Palatability of Methionine Hydroxy Analog or DL-Methionine for Lactating Dairy Cows

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ABSTRACT
A decrease in grain intake occurred initially after feeding supplemental methionine hydroxy analog (top-dressed or mixed with concentrate) but top-dressing DL-methionine did not affect intakes. After initial adjustment (1 to 3 d), cows generally returned to normal grain intakes on diets supplemented with methionine hydroxy analog. Intake patterns were similar at all methionine hydroxy analog levels, which attained three to four times that recommended for supplementation. Increases in plasma free methionine at methionine hydroxy analog intakes above 40 g/d suggest bypass of additive for intestinal absorption.

INTRODUCTION
Amounts of supplemental DL-alpha-hydroxy-y-methyl mercaptobutyrate calcium (MHA) recommended for increasing milk fat percent and fat corrected milk in lactating dairy cows are 20 to 30 g/d (1, 3, 4). Higher amounts reduced feed intake in some studies (3, 8) but not in others (9). Whiting et al. (9) blended MHA directly into the concentrate prior to pelleting, whereas Griel et al. (3) mixed the supplement loosely with grain.

Further information on amounts of supplemental MHA or methionine that inhibit feed intake and how method of feeding affects such limits is needed. This study was conducted to determine the influence of MHA or DL-methionine intake and method of delivery on grain consumption by lactating dairy cows. Because little information was available on feeding very high MHA, an exploratory approach was used.

MATERIALS AND METHODS
The experiment consisted of six short consecutive periods with 20 Holstein cows. All periods were 8 to 10 d in length and included 4 d of baseline, during which no methionine supplement was fed, followed by 4 to 6 d of treatment. Cows were allotted to four groups of five each according to milk yields 2 wk previous to the study. Periods 1 and 6 consisted of MHA top-dressed on purchased concentrate (15% CP) blended with 2.3 kg whole cottonseed at 0, 30, 40, and 60 g/d. Purchased concentrate consisted of the herd concentrate pellet along with rolled barley and corn. During period 2, cows received concentrate mixtures that furnished 0, 30, 60, or 90 g dry MHA/d. Liquid MHA (ALIMET®) was mixed with the concentrate during period 3 and fed at 0, 30, 60, and 90 g/d. The reason for higher amounts in mixed concentrate than when top-dressed was because intakes were thought not as affected with MHA blended in the mixture. In period 4, DL-methionine (DLM) was top-dressed on concentrate at amounts similar to periods 1 and 6. Concentrate mixed with DLM was fed to furnish 0, 30, 60, and 90 g/d of DLM during period 5.

One half of the daily allotment of concentrate mixture calculated at 1 kg/3 kg milk produced during baseline, was offered for 2 h (0600 to 0800 h) in the a.m. and 2 h (1800 to 2000 h) in the p.m. while cows were locked in individual mangers.

After the 2-h periods, feed refusals were weighed and recorded. Alfalfa hay was group-fed ad libitum at all other times and hay refusals were recorded before cows were fed concentrate.

Cows were milked twice daily at 0500 and 1700 h with milk yields recorded at each
milking. To determine cumulative effects of methionine sources on milk fat, milk samples were collected twice monthly and analyzed for percent fat at the Arizona DHIA laboratory. During period 2, coccygeal blood samples were taken on d 4 of baseline and on the last 2 d of treatment. Heparinized blood was placed in an ice bath immediately after sampling, and plasma was separated by centrifuging at 1800 × g for 10 min in a refrigerated centrifuge. Protein-free filtrates (PFF) were prepared by mixing plasma and 50% sulfosalicylic acid in a 10:1 ratio, centrifuging at 15,000 × g for 10 min and decanting the supernatant. Norleucine was added as an internal standard for amino acid analysis. Samples of PFF were analyzed for methionine by ion exchange chromatography with lithium citrate buffers. Feed intake, milk, and blood data were subjected to analysis of variance using the randomized block design described by Gill (2) with blocks assigned on the basis of pretreatment milk yields. Orthogonal contrasts were made on serum methionine values because treatment differences tested significant (P<.05).

RESULTS AND DISCUSSION

Feeding Trial

Intakes generally followed consumption patterns similar to those shown for Alimet in period 3 (Figure 1). Regardless of type of product offered, intakes usually declined on d 1 of treatment, but by d 3, they had returned to baseline values. These findings suggest a short period of adjustment after methionine analog is offered.

Concentrate top-dressed with MHA during period 1 resulted in a large drop in concentrate intake on d 1, but by d 3 intakes were generally back to baseline. Although not statistically significant, concentrate intakes were most depressed compared with baseline at low and high MHA additions (Table 1). When MHA was mixed with concentrate (Period 2), decreases in intakes were smaller than when top-dressed. At the lowest MHA feeding, the biggest initial drop in concentrate intake occurred. This might be because this group served as a control in period 1 and had no prior exposure to MHA. However, cows in this group adjusted quite rapidly and were consuming near pretreatment amounts by d 4 of treatment. Compared with baseline (Table 1), the low MHA group consumed about 10% less concentrate during the 4 d period, with 5% less for medium and high groups.

On the initial day of feeding the liquid ALIMET (Period 3), decrease in concentrate intake was greater than when the Ca salt of MHA was fed. Moreover, increasing ALIMET on d 3 resulted in another reduction in concentrate intake, which did not occur with the Ca salt of MHA, suggesting that taste adaptation to ALIMET is slower.

Addition of DLM as a top-dress (Period 4) did not affect concentrate intakes at any level of supplementation (Table 1) or during initial supplementation. This is in contrast to MHA effects on intake, which usually showed initial reduction. Mixing DLM with concentrate depressed grain intakes more than top-dressing of DLM.

Top-dressing of MHA was further investigated in period 6 (as in period 1) to test whether exposure to MHA or DLM during previous periods caused a residual effect on MHA intake patterns. In contrast to period 1 there was no
TABLE 1. Intake of concentrate of cows fed methionine hydroxy analog (MHA) or DL-methionine (DLM) as percent of baseline.¹

<table>
<thead>
<tr>
<th>Additive and feeding method</th>
<th>Period</th>
<th>Mean daily intake (kg)</th>
<th>Amount of MHA or DLM (% of baseline)</th>
<th>None</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHA, Top-dress³</td>
<td>1</td>
<td>7.3</td>
<td>92.3</td>
<td>81.3</td>
<td>96.7</td>
<td>90.0</td>
<td>6.93</td>
<td></td>
</tr>
<tr>
<td>MHA, Concentrate mix⁴</td>
<td>2</td>
<td>7.6</td>
<td>100.0</td>
<td>90.3</td>
<td>96.2</td>
<td>94.7</td>
<td>3.80</td>
<td></td>
</tr>
<tr>
<td>Alimet, Concentrate mix⁴</td>
<td>3</td>
<td>7.7</td>
<td>100.0</td>
<td>92.4</td>
<td>88.3</td>
<td>88.3</td>
<td>4.20</td>
<td></td>
</tr>
<tr>
<td>DLM, Top-dress²</td>
<td>4</td>
<td>7.6</td>
<td>99.2</td>
<td>99.8</td>
<td>100.0</td>
<td>100.3</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>DLM, Concentrate mix⁴</td>
<td>5</td>
<td>7.6</td>
<td>98.5</td>
<td>98.7</td>
<td>94.3</td>
<td>91.3</td>
<td>4.89</td>
<td></td>
</tr>
<tr>
<td>MHA, Top-dress³</td>
<td>6</td>
<td>7.3</td>
<td>107.4</td>
<td>99.2</td>
<td>101.8</td>
<td>95.1</td>
<td>3.32</td>
<td></td>
</tr>
</tbody>
</table>

¹ Five cows per treatment. Baseline of 4 d preceded treatment of 4 to 6 d.

² Mean daily grain intakes on a dry matter basis for each base period.

³ Low, medium, and high were 30, 40, and 60 g/d with increases to 60, 80, and 90 g on 3rd d of treatment.

⁴ Low, medium, and high were 30, 60, and 90 g/d with increases to 40, 80, and 120 g on 3rd d of treatment.

* Treatment effects for only period 6 approached significance (P<.10).

marked decrease in grain consumption on initial feeding of MHA, perhaps because cows now were accustomed to the taste and smell of MHA and related compounds.

In contrast to previous studies (3, 8) where cows failed to adjust to high MHA, our study showed that cows will adjust to increased methionine analog. Because our treatment period was only 4 to 6 d, long-term effects could not be ascertained. Previous exposure to methionine sources may play a role for cows to adjust to high concentrations of methionine in their diet. Even though intakes were relatively low due to the moderate milk yields, quantity

TABLE 2. Milk production of cows fed methionine hydroxy analog (MHA) or DL-methionine (DLM) as percent of baseline.¹

<table>
<thead>
<tr>
<th>Additive and feeding method</th>
<th>Period</th>
<th>Mean milk yields (kg)</th>
<th>Amount of MHA or DLM (% of baseline)</th>
<th>None</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHA, Top-dress⁴</td>
<td>1</td>
<td>21.2</td>
<td>89.8</td>
<td>94.8</td>
<td>92.0</td>
<td>94.6</td>
<td>3.16</td>
<td></td>
</tr>
<tr>
<td>MHA, Concentrate mix⁵</td>
<td>2</td>
<td>19.1</td>
<td>96.0</td>
<td>100.0</td>
<td>94.1</td>
<td>93.1</td>
<td>2.54</td>
<td></td>
</tr>
<tr>
<td>Alimet, Concentrate mix⁴</td>
<td>3</td>
<td>19.1</td>
<td>100.1</td>
<td>104.2</td>
<td>98.1</td>
<td>97.5</td>
<td>2.20</td>
<td></td>
</tr>
<tr>
<td>DLM, Top-dress⁴</td>
<td>4</td>
<td>18.9</td>
<td>99.1</td>
<td>95.4</td>
<td>96.5</td>
<td>97.0</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>DLM, Concentrate mix⁵</td>
<td>5</td>
<td>17.9</td>
<td>96.2</td>
<td>95.7</td>
<td>94.5</td>
<td>94.2</td>
<td>2.88</td>
<td></td>
</tr>
<tr>
<td>MHA, Top-dress⁴</td>
<td>6</td>
<td>16.4</td>
<td>97.2</td>
<td>95.9</td>
<td>100.6</td>
<td>98.2</td>
<td>3.85</td>
<td></td>
</tr>
</tbody>
</table>

¹ Five cows per treatment. Baseline of 4 d preceded treatment of 4 to 6 d.

² None of the treatment effects were significant (P<.10).

³ Mean milk yields during each base period.

⁴ Low, medium, and high were 30, 40, and 60 g/d with increases to 60, 80, and 90 g on 3rd d of treatment.

⁵ Low, medium, and high were 30, 60, and 90 g/d with increases to 40, 80, and 120 g on 3rd d of treatment.
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TABLE 3. Milk fat percent of cows fed supplemental methionine hydroxy analog or methionine (n = 20) and untreated herdmates (n = 14) fed normal rations during the same period.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pretreatment (%)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplemental methionine</td>
<td>3.34</td>
<td>3.97¹</td>
</tr>
<tr>
<td>Untreated herdmates</td>
<td>3.40</td>
<td>3.45</td>
</tr>
</tbody>
</table>

¹ Periods 1 through 6 composited.

Milk Fat

Combined fat tests for all treatment periods, compared with pretreatment, suggests increased milk fat percent from feeding supplemental methionine (Table 3). Admittedly, cows were alternately on and off treatment for short periods and were shifted between various MHA or DLM amounts, but milk fat percent increased .6% compared with that of pretreatment, and untreated herdmates of similar milk production showed little change in fat percentage during this period.

Plasma Amino Acids

Dietary MHA has often shown little or no effect on plasma methionine concentrations (3, 6, 9), but increases were reported previously (5).

In this study, a response in plasma free methionine was noted for MHA additions during period 2 (Table 4). Surprisingly, plasma methionine was not affected at low supplementation (30 to 40 g/d) but increased at medium and high supplementation; this suggested that MHA was delivered for post-ruminal absorption (7). The 80 to 120 g/d of supplemental MHA was apparently in excess of rumen degradation. Papas et al. (7) showed a linear increase for plasma methionine when rumen protected methionine was fed at 0, 157, 315, 472, and 630 mg/kg feed.

In conclusion, these data show an initial decrease in grain intake when introducing MHA into a dairy ration, but decreases persist for a short time (1 to 3 d) and are similar between 30 and 90 g/d. Results were not different for top-dressing or mixing MHA in concentrate. ALIMET resulted in a slightly greater inhibition of intakes than MHA.


<table>
<thead>
<tr>
<th>MHA Addition</th>
<th>None</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma methionine μM/dl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of Baseline</td>
<td>98</td>
<td>75</td>
<td>163</td>
<td>130</td>
</tr>
</tbody>
</table>

a,b,c Means with different superscripts differ (P<.05).

REFERENCES
