Assessing fertility and welfare of dairy cows through novel mid-infrared milk-based biomarkers

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Abstract<Times 14, bold>

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Although herd management and, more recently, selection have mitigated partially the deterioration of functional traits, these efforts are still hampered by the difficulties in direct recording of sufficient relevant phenotypes. Recent advances in the use of mid-infrared (MIR) spectroscopy, as the standardization of apparatuses, has led to the highly portable deployment of developed prediction equations. Also milk MIR spectral based predictions are considered promising tools for difficult or expensive-to-check status traits, such as body energy. Recently intensive work on milk MIR based biomarkers has been a major focus in several recent projects (e.g. GplusE project, www.gpluse.eu). Important aspects are in this context the assessment of fertility and welfare of dairy cows. The identification of impact of pregnancy stage on milk composition of dairy cows using the MIR spectra could lead to the early identification of lack of pregnancy, therefore support detection of infertility, improving reproductive efficiency and profitability on commercial dairy farms. Results from ongoing research comparing direct use of MIR spectra to conventional milk yields showed that the signature of gestation for certain MIR wavelengths were up to over 2 x stronger in the first 90 days of pregnancy then traditional traits. One of the concerns regarding animal welfare is heat stress as one of the most challenging environmental conditions. Even in temperate climates, it has been shown to impact negatively feed intake, wider performances and also well-being of dairy cows. Direct, diagnosis of heat stress is difficult; therefore the identification of novel milk-based biomarkers as thermal tolerance indicators would allow elucidating physiological, metabolic and genetic basis. First research results showed that amongst 45 milk biomarkers predicted by MIR signature of heat stress were associated during 5 years to two relative acclimation time points (summer and spring). Dairy cow reaction to acclimation conditions were modelled with multivariate statistical models and discriminant analysis. Several fatty acids, milk metabolites and traditional milk components showed sensitivity and specificity when discriminating heat stressed versus non-stressed dairy cows. The rationale why these milk biomarkers were detected might be linked to the expected signatures of heat-stress in milk through reduced intake, increased body reserve mobilisation, and changes in ruminal metabolism of dairy cows
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Keywords: Milk-based biomarkers, diagnosis, pregnancy, heat stress, functional traits