Bovine Somatotropin Hormone (BST). II. Effects of dosage rate and calcium-soap supplementation on milk yield responses of crossbred Sahiwal-Friesian dairy cattle

[Hormon Bovin Somatotropin (BST). II. Kesan kadar dos dan makanan tambahan lemak sabun kalsium terhadap pengeluaran susu lembu tenusu kacukan Sahiwal-Friesian]

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Key words: bovine somatotropin, calcium soap, milk yield

Abstrak

Kesan pemberian makanan tambahan lemak sabun kalsium dan suntikan hormon bovin somatotropin (BST) pada kadar dos yang berbeza-beza terhadap pengeluaran susu lembu kacukan Sahiwal-Friesian telah dikaji dalam dua percubaan yang berasingan. Dalam percubaan pertama, didapati pemberian makanan tambahan lemak sabun kalsium sebanyak 500 g/hari telah dapat meningkatkan pengeluaran susu lembu kacukan Sahiwal-Friesian sebanyak 1.4 kg/hari. Namun, pengeluaran susu lembu kacukan Sahiwal-Friesian yang disuntik dengan BST hanya meningkat sedikit sahaja walaupun diberi makanan tambahan lemak sabun kalsium. Dalam percubaan kedua, pengeluaran susu lembu kacukan Sahiwal-Friesian didapati bergantung pada dos BST dan dos optimum BST adalah pada tahap 250 mg untuk tempoh 14 hari.

Abstract

The effects of feeding calcium-soap and administration of bovine somatotropin (BST) at various dosage rates on the milk yield of crossbred Sahiwal-Friesian cows were evaluated in two separate experiments. In the first experiment, a 500 g/day supplement of calcium-soap increased milk yield of crossbred Sahiwal-Friesian cows by 1.4 kg/day. However, the milk yield response obtained from BST treatment was only marginally increased when the plane of nutrition was improved by the inclusion of calcium-soap. In the second experiment, the milk yield response of crossbred Sahiwal-Friesian cows was shown to be dependent on the BST dose rate and the optimum dose was 250 mg of BST at 14 day intervals.

Introduction

Numerous studies have shown that the magnitude of milk yield response to BST administration is linearly related to BST dosage rate and nutritional energy requirement (Peel and Bauman 1987; Peel et al. 1989; McCutcheon et al. 1989; Chilliard 1988; Chilliard 1989; Bauman 1992). For the *Bos taurus* dairy cows managed under favorable temperate environment, the optimal BST dosage rate was established at 31–50 mg/day (Annexstad et al. 1987; Chalupa et al. 1987; Bauman 1992). At these dosage rates and providing the energy

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density is adequate, lactational responses to BST were observed using diets which range from pasture only to high energy concentrate-based feeds (Chalupa and Galligan 1989; Chilliard 1989; Crooker and Otterby 1991, Bauman 1992; Patton and Heald 1992; Bauman and Vernon 1993).

Under hot and humid tropical environment, the limitation on nutritional energy is further compounded because of the relatively low quality of available feed. Increasing energy density of the ration through the addition of fats (calcium-soap) is a common practice used to reduce the discrepancy between energy input and output in high producing cows. Thus, the objective of this study was not only to establish the optimal dosage rate for BST application on crossbred Sahiwal-Friesian (SF) dairy cows but also to determine if improved plane of nutrition resulting from the use of calcium-soap supplement would result in an increased milk yield response when cows were treated with BST.

Materials and methods

In this study, two experiments (E1 and E2) were conducted at smallholder farms in Banting, Selangor. This study was carried out over a 16-week treatment period using multiparous lactating SF crossbred dairy cows. Prior to the start of both experiments, cows were ranked in order of descending milk yield based on the pre-treatment milk production records and then allocated at random in blocks of four to the four treatment groups. In E1, 32 SF dairy cows (80-140 days in milk) were allocated to four treatment groups: T1:control, T2:BST (sometribove 500 mg/14 days), T3: calciumsoap (500 mg/head/day) and T4:BST with calcium-soap. In E2, 40 SF dairy cows (104-112 days in milk) were allocated to four treatment groups: T1, T2, T3 and T4 which received either 0, 125, 250 or 500 mg BST at 14 day intervals, respectively.

In both E1 and E2, cows treated with BST received eight subcutaneous injection of BST administered into the ischio-rectal fossa at fortnightly intervals. Cows were housed in tie-stalls during the night and allowed to graze in oil palm plantations during the day. Wet brewers grain [289 g CP (crude protein) per kg DM (dried matter) and 10.6 MJ ME (metabolisable energy)/kg DM], palm oil sludge (139 g CP/kg DM and 9.2 MJ ME/kg DM) and cut forages formed the main diet ingredients of the cows. Cows also received dairy concentrate containing 172 g CP/kg DM and 11.6 MJ ME/kg DM offered at the rate of 1 kg/2 kg of milk produced.

In both experiments, individual milk yields were recorded twice daily. Milk samples (8.00 a.m. and 4.00 p.m.) were taken on day 2 and day 9 of cycle 2, 5 and 8 (BST injection cycle). Milk samples were analyzed for fat, protein and lactose. Body weights of all cows were measured at the start of the trial and at two weekly intervals during the 16 week treatment period. A calibrated body tape measure was used to estimate body weight. Individual health records were kept daily for all cows.

Statistical analysis

The experiments were of complete randomized design with 4 treatment effects. The pre-treatment values for milk yield and initial body weight were included in the statistical linear models as covariate to minimize experimental variation. The data were analyzed by Statistical Analysis System (SAS) using generalized linear model (GLM) procedure and the linear model was:

$$Y_{ij} = U + A_i + B * PRE_{ij} + E_{ij}$$

where:

- Y_{ij} = variable for cow in treatment
- U' = overall mean
- $A_i = treatment_i effect$
- *B* = linear regression coefficient for covariate PRE
- $PRE_{ij} = covariate (cow_j in treatment_i)$

$$E_{ii}$$
 = residual error

The milk composition data were compared using the mean values for each

cycle, which were obtained by averaging the mean values recorded on day 2 and day 9 of each cycle. These data which were not covariately adjusted were analyzed by SAS procedure for GLM with the linear model:

= U + A + EY_{ii} where;

> Y_{ij} U = variable for cow_i in treatment i

= overall mean

 $A_i = \text{treatment}_i \text{ effect}$

 E_{ii} = residual error

Results and discussion

In E1, the mean milk yield of cows supplemented with BST, calcium-soap and BST+calcium-soap were significantly (p < 0.01) increased by 2.5, 1.4 and 2.7 kg/day, respectively when compared with the control (Table 1). The milk yield response to BST injection alone is equivalent to a 25% increase in milk production. This result is similar to those recorded in an earlier study with the smallholder farms and confirms other studies conducted with crossbred cows in Zimbabwe, Kenya and Brazil (Phipps et al. 1991 and 1993; Fontes et al. 1993). The 1.4 kg/day increase in milk yield of cows supplemented with Calcium-soap (500 g/day) is in close agreement with other studies carried out both in tropical (Abu Bakar and Md. Eusof 1992: Lubis et al. 1993) and temperate (Knapp and Grummer 1990; Marty and Block 1992; Polan and Fisher 1993) climates.

However, the milk yield of cows supplemented with BST+calcium-soap (12.9 kg/day) was not significantly different (p > 0.05) when compared with that recorded for cows treated with BST (12.7 kg/day). Other studies carried out (Lough et al. 1988; Dell'Orto et al. 1992; Stegemen et al. 1992; Cattaneo et al. 1993) also showed no additive effects in terms of increase in milk response of BST treated cows supplemented with ruminally inert fat (calcium-soap).

In E2, the administration of 125 mg of BST did not significantly (p > 0.05) increase milk yield when compared with the control (*Table 2*), but milk yield was significantly

Table 1. The effect of BST, Ca-soap and BST+Ca-soap supplementations on the milk yield and body weight of crossbred SF dairy cows in E1

Treatment	Mean milk yield (kg/day)	Mean body weight (kg)
Control	10.2a	312.0
BST	12.7b	306.0
Ca-soap supplementation	11.6c	310.0
BST+Ca-soap supplementation	12.9bd	301.0

E1 = First experiment

Mean values with different letters differ significantly (p < 0.01) between treatments

Table 2. Mean milk yield and body weight measurements of crossbred SF dairy cows receiving 0, 125, 250 and 500 mg of BST/14 days in E2

Treatment (mg of BST/	Mean milk yield	Mean body weight
14 days)	(kg/day)	(kg)
0	10.2a	361.0a
125	11.2ab	352.0ab
250	12.2bc	348.0abc
500	12.4bcd	342.0bcd

E2 = Second experiment

Mean values with different letters differ significantly (p < 0.01) between treatments

increased (p < 0.01) when dose rate was raised to 250 mg. However, a further increase in dose rate to 500 mg did not significantly result in a further increase in milk yield. Phipps et al. (1993) and Fontes et al. (1993) also obtained similar results in crossbred dairy cows in Africa and Brazil, respectively. In the present study the optimum milk yield response of SF crossbred cows to BST administration was achieved at an equivalent dose rate of 18 mg/day when compared with 30-50 mg/day for Bos taurus cow (Bauman 1992). Prosser and Mepham (1989) have suggested that the overall milk yield response of dairy cows to exogenous BST treatment depends on the relative abundance of hepatic BST receptors, which are regulated by variety of factors including somatotropin, steroids and nutrition (Baxter et al. 1984; Gluckman and Breier 1989; Hard et al. 1992). The markedly lower optimum dose rate for SF crossbred cows in the current study may be due to a limited number of hepatic BST receptors when compared with Bos taurus cows. Although no work has been carried out to study hepatic receptors in SF crossbred cow genetic differences may exist between the lower yielding crossbred cows and high yielding Bos taurus cows. It has also been suggested that the lower quality of local feed when compared with that available in the temperate countries may also influence the number of hepatic BST receptors in crossbred cows although the present study in which calcium-soap was used to improve plane nutrition, does not support this hypothesis in the case of SF crossbred cows.

Milk fat, protein and lactose concentration of crossbred SF cows for the

16-week treatment period was not significantly affected by the imposing treatments in both experiments (Table 3 and Table 4). Similarly, studies have shown that cows treated with different BST dose levels or fed calcium-soap also recorded no significant alteration in their milk composition (Baer et al. 1989; Barbano et al. 1992; Hartnell et al. 1991). In E1, there was no significant (p > 0.05) effect of BST or calcium-soap supplementation on the mean body weight of crossbred SF cows. This shows that the cows in E1 received more than adequate feed supply. However, in E2, cows treated with 250 mg and 500 mg of BST at 14 days intervals recorded markedly lower body weight over 16-week treatment period when compared with the control (Table 1 and Table 2). Cows in this experiment probably were under fed. This further supports the suggestion that in under fed BST treated cows the body condition score might be reduced because of the BST partitioning effect where more nutrients will

Treatment	Mean values (g/kg)		
	Milk fat	Milk protein	Milk lactose
Control	36.2	36.4	43.5
BST	37.4	37.1	43.3
Ca-soap supplementation	38.1	34.1	44.6
BST+Ca-soap supplementation	37.8	35.5	42.7

Table 3. Milk fat, protein and lactose concentration of crossbred SF dairy cows in E1

E1 = First experiment

Mean values with different letters differ significantly (p < 0.01) between treatments

Table 4. Milk fat, protein and lactose concentration of crossbred SF dairy cows in E2

Treatment mg of BST/14 days	Mean values (g/kg)			
	Milk fat	Milk protein	Milk lactose	
0	36.2	36.4	43.5	
125	37.4	37.1	43.3	
250	38.1	34.1	44.6	
500	37.8	35.5	42.7	

E2 = Second experiment

Mean values with different letters differ significantly (p < 0.01) between treatments

be diverted for milk synthesis rather than for body tissue store (Bauman 1992).

Conclusion

The current study showed that the inclusion of calcium-soap in the diet of crossbred SF cows produced a substantial increase in milk production, although the response was lower than that recorded with BST. The addition of calcium-soap to the diet of BST treated cows only produced a small further increase in milk yield. The study also established that the optimum BST dose rate for crossbred SF dairy cows was at 250 mg at 14-day intervals. Treatment with BST did not significantly affect milk composition, body weight and health of the adequately fed crossbred cows.

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