NUTRITIONAL ASPECTS OF bST

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Disclaimer
This fact sheet reflects the best available information on the topic as of the publication date.
Date 5-26-2007

This Feed Management Education Project was funded by the USDA NRCS CIG program. Additional information can be found at http://www.puyallup.wsu.edu/dairy/joeharrison/publications.asp

This project is affiliated with the LPELC http://lpe.unl.edu

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

Research studies with lactating cows supplemented with bST resulted in increases in milk production (6 to 15 pounds with 5 to 15 percent increases in dry matter intake. The increased feed intake was not sufficient in the initial four to six weeks to provide the energy needed for higher milk yield and also provide sufficient nutrients for body weight gain. The increased yield due to bST was related to greater mammary gland partitioning of nutrients from diet and body reserves. Based on a series of research studies and reports, the following nutritional and management guidelines should be considered when bST is administered to lactating dairy cows.

Lactation Changes

Initial research studies indicated a lactation response from 6 to 41 percent milk increase. Field responses were 5 to 15 pounds more milk. The shape of the lactation curve is changed immediately with a vertical shift upward. No response occurs if nutrient needs are not met. bST is a tool to allow dairy manager to manipulate the lactation curve of cows that drop too fast, experience long calving intervals.

Dry Matter Intake Responses

Feed intake increases gradually and lags milk yield increases by 4 to 6 weeks. Dry matter intake increases 3 to 15 percent after the initial lag to support increased milk yield and body condition. Calorimetry and digestibility studies indicated bST-treated cows do not change digestive processes, maintenance requirements, or nutrient needs for milk synthesis.

Increased heat production associated with bST is exactly the amount predicted based on milk yield and dry matter intake increases. Research since bST was approved for commercial sale has shown that an additional function of bST is to increase dissipation of additional heat through increased sweating ability. In heat stressed conditions, as with non-supplemented cows, dissipating the heat can be a management concern. Milk increases were related to post-absorptive use of nutrients for milk synthesis. Current equations from the Dairy NRC for dry matter intake, nutrient needs, and milk synthesis apply to the higher producing cows. Improvements in feed efficiency (pounds of fat-corrected milk per unit of net energy) were related to diluting maintenance requirements and diverting nutrients from body tissue to milk.

Protein Considerations

Protein level and deqradability in the ration can impact bST responses. bST-treated cows produced 9.7 pounds more milk with a 40 percent rumen undeqraded protein or RUP (of crude protein content) ration compared to 5.9 pounds of 3.5% fat corrected milk on a ration containing 33 percent RUP. Cows fed 17 percent crude protein rations with bST produced 9 pounds more milk compared to cows fed 14 percent crude protein rations with an increased 6.6 pounds with bST. RUP had a greater impact than level of protein. Canadian researchers found similar results with rations higher in crude protein. Cows fed a 16 percent crude protein diet for 28 days and treated with bST produced 23.8 percent more milk (9.9 pounds) compared to controls while the cows receiving the higher RUP diet with bST increased milk yield 18.8 percent or 6.6 pounds.

Energy Relationships

Energy intake and balance will be key factors. Higher dry matter intake must be allowed and achieved. An additional 3 to 15 percent increase in total ration dry matter will required, higher quality forage, use of palatable feeds, excellent bunk management, shifting to total mix diets, optimal fiber levels (19 to 20 percent ADF, 28 to 32 percent NDF), adequate non-structural carbohydrate (35 to 40 percent), and limiting total ration moisture below 55 percent. Wisconsin data revealed cows on the lower forage diets produced more milk (heifers, 1,683 pounds more milk; older cows, 1,890 pounds more milk). More energy can be consumed by incorporating more grain, higher quality forage, and/or digestible by-product feeds.

Studies with supplemental sodium bicarbonate reported bST and buffer responses were additive increasing milk yield. Feed intake (increased 5.5 pounds), milk yield (increased 8.2 pounds), and fat test responses were favorable compared to control cows with buffer and bST. Mid-lactation responses in bST-treated and buffer supplemented cows showed similar responses.

Added dietary fat is another method to increase energy intake. bST-treated cows increased 3.5% FCM by 6.8 pounds per cow per day. With one pound of protected fat and bST, cows produced 14.3 pounds more 3.5% FCM. Milk protein percent was decreased (3.30 vs. 3.44) with added fat and tended to be lower with bST.

Body condition must be monitored because cows direct more nutrients to milk and away from body reserves. Cows receiving bST gained 4 to 10 percent less weight than controls. Body condition scores were 3.7 for

control cows while supplemented cows averaged a lower score of less the 3.0. Restoring body condition is more efficient in late lactation compared to cows that are dry (not lactating). It may be more economical to replace some weight in the dry period at lower efficiencies than stop bST use in late lactation. Cows in negative energy balance (any for any reason) can experience poorer reproduction performance (increased days to first heat, decreased estrus expression, and reduced conception rate). Also, if cows are in negative energy balance, little or no milk response to supplemented bST will occur.

NUTRIENT METABOLISM

Lipid Metabolism

bST is lipolytic which increases body fat mobilization (adipose tissue) and increases blood concentration of non-esterified fatty acids. Cows in negative energy balance temporarily increase milk fat. Milk fat composition shifted to a greater proportion of long chain fatty acids (from adipose tissue mobilized) which is typical and a small change for any cows in negative energy balance. When animals are in positive energy balance, milk fat percentage was not altered. Treatment with bST reduces lipid synthesis in adipose and is probably one mechanism by which BST partitions more energy toward milk production. .

Carbohydrate Metabolism

Meeting the glucose need for lactose synthesis represents a major challenge, especially before feed intake increases. A reduction in glucose oxidation, mobilization of glycogen reserves, glucose made from propionate in the liver (gluconeogensis), amino acid conversion to glucose, and hydrolysis of adipose-released glycerol are possible, but limited sources.

Protein Metabolism

Milk protein yield increases as milk yield increases. The change in percentage of the milk protein is dependent on the amount of amino acids available to the mammary gland. Cows in positive amino acid balance had no change in milk protein percent. Meeting the metabolizable protein requirements from microbial and RUP sources associated with higher milk yields and milk protein test due to bST supplementation is required. If cows were in negative amino acid balance, the percentage of milk protein declines when bST was administered. The primary source of additional amino acids (if cows are deficient) prior to increased feed intake could be from mobilized body reserves (not desirable and limited amount available).

Mineral Metabolism

Mineral demand is also increased with bST use. The rate of absorption from the digestive tract or mobilization of body reserves are primary sources for several macrominerals needed for milk synthesis. Milk mineral content is not altered and blood concentrations of calcium and phosphorus were unchanged.

ECONOMICS OF bST

The economics of supplementing bST will depend on the individual cow milk response and price of milk when using bST. The following costs are associated with cow/herd increasing 10 pounds of milk per cow per day.

- Cost of bST ($6.60 per injection for 14 days):$0.47
- Added cost of dry matter to support 10 pounds of milk (4 lb D.M. @ 8 cents): $0.32
- Increase in labor to identify cows and inject bST:$0.02

The additional total investment for bST supplementation is 81 cents per cow per day. If the milk response was 10 pounds of milk per cow per day valued at 13 cents a pound ($13.00 per cwt), the profit margin would be 49 cents a cow a day or $118 per lactation

(242 days on treatment). The cost of bST can vary due to contract prices and shipping charges.

IMPACT ON THE ENVIRONMENT

bST would reduce the impact on the environment as cows can produce more milk per cow lower maintenance nutrient needs, increase feed efficiency, and fewer cows are needed to supply the same amount of milk. This technology also increases the potential profitability per cow. No differences in nutrient digestibility occur leading to higher fecal or urinary losses.

Take home message

- bST increases the need for more nutrients related to higher milk yield per cow
- Profitability of bST supplemented cows increases.
- bST application is beneficial for the environment (fewer cows and higher feed efficiency)

Project Information

Detailed information about training and certification in Feed Management can be obtained from Joe Harrison, Project Leader, jhharrison@wsu.edu, or Becca White, Project Manager, rawhite@wsu.edu.

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