Phenotypic and genotypic impact of milk components and body weight composite on dry matter intake

S. Toghiani[1], P.M. VanRaden[1], M.J. VandeHaar[2], and R.J. Tempelman[2]

[1]USDA, Agricultural Research Service, Animal Genomics and Improvement Laboratory, Beltsville, MD 20705-2350, USA
[2]Department of Animal Sciene, Michigan State University, East Lansing, MI 48824

2021 J. Dairy Sci. *[Not published because of a technical error]*

ABSTRACT

Large datasets allow estimating feed intakes needed for individual milk components or for maintenance of cows with differing body dimensions. Previous theory estimated costs using only energy or by assuming output of milk protein requires higher priced protein input. Maintenance could differ for tall, thin cows vs. short, fat cows even if body weight is equal. Nutritionists usually use phenotypic regressions, but genetic regressions are more useful in breeding programs. Dry matter intake (DMI) records from 6,338 lactations of 5,094 Holstein cows were predicted by multiple regressions on phenotypes, genomic evaluations, or sire evaluations for milk components and body size traits. The mixed models also included days in milk, age-parity subclass, trial date, management group, and body weight change during the feeding trials that usually lasted 6 weeks during mid-lactation. Phenotypic regressions of DMI on milk (0.007±0.008), fat (2.82±0.13), and protein (5.32±0.31) were much less than corresponding genomic regressions (0.076±0.029, 10.82±0.60, and 7.88±1.34) or sire genomic regressions multiplied by 2 (0.043±0.054, 6.43±1.14, and 6.66±2.35). For standardized milk with 3.5% fat and 3.0% protein, total marginal costs of DMI as a percentage of standardized milk price were estimated to be 18% from phenotypic regression, 46% from genomic regression, and 31% from sire genomic regression multiplied by 2. The energy corrected milk formula assumes that 69% more DMI is required for fat than protein production with regressions of 0.122 for milk, 4.82 for fat, and 2.85 for protein. Net merit currently assumes that 38% more DMI is needed for protein than fat production with regressions of 0.225 for milk, 5.42 for fat, and 7.50 for protein and a marginal feed cost of 43% of the milk price. Estimates of annual maintenance in kg DMI / kg body weight / lactation were similar from phenotypic regression (5.8±0.18), genomic regression (6.3±0.42), and sire genomic regression multiplied by 2 (5.90±0.72), but are larger than published NRC values (2.7-3.4) and much larger than currently assumed in net merit (1.7). Multiple regressions on genomic evaluations for the conformation traits in body weight composite (BWC) showed that strength was most associated with both body weight and DMI, agreeing with the current BWC formula, but that dairy form did not significantly predict body weight or DMI. Breeders should select for cows that are smaller, eat less feed, and give more milk, fat, and protein to improve profit.

Keywords: Feed intake, maintenance, body weight, selection index