

Concentrations of bovine somatotropin and insulin-like growth factor-I in serum and milk samples of crossbred dairy cows treated with prolonged-release bovine somatotropin

(Kepekatan somatotropin bovin dan faktor-I tumbesaran seperti insulin dalam sampel serum dan susu lembu tenusu kacukan yang disuntik dengan somatotropin bovin lepas-berpanjangan)

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Key words: bovine somatotropin, insulin-like growth factor-I, Sahiwal-Friesian cows

Abstrak

Perembesan somatotropin bovin (SB) dan faktor-I tumbesaran seperti insulin (FITSI) pada lembu tenusu kacukan Sahiwal-Friesian dalam laktasi yang telah disuntik dengan SB lepas-berpanjangan telah disukat. Kajian ini menunjukkan peningkatan sebanyak 2–3 kali ganda perembesan SB dan FITSI dalam serum darah. SB dan FITSI dalam serum lembu yang disuntik dengan SB meningkat dengan bererti ($p < 0.05$) pada hari kedua dan seterusnya berada pada tahap itu hingga hari kesembilan, berbanding dengan lembu yang tidak disuntik. Namun, kedua-dua nilai tersebut menurun 14 hari selepas suntikan dilakukan. Nilai purata kepekatan serum SB pada hari kedua dan kesembilan dalam pusingan kelapan, dan 14 hari selepas suntikan dilakukan masing-masing ialah 6.3, 6.6 dan 4.3 ng/mL. Bagi nilai purata kepekatan serum FITSI pula, nilainya masing-masing 185.8, 215.1 dan 104.9 ng/mL. Sebaliknya, aras kepekatan SB dan FITSI dalam analisis susu tanpa lemak menunjukkan perbezaan yang tidak bererti ($p > 0.05$).

Abstract

Secretion of bovine somatotropin (BST) and insulin-like growth factor-I (IGF-I) was measured in lactating crossbred Sahiwal-Friesian dairy cows injected with prolonged-release bovine somatotropin (sometribove). The study showed an increase of two to threefold in both BST and IGF-I secretion in the blood serum. Serum BST and IGF-I increased significantly ($p < 0.05$) on day 2 and remained high on day 9 as compared with the non-injected control. Both values decreased on day 14 after the injection. The mean values for serum BST concentration at day 2 and day 9 of cycle 8, and 14 days post-injection period were 6.3, 6.6 and 4.3 ng/mL respectively while the corresponding mean serum IGF-I values were

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185.8, 215.1 and 104.9 ng/mL. On the other hand, the skimmed milk analysis of those cows showed no significant difference ($p > 0.05$) in BST and IGF-I levels.

Introduction

It is well documented that the administration of bovine somatotropin (BST) indirectly stimulating the mammary tissue functions through the physiological effects of insulin-like growth factor-I (IGF-I), enhances milk production in dairy cattle. It is widely accepted that IGF-I increases growth and the development of glucose transport system in mammary tissue (Dehoff et al. 1986; Disenhaus et al. 1988; Collier et al. 1989).

The administration of BST had enhanced the secretion of both BST and IGF-I in dairy cows (Hughes and Friesen 1985; Isaksson et al. 1987; Schams et al. 1989). This had resulted in an increase of two to threefold in BST (Schams et al. 1989) and three to fourfold in IGF-I (Davis et al. 1987; Prosser et al. 1989; Schams et al. 1989) in the plasma of BST-treated dairy cows. However, this treatment had no effect on BST and IGF-I levels in milk (Heeschen 1988; Schams 1989). All these findings were reported for *Bos taurus* cows and no studies have been reported either on *Bos indicus* or crossbred dairy cattle. The objective of this study was to evaluate the effects of prolonged-release formulation of BST (somatotropin) on the secretion of BST and IGF-I in serum and milk samples of crossbred dairy cows in Malaysia.

Materials and methods

The first study was conducted at MARDIS research station in Serdang, Selangor. In this study, 48 lactating Sahiwal-Friesian (SF) cows at three stages of lactation (90–120, 121–150 and 151–180 days in lactation) were allocated to two treatment groups (control versus BST-treated). The treatment period was 16 weeks with pre- and post-treatment periods of 1 and 2 weeks respectively. Prolonged-release BST (500 mg) formulation was administered in eight injection cycles of 2 weeks each. The cows

were housed in tie-stall during the day time and were allowed to graze on *Leucaena-Brachiaria decumbens* pasture at night. Concentrate supplements consisting of 24.0% crude protein and 11.27 MJ/kg metabolisable energy were given and the amount offered daily varied according to milk production of each cow. The cows were milked twice a day using the pipeline milking system.

The second study was conducted at four smallholder farms in Banting. In this study, 40 lactating SF cows (90–150 days in lactation) were allocated to two treatment groups (control versus BST-treated). The treatment period was 16 weeks with 1-week pre- and 2-week post-treatment periods. Prolonged-release BST formulation (500 mg) was administered in eight injection cycles of 2 weeks each. Cows grazed under oil palm plantation from the morning to evening milkings and were confined to the shed at night. Commercial dairy cattle pellet with minimum protein content of 16% was offered at 1 kg/2 kg of milk. In addition, wet brewers grains and oil palm sludge were also supplemented. All cows were machine milked.

In both studies, the mean initial milk production (pre-treatment) of cows was 12 ± 3.4 kg/head per day. Serum and milk samples were taken on day 2 and day 9 of cycle 8, and on day 14 after the first day of the last treatment period. The samples were freeze dried (2 mL) and sealed in glass vials before shipment to the Institute of Animal Physiology and Genetics Research, United Kingdom for BST and IGF-I radioimmunoassay analysis (RIA). BST was determined by the double antibody method (Gardner et al. 1974). The antisera (GH1/7) were raised in New Zealand White rabbits. The second antisera against rabbit serum were raised in sheep. IGF-I was analysed by

the acid-ethanol cryo-precipitation method as described by Breier et al. (1991).

The within assay variations for BST and IGF-I were calculated to be 3.8% and 7.5% respectively. The binding sensitivity for BST assay was 1.5–2.2 ng/mL and for IGF-I assay, 0.3–1.26 ng/mL. The SAS procedures for completely randomized design experiment were used to analyse the RIA results.

Results

Results from both studies showed that the concentrations of BST and IGF-I in serum samples of BST-treated cows were

significantly higher ($p < 0.05$) when compared with the non-treated cows (Table 1 and Table 2). Serum BST and IGF-I increased at day 2 and remained high at day 9 in BST-treated SF cows as compared with the control. Both values decreased at day 14 post-injection period. Mean values of the serum BST concentration for the two studies at day 2 and day 9 of cycle 8, and 14 days post-injection period were 6.3, 6.6 and 4.3 ng/mL respectively. The corresponding mean serum IGF-I values for the same sampling date were 185.8, 215.1 and 104.9 ng/mL.

Table 1. Concentrations of BST in serum and milk samples of Sahiwal-Friesian cows

Sample treatment		BST concentration (ng/mL)		
		Day 2 cycle 8	Day 9 cycle 8	14 day post-injection
Study 1				
Serum	BST	6.3 ± 4.80a	8.3 ± 11.9a	4.3 ± 3.40a
	Control	1.6 ± 1.01b	1.6 ± 0.82b	2.1 ± 0.96b
Milk	BST	1.1 ± 0.41c	0.8 ± 0.20c	0.8 ± 0.15c
	Control	0.9 ± 0.23d	0.9 ± 0.25c	0.8 ± 0.09c
Study 2				
Serum	BST	6.3 ± 2.50a	4.8 ± 1.95a	4.2 ± 2.28a
	Control	2.7 ± 2.12b	2.5 ± 2.46b	2.5 ± 1.75a
Milk	BST	0.4 ± 0.34a	0.6 ± 0.20a	0.7 ± 0.29a
	Control	0.4 ± 0.40a	0.5 ± 0.24a	0.6 ± 0.37a

Mean values with different letters in each column differ significantly at $p < 0.05$

Table 2. Concentrations of IGF-I in serum and milk samples of Sahiwal-Friesian cows

Sample treatment		IGF-I concentration (ng/mL)		
		Day 2 cycle 8	Day 9 cycle 8	14 day post-injection
Study 1				
Serum	BST	151.5 ± 63.0a	260.4 ± 200.5a	107.3 ± 66.6a
	Control	65.0 ± 24.7b	79.3 ± 27.7b	82.9 ± 34.4a
Milk	BST	6.7 ± 01.1a	9.3 ± 3.0a	9.6 ± 2.1a
	Control	7.0 ± 3.1a	8.7 ± 2.7a	9.2 ± 1.4a
Study 2				
Serum	BST	220.1 ± 107.2a	169.7 ± 83.7a	102.4 ± 55.6a
	Control	77.4 ± 28.4b	76.4 ± 37.7b	100.5 ± 40.6a
Milk	BST	8.6 ± 0.9a	8.7 ± 1.3a	9.6 ± 1.1a
	Control	8.3 ± 3.4a	9.8 ± 1.6a	9.2 ± 1.2a

Mean values with different letters in each column differ significantly at $p < 0.05$

The skimmed milk analysis showed no significant difference ($p > 0.05$) in the BST and IGF-I secretion in the milk of BST-treated cows in both studies (*Table 1* and *Table 2*) when compared with the control cows.

Discussion

The plasma or BST and IGF-I values in the BST-treated SF cows ranged from 4.83 to 8.33 ng/mL and 151.5 to 260.4 ng/mL respectively. The variations between cows were high. Similar findings were also observed by Schams (1990) in non-treated lactating cows, especially at the beginning and end of lactation. The serum and milk IGF-I levels in BST-treated SF cows were lower when compared with the German Simmental cows injected with somatotribove (500 mg/14 days). Schams et al. (1991) obtained mean BST values of 30.6 and 9.8 ng/mL at day 7, and IGF-I values of 1 004 and 607 ng/mL at day 14 over 11 injection cycles. The above findings strongly suggest that BST and IGF-I secretions may be correlated to the milk production. The average milk production of the German Simmental cows was about 17.2 kg/day while it was about 12.0 ± 3.4 kg/day before the start of the study for the SF cows in this study. The BST and IGF-I concentrations in the milk of BST-treated SF cows were 0.37–1.14 ng/mL and 6.7–9.6 ng/mL respectively. These results were in close agreement with data obtained by Schams (1989, 1990) and Prosser et al. (1989). The BST concentration reported by Schams (1990) was at a minimal level of below 0.5 ng/mL for skimmed milk while the IGF-I values obtained by Prosser et al. (1989) ranged from 3.2 to 11.7 ng/mL. From these results, it can be concluded that SF cows treated with prolonged-release BST formulation produced a response in terms of elevated BST and IGF-I concentrations in serum as compared with the untreated cows.

Results obtained in this study showed an increase of two to threefold in BST and IGF-I secretion in the plasma of BST-treated crossbred cows. Similar increases were also

observed by Davis et al. (1987), Prosser et al. (1989) and Schams et al. (1991) although the reported values for BST and IGF-I were higher than those observed in crossbred SF cows.

Acknowledgements

The authors wish to thank Mr Kamaluddin Majid, Mr Dzulkifli Mat Lajis, Mr A. Anthony and Mr Kamaludin Hassan for their cooperation and assistance in conducting the study.

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