EFFECTS OF DIETARY SARSAPONIN CONCENTRATION ON FERMENTATION AND DIGESTION IN SEMI-CONTINUOUS RUMEN CULTURES

F.R. Valdez[1], A.L. Goetsch[2], L.J. Bush[3]

Story in Brief

Sixteen *in vitro*, semi-continuous rumen cultures were used to determine the effect of sarsaponin concentration (0, 30, 50 and 70 g/ton air dry feed) on fermentation. The basal diet consisted of ground corn, soybean meal, and ground alfalfa with a 55:45 concentrate:roughage ratio. Numbers of protozoa decreased linearly while bacterial numbers tended to increase with increasing levels of Sarsaponin. Culture pH was similar for all treatments. Nitrogen digestion tended to be lowest for the highest concentration of sarsaponin. Microbial nitrogen production was similar for all groups. Acid detergent fiber digestion increased linearly with increasing concentrations of Sars. in the diet.

[Key Words: Sarsaponin, *In vitro* fermenters, Digestion, Steroidal glycosides.]

Introduction

Sarsaponin, a steroidal glycoside, has been used in rations for finishing cattle. There is some evidence that it has an effect on microbial growth through the stimulation of anaerobic fermentation (Peekstok, 1979). There is a possibility that sarsaponin could improve productivity through more efficient utilization of feed by ruminant animals.

The objective of this experiment was to determine the effects of sarsaponin concentration in semi-continuous *in vitro* fermentors under controlled conditions on fermentation of feed by rumen cultures.

Materials and Methods

A modification of a semi-continuous *in vitro* digestion system was used. Sarsaponin (SARS) was added at concentrations of 0, 30, 50, and 70 g/ton to a substrate consisting of 55% concentrate on an air dry-basis (Table 1). A total of 16 rumen cultures were in a completely randomized experiment with four cultures per treatment. The experiment lasted 22 days with sampling conducted on the last 12 days. Sarsaponin was administered as Sevarin (Distributors Processing, Inc., Porterville, CA), a commercial product containing a high percentage of steroidal sasaponins extracted from the plant *Yucca shidigera*.

Initially, each fermentor contained 150 ml buffer (McDougall, 1948) preheated at 39 ^{0}C, and 50 ml rumen fluid obtained from two mature Hereford heifers fed a 58 % concentrate diet of ground corn and chopped alfalfa. At 12-hour intervals (0645 and 1845), 50 ml samples were removed from each culture via suction with a plastic syringe and a mix

---

[1]Graduate Student [2]Former Research Associate [3]Professor

Table 1. Composition of basal substrate.

Item	%
Ground Corn	45
Ground Alfalfa	45
Soybean Meal	10

of .5 g substrate and 50 ml buffer was introduced into each fermentor flask through short tube. Cultures were then gassed with carbon dioxide for 15 seconds.

The initial 10 days of the experiment served as a stabilization period. Samples were obtained daily at 1845 hours pH was measured immediately. Samples were dried at 55 ^{0}C and analyzed for dry matter (DM), ash, nitrogen (N), acid detergent fiber (ADF), starch, nucleic acids and ammonia nitrogen (NH_3-N).

Bacterial and protozoal counts were conducted in duplicate. Protozoal numbers were determined with phase contrast microscopy at a magnification of 100 X. Bacteria were enumerated with a Petroff-Hauser chamber at a magnification of 600 X.

Data were analyzed by analysis of variance, and treatments were tested for linear and quadratic effects and a contrast of control diets versus supplementated diets with sarsaponin was made.

Results and Discussion

There was a tendency for bacterial numbers to increase with increasing levels of SARS. When the control was contrasted with the average of all treatments, the difference was found to be statistically significant (Table 2). The higher bacterial numbers were also associated with a significant linear decrease (P<.05) in numbers of protozoa from 3.6 x 10^4/ml to 2.9 x 10^4/ml respectively, as concentration of SARS increased from 0 to 70 g/ton.

Table 2.- Numbers of bacteria and protozoa.

	SARS concentration, g/ton				
Item	0	30	50	70	SE
Bacteria, X 10^{10}/ml	1.2[a]	1.2	1.3	1.3	.09
Protozoa, X 10^4/ml	3.6	3.3	2.8	2.9	.2

[a] Significantly different from average of other means (P<.05).

[b] Linear effect (P<.05).

The pH values for all treatments varied from 6.76 to 6.78 (Table 3). Slyter (1966) reported that cultures maintained at pH 6.7 normally contained most types of bacteria often found in large numbers in the rumen of cattle.

Ammonia-N values for all treatments were similar, with a range in total concentration of 4.6 to 4.9 mg/dl (Table 3). This is in contrast to results reported by Grobner et al. (1982), where NH_3-N values were depressed upon addition of 60 ppm of SARS to fermentor diets.

Addition of sarsaponin in the diet had a quadratic effect on starch digestibility ($P<0.1$), increasing digestion up to a concentration of 50 g/ton, and then decreasing with a concentration of 70 g/ton (Table 4). There is no explanation for this decrease, similar to that observed by Zinn et al. (1983) with high concentrate diets containing 60 g of sarsaponin per ton. Increasing starch digestibilities may be associated with an increase in the number of bacteria. Higher starch digestibility ($P<.05$) was observed for the average of all treatments with SARS than for control. Apparent digestibility of ADF increased linearly with increasing levels of SARS approaching significance ($P<.10$) (Table 4).

Table 3.- Culture pH and NH_3-N concentration.

Item	SAR Concentration, g/ton			
	0	30	50	70
pH	6.77	6.77	6.78	6.76
NH_3-N, mg/dl	4.7	4.8	4.9	4.6

Table 4.- Nutrient utilization.

Item	SAR Concentration, G/Ton			
	0	30	50	70
Apparent digestibility, %				
Starch[a]	96.4	97.6	98.2	97.4
ADF[b]	10.2	21.5	30.6	47.7
Net digestibility, %				
Feed nitrogen	67.4	67.4	63.9	49.8
Organic matter[c]	52.9	68.7	60.7	59.7
Microbial efficiency, g MN/kg OM ferm.	44.7	32.7	30.1	33.5

[a] Significant difference between control vs. Trts. ($P<.05$).
[b] Linear effect ($P<.10$).
[c] Linear effect ($P<.08$).

There was no significant difference (P>.05) among treatments in nitrogen digestion, which tended to be lowest at the highest level of SARS. Similar non-significant differences were observed for microbial-N and microbial efficiency (Table 4). In contrast, Zinn et al.(1983) reported increased microbial protein synthesis, and decreased ruminal-N digestion by cultures with 60 g/ton of SARS in high concentrate diets. Differences among treatments in net organic matter digestibility approached significance (P<.08), and a significant contrast (P<.05) was observed between treatments with SARS over control (Table 4), similar to observations by Goetsch and Owens (1984).

Sarsaponin caused changes in fermentation in the semi-continuous fermentation trial, as evidenced by an increase in net digestibility of organic matter and apparent digestibility of ADF and starch. Sarsaponin also increased numbers of bacteria and decreased numbers of protozoa with increasing concentrations.

Literature Cited

Goetsch, A. L., and F. N. Owens. 1984. Sarsaponin and site of digestion and passage rates in dairy cows. Ok Agri. Exp. Sta. MP-116:76.

Grobner, M.A., et al. 1982. Sarsaponin effects on in vitro continuous fermentation on high grain diets. West Sec. Am. Soc. Anim. Sci. 33:64.

Peekstok, L. A. 1979. An investigation to the application of Yucca schidigera extract of biological waste treatments. M.S. Thesis. Miami Univ. Oxford, Ohio.

Slyter, L. L., et al. 1966. Effect of pH on population and fermentation in a continuous cultured ecosystem. Appl. Microbiol. 14:573.

Zinn, R. A., et al. 1983. Univ. California Res. Rep. 150pp.