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New Milk Analysis Metrics for Dairy Herd Management

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New mid-infrared milk analysis metrics have been developed to provide actionable dairy herd management data. New milk analysis metrics are: 1) groups of milk fatty acids [i.e., de novo (DN: C4 to C15), mixed origin (MO: C16:0, C16:1), and preformed fatty (PF: C18 and longer) acids], 2) fatty acid (FA) chain length (expressed as carbon number), 3) FA unsaturation (expressed as double bonds per FA) and 3) estimated blood non-esterified FA (NEFA).

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 the efficiency of rumen fermentation and production of the microbial biomass load (essential amino acid production) in the rumen and are positively correlated with milk fat and protein content.

Studies conducted at the St. Albans Cooperative Creamery on high frequency bulk tank milk from about 400 farms demonstrate that feeding and farm management practices that maximize de novo milk fatty acids will maximize weight of milk fat and protein produced per cow per day. For Holstein herds, a concentration of 0.85 g of de novo fatty acids is needed to achieve a 3.75 percent bulk tank fat test at a herd average of about 150 to 200 days in milk.

When double bonds per fatty acid increases, in general, milk fat will decrease. When double bonds per fatty acid is higher than 0.31, the risk of trans fatty acid induced milk fat depression is higher. Feeding and management practices that achieve higher concentration of de novo fatty acids in milk will result in higher fat and protein percent in Holstein milk. We are currently working on development of similar performance evaluation relationships for milk fatty acid composition of Jersey herds.

Several laboratories in different regions of the U.S. routinely use the new milk analysis models for bulk tank bovine milk analysis simultaneously with payment testing for individual farms on almost every milk pick up basis. Seasonal variation in bulk tank milk fat and protein content are highly correlated with seasonal variation in milk DN FA.

The interpretation of these milk analysis metrics becomes more challenging when testing milk from pens of cows (different feeding groups) within a farm. Milk FA composition changes systematically with stage of lactation. We have developed stage of lactation curves for all of the new milk FA metrics for heifers and older cows. Milk FA composition changes rapidly as dairy cows transition from negative to positive energy balance. This needs to be factored into the interpretation of milk composition data from pens within the farm and for individual cows.

For milk from individual cows, 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, and thereby improve recovery, while reducing the negative impact of adverse metabolic health events on animal welfare and lactation performance. Frequency of milk sampling and testing for effective use of these metrics on individual cows needs to be higher than is currently done in DHIA testing laboratories, so more frequent testing is needed. Research is continuing to develop new milk analysis metrics for management of health and reproduction of individual cows. Future work will focus on approaches to integrate this type of milk testing into milk systems in the form of a milk testing sensor. ▮

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