SARSAPONIN AND SITE OF DIGESTION AND PASSAGE RATES IN DAIRY COWS

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Story In Brief

Sarsaponin was added to diets for four dairy cows and site of digestion and passage rates were measured. Four cows fitted with duodenal cannulas were fed a 50 percent concentrate diet, without (C) or with sarsaponin (S) at 44.1 ppm dietary dry matter. Cows were fed 85 percent of ad libitum intake in a crossover experiment. Sarsaponin increased ruminal ($P<.08$) and total ($P<.05$) tract organic matter (OM) digestibilities (S, 43.7 and 52.1 vs C, 32.4 and 48.2 percent, respectively). Starch digestion coefficients displayed similar trends. Duodenal flow of total and feed nitrogen (N) tended to be lower for cows receiving S, while microbial N was not affected. Fecal N loss also tended to be less with S added. Ruminal and total N digestibility both tended to be greater with sevarin supplementation. Passage rates of concentrate, silage and fluid from the rumen tended to be enhanced by S addition.

Introduction

Feed additive regulations for lactating dairy cows are among the most stringent for all livestock classes. Sevarin[3], a commercial product containing sarsaponin, is classified as a natural feed flavoring. Hence, if milk production were increased by sarsaponin supplementation, this product could be readily adopted by milk producers.

Sarsaponins, a group of naturally occurring steroid saponins of the yucca plant, have been suggested to enhance fermentation. With high concentrate diets, performance responses have most often occurred when dietary protein is marginal. Zinn et al. (1983) observed that duodenal flow of feed N increased when sarsaponin was added to a high concentrate, high protein diet. Currently, no information exists concerning effects of sarsaponin on digestion of diets containing moderate levels of roughage. The objective of this study was to investigate the effects of sarsaponin on site of digestion and passage rate in dairy cows.

Experimental Procedure

Four mature dairy cows (1063 lb) in late lactation fitted with duodenal cannulas were used in a crossover experiment. Ad libitum intake of a 50 percent concentrate diet was determined during a 14-day period. Cows were then restricted to 85 percent of this level for collection. Feeding was at 0300 and 1500 hr and cows were milked at 0430 and 1630 hr. Diets (Table 1) were formulated to 50 percent concentrate, considering that silage contained 25 percent grain.

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Table 1. Diet composition, % dry matter.

Ingredient	Diet	
	Control	Sarsaponin
Sorghum silage	66.7	66.7
Corn, ground	18.4	18.4
Soybean meal	7.7	7.7
Milo grain, ground	6.0	6.0
Dicalcium phosphate	.73	.73
Salt, trace mineralized	.20	.20
Chromic oxide	.30	.30
Sevarin		+[a]

[a]44.1 ppm of dietary dry matters.

Sevarin was supplemented at 44.1 ppm of dietary dry matter and chromic oxide was included as an indigestible marker.

Periods were 21 days in length with digesta sampled on the last four days of each period. Feeds were sampled each day at mixing time and refrigerated. On day 16, digesta markers (CoEDTA crystals for fluids; ytterbium-labeled concentrate for concentrate; dysprosium labeled silage for silage) were mixed with the 0300 hr feed. Duodenal and rectal samples were taken at specific time intervals thereafter. Feed, duodenal and fecal samples were subjected to all or part of the following analyses: DM, ash, N, acid detergent fiber (ADF), ADF nitrogen (ADFN), starch, chromium, nucleic acid N, ammonia N and markers.

Results and Discussion

Crude protein content of the diets were slightly lower than expected (12 percent) but in excess of the estimated protein requirement for the cows at this stage of lactation. The ADFN content of the diets was 29 percent of the total N content, indicative of heat damage. Dry matter intake was 13.8 kg/day while daily sevarin consumption averaged 608 mg per cow. True ruminal OM digestion was greater ($P<.08$) with S added to the diet. Ruminal OM digestion was directly related to concentrate ($r=.81$; $P<.05$) and fluid ($r=.75$; $P<.04$) passage rates (Table 3). Faster ruminal digesta passage rates generally are associated with lower ruminal digestibilities. In a previous trial, sarsaponin at 60 g/ton air dry feed slightly decreased ruminal OM digestion in trials with steers fed a high concentrate diet (Zinn et al., 1983). In our trial, perhaps sarsapsonin increased the rate of ruminal digestion of particles or altered the location of particles and increased the proportion of particles ready for exit. Such action should have greater effects on passage at higher intake levels and with diets of higher roughage content.

Total OM digestion in our trial was increased ($P<.05$) with S addition. Both treatment means are considerably lower than expected. The trial was conducted just prior to refilling the silage pit causing

low availability of high quality forage. Thus, low roughage quality may have been involved in these low digestibility estimates. However, low absolute digestion measures should not bias the relative treatment comparisons. Ruminal and total tract starch digestibilities (Table 2) followed patterns similar to OM digestion. Total ADF digestion also was slightly greater ($P>.05$) for S cows. Zinn et al. (1983) reported small increases in ADF digestion due with sarsaponin supplementation.

Total N entering the duodenum (Table 3) was slightly lower for C cows. This difference was primarily due to greater ruminal escape of feed N for the C treatment. This is in contrast to the report of Zinn et al. (1983) who noted that microbial and feed protein passage increased when S was fed. Microbial N (MN) passage values were similar in our study.

Effects of sarsaponin on ruminal fermentation in our study may be due to increased production and activity of microbial enzymes, shifts in microbial species or metabolism. A negative relationship existed between fluid passage rate and duodenal MN flow ($r=-.77$; $P<.03$). This may reflect increased ruminal digestion facilitating faster digesta passage with S cows. Since duodenal OM flow was less ($P<.07$) for S cows and MN was similar for both treatments, microbial OM (MOM) comprised a slightly greater proportion of duodenal digesta for S versus C cows (1037 vs 1131 g MOM/day and 12.5 vs 11.6 percent of total duodenal OM).

Table 2. Digestibilities.

Item	Diet	
	Control	Sarsaponin
Organic matter, %		
Ruminal	34.4	43.7
Total tract	48.2[a]	52.1[b]
Starch, %		
Ruminal	27.1	47.9
Total tract	66.9	69.4
Fiber, acid detergent, %		
Total tract	20.5	27.5
Nitrogen		
Passage, g/d		
Intake	278	278
Entering duodenum		
Total	364	330
Microbial	107	104
Feed	238	206
Ammonia	19	20
Feces	189	169
Digestion, %		
Ruminal	15.1	25.8
Total tract	32.8	39.1
Microbial efficiency, g MN/kg organic matter fermented	29.8	19.0

[a,b]Means in a row with different superscripts differ ($P<.05$).

Table 3. Digesta marker passage rate, h^{-1}.

Fraction	Diet	
	Control	Sarsaponin
Concentrate	4.6	4.7
Silage	3.7	4.0
Fluid	4.3	5.0

Ruminal N digestion tended to be greater for cows fed S contrasting with a depression observed with S addition in steers fed an 80 percent concentrate diet (Zinn et al., 1983). Total N digestion in our trial tended ($P>.05$) to be greater for S cows. Microbial efficiency tended ($P>.05$) to be lower for the S treatment, with OM fermented in the rumen being the major determinant.

Passage rates of markers associated with concentrate, silage and fluid should represent ruminal dilution rates for these fractions. All values tended to be greater with S addition. These trends are probably a reflection of increased ruminal digestion of feed. Fluid and concentrate passage rates were positively correlated ($r=.77$; $P<.03$), but neither was significantly related to silage passage rate.

Effects of S in our trial may differ from effects noted by others which may be due to feedstuff recalcitrance. Sevarin supplementation increased both digestion and passage rate with this medium concentrate diet. When ruminal fill limits feed intake, as may occur with certain dairy production systems, sevarin may permit greater ad libitum feed consumption. Further study of rates of ruminal feedstuff disappearance and performance trials with high producing dairy cows consuming feed ad libitum must be performed. Possible adverse effects of sarsaponin on milk fat and effects on reproduction need attention.