Development and Field Use of Mid Infrared Spectra to Measure Milk Fatty Acid Parameters and Estimated Blood NEFA for Farm Management

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Partial least square (**PLS**) models were developed from Fourier transform mid-infrared (MIR) spectra, externally validated, and are being used commercially in the US for direct measurement of: 1) groups of milk fatty acids [i.e., de novo (**DN**), mixed origin (**MO**), and preformed fatty (**PF**) acids], 2) fatty acid (**FA**) chain length (expressed as carbon number), 3) FA unsaturation (expressed as double bonds per FA) and 4) estimated blood nonesterifed FA (**NEFA**). Six laboratories in different regions of the US are routinely using the models for bulk tank bovine milk analysis simultaneously with payment testing for individual farms on almost every milk pick up basis. Two research laboratories are testing both bulk tank and individual cow milk samples, while one is also testing sheep and goat milk. There is a high correlation in bulk tank milk of DN (C4 to C15) FA concentration (g/100 g milk) with increased bulk tank milk fat and milk protein percentage. The DN FA are made in the mammary cells from acetate and butyrate produced by the microbial fermentation of carbohydrates in the rumen. The changes in concentration of DN FA in milk reflect efficiency of rumen fermentation and the microbial biomass load (i.e., essential amino acid production) in the rumen. Seasonal variation in bulk tank milk fat and protein content are highly correlated with seasonal variation in milk DN FA. As milk FA chain length and double bonds per FA increase, milk fat decreases, and DN and MO FA synthesis and output per cow per day decreases. Farms with high bulk tank milk double bonds per FA, where the average days in milk of the herd is >120 d, have a much higher incidence of trans FA induced milk fat depression. These FA metrics in combination with milk fat and protein concentration, plus milk weight, MUN, and milk SCC have been used to make decisions to adjust feeding to increase production of grams of fat and protein per cow per day and net income from milk minus feed cost. The estimated blood NEFA and DN FA (expressed as DN as a percentage of total FA) are used in combination to monitor fresh cow metabolic status for early detection of individual cows that will develop clinical ketosis or displaced abomasum. These milk-based transition cow analytical tools provide an opportunity to intervene earlier thereby improving recovery while reducing the negative impact of these adverse metabolic health events on animal welfare and lactation performance.