**2013F029R How do dietary protein and energy interact**

**to impact milk protein synthesis?**

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Background: Milk protein synthesis is an energy intensive process, whereby both dietary energy and protein are highly inter-related in their effect on milk protein yield. The efficiency of dietary protein capture in milk protein is stimulated by increases in energy intake, and milk and lactose yields are affected by protein supply. The fact that milk protein yield (MPY) changes in response to energy source, without a change in dietary protein, highlights the need for a better understanding of the mechanism driving milk protein synthesis.

Objectives:

1. Determine if glucogenic and lipogenic substrates can be considered equivalent energy sources fir stimulation of milk protein yield
2. Determine how dietary energy source affects the efficiency of transfer of dietary protein to milk and milk protein yield
3. Explore the cellular mechanisms by which energy source and metabolizable protein supple influence milk and milk protein synthesis

Methods: Eight Holstein cows in their first or second lactation were subjected to 4 dietary treatments in early lactation (90 days in milk) in 4 separate periods. Treatments were source of energy: a lipogenic diet based on fibre and fat vs. a glucogenic diet based on starch (grains), and amount of metabolizable protein: 100 % vs. 75 % of requirement. Cows were fed once per day for the first 16 d of each period and then every 4 hours in the last 5 days (total of 21 d per period).

Milk yield was measured daily for the last 7 d and milk samples were taken at each milking for the last 4 days and components analyzed. On day 19 blood samples were taken every 2 hours between morning and evening milking (6 samples total) to determine mammary uptake of key nutrients. On day 20 a continuous dose of leucine and glucose were infused into the jugular vein for 4 hours and 6 blood samples were collected in the last 2 hours to determine whole body protein metabolism and whole body rate of glucose appearance. On day 21 mammary tissue was obtained by biopsy to determine expression levels of genes related to milk protein, regulation of protein synthesis and cell turnover.

Outcome: Dry matter intake was higher for high starch vs. high fat diets and tended to be higher for high protein vs. low protein diets. Milk yield was higher for HS vs HF diets, however energy-corrected milk yield only tended to be higher for HS vs. HF. Amount or protein had no effect on milk yield but HP diets increased MPY compared to LP. The 5% decrease in MPY in LP diets was accompanied by a 45% in milk urea nitrogen and an increase in efficiency of transfer of metabolizable protein to milk protein. Milk fat content was lower with HS vs. HF but lactose content was higher for HS vs. HF. Mammary uptake of individual or groups of amino acids was higher, or tended to be higher, with HS vs. HF. IN general mammary AA uptake to milk protein output was unaffected by energy source. These increases in AA uptake and use may have been due to increased DMI in the HS diet compared to HF diets. The availability of energetic precursors to the mammary gland was not diminished by deficient MP supply, regardless of energy source in the diet. MP supply had no effect on mammary gene expression.

Recommendations: Protein content in the lactating cow diet can be reduced from the current norm (not quite to the same extent in this study) to increase efficiency of protein use without negatively affecting milk yield.

Impact on Industry: Reducing dietary protein can reduce feed cost and nitrogen excretion in to the environment, without negatively impacting production.

KTT:

* 1 post-doctoral fellow, 1 PhD student, and 1 undergraduate student was trained
* Manuscript in preparation for publication in scientific journal
* 2 poster presentations at scientific conference and 2 industry oriented presentations