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Effects of Ground Ear Corn vs. Ear Corn Silage on Rumen Fatty Acid Content

A. D. PRATT

H. R. CONRAD

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER
WOOSTER, OHIO

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REVIEW OF LITERATURE

In previous research (4), the need was shown for unfermented grain or forage to supplement high moisture grass silages for milk production.

Many experiments have been reported (1, 2, 3, 7, 8) which show that dry matter intake is greater from high dry matter silage than from high moisture silage.

Furthermore, experimental work (5) in connection with the research reported here showed that treatment of ear corn silage with bacitracin was associated with increased butterfat percentage and milk production and lowered solids-not-fat compared with untreated ear corn silage. Treatment with limestone was associated with increased butterfat percentage and decreased solids-not-fat. The effects of fermentation of ground ear corn on rumen fatty acid concentration are not known.

EXPERIMENTAL PROCEDURE

Purpose

This experiment was planned to determine the effects on the fatty acid content of rumen fluid of changing from ground ear corn to ear corn silage as a source of grain.

Experimental Animals

A Jersey cow near the end of her lactation and a Holstein steer, both of which had been fistulated for 1 year or more, were used for this feeding experiment.

Forage

Haylage from a gas-tight silo was fed until January 11, after which silage of low dry matter content was fed. The low dry matter silage was exhausted and a high dry matter silage from a conventional tower silo was fed beginning January 21 prior to the last sampling.

Ear Corn

The ground whole ear corn varied in dry matter content from 86.5 to 89.0 percent.

The corn for ear corn silage was picked at approximately 55 percent dry matter with many of the husks remaining on the ears. The ears were chopped through a picker-grinder (used as a stationary unit at the silo) by revolving blades. The material was passed through a screen and then between rollers which crushed it thoroughly. Some portion of each kernel was crushed, thus favoring more rapid fermentation.

The ear corn silage used during this experiment was treated with zinc bacitracin. The treatment consisted of 5 lb. of Silotracin (containing 5 grams of zinc bacitracin) per ton. This treatment has been shown to decrease the lactic and increase the acetic acid content of the resulting legume-grass silage (6).

Feeding Plan

Both the Jersey cow 1575 and the Holstein steer 1502 were fed legume-grass silage. Grain (or ear corn silage) was fed in the ratio of 60 percent forage dry matter and 40 percent grain dry matter.

Dry matter analyses were made twice weekly on the ration components.

Sampling

Sampling of rumen fluid was accomplished by covering a beaker with the hand entering through the rumen fistula and then uncovering the beaker in five of the most widely separated portions of the rumen. The samples were composited for analysis. Grain and silage were fed at 6 a.m. Rumen fluid was sampled at 4 a.m., 7 a.m., 9 a.m., and 11 a.m.

The two animals were fed in a switchback design.

The sampling on November 11 was done on the first day of experimental feeding, while that on December 6 was just prior to the change in grain feeding. The steer (1502) was fed ear corn silage (bacitracin-treated) during the first three sampling periods and was changed to ground ear corn on December 8. During the three later samplings, he was fed ground ear corn. The cow (1575) was fed ground ear corn during the first three sampling periods and ear corn silage during the last three.

Chemical Analyses

Volatile fatty acids were determined with an Aerograph HY-FI Model 600 gas chromatograph using a column composed of 20% Tween 80 and 2% phosphoric acid on 60/80 chromosorb-W. Samples were prepared by adding 1 part of 25% metaphosphoric acid to 5 parts of rumen fluid and centrifuging for clarification. Quantitation was made by comparing areas on chromatograms of sample response with standard acids containing 10 to 40 m moles per liter.

RESULTS

The analytical data appear in Tables 1 and 2. The concentration of acetic acid was averaged for each of the sampling dates when animals were fed ear corn silage and also for ground ear corn at each sampling hour. The change with respect to feeding may be noted from the means for each hour (Table 2). The highest values are 3 hours post-feeding, which is the usual case.

The data were similarly assembled for each of the five volatile fatty acids and appear in Table 2. The comparative concentrations of the different acids suggest that the values are in a normal range. There was a tendency for acetic acid to decrease with time whether the grain was ear corn silage or ground ear corn and the total means were essentially the same for both types of corn. The propionic acid means also were not different.

Propionic acid was higher for the steer fed ear corn silage for the initial sampling day and higher for the cow fed ground ear corn for the other two sampling days before the grain feeding was reversed. After the change, the steer fed ground ear corn yielded rumen juice of definitely higher propionic acid content. These animal period interactions were statistically significant but have no long-time biological effects since the overall mean propionic acid contents were the same for the two types of corn.

Butyric acid concentration was higher in the rumen juice of the animals during the period in which they were fed ear corn silage. Again, the animal period interactions were significant. Such variations may reflect differences in the ear corn silage at different levels in the silo and should be a subject of future study, since the amount of fermentation may result in variations in feed intake (4, 5). Valeric acid was consistently higher in the animals fed ear corn silage.

During the initial sampling day, the concentration of isovaleric acid was the same in both animals. Thereafter the concentration was higher in the cow regardless of which ration she was fed. There were no real differences in the mean quantities of isovaleric acid.

The animals had water cups in the stalls and water was available to them at all times. Thus, water intake constituted an uncontrolled variable which may have caused some of the variability as evidenced by occasional high values for standard error.

CONCLUSIONS

Although the data presented here were collected from only two animals and application is therefore limited, the differences in butyric and valeric acid content are real and are an appropriate subject for further investigation in studies concerned with feed intake problems frequently encountered in feeding high moisture corn to dairy cows. Metabolically, the increased butyric and valeric acids are of interest since they may indicate somewhat increased availability of reducing equivalents.

TABLE 1.—Amounts of Acetic, Propionic, Butyric, Isovaleric, and Valeric Acids in Rumen Juice with Changes in Rations and at Different Hours.

Date	Haylage Dry Matter	Hour	Fatty Acids									
			Acetic		Propionic		Butyric		Isovaleric		Valeric	
			1502	1575	1502	1575	1502	1575	1502	1575	1502	1575
	Percent	a.m.	Grams per Liter									
11/12	36.5	4	5.00*	4.43†	1.84	1.46	1.32	0.78	0.16	0.26	0.26	0.16
		7	4.43	3.65	1.77	1.28	1.71	0.87	0.19	0.24	0.31	0.17
		9	4.26	3.52	1.69	1.08	2.28	0.73	0.26	0.20	0.32	0.14
		11	4.88	3.56	2.01	1.21	2.86	0.65	0.26	0.13	0.36	0.13
11/29	39.5	4	3.53*	5.60†	0.82	1.87	0.91	1.43	0.09	0.28	0.12	0.25
		7	3.90	4.82	0.83	3.12	0.91	1.23	0.13	0.25	0.79	0.28
		9	4.35	4.60	1.41	1.72	1.04	1.32	0.28	0.28	0.21	0.19
		11	4.66	5.44	1.39	1.71	1.16	1.38	0.25	0.18	0.19	0.21
12/6	42.5	4	4.64*	3.45†	1.11	1.08	1.53	0.93	0.17	0.24	0.08	0.13
		7	3.80	4.10	0.93	1.49	0.82	0.90	0.14	0.32	0.08	0.19
		9	5.02	4.62	1.16	1.57	1.06	1.23	0.27	0.29	0.18	0.20
		11	4.16	4.48	1.06	1.33	0.96	1.12	0.23	0.22	0.14	0.15
12/22	41.0	4	4.38†	3.93*	1.16	1.05	0.86	0.87	0.16	0.15	0.11	0.13
		7	3.56	4.47	0.80	1.73	0.63	1.25	0.14	0.39	0.06	0.23
		9	3.25	4.47	0.95	1.74	0.70	1.28	0.20	0.37	0.13	0.32
		11	3.53	3.47	0.95	1.32	0.73	1.01	0.16	0.22	0.09	0.21
12/29	40.0	4	4.04†	4.01*	1.08	1.22	0.87	0.98	0.16	0.16	0.12	0.12
		7	3.48	4.08	1.03	1.51	0.72	1.19	0.19	0.46	0.08	0.29
		9	4.47	4.33	1.46	1.46	1.08	1.26	0.31	0.30	0.21	0.26
		11	4.22	3.94	1.37	1.18	1.06	1.04	0.21	0.18	0.15	0.11
1/27	43.5	4	3.94†	2.63*	1.20	0.61	0.93	0.94	0.16	0.13	0.08	0.06
		7	3.56	4.09	0.95	1.55	0.92	0.96	0.17	0.35	0.07	0.20
		9	3.75	4.21	1.09	1.39	0.33	1.06	0.20	0.39	0.08	0.33
		11	3.97	3.68	1.08	1.11	0.98	0.96	0.22	0.22	0.15	0.31

*Fed ear corn silage, varying from 54.0 to 55.5% dry matter. †Fed ground ear corn, varying from 86.5 to 89.0% dry matter.

TABLE 2.—Variability in Fatty Acid Concentrations in Rumen Juice as Affected by Ration and Time of Sampling.

	Time of Sampling*				Mean for All Sampling Times
	1	3	5	22	
Acetic Acid					
Ear Corn Silage	4.13 ± 0.30	4.44 ± 0.46	4.13 ± 0.62	3.96 ± 0.93	4.16
Ground Ear Corn	3.86 ± 0.58	4.03 ± 0.55	4.20 ± 0.79	4.31 ± 0.82	4.10
Propionic Acid					
Ear Corn Silage	1.39 ± 0.45	1.48 ± 0.24	1.35 ± 0.39	1.11 ± 0.43	1.33
Ground Ear Corn	1.45 ± 0.96	1.31 ± 0.35	1.28 ± 0.30	1.31 ± 0.35	1.33
Butyric Acid					
Ear Corn Silage	1.14 ± 0.36	1.33 ± 0.53	1.33 ± 0.95	1.09 ± 0.30	1.22†
Ground Ear Corn	0.88 ± 0.23	0.90 ± 0.42	0.99 ± 0.30	0.97 ± 0.26	0.93
Isovaleric Acid					
Ear Corn Silage	0.28 ± 0.158	0.31 ± 0.061	0.23 ± 0.031	0.14 ± 0.033	0.24
Ground Ear Corn	0.25 ± 0.082	0.25 ± 0.058	0.18 ± 0.042	0.21 ± 0.020	0.22
Valeric Acid					
Ear Corn Silage	0.32 ± 0.070	0.27 ± 0.005	0.22 ± 0.012	0.18 ± 0.010	0.23†
Ground Ear Corn	0.14 ± 0.009	0.16 ± 0.003	0.15 ± 0.002	0.16 ± 0.005	0.15

*Hours after feeding.
†Differences between means greater than would be expected by chance alone ($P < .01$).

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