EFFECTS OF SLOW RELEASED RECOMBINANT BOVINE SOMATOTROPIN AND CONCENTRATE ALLOWANCE ON DAIRY COW PERFORMANCES, BODY COMPOSITION AND BLOOD METABOLITES AND HORMONES

Y. Chilliard[1], B. Rémond[1], M. Cissé[1,a], V. Coxam[2]

[1] Lactation Laboratory and [2] Mineral Metabolism Unit
INRA, Theix 63122, Ceyrat, France
[a]Senegalese Institute of Agricultural Research-Dakar, Senegal

Introduction

Prolonged release formulations of recombinant bovine somatotropin are presently produced in sufficient amounts to allow large scale long-term experiments (reviews by Peel and Bauman, 1987, and Chilliard, 1988). Dairy cow milk yield response to BST is highly variable from one experiment to another, and it is speculated that nutritional factors affecting mammary metabolism or body reserves are of importance.

Materials and Methods

Twenty-six primiparous and 24 multiparous Holstein x Friesian cows were randomly allocated to 4 treatment groups in a 2 x 2 (BST x concentrate) factorial design. They received ad libitum a mixed diet containing corn silage (30-35% dry matter, DM), formaldehyde treated soya and rapeseed meals, energy concentrate, urea and minerals. Concentrates were given to each cow according to its milk yield during the 2nd week of lactation. Energy concentrate allowance was increased (+10.7 MJ net energy/d, "H" group) or decreased (−17.8 MJ/d, "L" group) from the 3rd week. Placebo, "P" or 500 mg BST (Sometribove, Monsanto, USA) ("B") were injected subcutaneously at 14-day intervals for 10 weeks from day 60 ± 3 of lactation. Production results were adjusted by variance − covariance analysis, using the first 8 weeks of lactation as covariable.

Blood was sampled before morning meal distribution, and was analysed for metabolites and hormones. Blood was also taken every 20 min. during a 6-hour period ("short-term study") in 5 HP and 7 HB cows, 3 and 10 days after the 3rd BST injection (weeks 13 and 14).

Dilution space of deuteriated water (D_2O, 0.5 g/kg BW) was estimated in 24 multiparous cows at weeks 1, 8 and 18 of lactation, by measuring the decrease of D_2O concentration in milk from 6 consecutive milkings (until about 65-h after D_2O injection). Body lipids and proteins were calculated from dilution space and body weight, using equations previously calculated on 20 slaughtered cows (see Chilliard and Robelin, 1983).

Results and Discussion

Concentrate DM intake was 1.7 kg higher in H than in L group (4.9 vs 3.2 kg/d), but silage DM intake was 1.1 kg lower, resulting in no significantly different intakes of total DM (17.2 vs 16.6 kg/d). There was no significant effect of concentrate allowance on milk yield and composition, nor interactions with BST treatment.

BST increased milk yield by 2.3 kg/d (table 1), without interacting with cow parity. DM intake was not increased. This was not unexpected because 1) in most published assays, intake res-

TABLE 1. EFFECTS OF BST ON DAIRY PERFORMANCES DURING WEEKS 9-18 OF LACTATION

GROUP	Milk yield (kg/d)	Fat (g/l)	Protein (g/l)	Lactose (g/l)	DM intake (kg/d)	BCS (1) change
Placebo	23.6(2)	38.6	29.1	47.1	17.0	+0.3
BST	25.9[c]	38.4	28.3[a]	47.5[a]	16.8	0.1[b]

(1) Body condition score (scale 0-5); (2) adjusted means; 24 cows per group; a, b, c = $P < 0.10; 0.05; 0.01$.

ponse was delayed for 6-8 weeks after the beginning of BST treatment and 2) the milk response was relatively low when compared with US experiments (see Chilliard, 1988). This low response was apparently not due to energy shortage since DM intake and milk yield of BST cows were not affected by concentrate allowance (17.1 and 25.7 vs 16.5 and 26.2 kg/d, in HB vs LB groups, respectively).

Rumen volatile fatty acids and digestibility of DM, organic matter and crude fiber as measured in 4 x 3 cows, were not significantly affected by BST treatment. Variations in body lipids and proteins (table 2) were similar in both groups during the preexperimental period, and of the same magnitude as in other assays (Chilliard and Robelin, 1983). The body lipid change between W8 and W18 was not significant in control cows, but was significant in BST cows. BST treatment resulted in a greater loss of body lipids (−12 kg; $P < 0.18$) and a smaller gain in body proteins (2 kg lower; $P < 0.25$), that were not significant, but fit well with differences in body condition score and calculated energy balance (see above).

TABLE 2. BODY COMPOSITION AND ITS CHANGES (kg) ACCORDING TO LACTATION STAGE AND BST TREATMENT

	INITIAL (WEEK 1)		WEEKS 1 to 8		WEEKS 8 to 18	
	Lipids	Proteins	Lipids	Proteins	Lipids	Proteins
Placebo	96	88	−27**	1	9	+4**
BST (a)	105	88	−33**	−2*	−21**	+2*

(a) 12 cows per group; BST treatment began at week 9.
*, ** = Value significantly different from zero ($P < 0.05$ or 0.01).

Milk fat content was not affected, but protein content tended to decrease and lactose content to increase (table 1). The decrease in protein content and in body condition were probably related to the lower calculated energy balance of BST cows (about 8.3 MJ net energy/d lower in B than in P group). Cyclic patterns of milk yield and composition were observed between BST injections. Milk yield response was highest 8-10 days after BST injection. Milk fat was highest between days 8 and 12. Milk protein was lowest during the first week and highest during the second week, and the reverse was true for milk lactose.

Blood plasma non-esterified fatty acid (NEFA) concentration was increased at week 14 (W14) in BST cows (0.32 vs 0.14 mM, $P < 0.01$ after log. transformation), whereas urea was decreased at W20 (196 vs 290 mg/l, $P < 0.05$). There was no significant effect of BST on plasma glucose, 3-hydroxybutyrate, insulin or triiodothyronine, whereas circulating BST and IGF-1 (insulin-like growth factor 1) were both increased at W14 and W20 ($P < 0.01$). During the "short term study", urea was decreased at 3 and 10 days after BST injection, but NEFA were increased only at day 10, before and shortly after meal distribution. This could be related to increased milk fat content (see above). Circulating BST in BST treated cows showed episodic peaks, and was higher at day 10 than at day 3. These results suggest that blood NEFA levels could be related to circulating BST, in interaction with nutrient intake and absorption.

(**Key Words**: Somatotropin, Concentrate Allowance, Lipid Metabolism).

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