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The effects of oxytocin and bovine somatotropin on production of cows milked once a day

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ABSTRACT

The effects of oxytocin and bovine somatotropin (BST) on production of cows milked once a day (OAD) were assessed in late lactation. Seventy four cows were milked OAD for 28 days including 7 days adaptation, 14 days treatment, and 7 days post-treatment. Treatments were OAD controls, OAD plus 5 i.u. oxytocin injected intravenously each day or OAD plus 20 mg BST injected subcutaneously each day. An additional 20 cows were milked twice a day (TAD) throughout the trial.

Production of OAD cows averaged 11% less than that of the TAD controls during the first week of OAD milking. Milk yield was significantly increased by 13% in BST treated cows but was not affected by oxytocin. Cessation of both treatments resulted in a reduction in yield compared to the OAD and TAD control groups. The failure of oxytocin to increase yield was not in agreement with previous results, possibly due to a lower dose rate of oxytocin in the present trial. Increased yields in BST treated cows suggested that udder capacity was not constraining yield and that BST may override the inhibition of milk secretion which occurs with extended milking intervals.

Keywords Dairy cows, milking interval, oxytocin, bovine somatotropin, milk production.

INTRODUCTION

Production of milk solids is 10-25% lower in cows when milked once a day (OAD) than when milked twice a day (Carruthers and Copeman, 1990). Possible mechanisms are an insufficient capacity in the udder and the presence of an inhibitor of milk secretion in the accumulating milk. Evidence for an inhibitor arises from recent studies on goats (Henderson and Peaker, 1984; Wilde and Gamble, 1985; Wilde and Peaker, 1990), and is discussed elsewhere at this Conference. Comparisons of Jersey and Friesian cows have indicated that Jersey cows producing more concentrated milk stored more hours worth of secretion in the udder before capacity became limiting, and that this was associated with lower losses on OAD milking (Davis *et al.*, 1987; Carruthers *et al.*, 1989). Removal of residual milk by oxytocin may increase the yield at each milking through more complete evacuation of the udder, as well as removing any inhibitor present in the residual milk. There is some evidence that administration of oxytocin at milking will increase yields from cows milked once a day (Woolford *et al.*, 1982). A high level of residual

milk was found to be associated with high loss in milk yield on OAD milking (Carruthers *et al.*, 1989), although the relationship was sufficiently variable to suggest that other factors were also involved.

The importance of udder capacity in determining yields on OAD may also be assessed by administering bovine somatotropin (BST) to cows on OAD milking. Increases in milk yield of 15-25% have been observed in cows milked twice a day and given BST (e.g. Oldenbroek *et al.*, 1989). Whether cows milked OAD have the ability to respond to BST has not been determined. This paper reports on the effects on OAD production of administering oxytocin and BST to Jersey and Friesian cows in late lactation.

MATERIALS AND METHODS

Cows and Treatments

Ninety-four Friesian and Jersey cows aged 3 to 8 years were used in the sixth month of lactation. All cows were milked twice a day (TAD) during a 14 day uniformity period. Subsequently 20 cows remained on TAD milking

while the remaining 74 were milked OAD for 28 days. This included a 7 day adaptation period, a 14 day treatment period, and a 7 day post-treatment period. TAD milking was resumed at the completion of the OAD period.

The OAD treatments and number of cows in each treatment were:

OAD controls	(OADc, 20 cows)
OAD + oxytocin ^a	(OADo, 28 cows)
OAD + BST ^b	(OADb, 26 cows)

Each group included both Friesian and Jersey cows. OADo cows were injected intravenously (jugular) with 5 iu of oxytocin before milking each day. Cups were placed on each cow within 30 seconds of the injection. OADb cows were injected subcutaneously with 20 mg BST each day after milking.

Cows were allocated to treatment groups based on their milk and fat yields during the TAD milking period. The 4 treatment groups were grazed together during the uniformity period but subsequently they were grazed separately. Visual estimates of pasture mass before and after grazing were used to allocate similar feeding levels to each herd. In addition, each herd was supplemented with silage during the treatment and post-treatment periods, providing 4 kg dry matter/cow/day on average over these periods. Cows milked OAD were milked in the morning and remained in their paddock when TAD cows were milked in the afternoon.

Measurements

Milk yield and composition

Milk yield and fat, protein and lactose contents were measured at 4 milkings each week for all cows milked twice daily during the uniformity period. Subsequently milk yield and composition were measured on days 5-7 in each week during the adaptation, treatment and post-treatment periods.

Udder capacity and residual milk

Udder capacity and the amount of milk remaining in the udder after machine milking (residual milk) were estimated for each cow on one occasion prior to the start of the trial. Udder capacity was estimated from the

amount of milk plus residual milk contained in the udder after a 40 hour interval. At 40 hours, cows were milked normally then injected intravenously with 5 I.U. of oxytocin and remilked immediately. The milk obtained at the second milking was the residual milk.

Statistical Analysis

Daily milk yield and composition data averaged for each period were analysed using uniformity data as covariates.

RESULTS

The drop in milk yield that occurred when the cows were milked OAD (before treatments were applied) compared to the TAD controls averaged 11.4% ($P < 0.001$) for the 3 groups. The drop in yield was greater for the OADb group than for OADc and OADo groups (15.8, 9.2, and 9.1%, respectively, *sed* 0.7, Figure 1). Losses in fat, protein and lactose yields averaged 8.8, 8.5 and 13.1%, respectively, compared to TAD controls ($P < 0.001$). OAD milking increased fat and protein percents ($P < 0.001$, Figures 2,3) and decreased lactose percent ($P < 0.001$, Figure 4) in milk.

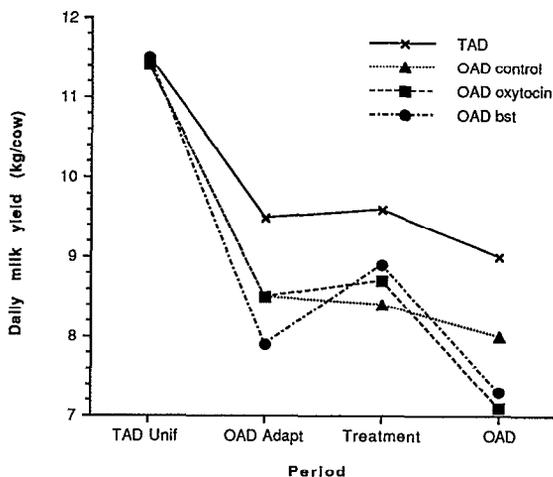


FIG 1 Daily milk yield (kg/cow) during the uniformity period on twice daily milking (TAD unif., 14 days), once a day adaptation (OAD adapt., 7 days), treatment (14 days) and post-treatment OAD (7 days) for TAD controls and OAD treatment groups.

^a Oxytocin-S Intervet (Aust) Pty Ltd., 31-33 Sirius Rd, Lane Cove, NSW 2066, Australia.

^b Somidobove, Lot X-47710, Elanco Products Company, Indianapolis, U.S.A.

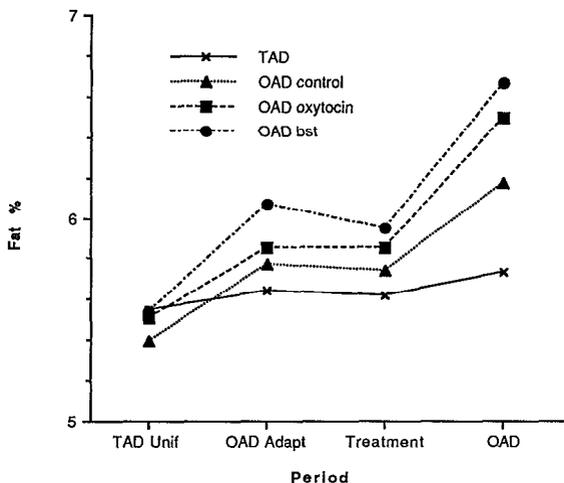


FIG 2 Fat percent during the uniformity period on twice daily milking (TAD unif., 14 days), once a day adaptation (OAD adapt., 7 days), treatment (14 days) and post-treatment OAD (7 days) for TAD controls and OAD treatment groups.

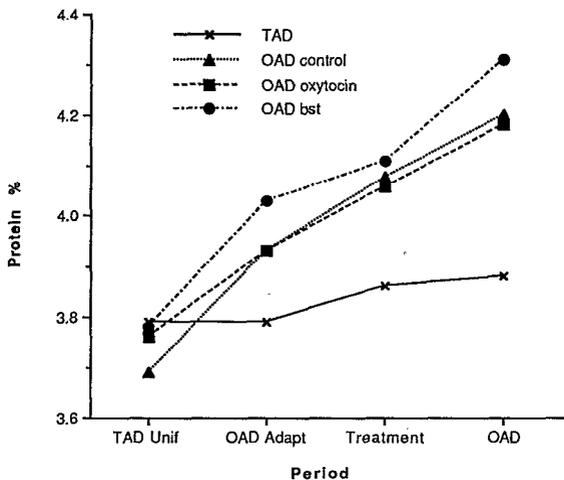


FIG 3 Protein percent during the uniformity period on twice daily milking (TAD unif., 14 days), once a day adaptation (OAD adapt., 7 days), treatment (14 days) and post-treatment OAD (7 days) for TAD controls and OAD treatment groups.

Treatment with BST increased ($P < 0.001$) the

yields of milk, fat, protein and lactose by 15 to 19% if compared with OADc (Table 1, Figure 1). Fat yield was restored to the level of the TAD controls. Treatment with BST increased lactose percent (Figure 4) but did not affect fat or protein percents in milk (Figures 2, 3). Jersey and Friesian cows in each treatment group did not differ in their response to the oxytocin or BST treatments. The effect of BST on yields and on lactose percent disappeared when treatment ceased. Milk yield and lactose percent were lower for the OADb group than for the OADc group during the OAD post-treatment period. Treatment with oxytocin significantly increased the yield of protein but not yields of milk, fat or lactose. Fat, protein and lactose percents were not affected by administration of oxytocin, although milk yield and yields of protein and lactose decreased when oxytocin treatment ceased. Yields of milk, fat, protein and lactose were lower for the OADo group than for the OADc group during the OAD post-treatment period.

TABLE 1 Daily yields (kg/cow) of milk, fat, protein and lactose during the adaptation period on OAD and the percent response (Resp %) during the subsequent 14 days when cows were milked as controls (OADc) or treated daily with oxytocin (5 IU/cow intravenously; OADo) or with BST (20 mg/cow subcutaneously; OADb).

Variable	Period	Treatment			sed*
		OADc	OADo	OADb	
Milk yield	OAD	8.5	8.5	7.9	
Fat yield	Resp %	-1.5	3.2	13.4	2.5
	OAD	0.48	0.49	0.46	
Protein yield	OAD	0.33	0.33	0.30	
	Resp %	1.8	6.2	15.9	2.2
Lactose yield	OAD	0.40	0.41	0.37	
	Resp %	-1.9	1.9	16.7	3.1

* Standard error of the difference

Udder capacity (kg milk) was slightly smaller for the OADo group and percentage residual milk higher for the OADb group (Table 2), arising from the allocation of cows to treatment groups. Udder capacity ranged from 6.3 to 30.8 kg. The amounts and percentages of residual milk ranged from 0.2 to 7.2 kg and 1.1 to 47.7 %, respectively. There was no association between response (kg or %) to the oxytocin or BST treatment and

either udder capacity (total milk (kg) stored at 40 hours) or the level of residual milk (as amount (kg) or percent of udder capacity).

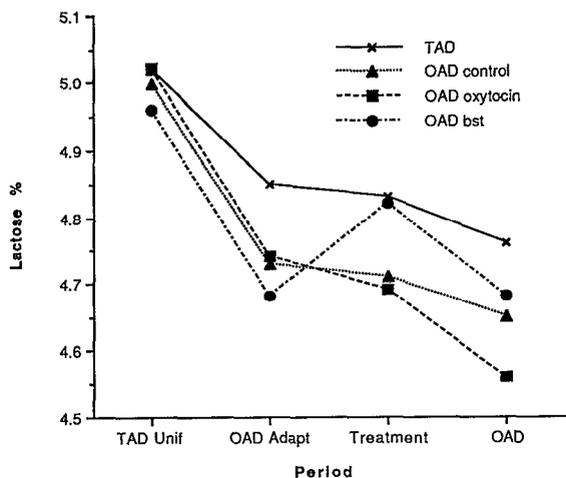


FIG 4 Lactose percent during the uniformity period on twice daily milking (TAD unif., 14 days), once a day adaptation (OAD adapt., 7 days), treatment (14 days) and post-treatment OAD (7 days) for TAD controls and OAD treatment groups.

TABLE 2 Total amount of milk contained in the udder after 40 hours (capacity) and residual milk as a percent of total milk at 40 hours for cows milked twice a day (TAD) or once a day as controls (OADc), with oxytocin (OADo) or with BST (OADb).

Variable	Treatment			
	TAD	OADc	OADo	OADb
Capacity (kg)	16.2	16.2	14.6	16.6
Residual milk (%)	9.7	8.8	8.9	12.2

DISCUSSION

Production decreases in cows milked OAD are due in part to constraints of udder capacity to store the milk produced over 24 hours (Davis *et al.*, 1987, Carruthers *et al.*, 1989), and to the effects of an inhibitor of secretion (Wilde and Peaker, 1990). The increase in production associated with BST treatment was slightly lower than that commonly shown by cows milked twice

daily and receiving BST. The quality of the feed available during the trial may have contributed to the lower response. Lack of capacity to store the extra milk secreted over 24 hours was unlikely to be a constraint as there was no association between 40 hour milk yield and response to BST. If udder capacity was a constraint, cows with large capacity may have shown a relatively greater increase on BST treatment than those with less capacity.

Response to BST may be affected by the level or activity in milk of an inhibitor of milk secretion, although level of residual milk was not associated with response to BST in this study. Studies with goats have shown that the increase in yield associated with BST is additive to that resulting from removal of the inhibitor of secretion by more frequent milking (Wilde and Peaker, 1990).

OADo cows did not increase milk or fat yields as has previously been observed in oxytocin treated cows (Woolford *et al.*, 1982), although protein yield increased slightly. The two studies differed in dose of oxytocin given, being 20 I.U. in the previous study compared to 5 i.u. in the present work. In the absence of a response, any association between level of residual milk and response to OAD milking could not be established.

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