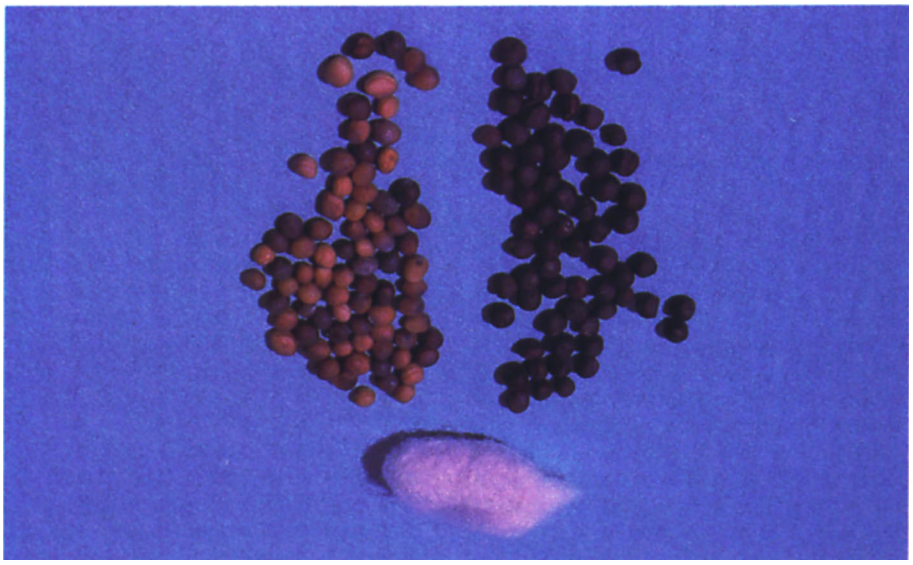
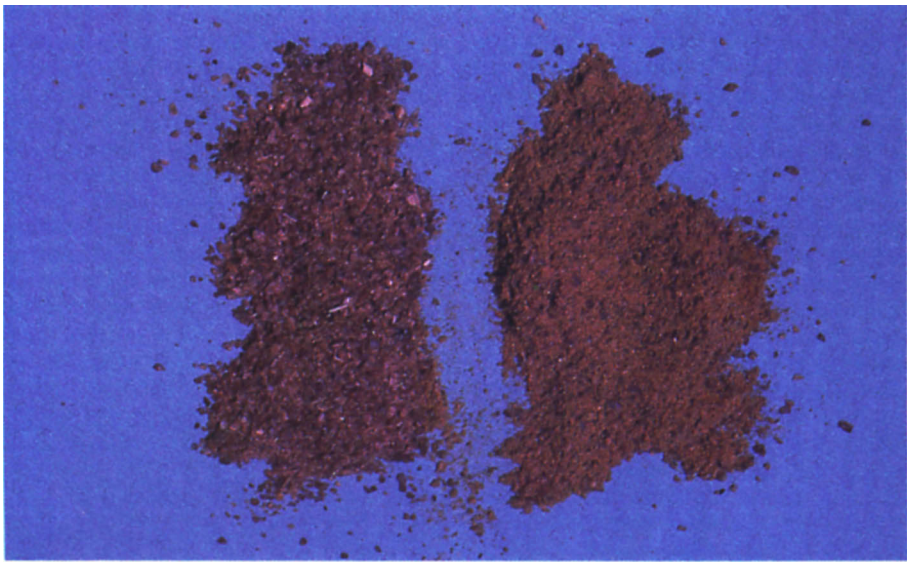
Canola meal can replace cottonseed meal in dairy diets

Edward J. DePeters □ Donald L. Bath

Production, feed intake, body weight change similar for both



The oil extract of two species of canola seed (above, with cottonseed) is used in mayonnaise and margarine. The canola meal (below, left) can be used as a protein supplement replacement for cottonseed meal (below right) in dairy diets.



Canola meal, derived from the crush of canola seed, is used as a protein supplement for livestock in Canada. Canola is a genetic cultivar of rapeseed, which was first introduced into Canada in about 1942 for its oil, used primarily as a lubricant for marine engines.

Rapeseed is high in erucic acid and glucosinolates, and feeding high levels of the meal to animals reduced diet palatability and animal performance. The glucosinolates, or more specifically their hydrolytic products, have goiter-producing properties. In 1974, Canadian plant breeders produced a "double low" cultivar of rapeseed called Tower (*Brassica napus*) that was low in both erucic acid and glucosinolate. By 1981, they developed a second "double low" cultivar of *Brassica campestris.* In 1979, the name "canola" was adopted in Canada for all the new "double low" cultivars.

Canola of both rapeseed species is grown in Canada. *Brassica napus* requires over 100 days to mature; *B. campestris* matures in less than 90 days. *Brassica campestris* has a lower seed yield and protein content, but both species are similar in fiber and energy content. Crushed canola seed yields approximately 41 percent oil and 57 percent meal. The oil is used as salad and cooking oil, and in products such as mayonnaise, margarine, and shortening. The canola meal used as a protein supplement in livestock diets is usually a mixture of *B. napus* and *B. campestris.*

Canadian animal nutritionists have demonstrated that canola meal can re-

TABLE 1. Ingredient and chemical composition of complete mixed diets (experiments 1 and 2)

Item	Diet*	
	Cottonseed meal	Canola meal
	------ % -----	
Ingredient		
Alfalfa hay, chopped	40	40
Oat hay, chopped	10	10
Beet pulp, dried	10	10
Corn, cracked	12	12
Barley, rolled	13	12
Cottonseed meal	12	—
Canola meal	—	13
Fat, animal	2	2
Trace mineral salt	.5	.5
Dicalcium phosphate	.3	.1
Monosodium phosphate	.2	.4
Chemical composition		
Crude protein	17.9	18.0
Acid detergent fiber	24.0	23.8
Ash	7.7	8.0

* Values are on a 100 percent dry basis.

place soybean meal as the protein supplement in dairy diets. Yields of milk and milk components and percentage of butterfat, protein, and solids were similar for diets containing either canola meal or soybean meal. There has been little work, however, comparing canola meal with cottonseed meal, which is the primary protein supplement fed to cattle in the western United States.

We conducted a study substituting canola meal for cottonseed meal in the diet of dairy cows in early lactation. The study evaluated effects on milk yield, milk composition, feed intake, and body weight change of cows.

Experiment 1

Thirty-six Holstein cows, 12 first-calf heifers, and 24 older cows (second or later lactation) were randomly assigned to one of two dietary treatments for the first 12 weeks of lactation after calving. Complete mixed diets containing either cottonseed meal or canola meal as a protein supplement were formulated to be equal in crude protein, energy, fiber, calcium, and phosphorus (table 1). Protein supplements provided approximately 30 percent of the dietary protein. Canola meal contained 41.6 percent crude protein, 1.4 percent ether extract, 18.2 percent acid detergent fiber, and 7.5 percent ash. Values for cottonseed meal were 45.7 percent crude protein, 1.1 percent ether extract, 20.7 percent acid detergent fiber, and 6.8 percent ash. All of these values are on a dry matter basis.

Cows were individually fed free choice twice daily, and feed intake was recorded weekly. Cows were milked and milk weights recorded twice daily. A milk sample was collected from each cow at milking and composited by week. Milk samples were analyzed for fat, protein, and total solids. Body weights were recorded weekly on a common day. Data for first-calf heifers and older cows were analyzed separately (by a one-way analysis of variance).

Yields of actual and 4 percent fat-corrected milk were not significantly different for diets containing either cottonseed meal or canola meal when fed to older cows or first-calf heifers during the first 12 weeks of lactation (table 2). Production responses of all cows were high regardless of diet. Older cows averaged 88 or 91 pounds milk per day when fed diets containing cottonseed meal or canola meal, respectively. First-calf heifers averaged 59 or 57 pounds per day. There were no differences in composition (percent) or yield of milk components.

Cottonseed meal and canola meal did not differ in their effects on intake of dry matter, acid detergent fiber, and estimated net energy for lactation when incorporated into diets of older cows or first-calf heifers (table 2). Intake of dry matter was high for both diets. Older cows on either diet consumed 3.5 percent of body weight. Similar values for first-calf heifers fed cottonseed meal or canola meal were 3 or 2.9 percent, respectively. Body weight change was not affected by diet; all groups lost weight, as is typical for high-producing cows in early lactation.

TABLE 2. Yield of milk and milk components, milk composition, feed intake, and body weight change of cows for 12 weeks in early lactation (experiment 1)

Item	Older cows		First-calf heifers	
	Cottonseed meal	Canola meal	Cottonseed meal	Canola meal
Number of cows	11	12	6	6
Actual milk (lb)	7,365	7,662	4,928	4,771
4% fat-corrected milk (lb)	6,796	7,129	4,900	4,677
Butterfat (lb)	256	271	194	185
Butterfat (%)	3.5	3.5	4.0	3.9
Protein (lb)	33	35	22	22
Protein (%)	2.93	2.93	2.93	3.06
Solids (lb)	900	937	631	611
Solids (%)	12.3	12.2	12.8	12.8
Dry matter intake (lb)	3,883	3,846	2,820	2,732
Acid detergent fiber intake (lb)	931	908	646	664
Net energy (NE_1) intake*	2,818	2,791	2,076	1,983
Body weight change (lb)	−17	−48	−23	−25

*NE_1 is estimated net energy for lactation.

Experiment 2

Six lactating, first-calf Holstein heifers were fed the same diets used in experiment 1 during two periods of three weeks. Cows were 155 days in milk when the study began. Cows were individually fed free choice twice daily, and weekly feed intakes were recorded. Cows were milked and milk weights were recorded twice daily. Milk samples were collected twice during the third week of each period and consisted of an afternoon and morning composite for each cow (Monday p.m./Tuesday a.m. and Wednesday p.m./Thursday a.m.). No preservatives were added to milk samples, which were kept refrigerated and analyzed immediately after the morning collection of each sample day. Milk samples were analyzed for fat; nitrogen; casein, whey, and nonprotein nitrogen; lactose; ash; and total solids (by a two-way analysis of variance with diet and period as effects).

Diet had no significant effect on composition of milk from first-calf heifers (table 3). Fat test was slightly lower for cows fed canola meal, similar to the trend observed for first-calf heifers in experiment 1. There were no differences in milk nitrogen, lactose, ash, or total solids due to protein supplement. Content of casein, whey, and nonprotein nitrogen was not affected by feeding diets containing cottonseed meal or canola meal. Distribution of nitrogen fractions did not differ by diet and was similar to reported values of 78 percent casein nitrogen, 17 percent whey nitrogen, and 5 percent nonprotein nitrogen.

TABLE 3. Composition of milk from first-calf heifers (experiment 2)

Item	Diet	
	Cottonseed meal	Canola meal
	---- % ----	
Fat	3.57	3.49
Lactose	4.96	4.94
Ash	.70	.70
Solids	12.60	12.49
Nitrogen	.51	.51
Casein nitrogen*	.394	.404
Whey nitrogen	.081	.080
Nonprotein nitrogen	.031	.031
% total nitrogen		
Casein nitrogen	77.9	78.5
Whey nitrogen	16.0	15.5
Nonprotein nitrogen	6.1	6.0

* To convert nitrogen values to protein values, multiply percent nitrogen times 6.38. For example: casein protein % = 0.394 × 6.38 or 2.51%.

Conclusions

Canola meal can successfully replace cottonseed meal on an equivalent protein basis in diets of high-producing cows in early lactation. Yields of milk and milk components, milk composition, feed intake, and body weight change of cows were similar with diets containing either cottonseed meal or canola meal as the protein supplement. Canola meal can be fed at a level of 13 percent of the total diet dry matter or 26 percent of the concentrate dry matter in early lactation with no palatability problems. The choice of protein supplement to use in the diet will depend on their relative costs.

Edward J. DePeters is Assistant Professor, Department of Animal Science and Donald L. Bath is Extension Dairy Nutritionist, Animal Science Extension. Both are with the University of California, Davis.
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