COMPARISON IN CHEMICAL AND MICROBIAL PROPERTIES BETWEEN THE RUMEN CONTENTS TAKEN BY A STOMACH TUBE AND TAKEN THROUGH A RUMEN FISTULA

H. Kajikawa and A. Abe
National Institute of Animal Industry, Tsukuba 305, Japan

and

Y. Nagasaki
Okinawa Prefectural Livestock Experiment Station, Okinawa 905-04, Japan

Introduction

A stomach tube is a useful means by which rumen fluid is taken easily from many animals. However, it has a disadvantage in that it is difficult to avoid contamination by saliva. This study was conducted to examine the difference between rumen contents taken by a stomach tube and taken through a rumen fistula.

Material and Methods

Exp. 1: Two rumen fistulated Japanese Black steers weighing 680 kg which had been fed a roughage-concentrate (2.5:1) diet were used. Rumen fluid was taken at 4 hr after feeding by a stomach tube (18 mm OD of outer tube, 6 mm ID of inner tube) and by squeezing the rumen content taken by hand via the rumen fistula. The time needed for the insertion of the stomach tube (=a) and suction of 100 ml rumen fluid (=b) was measured, and the relation between these times and the difference in pH between both the rumen fluids (=dpH) was studied.

Exp. 2: The two steers used in Exp. 1 were fed Italian ryegrass hay 5.0 kg/d (Diet R) and Italian ryegrass hay 3.0 kg/d + flasked corn 5.0 kg/d (Diet C). Comparisons were made between the rumen fluid taken by the stomach tube (ST), the fluid portion taken by suction through the fistula (FL) and the homogenized mixture (1:1) of the fluid portion and the solid portion taken by hand through the fistula (FM). These samples were taken at the same time just before feeding for 4 d after adjusting to each diet for more than 4 wk. pH, VFA (by a gas chromatograph with Thermon 1000 + 0.5% H_3PO_4 on Chromosorb W) and NH_3-N (by microdiffusion analysis) were measured. In addition, protozoa, total viable (Bryant and Robinson, 1961), cellulolytic (Mann, 1968) and amylolytic bacteria were enumerated. The carbohydrates of the medium 98-5 of Bryant and Robinson was modified to glucose, starch, cellobiose, maltose and xylose (0.02% each), and Tripticase (0.2%) was added. Bacto Casitone and Cysteine-HCl of the Mann's medium were changed to Tripticase (0.2%) and Cysteine-HCl + Na_2S (0.025% each), respectively. Amylolytic bacteria was enumerated by counting the colonies showing starch hydrolysis by adding a lugol solution after a 24 hr incubation on medium 98-5 in which the carbohydrate had been modified to only starch (0.3%). A paired experiment based on t-table was used for comparison between the methods of taking rumen content. Comparison between diets R and C were conducted by t-test except for the bacteria counts, for which the Mann-Whitney test was used because there were considerable differences in the variance of bacteria numbers between the diets.

Results

In Exp. 1, correlation coefficients between dpH and a+b, and dpH and b were 0.731 and 0.893 (n=16), respectively, and were both significant ($p<.01$). In one steer (no.1) it was easy to take the rumen fluid through the stomach tube with 11.0 and 0.10 as averages of b (sec) and dpH. For the other (no.2), however, it was relatively difficult, and 22.4 and 0.22 were the averages for the same measurements.

In Exp. 2, pH, NH_3-N and total VFA for steer no. 2 tended to be different between FL and ST, especially on diet R, although acetate/propionate did not differ. On the other hand, all these values for steer no. 1 showed little difference between FL and ST in both the diets. Protozoa and

TABLE 1. CHEMICAL AND MICROBIAL PROPERTIES OF RUMEN CONTENT TAKEN BY STOMACH TUBE OR TAKEN THROUGH RUMEN FISTULA ON ALL-HAY (R) OR HIGH-CONCENTRATE (C) DIET

		Steer No. 1				Steer No. 2			
	Diet	FM[a]	FL[a]	ST[a]	P<.05[b]	FM[a]	FL[a]	ST[a]	P<.05[b]
pH	R		6.98	7.07			7.02	7.47	LS
	C		6.89*	6.83*			6.58*	6.99*	
NH_3-N (mg/l)	R	35.7	34.3	31.6		48.7	46.5	35.5	LS
	C	58.7	50.9	52.1	ML	106.3*	100.0*	92.3*	
Total VFA (mM)	R	88.4	84.1	85.1	ML	87.4	82.3	71.4	ML MS
	C	113.2*	97.6*	99.0*	ML	108.2	102.5*	86.6	MS LS
Acetate/Propionate	R	4.01	3.96	3.94		4.54	4.47	4.58	
	C	2.79*	2.74*	2.75*		2.74*	2.68*	2.76*	
Protozoa	R		20.1	19.9			10.9	14.3	
($x10^4$/ml)	C		20.0	21.1			40.1*	41.3*	
Viable Bacteria	R	26	7.4	6.4	ML MS	33	16	16	
($x10^8$/ml)	C	50*	39*	42*		102*	70*	67*	
Amylolytic	R	1.4	.15	.14	ML MS	2.1	.34	.28	ML MS
Bacteria ($x10^8$/ml)	C	9.0*	7.3*	11.1*		6.5*	4.0*	4.2*	ML MS
Cellulolytic	R	2.6	.52	.25	ML MS	9.2	3.5	4.3	MS
Bacteria ($x10^8$/ml)	C	.08*	.07*	.03*		.71*	.11*	.14*	ML MS

[a]FM= solid and fluid (1:1) sample taken through rumen fistula. FL= fluid fraction taken through rumen fistula. ST= sample taken by stomach tube.

[b]ML, MS and LS indicate significance difference (P<.05) between FM and FL, FM and ST, and FL and ST, respectively.

*indicates significant difference (P<.05) between the diets.

bacteria numbers showed no difference between FL and ST for both steers in both the diets. Each bacteria count of FM was higher or tended to be higher than those of FL and ST, especially when diet C was given except for cellulolytic bacteria for steer no. 2. Total VFA was also higher in FM than in FL for steer no. 1. The values from FM, FL and ST similarly indicated lower pH, acetate/propionate and cellulolytic bacteria and a higher total and amylolytic bacteria in diet C than in diet R for both the steers.

Discussion

The results of this study indicate that rumen fluid taken by a stomach tube within about 10 sec for the suction of 100 ml of that fluid would be similar in pH, chemical and microbial properties to the fluid fraction sucked through rumen fistula. Dilution by saliva may not be ignored in pH and chemical properties when it takes more than 20 sec with a stomach tube; however, the effect of saliva on microbial numbers seems to be small because of the relatively wide variation in bacteria counts between the samplings. Some properties, especially bacteria numbers in the solid portion, were higher than those in the liquid portion especially when a high-roughage diet was given. However, the change of the ruminal properties in the fluid fraction accompanied by a dietary change may have the same tendencies as the change in the solid fraction.

(**Key Words**: Stomach Tube, pH, Bacteria)

Literature Cited

Bryant, M.P. and I.M. Robinson. 1961. An improved nonselective culture medium for ruminal bacteria and its use in determining diurnal variation in numbers of bacteria in the rumen. J. Dairy Sci. 44: 1446-1456.

Mann, S.O. 1968. An improved method for determining cellulolytic activity in anaerobic rumen bacteria. J. Appl. Bacteriol. 31: 241-244.