Limited Supply of Phenylalanine and Threonine, but Not Tryptophan, Decreases Milk Protein Yield

I.H. Iroshan[1], H. Lapierre[2], and L. Doepel

[1]University of Calgary Faculty of Veterinary Medicine, Calgary, AB T2N 4N1
[2]Agriculture and Agri-Food Canada, Sherbrooke, QC, J1M OC8
Email: ldoepel@ucalgary.ca

The mammary gland extracts from the blood all essential amino acids (AA) to support milk protein secretion. Although considerable research has been conducted on lysine, methionine, the branched-chain AA, and more recently histidine, minimal data are available on the relative importance of the supply of other essential AA, namely phenylalanine (Phe), threonine (Thr), and tryptophan (Trp), to sustain milk protein secretion. The objective of this study was to determine how milk and milk component yields change when the supply of Phe, Thr, and Trp is limited.

Five lactating Holstein cows were used in a 5×5 Latin square design with 10-day periods. Cows were fed a diet that supplied 100% of the NRC (2001) net energy requirement and 70% of the metabolizable protein requirement. The treatments were abomasal infusions of water (CTL), all AA (TAA) with the same profile as casein, all AA excluding Thr (No-Thr), all AA excluding Phe (No-Phe), and all AA excluding Trp (No-Trp). The TAA treatment was estimated to supply, with the diet, 100% of the metabolizable protein requirement.

Dry matter intake and milk yield were not different between treatments and averaged 17.5 and 31.3 kg/day, respectively. Milk protein yield with TAA (914 g/day) was higher (P<0.02) than CTL (781 g/day) and No-Phe (771 g/d), and tended (P=0.13) to be higher than for No-Thr (843 g/day). Milk fat yield (1128 g/day) and lactose yield (1428 g/day) were not affected by treatment. Milk urea-N (MUN) was lower (P=0.01) for CTL (8.8 mg/dl) than TAA (14.1 mg/dl). Plasma urea-N followed the same pattern as MUN, being lower (P<0.01) for CTL (9.5 mg/dl) than TAA (15.7 mg/dl) and No-Phe (18.5 mg/dl).

Implications: This study demonstrates that a deficiency of Phe or Thr negatively affects milk protein synthesis, indicating the necessity to better define their requirement for dairy cows.