Risk Factors for Bulk Tank Milk Fat Depression in Northeast and Midwest U.S. Dairy Herds Feeding Monensin

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Introduction

Farm gate milk prices in the US are based on milk components, including fat. Of these components, fat is most easily altered quickly. Understanding management strategies to influence milk fat percentage (MFP) is therefore useful. The biohydrogenation theory of milk fat depression (MFD) has improved our comprehension; however, many of the ruminal conditions that can result in MFD are not clearly understood. The objectives of this study were to investigate nutritional risk factors associated with bulk tank MFD and to characterize the fatty acid profile of bulk tank milk in relation to MFP in herds feeding monensin in the northeast and midwest US.

Materials and Methods

An observational, cross sectional study was performed in commercial dairy herds. To be included in the study, the herd had to be feeding monensin in a total mixed ration (TMR). The outcome variable of interest was bulk tank milk fat percentage. Data collected on potential explanatory variables included: herd demographics and management; TMR composition, ingredients, and particle size; fermentation and starch availability of component silages; and fatty acid analysis of bulk tank milk and TMR. Univariable and multivariable regression analysis was performed to determine the association of these factors with herd-level MFP using commercially available software (SAS Institute, Cary, NC).

Results

Seventy-nine commercial herds (mean herd size = 370 cows) with bulk milk fat percentages ranging from 2.7 – 4.3 % (mean = 3.45%) were enrolled in the study. They were feeding monensin between 150-410 mg/d (mean = 258). The nutrient content of the TMRs was typical of midwest and northeast dairies. The relationship between milk trans 10, 18:1 content (g/100g FA) and milk fat percentage (MFP) was strongly negative and curvilinear (MFP = 3.37 * x exp(-0.12); R-square= 0.53). Generally, there was a positive association with de novo synthesized milk fatty acids and a negative association of preformed fatty acids with milk fat percentage ($P < 0.05$). There was no univariable association of monensin dose and MFP ($P = 0.98$). Further, there was not a univariable association between dry matter, ADF, NDF, starch, NFC, crude fat, or total fatty acid % and MFP ($P > 0.15$). However, the proportion of particles on the middle screen and in the bottom pan of the Penn State Particle Separator (PSPS) were predictors of MFP ($P < 0.008$). Offering these factors to a multivariable model, greater than or less than 50% dry matter and greater than or less than 54% of particles in the bottom pan of the PSPS explained 21% of the variability in MFP ($P = 0.0003$). None of the TMR ingredients analyzed (e.g. corn silage, hay silage, cereals, etc.) explained more than 10% of the variability seen in MFP by themselves. A final multivariable model included significant terms of hay silage, corn silage, cereal, fat containing by-products, proportion of particles in the bottom pan of the PSPS, and interactions between hay crop silage and by products, corn silage and cereal, and corn silage and by-products. This model explained 38% of the variability seen in MFP ($P < 0.0001$). This model indicated that, while holding the other significant variables constant, a herd with > 54% of TMR particles in the bottom pan of the PSPS could expect to have 0.19% less MF.

Significance

Consistent with the biohydrogenation theory of MFD, herd-level MFP was strongly associated with specific fatty acid isomers in milk fat that are produced during altered ruminal biohydrogenation. Also consistent with the concept that MFD is caused by interactions of dietary factors rather than single factors, univariable relationships failed to explain more than 10% of the variation in MFP by themselves. However, when considering many TMR ingredients and composition and their interactions together, up to almost 40% of a herd's MFP could be explained.