

Effect of Heating of Soybean Meal on Milk Production and Degradation of Protein in the Rumen of Lactating Dairy Cows

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Story in Brief

A feeding trial utilizing lactating cows was conducted to compare soybean meal (SBM) processed in a conventional manner with meal which received extra heat during processing. There was a trend for higher milk yield by cows fed the extra-heat SBM compared to cows fed control SBM in a higher production group; however, no response was observed in cows in a lower production group. Weight change was positive and similar for cows fed both types of SBM.

The extent of ruminal degradation of protein in rations containing the two types of SBM was estimated using lactating cows previously fitted with cannulae in the proximal duodenum. The percentage of feed protein bypassing the rumen was 28.8 percent in cows fed extra-heat SBM compared to 27.8 percent in those fed control SBM.

Introduction

The demand for nutrients for milk synthesis are especially high in the dairy cow during early lactation. A ration relatively high in protein content is needed to meet the requirements of lactating cows, partially because of a high rate of degradation of feed protein in the rumen. A great potential for improving the utilization of dietary protein has been demonstrated in trials wherein alternate sources of protein have been compared. Methods of treating soybean meal to enable a larger fraction of the protein to pass through the rumen without breakdown to the lower digestive tract and thus increase its feed value have been of particular interest. Alteration of soybean meal to reduce rumen degradation may increase the amount of metabolizable protein available at the site of absorption and result in a more efficient use of this feed protein to meet the protein needs for milk synthesis. The objectives of this study were to compare the feeding value of regular soybean meal with meal heated more extensively during processing and to compare ruminal bypass of feed nitrogen in rations containing regular and extra-heat soybean meal.

Materials and Methods

Continuous Feeding Trial

Soybean meal with a protein dispersion index (PDI) value of 10 and regular soybean meal (PDI~40) were compared in a continuous feeding trial using lactating dairy cows. Solubility of nitrogen in NaCl was 11 and 19 percent of total nitrogen in the two soybean meals, respectively. These were included in concentrate rations at two protein levels (Table 1). The higher protein rations with the two types of soybean meal were fed to cows producing 70 lb or more of milk daily, and the lower protein rations to those with lower production. It was intended that protein intake would be sufficient to meet approximately 90 percent of the National Research Council standard for milk production during the early part of the trial, thus allowing ample opportunity for any difference in efficiency of utilizing protein in the two types of soybean meal to be reflected in a difference in milk yield.

Table 1. Composition of concentrate mixtures used in feeding trial

Item	Protein level	
	High	Low
Ingredients, % as fed		
Corn, ground	66	72
Soybean meal	26	20
Molasses, liquid	5	5
Dicalcium phosphate	1	1
Limestone	1	1
Salt	1	1
Protein content, % air dry	17.8	16.0

On a dry matter basis, all four rations initially consisted of 60 percent grain mix, 28 percent sorghum silage and 12 percent prairie hay; thus, they were equal in energy content. Adjustments in concentrate-to-forage ratio were made to minimize overfeeding protein as milk production declined over the lactation period.

Prior to initiating the study, 40 cows (28 Holsteins; 12 Ayrshires) were adjusted to rations with a 60:40 concentrate-to-forage ratio. The cows were paired within two production groups. The higher production group consisted of cows producing 70 to 84 lb daily during the preliminary period, whereas cows in the lower production group ranged from 55 to 67 lb daily during this period. The cows were approximately 4 weeks postpartum when started on the trial. Cows were fed in individual stalls twice daily, and feed weighbacks were recorded daily. Sufficient feed was offered each cow to allow some feed weighback nearly every day. When the amount of weighback exceeded 10 percent of the feed offered on 2 or 3 days during a given week, the amount of ration was reduced. Milk yield was recorded twice daily, and samples were taken at four consecutive milkings each week for fat and protein analysis. Cows were weighed on 3 consecutive days at the end of the preliminary adjustment period and at the end of each 4 weeks of the 16-week trial.

Ruminal Bypass Trial

Soybean meal with a PDI value of 10 and regular soybean meal (PDI-40) were compared in a ruminal bypass study to determine the amount of feed nitrogen that bypassed the rumen. Soybean meal comprised 32 percent of the total concentrate mixtures used in this trial. Rations were formulated to meet NRC feeding standards for all required nutrients and consisted of 60 percent grain mix, 28 percent sorghum silage and 12 percent prairie hay on a dry basis.

Prior to initiation of the study, five cows (four Holsteins; one Ayrshire) were fitted with T-cannulae in the proximal duodenum. After calving they were adjusted to rations with a 60:40 concentrate-to-forage ratio and were continued on rations with this percentage of concentrates throughout the trial from 4 to 22 weeks of lactation.

In a replicated crossover design, diets with chromic oxide as a digesta flow marker were fed in equal portions every 8 hours. Cows were fed in individual stalls three times daily, and feed weighbacks were recorded daily. Cows were fed the diets 2 weeks prior to two 4-day sampling periods. Duodenal digesta and fecal samples were collected every 8 hours during each of the 4-day periods.

Results and Discussion

In the feeding trial, intakes of dry matter by cows were similar for the two soybean meal treatment groups within production levels (Table 2). Soybean meal protein represented approximately 53 percent of the total protein intake by the high production group and 47 percent of the total by the lower production group. In both groups soybean meal protein constituted a high enough percent-

Table 2. Responses of cows in feeding trial

Item	Production group			
	Low		High	
	PDI-40	PDI-10	PDI-40	PDI-10
Feed intake				
Dry matter, lb/day	43.2	43.9	49.8	50.5
Total protein, lb/day	6.2	6.4	8.4	8.6
Protein, % of DM	14.3	14.6	16.8	17.0
Weight change, lb/day				
	.95	.97	1.08	1.12
Milk yield				
Milk, lb/day ^a	57.2	55.4	69.4	73.9
Fat, %	3.8	3.7	3.6	3.6
Protein, %	3.10	3.17	2.96	2.98

^aMeans adjusted by covariance for initial production.

age of the total protein intake that the treatment of the soybean meal could influence production responses. Protein intakes were higher in relation to the NRC standard than planned, especially in the higher production group during the second 4-week period of the trial (Table 3). This was the result of milk yield declining to the lower part of the range stipulated for cows to receive the higher protein ration. Although this situation probably decreased the likelihood for a difference between types of soybean meal to be expressed in milk yield, a response to feeding extra-heat soybean meal was observed in a previous trial (Bush et al., 1980) wherein protein intake exceeded NRC requirements.

Table 3. Protein intake relative to NRC standard

Item	Period of experiment ^a			
	1	2	3	4
Low group				
SBM PDI-40	75	91	97	85
SBM PDI-10	81	98	107	95
High group				
SBM PDI-40	100	117	104	105
SBM PDI-10	105	115	108	102

^aEach period represents 4 weeks of the trial.

In both production groups, actual milk yield averaged over the entire 16-week trial was slightly higher for the cows fed PDI-10 soybean meal than for those fed regular soybean meal. However, in the lower production group initial daily production of cows assigned at random to receive extra-heat SBM was higher than that of cows fed control SBM (Figure 1); therefore, it was obvious that there was no response to extra-heat SBM. On the other hand, initial daily yield of cows fed both types of SBM averaged nearly the same amount in the high production

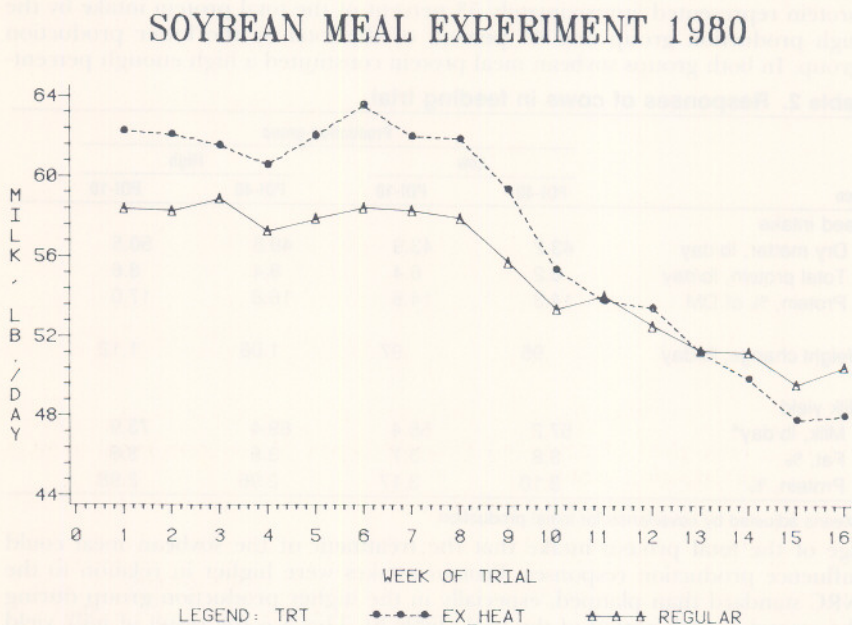


Figure 1. Milk yield of cows fed different types of soybean meal in low production group

group. There was a definite trend toward higher milk yield by cows fed extra-heat SBM than by the control cows in this production group (Figure 2). Comparative performance of one pair of cows in the group accounted for most of the inconsistency in response and, hence, lack of statistical significance of the difference between treatment groups. Milk composition was not affected by treatment (Table 2). Weight change was positive and similar for cows fed rations containing both types of soybean meal. The magnitude of the weight gains, i.e., approximately 1 lb/day over the 16-week trial, reflected adequate energy intake by cows in all groups.

In the bypass study, total nitrogen in digesta samples collected from the proximal duodenum was corrected for microbial nitrogen and non-ammonia nitrogen so that the portion of the protein in the total diet that bypassed degradation in the rumen was measured. Protein intake, expressed as a percentage of dry matter, and milk yield were similar for both treatments (Table 4).

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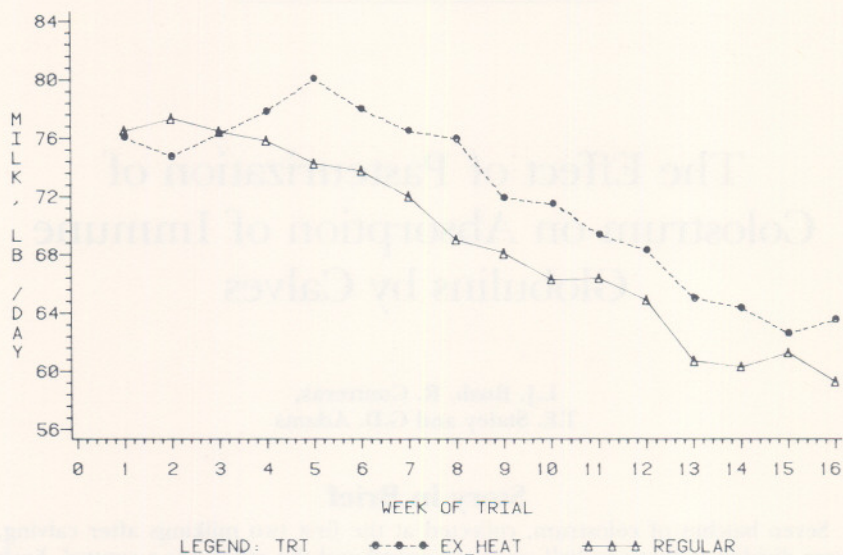


Figure 2. Milk yield of cows fed different types of soybean meal in high production group

Table 4. Effects of heating SBM on ruminal bypass of protein

Item	SBM treatment	
	PDI-40	PDI-10
Milk, lb/day	54.9	55.1
DM intake, lb/day	41.7	45.0
Total protein, lb/day	7.3	7.9
Protein, % of DM	17.5	17.6
% ruminal bypass of feed N	27.8	28.8

The protein from SBM in the rations comprised approximately 61 percent of total protein intake. The estimated percentage of ruminal bypass of feed protein was only slightly higher in cows fed extra-heat SBM compared to the control group (28.8 vs 27.8 percent). Therefore, based on these data and those in the feeding trial, it appeared that the extra-heat SBM (PDI-10) used in this trial was not heated extensively enough during processing to make it a high bypass feed protein source. Nevertheless, the values obtained on percentage of feed protein bypassing the rumen of cows consuming a 60 percent concentrate ration at the rate achieved in this trial are of interest. These data will be useful as reference points for future trials in which extent of degradation of different sources of feed protein will be estimated.

Literature Cited

Bush, L.J. et al. Okla. Agr. Exp. Sta. MP-107, pp 96-101.

The Effect of Pasteurization of Colostrum on Absorption of Immune Globulins by Calves

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Story in Brief

Seven batches of colostrum, collected at the first two milkings after calving, were divided so that one-half was pasteurized and the other was a control. Each was fed to an equal number of newborn calves obtained before nursing their dams. Concentration of the IgG class of immune globulins, as measured by radial immunodiffusion, was higher at 12 hours in serum of calves fed pasteurized colostrum. IgG values at subsequent sampling periods were similar for both treatment groups as were concentrations of IgM at all sampling periods.

Introduction

The importance of the transfer of passive immunity against disease from a cow to her newborn calf by way of colostrum is well established. Moreover, this is especially important in large dairy operations where newborn calves are likely to be exposed to a wide range of disease organisms due to concentration of animals and repeated use of the same facilities for raising calves. In some instances calves