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CASE STUDY: A comparison of 2 methionine sources for early lactation Holstein cows

J. M. DeFrain,*[1] PAS, D. H. Kleinschmit,* PAS, D. J. Tomlinson,* PAS, M. D. Edmonds,† and E. D. Sharman,† PAS
*Zinpro Corporation, Eden Prairie, MN 55344; and †Johnson Research LLC, Parma, ID 83660

ABSTRACT

The objective was to determine whether DL-Met supplied from metal specific AA complexes (MSAAC) of zinc and manganese could maintain milk yield and composition of multiparous Holstein cows in early lactation relative to a commonly used rumen-protected DL-Met source. Forty-seven multiparous Holstein cows were ranked by previous 305 ME milk and randomly assigned to 1 of 2 treatments delivered daily as gelcap boluses and fed a common basal diet predicted by Cornell Net Carbohydrate and Protein System v6.1 to be 4.9 g/d deficient in Met. Treatments were (1) 15.1 g/d of Zinpro 120 and 9.2 g/d of Manpro 160 (Zinpro Corporation, Eden Prairie, MN), which supplied 6.58 g/d of metabolizable Met (MSAAC:Met), and (2) 6.58 g/d of metabolizable Met supplied from 11.6 g of Smartamine M (Adisseo, Antony, France) and similar levels of Zn and Mn but supplied by zinc and manganese AA complexes (Availa Zn 120 and Availa Mn 80, Zinpro Corporation; AAC+SM). All cows were fed, milked, and housed together. Milk yield was collected daily, and milk composition was analyzed weekly. Treatment × time interactions were noted for milk yield and the yield of almost all milk components, largely due to cows treated with MSAAC:Met yielding 1.5 and 1.8 kg/d more milk at 35 and 42 DIM, respectively. The Met supplied as metal MSAAC is at least similar in availability as Met supplied from Smartamine M. Therefore, Met provided by MSAAC of zinc and manganese should be included in the summation of dietary metabolizable Met supply when balancing diets for AA in early lactation cows.

Key words: methionine, amino acid complex, zinc, manganese

INTRODUCTION

Methionine and Lys have been shown to be the 2 most limiting AA for milk protein production in lactating dairy cows in North America (NRC, 2001). Milk protein percentage has generally been the most sensitive performance parameter to alterations in intestinal supply of Lys and Met (Rulquin et al., 1993; Rulquin and Verite, 1993). A meta-analysis by Patton (2010) reported the addition of Mepron (Evonik Industries, Hanau, Germany) and Smartamine (75% DL-Met, Adisseo, Antony, France) increases yield and composition of milk true protein with only minor effects on DMI, milk yield, and milk fat. A second meta-analysis by Zanton et al. (2014) evaluating Met hydroxyl analog in a form of 2-hydroxy-4-methylthio butanoic acid (e.g., Alimet, MFP, or MHA from Novus International, St. Charles, MO) as well as Mepron and Smartamine reported all sources of rumen-protected Met to increase milk protein yield with no change in milk yield.

Complexing trace minerals with AA has improved production and reproduction in lactating cows (Kellogg et al., 2003; Rabiee et al., 2010). Metal specific AA complexes (57.151; AAFCO, 2000) are produced by complexing a soluble metal salt with a specific AA. One example of such products is 4-Plex (Zinpro Corp., Eden Prairie, MN), where the Zn and Mn are complexed with DL-Met, and Cu is complexed with Lys. Kincaid and Cronrath (1993) demonstrated that complexes of Zn Met and Zn Lys can have a significant effect on lactation performance of early lactation cows. In the 16-wk study, feeding Zn Met and Zn Lys complex to supply 5.8 g/d of Met and 7.2 g/d of Lys, respectively, yields of both milk protein and fat increased because of the increase in the yield of 3.5% FCM (4.4 kg/d) with no change in percent fat

[1]Corresponding author: jdefrain@pdscows.com

or protein in milk. All of these data suggest the AA associated with metal specific AA complexes may be used to meet the AA needs of lactating dairy cattle, especially if the complexes contain Met. The objective of this work was to determine whether the DL-Met from Zn Met and Mn Met could maintain milk yield and composition of multiparous Holstein cows in early lactation relative to a commonly used rumen-protected source of DL-Met.

MATERIALS AND METHODS

The experiment was a block design carried out by a private research organization and on an 1,800-cow commercial dairy equipped with a 40-cow carousel milking parlor. At approximately 0600 h each day, all cows that calved were ranked by previous 305 ME milk and randomly assigned to 1 of 2 treatments. Based on the meta-analysis by Zanton et al. (2014), previous trials using a similar experimental design used 3 to 38 cows per treatment. Therefore, 64 multiparous Holstein cows were enrolled within a 22-d period. It was necessary to assume cows were likely to be removed from the study because of difficulties associated with the immediate postpartum period. Prior to the start of the experiment, it was necessary to establish an exclusion criteria for cows developing mastitis and requiring therapeutic treatment. It was necessary to remove these cows because they were moved to a different pen, milked in a different parlor, and fed a different basal diet containing supplemental trace minerals. All cows enrolled in the experiment were identified with a color-coded, sequential numerical tag for treatment identification purposes. Colored leg bands were used to distinguish study cows from other nonstudy cows on the dairy. All personnel at the dairy were blinded to treatment assignment and unaware of treatment color code identification.

All cows were housed together in a single, open lot pen bedded with dried manure compost and wheat straw during inclement weather. Cows were milked 3 times per day and fed a common basal diet devoid of supplemental trace minerals (Tables 1 and 2). Cows were individually dosed once daily with 3 gelcap boluses (Torpac Inc., Fairfield, NJ) delivered simultaneously from a single insertion of a multidose balling gun (Jorgensen Labs, Loveland, CO) in headlocks following the first milking of the day. Bolus content is shown in Table 3. The difference between boluses was limited to the source (but not level) of rumen-protected Met. The first treatment was formulated using metal specific AA (Met in this case) complexes of Zn and Mn (57.151; AAFCO, 2000; **MSAAC:Met**) and contained 15.1 g/d of Zinpro 120 (17.6% CP, 27.3% Met) and 9.2 g/d of Manpro 160 (21.4% CP, 43.4% Met). A 90% rumen bypass and 90% intestinal AA digestibility was assumed based on previously published work on ruminal solubility and breakdown of a metal specific AA complex (Heinrichs and Conrad, 1983) and duodenally infused Met (Socha et al., 2008). Therefore, MSAAC:Met supplied 6.58 g/d of metabolizable Met. The other treatment was formulated to provide 6.58 g/d of metabolizable Met using 11.6 g of Smartamine M (minimum of 70% Met, 80% Met bioavailability according to Schwab, 2007; Adisseo) and similar levels of Zn and Mn but supplied as metal AA complexes (57.150; AAFCO, 2000; **AAC+SM**) from Availa Zn 120 and Availa Mn 80 (Zinpro Corp.). The amount of metabolizable Lys and Met supplied by Availa Zn 120 and Availa Mn 80 in cows treated with AAC+SM was a total of 0.161 and 0.052 g, respectively, because these products are nonspecific AA complexes.

Cows were weighed on 2 consecutive days after the first milking on d 4 (±1 d) and 50 (±1 d). Milk yield was measured and recorded using calibrated meters in the parlor. Milk samples for weekly compositional analysis were collected at the first daily milking on Thursday and Saturday of each week, such that samples are within ±3 d of 7, 14, 21, 28, 35, 42, and 49 DIM. Samples were stored at 4°C with a preservative (bronopol tablet, Broad Spectrum Microtabs II, Advanced Instruments Inc., Norwood, MA) and analyzed by a certified DHI testing laboratory (High Desert Dairy Lab Inc., Nampa, ID) within 24 h for SCC, fat and protein content, and

Table 1. Ingredient composition of the basal diet

Ingredient	% diet DM
Corn silage	24.6
Corn grain, high moisture	15.8
Alfalfa hay	13.8
Canola meal	9.6
Dried distillers grain, corn	9.6
Alfalfa haylage	9.0
Whole cottonseed	8.8
Beet pulp	2.98
Macrominerals–vitamins[1]	2.98
Molasses–fat blend[2]	1.76
Energy Booster[3]	0.96
Omnigen AF[4]	0.12

[1]28.5% sodium sesquicarbonate, 25.45% calcium carbonate, 20.0% blood meal, 11.43% white salt, 6.30% magnesium oxide, 5.73% potassium carbonate, 1.78% yeast culture (XPC, Diamond V Mills Inc., Cedar Rapids, IA), 0.40% white mineral oil, 0.23% sodium monensin (Rumensin 90, Elanco Animal Health, Greenfield, IN), 0.16% vitamin E 50%, and 0.02% vitamin A and D.

[2]Comprised 31.3% fat as pork tallow and 31.3% sugar from a blend of cane and beet molasses all on a DM basis.

[3]96.1% fatty acids (46.2% C18:0, 37.0% C16:0, 3.96% C18:1 *cis*-9, 2.66% C14:0, and others <2% each); Milk Specialties Global (Eden Prairie, MN).

[4]Mixture of active dried *Saccharomyces cerevisiae*, dried *Trichoderma longibrachiatum* fermentation product, niacin, vitamin B_{12}, riboflavin-5-phosphate, D-calcium pantothenate, choline chloride, biotin, thiamine monohydrate, pyridoxine hydrochloride, menodione dimethylpyrimidinol bisulfate, folic acid, calcium aluminosilicate, sodium aluminosilicate, diatomaceous earth, calcium carbonate, rice hulls, and mineral oil; Omnigen Research LLC (Corvallis, OR).