Canola Meal for Early Lactation Cows

Spencer A. E. Moore
University of Wisconsin
Madison, WI

Kenneth F. Kalscheur
USDA-ARS, U.S. Dairy Forage Research Center
Madison, WI

Introduction

Energy and protein demands in early lactation are great. Feed intake during the postpartum period does not provide the nutrient quantity necessary for the lactating animal and therefore, body reserve mobilization occurs (Drackley, 1999; Ji and Dann, 2013). It is common to raise the energy density of the early lactation diet to combat this problem. However, caution must be taken to ensure rumen health is not negatively impacted by this practice. Transition-related disorders can be exacerbated when this balance is not negotiated with care. Alternatively, increasing the protein concentration of the diet in early lactation has not shown to negatively impact the rumen environment. The dairy cow utilizes protein as an energy source and amino acids for the synthesis of milk lactose and protein, respectively. Increasing the quantity or the quality of the protein provided during this period can be a useful tool in managing the highly sensitive and important transition period. The focus on this period of lactation is imperative because it dictates the production potential for the lactation.

Amino acids

Feed protein serves to supply many tissues with essential amino acids for innumerable functions within the body. The first two limiting amino acids, lysine (Lys) and methionine (Met) are recommended for inclusion at a ratio of 3:1 to optimize metabolizable protein for milk production (NRC, 2001; Liu et al., 2013). The amino acid profile of canola meal has a ratio of Lys to Met at 3.01:1, whereas soybean meal has a ratio of 4.37:1 (NRC, 2001). Therefore, canola meal can be used to provide essential amino acids in a proportion needed by the cow with limited reliance on protein from other feedstuffs. The impact of providing adequate Lys and Met in early lactation can have dramatic effects on maximizing milk yield and components. Enriching diets with Lys and Met during the transition period (3 weeks pre-partum to 3 weeks postpartum) increased daily milk yield 1.50 lb/d and milk protein 0.18 lb/d throughout the first 16 weeks of lactation (Garthwaite et al., 1998; Grummer, 1995; Liu et al., 2013). This describes the importance of balancing for essential amino acids during the transition period and the responsiveness of the cow to varying concentrations or supplementation of amino acids.

Increase in early lactation milk yield

An experiment was conducted at the U.S. Dairy Forage Research Center in Prairie du Sac, WI. Four treatment diets were fed, beginning at parturition. A total of 79 multiparous Holstein cows received high protein (17.6% CP, % of DM) or low protein (15.4% CP, % of DM) diets. The main protein source was provided by either canola or soybean meal. The diets were formulated to reflect a typical Midwestern ration composition; 55.0% forage (39.6% corn silage, 15.4% alfalfa silage) and 45% concentrate mix on DM basis. Canola meal was included at 19.4% and 11.9% DM, whereas soybean meal was included at 14.5% and 8.9% DM. The study lasted 8 months and followed each animal through 16 weeks of lactation.

Replacing soybean meal with canola meal produced a significant increase in milk production in treatment animals; (mean ± SEM) 122.8 vs 112.9 ± 2.14 lb/d of milk, respectively (Moore and Kalscheur, 2016; Figure 1). There was not a commensurate increase in DMI to support the increase in production. Canola meal-fed cows tended to have higher DMI (56.9 vs 55.1 ± 0.74 lb/d; Moore and Kalscheur, 2016; Figure 2). This resulted in a trend for improved feed efficiency (ECM/DMI) in canola meal-fed cows compared those fed soybean meal (2.27 vs 2.16 ± 0.38; Moore and Kalscheur, 2016). Therefore, efficiency of nutrient utilization and body reserve turnover contributed to the additional energy required for greater milk yield. The source of CP did not affect milk fat, protein, lactose, or total solids concentration. Dietary CP concentration had an inverse relationship with the concentration of milk fat and total solids. As diet CP was reduced, milk fat and total solids percentage increased (4.09 vs 3.90 ± 0.07% fat and 12.8 vs 12.5 ± 0.95% total solids; Moore and Kalscheur, 2016). There are concerns to consider when feeding higher protein levels. While the animal is able to use the higher protein concentration to meet some energy and protein deficiencies, the amount of nitrogen excreted as waste also increases. This was reflected in greater milk urea N (MUN) from cows fed high protein diets than those fed low protein diets (12.6 vs 9.82 ± 0.22 mg/dL; Moore and Kalscheur, 2016). Milk urea N tended to be lower for cows fed canola meal compared to cows fed soybean meal (10.9 vs 11.4 ± 0.22 mg/dL) which is consistent with previous work (Martineau et al., 2014; Broderick et al., 2015). It should be noted that milk yield did not increase with additional dietary protein. This is indicative of a protein quality effect versus a quantity response. The additional protein in the diet did not produce a significant increase in milk yield. However, the quality of protein provided by canola meal induced a dramatic response during this early lactation period.

Conclusion

In this study, early lactation dairy cows fed diets formulated with canola meal tended to have greater DMI, produced more milk, and showed a greater efficiency of nitrogen utilization. These data suggest that fluid milk production and efficiency of nutrient conversion to milk can be improved in early lactation with the inclusion of canola meal in dairy rations. There are a vast number of systems within the biology of the cow that are affected by transition-related nutrition. The system is in a deficit at this time and therefore more responsive to the type of protein supplied. This study did not balance for amino acids, but rather replaced one protein source for the other on an isonitrogenous basis. Evaluating transition cow nutrition in this way was valuable in discerning the differences in the protein sources and the biological system.

References

Broderick, G. A., A. P. Faciola, and L. E. Armentano. 2015. Replacing dietary soybean meal with canola meal improves production and efficiency of lactating dairy cows. J. Dairy Sci. 98:5672-5687.

Drackley, J. K., 1999. Biology of dairy cows during the transition period: The final frontier? J. Dairy Sci. 82:2259-2273.

Garthwaite, B. D., C. G. Schwab, and B. K. Sloan. 1998. Amino acid nutrition of the early lactation cow. Proc. Cornell Nutr. Conf. Feed Manuf. Pages 38-50.

Grummer, R. R., 1995. Impact of changes in organic nutrient metabolism on feeding the transition dairy cow. J. Anim Sci. 73:2820-2833.

Ji, P. and H. M. Dann. 2013. Negative protein balance: Implications for transition cows. Proc. Cornell Nutr. Conf. Feed Manuf.

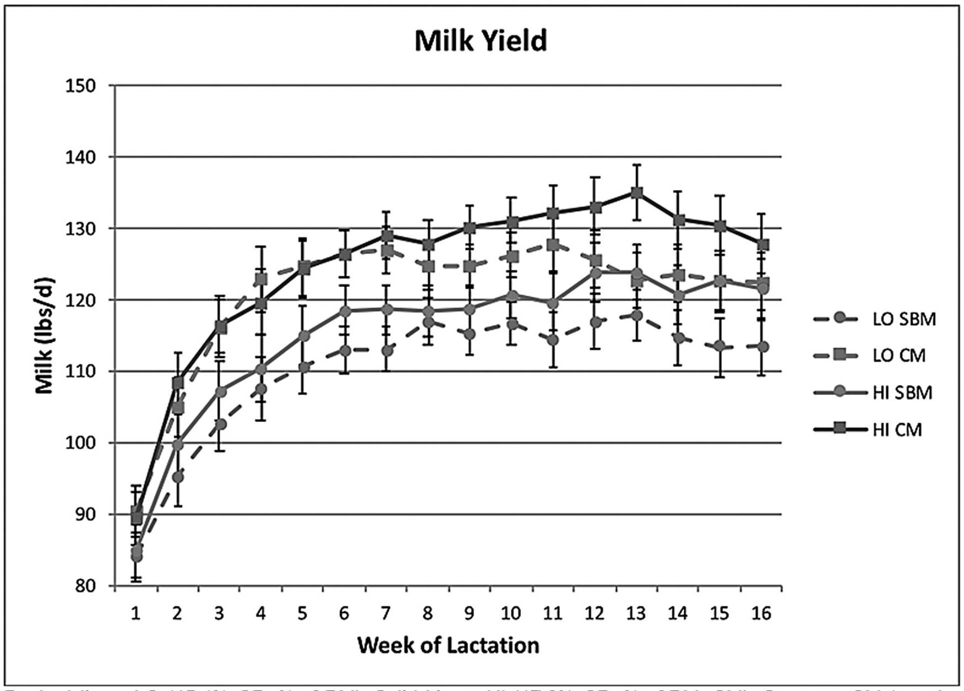
Liu, Y. G., H. H. Peng, and C. G. Schwab. 2013. Enhancing the productivity of dairy cows using amino acids. Anim. Prod. Sci. 53:1156-1159.

Martineau, R., D. R. Ouellet, and H. Lapierre. 2014. The effect of feeding canola meal on concentrations of plasma amino acids. J. Dairy Sci. 97:1603-1610.

Moore, S. A. E., and K. F. Kalscheur. 2016. Canola meal in dairy cow diets during early lactation increases production compared to soybean meal. J. Dairy Sci. 99(E-Suppl. 1):718. (Abstr.)

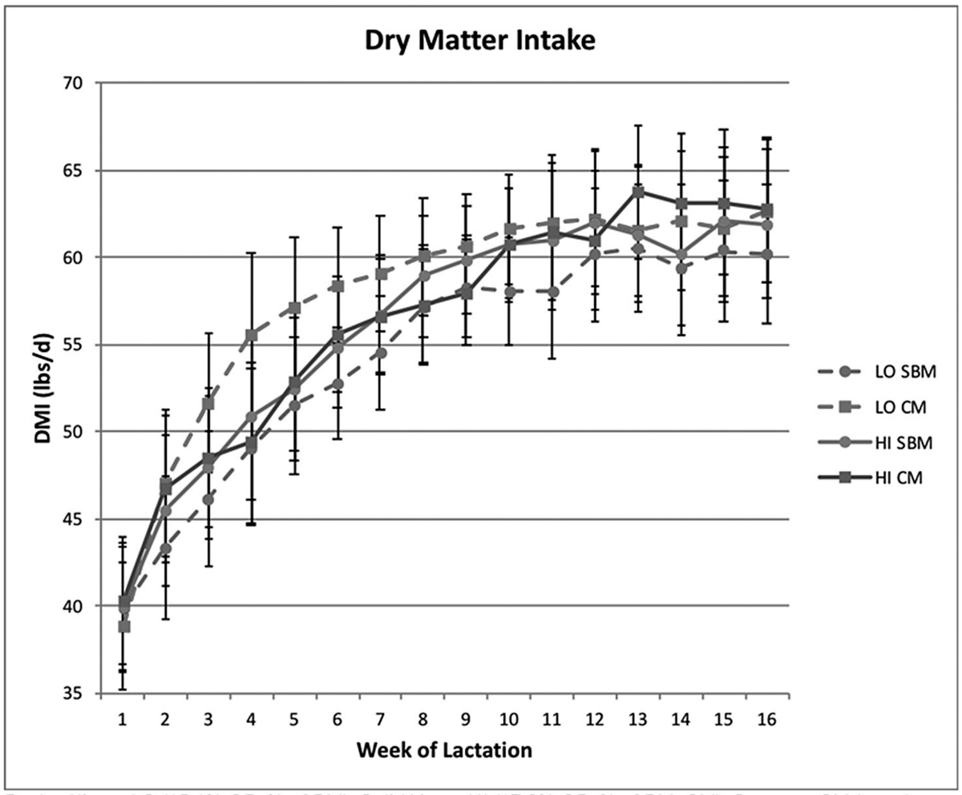
National Research Council. 2001. Nutrient Requirements of Dairy Cattle. 7th rev. ed. National Academies Press. Washington, DC.

Figure 1. Milk yield by week of lactation



Dashed line = LO (15.4% CP, % of DM); Solid Line = HI (17.6% CP, % of DM; CM); Square = CM (canola meal); Circle = SBM (soybean meal).

Figure 2. Dry matter intake by week of lactation.



Dashed line = LO (15.4% CP, % of DM); Solid Line = HI (17.6% CP, % of DM; CM); Square = CM (canola meal); Circle = SBM (soybean meal).