



ZEN-NOH

# Effect of Dietary and Metabolizable Protein in Early Lactation on the Lactational Performance and Metabolism of Dairy Cows

H. M. Dann<sup>1</sup>, P. Ji<sup>1</sup>, K. W. Cotanch<sup>1</sup>, H. M. Gauthier<sup>1</sup>, M. P. Carter<sup>1</sup>, S. Y. Morrison<sup>1</sup>, J. Darrah<sup>1</sup>, Y. Koba<sup>2</sup>, and R. J. Grant<sup>1</sup>

<sup>1</sup>William H. Miner Agricultural Research Institute, Chazy, NY

<sup>2</sup>ZEN-NOH National Federation of Agricultural Cooperative Associations, Tokyo, Japan



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## INTRODUCTION

- Regional field surveys indicate a shift to lower crude protein diets for lactating cows
- Cows experience negative protein balance in early lactation
- It is unclear if there are benefits to feeding more metabolizable protein during the immediate postpartum period

## OBJECTIVE

- To evaluate the effect of crude protein and metabolizable protein in corn silage-based diets fed from 1 to 91 days in milk (DIM) on performance and blood metabolites of lactating cows

## MATERIALS AND METHODS

### Experimental Design

- Randomized design with 84 multiparous lactating Holstein cows
  - Managed similarly during 55-d dry period
  - Fed treatments once daily from 1 to 91 DIM in a Calan Broadbent Feeding System (Table 1 and 2)
  - Housed in a freestall pen and milked 3x daily

Table 1. Treatments.

| Treatment             | Treatment Code | Dietary Crude Protein, % |              |
|-----------------------|----------------|--------------------------|--------------|
|                       |                | 1 to 21 DIM              | 22 to 91 DIM |
| Low protein           | LL             | 15.3%                    | 15.3%        |
| High/low protein      | HL             | 17.0%                    | 15.3%        |
| High/moderate protein | HM             | 17.0%                    | 16.2%        |

### Data Collection and Analysis

- Intake and milk yield were recorded daily
- Milk composition was measured weekly starting at wk 2
- Serum was analyzed for nonesterified fatty acids, beta-hydroxybutyrate, blood urea nitrogen, and creatinine
- Plasma was analyzed for 3-methylhistidine

### Statistical Analysis

- ANOVA with the MIXED procedure of SAS using treatment and time as fixed factors and cow within treatment as a random factor

Table 2. Ingredients, chemical composition, and digestibility of treatments.

| Item   | Low (L) | High (H) | Moderate (M) |
|--|---------|----------|--------------|
| Ingredients, % of ration dry matter            |         |          |              |
| Conventional corn silage                       | 20.1    | 20.1     | 20.1         |
| Brown midrib corn silage                       | 20.1    | 20.1     | 20.1         |
| Haycrop silage                                 | 11.8    | 11.8     | 11.8         |
| Corn meal                                      | 9.4     | 9.9      | 9.4          |
| Canola meal                                    | 9.4     | -        | 7.1          |
| Wheat middlings                                | 6.5     | 5.7      | 7.1          |
| Distillers dried grains with solubles          | 4.7     | -        | -            |
| Soybean meal                                   | 2.4     | 10.4     | 7.1          |
| AminoPlus                                      | -       | 7.1      | 2.4          |
| Soybean hulls                                  | 5.6     | 5.6      | 5.6          |
| Beet pulp                                      | 4.7     | 4.7      | 4.7          |
| Other  | 5.3     | 4.6      | 4.6          |
| Analyses                                       |         |          |              |
| Crude protein, %                               | 15.3    | 17.0     | 16.2         |
| Acid detergent fiber, %                        | 20.9    | 19.5     | 20.3         |
| Neutral detergent fiber (NDF), %               | 35.6    | 33.3     | 34.4         |
| Acid detergent lignin, %                       | 3.4     | 2.6      | 3.0          |
| Starch, %                                      | 24.2    | 24.6     | 24.5         |
| Sugar, %                                       | 4.5     | 4.8      | 4.5          |
| Fat, %   | 3.9     | 3.3      | 3.5          |
| 24-h NDF digestibility, % NDF                  | 59.8    | 62.1     | 60.7         |
| 7-h starch digestibility, % starch             | 74.8    | 73.8     | 74.6         |
| Metabolizable protein supply, g/d <sup>1</sup> | 1798    | 1999     | 1895         |

<sup>1</sup>Estimated with NDS (v3) at 19.1 kg dry matter intake

## RESULTS

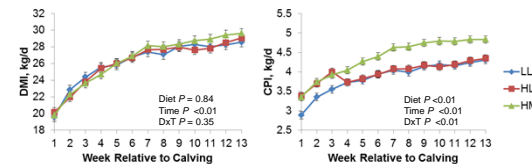


Figure 1. Dry matter intake (DMI) and crude protein intake (CPI).

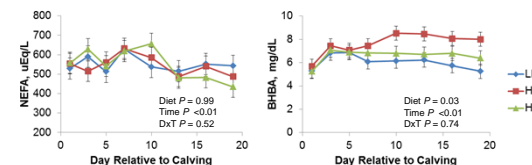


Figure 2. Serum nonesterified fatty acids (NEFA) and beta-hydroxybutyrate (BHBA) concentrations.

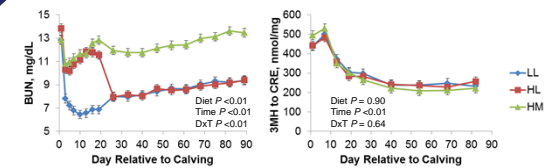


Figure 3. Blood urea nitrogen (BUN) concentration and 3-methylhistidine (3MH) to creatinine (CRE) ratio.

Table 3. Lactational performance during the 1<sup>st</sup> 13 wk of lactation.

| Item            | LL               | HL               | HM                | SE   | Diet P | Time P | DxT P |
|-----------------|------------------|------------------|-------------------|------|--------|--------|-------|
| DMI, kg/d       | 26.2             | 26.2             | 26.5              | 0.4  | 0.84   | <0.01  | 0.35  |
| Milk, kg/d      | 51.2             | 50.2             | 52.4              | 1.2  | 0.39   | <0.01  | 0.17  |
| SCM, kg/d       | 47.9             | 47.5             | 49.7              | 0.9  | 0.21   | <0.01  | 0.24  |
| Fat, %          | 3.51             | 3.58             | 3.58              | 0.09 | 0.78   | <0.01  | 0.15  |
| True protein, % | 2.82             | 2.86             | 2.89              | 0.04 | 0.41   | <0.01  | 0.93  |
| MUN, mg/dL      | 8.3 <sup>b</sup> | 9.0 <sup>b</sup> | 11.8 <sup>a</sup> | 0.2  | <0.01  | <0.01  | <0.01 |
| Milk/DMI        | 1.97             | 1.94             | 1.99              | 0.04 | 0.62   | <0.01  | <0.01 |
| SCM/DMI         | 1.81             | 1.81             | 1.86              | 0.03 | 0.42   | <0.01  | <0.01 |

<sup>ab</sup>P < 0.05

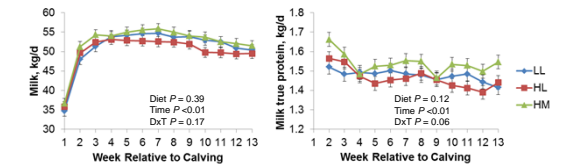


Figure 4. Milk yield and milk true protein yield.

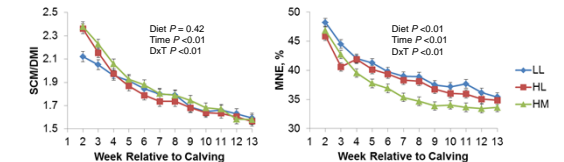


Figure 5. Solids correct milk (SCM) efficiency and milk nitrogen efficiency (MNE).

## CONCLUSIONS

- Diets containing lower crude protein can be fed successfully to cows in early lactation as long as the metabolizable protein supply is adequate.