Canola meal enhances early lactation milk production

Canola may bring added value to rations due to its methionine content.

by Jordan Kuehnl and Kenneth Kalscheur

EARLY lactation is widely regarded as both the most precarious and the most rewarding time in the lactation cycle for dairy cows. During this period, cows face challenges such as recovery from calving, greater susceptibility to metabolic disorders, and meeting the escalating nutrient demands of milk production. Improved diet formulation is one method that can alleviate these stressors by better matching nutrient requirements with the demands of high milk production.

Optimizing amino acids

A hot research topic of recent years is optimizing the amino acid profile of dairy cow diets to support high milk production. Of the 20 amino acids utilized for milk protein production, methionine is perhaps the most widely examined. That's because methionine is among the first amino acids that limits milk protein production. In cows, methionine is an essential amino acid that must be consumed via the diet because it cannot be synthesized in the body from other sources.

Traditionally, soybean meal (SBM) is the protein source most utilized to formulate dairy cow diets. However, canola meal (CM) is an alternative protein source that is rapidly gaining popularity. Canola meal is being used by many dairy farmers in place of or in combination with soybean meal. This trend is largely due to heightened knowledge of the positive production effects when substituting canola meal for other protein sources in diets fed to dairy cows during lactation. The elevated methionine content in canola meal, when compared to soybean meal, is hypothesized to be one of the main reasons for the positive production effects.

Several studies from the past 10 years compared the effect of canola meal versus other protein sources such as soybean meal, cottonseed meal, or fish meal in diets fed to dairy cows. These studies concluded that substituting canola meal for these other protein sources improved production-related measures such as dry matter intake (DMI), milk production, and milk component yields.

However, it is important to note that these studies utilized experiments conducted during middle and late lactation rather than early lactation. The focus for the rest of this article is results from canola meal feeding studies conducted during early lactation.

A focus on early lactation

To our knowledge, there are four feeding studies exploring the effects of including canola meal versus soybean meal in diets fed to cows during early lactation. The results of these experiments are summarized in the table.

The first experiment, Moore and Kalscheur (2016), was conducted by our laboratory at the USDA Dairy Forage Research Center farm near Prairie du Sac, Wis. We analyzed the effects of feeding a low (16.2%) versus a high (18.1%) crude protein diet formulated with either canola meal or soybean meal as the primary protein source from calving through Week 16 of lactation. Remarkably, milk yield rose by 9.8 pounds per day for cows fed the canola meal-based diets when compared to the soybean meal-based diets. This gain was accompanied by a disproportional DMI increase of 1.9 pounds per day for cows fed the canola meal-based diets.

It is not surprising that we also observed improved feed efficiency for cows fed the canola meal-based diets when compared to the soybean meal-based diets. Furthermore, milk urea nitrogen (MUN) levels dropped for cows fed the canola meal-based diets, which suggests a better nitrogen balance for these cows. However, no differences were observed for body weight or body condition score.

Following the experiment of Moore and Kalscheur, researchers at the University of California-Davis conducted two experiments (Gauthier et al., 2019; and Swanepoel et al., 2020) at a 5,000-cow commercial dairy farm in Hanover, Calif. These trials assessed the effect of canola meal versus soybean meal in isonitrogenous diets fed to early lactation dairy cows. While both experiments utilized three large pens of cows from approximately 12 through 160 days in milk (DIM), different dietary treatments were tested in each trial.

In Gauthier et al., canola meal replaced soybean meal in progressively increasing amounts, with three diets containing:

1. 3.5% CM and 7% SBM
2. 8.2% CM and 3.5% SBM
3. 13% CM and 0% SBM

In the second experiment, two of the isonitrogenous diets tested in Swanepoel et al. included:

1. 14.3% CM and 0% SBM
2. 6.6% CM and 6.3% SBM

Interestingly, while dry matter intake was not different in either experiment, milk yield climbed with increasing inclusion of canola meal in the diet. Feed conversion efficiency, defined as units of energy-corrected milk (ECM) produced per unit of DMI, was not directly measured in either experiment. However, improved milk yield, with no difference in dry matter intake, suggests enhanced feed efficiency for those cows. Furthermore, body condition score during the experimental period progressively improved as canola meal inclusion rose in the diet for cows in the first experiment, suggesting better energy balance for those cows.

While the previous three experiments arrived at the consensus that including canola meal in diets fed to early lactation dairy cows raises milk yield when compared to soybean meal, the effect of feeding canola meal during the close-up dry period was still uncharacterized. Previous research on the effect of supplementing rumen-protected methionine during the dry period yielded mixed results for milk production up to this point in time.

Therefore, we recently conducted an experiment (Kuehnl and Kalscheur, 2021) at the USDA farm near Prairie du Sac, Wis., to determine the effect of including canola meal versus soybean meal in diets fed to dairy cows during the transition period through Week 16 of lactation. Cows were fed a diet containing either canola meal or soybean meal during the close-up dry period.

Immediately following calving, half of the cows on each close-up diet remained on the diet with the same protein source during early lactation, while the other half switched to the diet with the other protein source. Each pair of diets fed during the close-up dry period and early lactation was isonitrogenous. We were able to determine not only the effect of feeding canola meal versus soybean meal during both periods, but also whether there was a positive synergistic effect of feeding canola meal during both periods on production.

In our experiment, cows fed the diets with canola meal ate more both pre- and postcalving. However, milk yield increased by 4.2 pounds per day only for cows fed the diet with canola meal postcalving compared to soybean meal. Unfortunately, we did not observe a synergistic rise in milk yield for cows fed the diets with canola meal both pre- and postcalving. As with the 2016 trial, we observed decreased MUN for cows fed the diet with canola meal postcalving compared to the soybean meal diet, suggesting better nitrogen balance for cows fed the canola meal diet.

Additional study

Further analyses are currently underway to determine amino acid supply and utilization, digestibility of the diets, and effects on gene expression in the liver and mammary gland. We will also investigate how each of these factors are influenced over time by these protein sources during the transition period and early lactation. Determining effects in these physiological areas may provide more insight to how canola meal improves milk yield during early lactation compared to soybean meal.

Although the data set on substituting canola meal for soybean meal in diets fed during the transition period and early lactation is limited, the collective results for milk production are clearly positive. While the difference in methionine content is hypothesized to be a big reason why canola meal bolsters milk yield when compared to soybean meal, research in areas such as digestibility and gene expression, and how they change over time, also are important considerations.

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Summary of results for canola meal feeding trials during early lactation

Experiment	DMI lbs./day	Milk yield lbs./day	Fat %	Fat yield lbs./day	Protein %	Protein yield lbs./day	MUN mg/dL	Feed efficiency lbs. ECM/ lbs. DMI
Moore and Kalscheur (2016)[1]	57.0 vs. 55.1	122.7 vs. 112.9	NS[5]	4.80 vs. 4.49	NS	3.42 vs. 3.24	10.9 vs. 11.5	2.27 vs. 2.17
Gauthier et al. (2019)[2]	NS	93.3 vs. 98.8 vs. 98.1	3.58 vs. 3.58 vs. 3.63	3.33 vs. 3.53 vs. 3.55	2.97 vs. 2.96 vs. 2.98	2.76 vs. 2.91 vs. 2.91	NR[5]	NR
Swanepoel et al. (2020)[3]	NS	113.1 vs. 109.2	NS	3.92 vs. 3.77	2.84 vs. 2.80	3.20 vs. 3.04	NR	NR
Kuehnl and Kalscheur (2021)[4]	57.8 vs. 55.1	116.4 vs. 112.2	NS	NS	NS	NS	12.9 vs. 13.7	NS

[1]Differences expressed as canola meal versus soybean meal.
[2]Differences expressed as Diet 1 (3.5% canola meal and 7% soybean meal) versus Diet 2 (8.2% canola meal and 3.5% soybean meal) versus Diet 3 (13% canola meal and 0% soybean meal).
[3]Differences expressed as Diet 1 (14.3% canola meal and 0% soybean meal) versus Diet 2 (6.6% canola meal and 6.3% soybean meal).
[4]Differences expressed as canola meal versus soybean meal fed postcalving.
[5]NS = not significant; NR = not reported.