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The effect of calcareous marine algae, with or without marine magnesium oxide, and sodium bicarbonate on rumen pH and milk production in mid-lactation dairy cows

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ABSTRACT

Two experiments were carried out to evaluate different dietary buffers and their influence on (1) rumen pH in dairy cows and (2) milk production in dairy cows. The supplements included were calcareous marine algae (CMA; *Lithothamnion calcareum*), with or without marine magnesium oxide (MM; precipitated magnesia derived from seawater), and sodium bicarbonate (SB). Dietary treatments in experiment 1 consisted of the control [32.9% starch and sugar, and 19.9% neutral detergent fiber from forage per kg of dry matter (DM)] including no dietary buffer (CON); the control plus 0.45% DM CMA (CMA); the control plus 0.45% DM CMA and 0.11% DM MM (CMA+MM); the control plus 0.9% DM SB (SB). Diets were formulated to a dry matter intake (DMI) of 18 kg per cow/d. Dietary treatments in experiment 2 also consisted of CON (28.3% starch and sugar, and 23% neutral detergent fiber from forage per kg of DM), CMA, CMA+MM, and SB and were formulated to achieve identical intakes of experimental ingredients (80 g of CMA, 80 g of CMA plus 20 g MM, and 160 g of SB per cow/d) with a DMI of 22.6 kg per cow/d. Experiment 1 used 4 rumen-cannulated dairy cows in a 4 × 4 Latin square design. Rumen pH was measured over five 2-h periods, following feeding, using rumen pH probes. In experiment 2, 52 multiparous and 4 primiparous cows (62.7 ± 3.4 d in milk) were assigned to 4 experimental treatments for 80 d. Both CMA treatments maintained a greater mean rumen pH than the CON during 4 of the 5 periods following feeding and the CON had a greater number of hours below rumen pH 5.5 compared with all other treatments. Dry matter intakes tended to be higher on the SB compared with CON. The CMA treatment increased the production of milk fat and protein yield (kg/d) compared with all other treatments. Both CMA and CMA+MM increased milk fat yield compared with CON but were similar to each other and SB. Protein yield was highest in the CMA treatment compared with CON, CMA+MM, and SB. All 3 buffer treatments increased milk fat concentration compared with CON but did not differ from each other. The SB treatment reduced milk protein concentration and milk production efficiency, energy-corrected milk per kilogram of DMI. Results indicate that the addition of CMA can benefit milk fat and protein production when included in diets based on typical feedstuffs of the northern European region. The use of CMA when compared with SB, in such diets, can increase milk protein production and milk production efficiency.

Key words: calcareous marine algae, marine magnesium oxide, rumen buffer, lactating dairy cow, rumen pH

INTRODUCTION

Improved genetics for milk production in dairy cows has resulted in the requirement for more nutrient-dense diets containing highly fermentable carbohydrates (Plaizier et al., 2008). Formulating diets to provide adequate energy levels while also supplementing sufficient effective fiber to prevent digestive upsets is a difficult task. Physically effective fiber encourages rumination and the production of saliva, which acts as a natural rumen buffer for the dairy cow (Beauchemin and Yang, 2005). However, fiber sources are often poor suppliers of energy (Mertens, 1997). The production of VFA are necessary for the energy supply of the dairy cow but can reduce rumen pH (Whelan et al., 2013) if allowed to accumulate. Prolonged periods of rumen pH depression can lead to reduced fiber digestion (Mulligan et al., 2002), negative alterations to the rumen microbial population (Allen, 1997), negatively altered milk composition (Plaizier et al., 2014), and health issues such

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