

Feeding Canola Meal to Dairy Cows: A Meta-Analysis Suggests That NRC (2001) Underestimates the Supply of Metabolizable Protein from Canola Meal

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The objective of this meta-analysis was to determine how substitution of a protein source by canola meal (CM) would affect lactational responses in dairy cows. The study included 49 pairs of isoproteic ($\pm 1.0\%$ crude protein) diets published since 1975 (22 articles). The CM intake ranged from 1.0 to 4.0 kg/d (standard deviation: 0.65). The level of inclusion of CM ($\Delta\text{CM} = \text{CM}$ minus control) was expressed as 100 g/kg of diet (dry matter (DM)); therefore, the coefficient associated with ΔCM represents the response observed with each 10% increment in the dietary proportion of CM (e.g., 2 kg of CM for 20 kg DM intake (DMI) = ΔCM of 10%). Diet characteristics were estimated using NRC (2001). Regressions were forced through the origin, weighted by sample size and controlled for differences in DMI and diet protein concentration. Milk yield (MY, kg/d) and milk protein yield (MPY, g/d) responded linearly to increasing ΔCM : $\Delta\text{MY} = 0.6^{***} (\pm 0.08) \times \Delta\text{CM}$, $R^2 = 0.53$, $n = 49$; and $\Delta\text{MPY} = 26^{***} (\pm 3.1) \times \Delta\text{CM}$, $R^2 = 0.59$, $n = 49$. The MPY response, however, was different ($P = 0.01$) depending on the type of protein substituted. The ΔCM coefficients were $17^{***} (\pm 3.4)$ and $32^{***} (\pm 4.3)$ with substitutions involving only soybean meal ($n = 22$) or other protein sources ($n = 26$), respectively. The greater effect with other protein sources was due to an additional positive effect of ΔCM on milk protein percentage. The efficiency of N utilization (milk N yield/N intake; mg/g) also responded linearly to increasing ΔCM : $7^{***} (\pm 1.0) \times \Delta\text{CM}$, $n = 49$. To explain the responses to ΔCM , estimated supply of metabolizable protein (MP) was examined. Surprisingly, there was a negative effect of CM inclusion on ΔMP : $-72^{***} (\pm 12.1) \times \Delta\text{CM}$, $R^2 = 0.42$, $n = 49$, contrarily to the usual positive relationship between MP supply and MY or MPY. In conclusion, current results suggest that CM can substitute other protein sources with an overall positive effect on lactational performances. Results also suggest that there is a systematic underestimation of MP supply associated with CM inclusion in dairy rations using the NRC (2001) model.

Implications: Overall, substitution of a protein source by CM increases milk production by 0.6 kg/d for each 10% inclusion of CM (highest level of substitution in the meta-analysis, 17%). Prediction of protein supply by NRC (2001) model underestimates MP supply when CM is included in dairy rations.