**Feedstuffs**, October 1st, 2018 Feedstuffs Reprint

# Can canola replace soybean meal in dairy diet?

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SOYBEAN meal is the main protein supplement included in U.S. dairy cow diets. However, canola meal has recently become more competitive as a protein source for dairy rations as its availability has improved considerably.

Recent expansion of the Canadian canola industry has increased the supply of canola meal. According to the Canola Council of Canada, during the 2017-18 crop year, the U.S. imported 2.976 million tons, representing more than 70% of Canada's total meal exports. In addition, the U.S. imported 500,000 tons of canola seed. The top dairy-producing states are the main destination of Canada's canola meal.

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Six research projects conducted in the U.S. (Wisconsin, South Dakota and Ohio) and Canada (Quebec) during the last decade have evaluated the effects of replacing soybean meal with canola meal on the performance and protein efficiency of mid-lactation dairy cows. Both meals were extracted by solvents.

The nutrient compositions of canola and soybean meal used in five of those studies are reported in Table 1. The study carried at Ohio State University (Weiss et al., 2015) did not publish the chemical composition.

On average, compared with canola meal, soybean meal was 27% greater in protein content on a dry matter (DM) basis, at 41.8% versus 53.0%. However, canola meal was higher in both neutral detergent fiber (NDF) — 27.3% versus 8.0% — and acid detergent fiber (ADF) — 18.3% versus 4.9% — as well as fat — 3.5% versus 1.6% — compared to soybean meal.

**Experimental diets.** To summarize, the ingredient compositions of the experimental diets were:

- In the first study by Brito and Broderick (2007) conducted at the U.S. Dairy Forage Research Center in Wisconsin (DFRC), the diets consisted of 56% forage on a DM basis (35% corn silage and 21% alfalfa haylage), high-moisture shelled corn and either 14.1% canola meal or 12.1% soybean meal as a protein supplement. Total mixed diets averaged 16.6% crude protein.
- At the South Dakota State University Dairy Research Unit, Christen et al. (2010) formulated corn silage/alfalfa hay diets to contain 55% forage and either 12.7% canola meal or 11.1% soybean meal. The diets contained 15.3% crude protein, with 38% of the protein from one of the two protein supplements.
- The diets fed at the Dairy & Swine Research & Development Centre in Quebec (Maxin et al., 2013) were based on grass hay (38% on a DM basis). Canola meal and soybean meal were included at 20.8% and 13.7% of DM, respectively, and

## 1. Nutrient composition of canola meal and soybean meal

| Nutrient (% DM) | Brito and Broderick (2007) | Christen et al. (2010) | Maxin et al. (2013) | Broderick et al. (2015) | Paula et al. (2018) | Average |
|---|---|---|---|---|---|---|
| **Canola meal** | | | | | | |
| DM (% fresh matter) | 91.9 | 92.4 | NA | 89.6 | 92.0 | 91.5 |
| Crude protein | 42.7 | 43.7 | 40.1 | 40.6 | 41.8 | 41.8 |
| Ash | 9.4 | NA | 8.0 | 9.0 | 7.7 | 8.5 |
| Fat | NA | 3.8 | 3.6 | 3.0 | NA | 3.5 |
| NDF | 23.7 | 22.0 | 31.9 | 29.9 | 28.9 | 27.3 |
| ADF | 15.8 | 16.4 | 22.5 | 18.2 | 18.6 | 18.3 |
| Hemicellulose | 7.9 | 5.6 | 9.4 | 11.7 | 10.3 | 9.0 |
| **Soybean meal** | | | | | | |
| DM (% fresh matter) | 90.3 | 87.7 | NA | 89.6 | 90.0 | 89.4 |
| Crude protein | 53.7 | 50.6 | 53.6 | 53.6 | 53.6 | 53.0 |
| Ash | 8.0 | NA | 6.9 | 7.6 | 6.7 | 7.3 |
| Fat | NA | 1.5 | 1.5 | 1.7 | NA | 1.6 |
| NDF | 6.7 | 9.1 | 9.5 | 7.0 | 7.8 | 8.0 |
| ADF | 3.7 | 5.6 | 6.4 | 4.2 | 4.6 | 4.9 |
| Hemicellulose | 3.0 | 3.5 | 3.1 | 2.8 | 3.2 | 3.1 |

NA = Data not available.

## 2. Production response contrasting soybean meal (SBM) and canola meal (CM) diets

| | -Brito & Broderick- (2007) | | -Christen et al. - (2010) | | --Maxin et al.-- (2013) | | -Broderick et al.- (2015) | | --Weiss et al.-- (2015) | | --Paula et al.-- (2018) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cow response** | **SBM** | **CM** | **SBM** | **CM** | **SBM** | **CM** | **SBM** | **CM** | **SBM** | **CM** | **SBM** | **CM** |
| DM intake, lb./day | 54.8[a] | 53.2[b] | 53.0 | 55.4 | 52.8 | 51.9 | 54.6[a] | 55.4[b] | 56.1 | 58.1 | 58.7 | 59.6 |
| Milk production, lb./day | 88.0 | 90.4 | 69.7 | 69.7 | 70.2 | 68.0 | 86.5[a] | 88.7[b] | 83.2 | 86.2 | 88.0 | 90.9 |
| ECM yield, lb./day | NA | NA | 77.2 | 76.1 | 68.0 | 66.0 | 84.7[a] | 86.9[b] | NA | NA | 86.2 | 88.2 |
| Feed efficiency | 1.5 | 1.5 | 1.5 | 1.4 | NA | NA | 1.6 | 1.6 | NA | NA | 1.5 | 1.5 |
| Milk fat yield, lb./day | 2.7 | 2.8 | 2.9 | 2.8 | 2.5 | 2.4 | 3.4[a] | 3.5[b] | 3.1 | 2.9 | 3.5 | 3.6 |
| Milk protein yield, lb./day | 2.7 | 2.8 | 2.3 | 2.3 | 2.5 | 2.5 | 2.6[a] | 2.7[b] | 2.6 | 2.7 | 2.8 | 2.8 |
| Nitrogen efficiency | 30.4 | 30.2 | 29.9 | 27.2 | 27.4 | 27.0 | 30.0[a] | 30.8[b] | NA | NA | 30.7 | 29.2 |

[ab]Values in the same row with different superscript are different (P < 0.1). NA = Data not available.

the diets averaged 17.2% crude protein.

• The second work carried out at DFRC included more forage (66%) than the first one. Broderick et al. (2015) replaced an equal amount of soybean meal protein with protein from canola meal containing either 14.7% (low) or 16.5% (high) crude protein. The inclusion rates of soybean meal and canola meal were 8.7% and 11.5% of DM in the low-protein diets and 12.7% and 17.1% in the high-protein diets, respectively.

• At Ohio State University, Weiss et al. (2015) supplemented high-forage (40% corn silage and 20% alfalfa silage), low-protein (15%) diets with either 13.8% canola meal (8.1 lb.) plus 3.3% soybean hulls or 9.33% soybean meal (5.4 lb.) plus 7.2% soybean hulls.

• In the latest study from DFRC, Paula et al. (2018) fed 16% protein diets by including 11.4% canola meal (6.6 lb.) or 8.6% soybean meal (5.0 lb.).

Since canola meal contains less protein, the average inclusion level of this meal across the studies was around 35% greater than the soybean meal level.

## Cow performance

Intake, milk production and feed efficiency results of cows fed canola meal and soybean meal are summarized in Table 2.

Findings from the second study conducted at DFRC (Broderick et al., 2015) showed that replacing soybean meal with canola meal significantly improved milk production and protein efficiency in both low- and high-protein diets. Cows fed canola meal diets had greater DM intake (0.8 lb. per day), milk yield (2.2 lb. per day), energy-corrected milk (ECM) level (2.2 lb. per day) and true protein (0.06 lb. per day) than cows on soybean meal diets. Moreover, canola meal diets improved nitrogen utilization, as indicated by increased milk-nitrogen/nitrogen intake (30.8% versus 30.0%).

Substituting soybean meal with canola meal, however, did not show any effect on dairy cow performance in the other five trials. Milk production, milk component yield and feed and nitrogen efficiencies were similar among diets.

## Conclusion

Soybean meal and canola meal are good protein concentrates for dairy cows. These studies show that canola meal may successfully replace soybean meal in mid-lactation cow diets without affecting performance and efficiency. Feed price and inclusion rate must be considered when the goal is to improve income over feed cost by replacing soybean with canola meal.

## References

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