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Evaluation of calcareous marine algae supplements on production and metabolic parameters of early lactation dairy cows

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ABSTRACT

Thirty-six lactating Holstein cows were used in a randomized design trial to evaluate the effect of feeding supplemental calcareous marine algae on performance and select metabolic indices of health of Holstein cows in early lactation. Treatments included no supplement (NEG), 204 g/d of sodium bicarbonate (POS), or 87 g/d of calcareous marine algae (AB, Acid Buf, Celtic Sea Minerals). Beginning at 14 ± 4 DIM, all cows were fed NEG for 2 wk before being assigned randomly within parity and calving date to treatment for the following 10 wk. An interaction of treatment and week was observed for DMI, which was lowest during wk 1 and greatest during wk 9 and 10 for POS compared with NEG and AB. No differences were observed for yield of milk, components, or energy-corrected milk. Milk protein percentage tended to be greater for NEG compared with NEG and AB. An interaction of treatment and week was observed for efficiency of milk production (energy-corrected milk/DMI) because efficiency was greatest for POS during wk 1 compared with all other treatments, but was greatest for AB during wk 8 to 10 compared with NEG and POS. Concentrations of MUN were greater for AB compared with NEG, but not different from POS. Serum glucose concentrations were greater for NEG compared with POS and AB. No differences were observed in concentrations of other serum metabolites or enzymes. Supplemental calcareous marine algae supported similar performance but improved efficiency of milk production during the wk 8 to 10 of the trial compared with diets with or without sodium bicarbonate.

Key words: sodium bicarbonate, calcareous marine algae, dietary cation-anion difference, milk yield, milk composition

INTRODUCTION

Calcareous marine algae is produced from *Lithothamniom* spp. and contains (DM basis) 30% Ca, 0.5% P, 6.0% Mg, 0.1% K, and trace minerals that are slowly released in the rumen (**AB**; Acid Buf, Celtic Sea Minerals). Previous research (Calitz, 2009; Mesgaran et al., 2013) suggested the supplement could be used as a buffer in diets fed to lactating dairy cows. When fed at 0.3% of dietary DM, milk yield was increased compared with diets containing 0.125% of buffer (Cruywagen et al., 2004). No additional gains were observed when feeding the buffer at 0.6 or 0.9%. When compared with sodium bicarbonate in high-concentrate diets fed to lactating dairy cows, AB increased ruminal pH compared with the control diet and supported greater yield of milk compared with those fed diets supplemented with or without sodium bicarbonate (Cruywagen et al., 2007).

Dietary buffers are frequently included in diets fed to lactating dairy cows to prevent acidosis and milk fat depression (Enemark, 2008). Erdman (1988) suggested that supplemental buffers were justified when buffer flow from saliva is inadequate and that sodium bicarbonate, magnesium

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oxide, potassium carbonate, and potassium bicarbonate have successfully increased ruminal pH, acetate-to-propionate ratio, and milk fat percentage when included in low-forage diets. In a review of 83 experiments, supplemental sodium bicarbonate was found to increase DMI and FCM when included in diets based on corn silage, but no response was observed when included in diets based on alfalfa haylage or hay crop silage (Erdman, 1988). That author stated that diets based on alfalfa haylage or hay crop silage would stimulate greater total chewing time, resulting in greater saliva production. The objective of the current trial was to evaluate a supplement produced from *Lithothamniom* spp. compared with diets with or without supplemental sodium bicarbonate on intake, milk yield and composition, and select serum metabolites and enzymes of high-producing dairy cows in early lactation.

Table 1. Ingredient composition of experimental diets with or without supplemental calcareous marine algae (% of DM)

	Treatment[1]		
Ingredient	NEG	POS	AB
Corn silage	34.19	34.19	34.19
Alfalfa hay	5.70	5.70	5.70
Ryegrass baleage	9.50	9.50	9.50
Brewers grains, wet	12.35	12.35	12.35
Ground corn	14.63	14.63	14.63
Citrus pulp	7.60	7.60	7.60
Soybean hulls	5.70	5.70	5.70
Megalac[2]	1.33	1.33	1.33
Soybean meal	2.28	2.28	2.28
Prolak[3]	3.32	3.32	3.32
Urea	0.28	0.28	0.28
Salt	0.42	0.42	0.42
Calcium monophosphate	0.08	0.08	0.08
Potassium magnesium sulfate	0.09	0.09	0.09
Vitamin E, 44,000 IU/ kg	0.02	0.02	0.02
Rumensin,[4] 3 g/lb	0.25	0.25	0.25
Zinpro Availa-4[5]	0.04	0.04	0.04
OmniGen-AF[6]	0.24	0.24	0.24
Trace mineral vitamin premix	0.14	0.14	0.14
Treatment premix[7]			
Ground corn	0.57	0.57	0.57
Cottonseed hulls	0.68		0.68
Sodium bicarbonate		0.85	
Magnesium oxide	0.08	0.08	0.04
Salt	0.17		0.17
Limestone	0.34	0.34	
AB			0.38

[1]NEG = negative control without any dietary buffer; POS = supplemented with sodium bicarbonate; AB = supplemented with calcareous marine algae.

[2]Church and Dwight Co. Inc., Princeton, NJ.

[3]H. J. Baker & Bros. Inc. Westport, CT.

[4]Elanco Animal Health, Greenfield, IN.

[5]Zinpro Corporation, Eden Prairie, MN.

[6]Prince Agri Products Inc., Quincy, IL.

[7]Ingredients were mixed as a premix and added to the final mix.

MATERIALS AND METHODS

Thirty-six Holstein cows (9 primiparous, 27 multiparous) from the Dairy Research Center located at the University of Georgia Tifton Campus were used in the 12-wk randomized design trial. All protocols were approved by the Institutional Animal Care and Use Committee. All cows were trained to eat behind Calan doors (American Calan, Northwood, NH) during their dry period. At 14 ± 4 DIM, cows were fed the negative control diet for 2 wk and data collected were used as a covariate in the statistical analysis. At the end of the preliminary period, cows were assigned randomly within parity and calving date to 1 of 4 treatments for the following 10-wk experimental period.

Treatments included a negative control (**NEG**), positive control supplemented with sodium bicarbonate (**POS**), or AB. Experimental diets (Table 1) were mixed and fed once daily using a Super Data Ranger (American Calan). Cows were fed in amounts to provide a minimum of 5% refusal. The amount of feed offered and refused was recorded daily. Samples of dietary ingredients and experimental rations were collected for DM analysis 3 times each week. Rations were adjusted as necessary to account for changes in the DM content of individual ingredients. Individual samples were composited by week and ground to pass through a 1-mm screen using a Wiley mill (Thomas Scientific, Swedesboro, NJ). Composite samples underwent analysis of DM, ash (AOAC, 2000), CP (Leco FP-528 Nitrogen Analyzer, St. Joseph, MO), ADF (AOAC, 2000), NDF (Van Soest et al., 1991), starch (Hall, 2009), ether extract (AOAC, 2000), and minerals (AOAC, 2000; Ca, P, Mg, K, S, Na, and Cl).

Cows were milked 3 times daily at 0700, 1500, and 2300 h. Daily milk yields for each cow were recorded electronically (Alpro, DeLaval, Kansas City, MO). Milk samples were collected from 3 consecutive milkings once each week for analysis of milk