature on differential cell count (DCC) as a potential biomarker for improved mastitis screening.

The SCC is a well-established, robust and quantitative measurement in the diagnosis of mastitis, but does not differentiate between the different types of cells in milk. DCC, however, refers to the differentiation of immune cells occurring in milk into lymphocytes, macrophages, and polymorphonuclear neutrophils (PMN). These three cell populations play a vital role in inflammatory responses within the mammary gland. While lymphocytes and macrophages primarily regulate the immune response, the main task of PMN is to defend against invading bacteria at the beginning of a mastitis.

SCC are low in milk of cows with healthy udders and consist predominantly of lymphocytes and macrophages. In the event of an infection (i.e. mastitis) the SCC increases evidently and the composition of cells changes significantly to up to 95% PMN. Hence, both the SCC and the DCC are clearly different in milk of cows that are udder healthy compared to those being affected by mastitis.

Various potential applications of DCC in terms of udder health management have been suggested in the literature. Firstly, detection of mastitis, in particular subclinical mastitis, at an earlier stage could be possible. Several studies have described altered DCC patterns (i.e. elevated proportions of PMN) in udder quarters with low SCC (<100,000 cells/ml). These observations have been interpreted as indication for mastitis in its early stage.

Secondly, cows suffering chronic mastitis could be identified at an earlier stage using DCC compared to working with SCC alone. PMN are the predominant cell type in the presence of acute mastitis. In contrast, studies described macrophages being the dominant cell population in chronic mastitis cases.

Thirdly, adding the DCC parameter to the existing SCC in mastitis screening programmes, would allow a clearer and more precise description of the udder health status of dairy cows. In this context, the analysis of the monthly collected DHI samples could for example reveal more information about the definite stage of a mastitis (i.e. initial vs. late/cure phase).

In conclusion, in addition to SCC, DCC provides more information about the actual udder health status of dairy cows and thus clearly has the potential to be a valuable tool allowing improved mastitis screening in the frame of DHI testing. This could help to reduce the prevalence of mastitis and eventually lead to reduced administration of antibiotics.

Keywords: mastitis, udder health, SCC, dairy herd improvement testing, milk quality