RumiWatch – An automatic health monitoring system for dairy cows

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Problem

Sustainable and competitive milk production requires achieving the performance potential, health and fertility of dairy cows. Today's performance-oriented dairy cow nutrition aims to contribute both adequate nutrient supply and best possible profitability of dairy farming. Rations are marked by an increased proportion of easily fermentable carbohydrates and risks for deficits in structured fiber contents. This may represent possible causes of non-physiological strains of forestomach digestion and facilitate occurrence of metabolic diseases. These disorders have an increased prevalence in intensive dairy farming and are highly correlated to boosted milk yield and production stress (Fleischer et al., 2001). In addition, the period around calving and early lactation represents a phase of increased physiological disposition for deficiency diseases and secondary complications (Overton and Waldron, 2004).

Studies by Gonzalez et al. (2008) and DeVries et al. (2009) revealed significant changes in ruminating, eating and motion behavior being indicators for impairments of dairy cows' metabolic health. These pathophysiologic impacts may result in economic losses by decrease in milk yield and milk quality, costs for veterinary treatments, increased working time, and early culling of dairy cows (Gonzalez et al., 2008).

Lameness has been specified as one of the main health problems in modern dairy herds (Kossaibati and Esslemont, 1997). With increasing livestock numbers per farm, the available time per cow for individual observation of abnormalities, deficiencies and disorders will decrease, which will affect the early diagnosis of lameness and further impairments of animal health. Making use of sensor data might support the farmer in his daily management (de Mol et al., 2013).

Objectives

A novel automatic health monitoring system for dairy cows (RumiWatch) aims to provide effective support in health and feeding management for researchers, veterinarians, consultants and commercial dairy farmers. Particularly for large-scale dairy farms with high livestock numbers and high

levels of milk yield, a system for automatic monitoring of activity and health parameters may serve as an important management tool for optimized milk production. The aim of this study is to enable:

- Continuous automatic registration of relevant health and activity parameters in dairy cows
- Objective information about the health state of an animal derived from precise measurement data and animal-specific evaluation
- Automated detection of metabolic disorders, lameness, feed deficiencies and inadequate housing conditions
- Diagnostics and responses to critical conditions at an early, subclinical stage
- Reduction of production losses and health-related costs
- Securing animal welfare and performance potential of high-yielding dairy cows
- Improvement of health management and profitability in dairy farming

Here, the use of information and communication technology in animal husbandry is intended to generate a win-win-situation with equivalent benefits for animal and farmer.

Research and development approach

Development of an automated sensor-based health monitoring system for dairy cows requires close and valid interaction of sensor technology and evaluation functions. Based on previous studies by Nydegger et al. (2010) and Zehner et al. (2012), a noseband sensor and pedometer have been developed as sensor-technical components of the „RumiWatchSystem". These sensors enable non-invasive measurements of ruminating, eating, drinking, and motion behavior which represent sensitive parameters of ruminant health and activity. Preliminary validation of automatic measurements of ruminating and eating behavior has been conducted by Zehner et al. (2012). A re-validation of the further developed sensors and analysis algorithms for classifying ingestive and locomotory behavior by the noseband sensor and pedometer is in progress.

For its further development, the diagnostic components of the RumiWatchSystem need to be expanded by a function for animal-specific detection and evaluation of transition states between a physiologically healthy organism and different stages of impairment by disease (latent, subclinical, clinically indicated). Therefore, threshold values for reliable dissociation of health states and identification of critical, pathologic changes in behavioral parameters need to be generated on the basis of an extensive literature research and explorative data acquisition under farm conditions. To substantiate the findings, reference methods (milk, blood and fecal analytics, clinical examination) are required parallel to non-invasive measurement by the noseband sensor and pedometer. Due to

potential genetic predisposition, subsequently developed analysis algorithms should enable animal-specific evaluation of transition states and early detection of disorders and diseases.

In addition, research work comprises triggering an automated alert function for early detection of pathological changes in ingestive and locomotory behavior as part of the evaluation software. This function serves to inform the user about animals showing noticeable changes of one or several analysis parameters indicating the need for closer observation or examination of the animal. Automatic estrus detection and measurement of body temperature represent further prospective enhancements of the RumiWatch health monitoring system. As an elementary research and development goal, structure and configuration of the RumiWatchSystem is clearly oriented to meet the requirements of agronomic and veterinary consultants and to achieve highest possible usability for commercial dairy farmers.

User benefits

User benefits of the RumiWatchSystem derive from its suitability for preventive monitoring of animal health, applicability for feeding, housing and fertility management, and as a sensor to detect welfare issues in dairy cows. Livestock farmers, consultants and veterinarians will be able to make a diagnosis of critical health conditions at an early stage. Reactions and preventive measures can then be applied before significant production losses occur, leading to synergetic effects for animal health and performance.

Early detection of diseases reduces veterinary treatment and follow-up costs as well as early culling of dairy cows. Thereby, a reliable health monitoring system can provide a contribution for sustainable production and improvement of profitability in dairy farming. Moreover, the prospective system may represent a suitable measuring tool for research work on assessment of feedstuffs and housing systems as well as for ethological studies.

Project team and resources

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