

Sodium bicarbonate in dairy rations

Edward J. DePeters □ Alan H. Fredeen □ Donald L. Bath

It's not needed when rations include alfalfa hay

Sodium bicarbonate (NaHCO₃) has been used in ruminant diets to buffer rumen conditions under situations of dietary or rumen acid stress. For example, sodium bicarbonate has been added to diets of sheep and cattle entering feedlots because of radical (dietary) adjustments from diets of high roughage to high grain, which are associated with rumen acidosis (reduced pH). However, the efficacy of sodium bicarbonate in buffering the rumen environment is variable.

Sodium bicarbonate has also been used in dairy cattle diets at the beginning of lactation. At 0.7 to 1.5 percent of the diet dry matter, it has improved feed intake and milk yield in early lactation when added to diets based on corn silage as the forage. In addition, improvement in dietary fiber digestibility has sometimes been observed and has been associated with the maintenance of a more favorable rumen pH (6.6 to 6.8) environment for cellulolytic microorganisms. Consequently, sodium bicarbonate can sometimes be partially effective in maintaining normal milk-fat percentages when high grain, milk-fat-depressing diets are fed. Improving the rumen environment for cellulolytic microorganisms shifts the rumen fermentation towards acetic acid production, which is favorable for milk fat synthesis.

There has been little work evaluating sodium bicarbonate in dairy diets based on alfalfa hay as the forage. Alfalfa hay differs from corn silage in at least three aspects that may reduce the need for supplemental buffers: (1) effective fiber level is higher in alfalfa; (2) alfalfa has a higher buffering capacity; and (3) unlike corn silage, alfalfa hay is not acidic when fed.

In these experiments, we added sodium bicarbonate to diets based on alfalfa hay as the forage to evaluate its effects on digestibility of dietary fractions and rumen characteristics when fed to dairy cows in early lactation.

We conducted two experiments at the dairy facility at University of California, Davis. In experiment 1, four Jersey cows in early lactation were fed complete mixed diets containing 0, 0.25, 0.5, and 0.75 percent sodium bicarbonate (table 1) in a Latin square design in which each cow received each diet for 21 days. Diets were 40 percent chopped alfalfa and 60 percent concentrate. Cows were fed and

milked twice daily, and feed and fecal samples were collected for estimation of diet digestibility. Feed intake and yields of milk and milk components were recorded. Rumen samples were obtained by stomach tube from each cow two hours after feeding.

In experiment 2, four first-calf Holstein cows fitted with permanent rumen fistulas were fed complete mixed diets containing 0, 0.4, 0.8, and 1.2 percent sodium bicarbonate. Diets of 30 percent chopped alfalfa and 70 percent concentrate were fed in a Latin square design. Cows were fed twice daily and milked three times daily. Feed and fecal samples were taken for digestibility determination. Milk samples were collected at each milking. Rumen fluid was sampled at one hour before and at three, six, and nine hours after the morning feeding for each diet and animal.

Within each experiment, the addition of sodium bicarbonate to complete mixed diets containing alfalfa hay did not affect feed intake, milk yield, or milk composition (table 2). Feed intake and milk yield were high and normal for cows in early lactation. In both experiments, milk fat was normal and remained unchanged with sodium bicarbonate addition to the diets.

Apparent digestibility of dietary components was not affected by sodium bicar-

bonate in either experiment (table 3). In experiment 1, there were no differences in apparent digestibility of dry matter, crude protein, energy, or fiber fractions. Similarly, in experiment 2, apparent digestibility was not significantly affected, although there were small nonsignificant increases in digestibility of cellulose and acid detergent and neutral detergent fiber at 1.2 percent sodium bicarbonate. Previous reported research has shown either no change or an increase in fiber digestibility with sodium bicarbonate addition to diets with corn silage as the forage ingredient.

Molar percentages of rumen fluid volatile fatty acids were not affected by sodium bicarbonate in experiment 1 (table 4). The acetic-to-propionic ratio increased slightly with sodium bicarbonate addition, but all ratios were above the level associated with low milk fat. In experiment 2, molar percentage of acetic acid was markedly elevated and propionic acid was reduced in cows fed the diet containing 0.8 percent sodium bicarbonate when compared with the other diets. As a result, the acetic-to-propionic ratio was also significantly greater for that diet. As in experiment 1, the acetic-to-propionic ratios for all diets were above the level associated with milk fat depression, and milk fat was not affected by sodium bicarbonate addition to diets containing alfalfa.

Rumen pH was significantly affected by sodium bicarbonate addition to the diet (fig. 1). Diets containing 0 and 0.4 percent sodium bicarbonate were associated with a rapid decline in rumen pH following feeding for six hours. In contrast, diets containing 0.8 and 1.2 percent sodium bicarbonate showed rapid decreases in rumen pH during the first three hours after

TABLE 1. Ingredient and chemical composition of complete mixed diets for experiments 1 and 2

Component	Diet (% sodium bicarbonate)							
	Experiment 1				Experiment 2			
	0	0.25	0.5	0.75	0	0.4	0.8	1.2
	----- % dry matter -----							
Ingredient								
Alfalfa	40.0	40.0	40.0	40.0	30.0	29.88	29.76	29.64
Barley	30.7	30.4	30.0	28.8	—	—	—	—
Corn	—	—	—	—	30.0	29.88	29.76	29.64
Beet pulp	14.5	14.55	14.6	14.75	18.0	17.92	17.85	17.78
Cottonseed meal	6.5	6.5	6.6	7.6	13.0	12.95	12.89	12.84
Whole cottonseed	6.0	6.0	6.0	5.8	6.5	6.47	6.45	6.42
Fat	1.8	1.8	1.8	1.8	1.5	1.5	1.49	1.48
Trace mineral salt	.5	.5	.5	.5	.5	.5	.5	.5
Dicalcium phosphate	—	—	—	—	.5	.5	.5	.5
Sodium bicarbonate	—	.25	.5	.75	—	.4	.8	1.2
Chemical analysis								
Crude protein	17.3	17.7	17.6	17.7	18.2	17.6	17.7	18.0
Acid detergent fiber	23.1	23.6	22.6	23.2	19.1	20.0	20.2	20.7
Cellulose	17.6	17.9	17.0	17.5	14.8	15.6	15.7	16.2
Neutral detergent fiber	32.4	32.6	32.1	32.9	31.2	32.3	31.7	33.7
Ether extract	4.3	4.5	4.6	4.2	4.3	4.4	4.1	4.4
Lignin	4.8	5.0	4.6	4.7	4.3	4.4	4.4	4.4
Ash	6.9	7.8	7.3	7.8	6.5	6.4	6.6	7.1

