



The effect of buffering dairy cow diets with limestone, calcareous marine algae, or sodium bicarbonate on ruminal pH profiles, production responses, and rumen fermentation

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ABSTRACT

Six ruminally cannulated Holstein cows were used to evaluate the effect of 2 dietary buffers on rumen pH, milk production, milk composition, and rumen fermentation parameters. A high concentrate total mixed ration [35.2% forage dry matter (DM)], formulated to be potentially acidotic, was used to construct 3 dietary treatments in which calcareous marine algae (calcified remains of the seaweed *Lithothamnium calcareum*) was compared with limestone (control) and sodium bicarbonate plus limestone. One basal diet was formulated and the treatment diets contained either 0.4% of dietary DM as Acid Buf, a calcified marine algae product (AB treatment), or 0.8% of dietary DM as sodium bicarbonate and 0.37% as limestone (BC treatment), or 0.35% of dietary DM as limestone [control (CON) treatment]. Cows were randomly allocated to treatments according to a double 3 × 3 Latin square design, with 3 treatments and 3 periods. The total experimental period was 66 d during which each cow received each treatment for a period of 15 d before the data collection period of 7 d. Rumen fluid was collected to determine volatile fatty acids, lactic acid, and ammonia concentrations. Rumen pH was monitored every 10 min for 2 consecutive days using a portable data logging system fitted with in-dwelling electrodes. Milk samples were analyzed for solid and mineral contents. The effect of treatment on acidity was clearly visible, especially from the period from midday to midnight when rumen pH dropped below 5.5 for a longer period of time (13 h) in the CON treatment than in the BC (8.7 h) and AB (4 h) treatments. Daily milk, 4% fat-corrected milk, and energy-corrected milk yields differed among treatments, with AB being the highest, followed by BC and CON. Both buffers increased milk fat content. Treatment had no effect on milk protein content, but

protein yield was increased in the AB treatment. Total rumen volatile fatty acids and acetate concentrations were higher and propionate was lower in the AB treatment than in CON. The molar proportion of acetate was higher in AB than in CON, but that of propionate was lower in both buffer treatments than in CON. The acetate:propionate ratio was increased in the AB and BC treatments compared with CON. Lactic acid concentration was higher in the CON treatment than in the buffer treatments. Treatment had no effect on rumen ammonia concentrations. Results indicated that buffer inclusion in high concentrate diets for lactating dairy cows had a positive effect on milk production and milk composition. Calcareous marine algae, at a level of 90 g/cow per day, had a greater effect on rumen pH, milk production and milk composition, and efficiency of feed conversion into milk than sodium bicarbonate at a level of 180 g/cow per day.

Key words: Acid Buf, buffer, rumen metabolism, milk production

INTRODUCTION

To meet the energy demands for lactation and reproduction, animals of improved genetic merit are commonly fed highly digestible diets containing large amounts of readily fermentable carbohydrates (Plaizier et al., 2008). Providing such diets with limited amounts of effective fiber may result in changes in rumen VFA profiles that may increase rumen acidity (Krause and Oetzel, 2006), thus increasing the risk of SARA (Plaizier et al., 2008). Excess rumen acidity may also result in inconsistent DMI, poor feed and fiber utilization and diarrhea, (Allen, 1997; Nocek, 1997), milk fat depression, laminitis (Nocek, 1997), and death (Plaizier et al., 2008).

Although most of the VFA produced in the rumen are absorbed via the rumen wall, more than 30% are neutralized by salivary sodium bicarbonate and phosphate buffers, the flow of which is stimulated by chewing and consequently by the level of dietary effective NDF (Allen, 1997; Beauchemin, 2007). Sodium carbonates

Received September 18, 2014.

Accepted April 12, 2015.

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