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Implementation of a routine Fourier-transform infrared procedure for fatty acid analysis in milk

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The milk fatty acid (FA) profile is closely related to cow efficiency and farm conditions. Routine analysis of milk FA profile from bulk tank and individual cow samples offers therefore a unique opportunity to develop diagnostic and prediction tools for nutrition, health and herd management for producers, nutritionists and advisory services, and to develop monitoring tools for consumers and processors. Fourier-transform infrared (FT-IR) offers a rapid analysis for milk FA but standard operational procedures for their implementation and validation are lacking. To ensure repeatability and accuracy over time, we implemented calibration and quality assurance procedures for milk FA in a central milk laboratory setting. Prediction models were installed on three FT-IR lines (MilkoScan FT+ / 7 RM Foss Electric A/S, Hillerød, Denmark) to provide four individual FA (C14:0, C16:0, C18:0, C18:1), and ten groups of FA based on their chain length (short, medium, long), saturation (saturated, mono-, poly-, trans-unsaturated), and origin (de novo, mixed, preformed). Regular monthly standardization as recommended in the FOSS Application Note compensates for instrument drift over time. Adjustment against gas chromatography (GC) ensures accuracy of measured FA against a reference method. Reference samples were obtained from local bulk tank milk with sufficient variation in FA on milk and fat basis to cover the natural variation of milk FA in Quebec herds. Comparison of reference samples between GC and FT-IR revealed a substantial agreement with a high concordance correlation coefficient (CCC) of 0.95–1.00 for most milk FA (CCC of ≥ 0.88 for C18:0). The poorer agreement for poly-unsaturated (CCC of ≥ 0.56) and trans-unsaturated FA (CCC of ≥ 0.37) might be due to their comparatively low recovery in milk (<3.7% and <2.4% of total FA, respectively, in our reference samples) and lower accuracy by FT-IR (coefficient of variation of 14–27% on our instruments). In order to validate the possibility to freeze calibration samples, reference samples were stored at -20°C and thawed weekly. A comparison between fresh and frozen reference samples for up to 8 weeks revealed a substantial agreement (CCC of 0.95–1.00) in milk FA per milk basis and within instrument precision. A comparison between fresh and bronopol-preserved milk samples revealed no impact on FT-IR milk FA (CCC of ≥ 0.99), except for a small bias observed for poly-unsaturated FA (CCC of 0.89) although within instrument precision. Furthermore, drifting from baseline was tested on a pilot sample run approximately every 10 min for internal validation purpose. Results suggested that milk FA variation was within instrument precision, with the exception of preformed and poly-unsaturated FA being off in, respectively, up to 9% and 19% of all runs across a day. This suggests that analyzing the major milk FA by FT-IR would likely not interfere with daily operations for the major milk components fat and protein through potential reruns of samples for milk FA. Validations are ongoing to benchmark milk FA from 3,500 herds in Quebec, Canada, to develop a nutrition and management diagnostic tool based on bulk tank samples and for individual cows based on milk recording samples.

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