Effect of Sustained-Release Somatotropin on Performance and Grazing Behavior of Ewes Housed at Different Stocking Rates

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ABSTRACT

This study evaluated the effects of recombinant bovine somatotropin (bST; one injection of 320 mg per ewe) on milk production and composition and on the grazing behavior of multiparous ewes in the third to fourth lactation. Forty Comisana lactating ewes were divided into four groups: 1) untreated, grazing on natural pasture (botanical composition: 35% of Graminaceae, 49% of Fabaceae, 6% of Cruciferae, 10% of other families) at a low stocking rate (16 m^2/d); 2) untreated, grazing at a high stocking rate (8 m^2/d); 3) treated with bST, grazing at a low stocking rate; and 4) treated with bST, grazing at a high stocking rate. The diets of the ewes were supplemented with vetch and oat hay (500 g/d) and with concentrate (500 g/d). Treatment increased milk production (923.8 vs. 669.5 g/d) but had little effect on fat and protein contents. Administration of bST significantly increased herbage intake; the effect on intake was more marked at the high stocking rate. Under these grazing conditions, the treated ewes reduced selective intake behavior and, thus, achieved good feed intake despite the low biomass availability.
(**Key words**: somatotropin, intake, grazing behavior, lactating ewes)

Abbreviation key: **BCS** = body condition score, **FPCM** = milk corrected for 6.5% fat and 5.8% protein.

INTRODUCTION

The efficacy of bST in determining significant increases in milk production, without seriously affecting quality, is well established (3). According to Chalupa and Galligan (5), the physiological responses of cows that are treated with bST are similar to those of genetically superior cows. In recent years, research in this field has focused on other species, and both goats and sheep responded with improved productivity and no substantial milk quality variations (9, 29).

Numerous studies on lactating cows have demonstrated that the magnitude of response to treatment depends on the capacity of the cows to satisfy increased nutritive requirements (3, 17, 22). In this regard, bST does not seem to improve the digestibility of feed, although bST usually can result in increased intake (5, 6). Generally, intake studies of treated cows have been conducted using cows fed mixed rations, but a smaller number of trials (6, 23, 34) have been reported for cows fed on pasture. The purpose of our experiment was to assess the effects of treatment with sustained-release bST on productive performance and grazing behavior of lactating ewes.

MATERIALS AND METHODS

Experimental Procedure

Forty Comisana lactating ewes were used. Ewes were at 45.7 ± 1.3 kg of BW, were in their third to fourth lactation, and had an initial body condition score (**BCS**) of 2.7 ± 0.4. Body condition was scored on a five-point scale (1 = thin to 5 = obese) (27). At wk 12 (78 to 83 d) of lactation (preexperimental period), on the basis of milk production and BW, ewes were allotted to two grazing groups: low stocking rate (16 m^2/d per ewe) or high stocking rate (8 m^2/d per ewe). At wk 14 (91 to 96 d) of lactation, each grazing group was allotted to two groups: untreated and treated with recombinant bST in a sustained-release preparation (Somidobove; Eli Lilly and Co., Indianapolis, IN). Ewes receiving the bST treatment were injected once (on March 21, ewes were separated into the treatment groups) with 320 mg of bST per ewe. The dosage was established on the basis of a previous research (29) conducted in the same environment and with the same breed of sheep. The experiment lasted 3 wk.

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Housing, Grazing Management, and Supplementation

All of the ewes were held in individual metallic pens (0.8 m × 1.5 m) placed on a concrete floor with litter of wood shavings. Every day, after the a.m. milking, the sheep were grazed on four separate plots (one for each experimental group) of natural pasture (initial biomass, 2.8 tonnes of DM/ha; mean herbage height, 27 cm) from 1000 to 1500 h. Ewes were not allowed to drink during grazing. After grazing, the ewes were returned to their pens where they were milked again and fed individually with 500 g of vetch and oat hay and 500 g of concentrate (Table 1).

Measurements and Analysis

The a.m. and p.m. milk production was recorded at d –11, –8, –1, 1, 4, 7, 10, 13, 16, 19, 22 of bST injection. Individual milk samples from a.m. and p.m. milkings were collected at d –8, –1, 1, 7, 13, 19 of bST injection. Fat, protein, and lactose contents were measured by infrared spectrophotometry (Milkoscan 133/B; Foss Electric, Hillerød, Denmark). Body condition was scored on same days that milk samples were collected.

At the beginning of the experiment, before ewes began to graze, herbage mass and botanical composition were estimated; on 16 plots of 0.3 × 4 m (four plots randomly distributed over each fenced area), herbage was cut with scissors close to ground level, and each species was separated and weighed.

Individual intakes of hay and concentrate were recorded daily. Herbage intake was recorded every 3 d, on the same days that milk production was recorded (20). All ewes, which had been fitted with harnesses and bags to collect feces and urine, were weighed before and after grazing. Insensible weight losses during grazing were estimated for 3 ewes that were not included in the experiment but that were similarly harnessed and prevented from grazing by muzzles. These ewes were weighed (w1), left to pasture for 2 h, and then reweighed (w2). Herbage intake was estimated as follows:

$$I = (W2 + IWL) - W1$$

where I = intake of herbage, W2 = weight after grazing, IWL = insensible weigh loss, and W1 = weight before grazing.

$$IWL = t\ (w1 - w2)/2.$$

where t = hours of grazing.

TABLE 1. Ingredients and chemical composition of concentrate and hay.

Composition	Concentrate	Vetch and oat hay
Ingredient, % of fresh matter		
Vetch and oat hay	. . .	100
Corn	33.0	. . .
Barley	28.0	. . .
Wheat bran	8.0	. . .
Carrob meal	8.5	. . .
Soybean meal, 44%	10.0	. . .
Brewers grain	8.0	. . .
Calcium carbonate	1.0	. . .
Magnesium oxide	1.0	. . .
Monosodic phosphate	1.0	. . .
Salt	1.0	. . .
Vitamin and mineral premix[1]	0.5	. . .
Chemical		
DM, %	87.8	85.9
CP, % of DM	13.9	6.2
Ether extract, % of DM	1.4	1.2
NDF, % of DM	27.9	70.6
ADF, % of DM	8.5	39.9
Lignin, % of DM	3.3	7.0
DOM,[2] % of DM	74.8	55.2

[1]Premix supplied (per kilogram of diet) 5,000,000 IU of vitamin A, 830,000 IU of vitamin D, 3,300,000 IU of vitamin E, 1200 mg of vitamin B_1, 4.2 mg of vitamin B_2, 8300 mg of Fe, 15,000 mg of Mn, 1200 mg of Cu, 5300 mg of Zn, and 1700 mg of butylated hydroxytoluene.

[2]Digestible OM.

Selectivity at pasture was recorded weekly. Throughout grazing (5 h/d), every 20 min, four observers (one per experimental group) who were equipped with binoculars recorded the species and parts of plant selected by each ewe.

Once a week, on the basis of behavioral observations, three herbage samples for each group were manually collected; plants were picked to provide representative mixed samples of the selected diet. At the same time, three samples of whole pasture and three samples of each plant species were collected by cutting at ground level.

Herbage, hay, and concentrate were analyzed for DM, CP, ether extract, and ash according to procedures of the AOAC (1); for ADF, NDF, and lignin by the procedure of Goering and Van Soest (15); and for digestible organic matter using pepsin from porcine stomach mucosa and cellulase from *Thrichoderma viride* (11).

Live weight recorded before ewes went on pasture for herbage intake estimation was used for energy balance calculation.

Net energy balance was calculated on a weekly basis. Milk energy (kilocalories per kilogram) was calculated using the percentages of fat (F), protein

(P), and lactose (L) according to the following equation (19):

$$\text{milk energy} = 9.20\ F + 5.86\ P + 3.95\ L.$$

Net energy for maintenance was estimated according to the method of Institut National de Recherches Agronomique (18) as modified by Pulina et al. (25) specifically for dairy sheep breeds, as follows:

$$\text{UFL for maintenance} = (0.033 + 0.005\ \text{FPCM}) \times LW^{0.75} \times 1.25$$

where UFL = unité fourragère lait, **FPCM** = milk corrected for 6.5% fat and 5.8% protein, and LW = live weight (26). The unité fourragère lait was then converted into kilocalories of NE_L by multiplying by 1700.

Statistical Analysis

The pretreatment mean of milk production and composition, DMI, and BCS was used as a covariate. Because covariance was never significant ($P > 0.05$), it was removed from the model.

As a consequence, data for each week or day of treatment were analyzed using the method of least squares analysis of variance as follows:

$$Y_{ijk} = \mu + a_i + b_j + ab_{ij} + e_{ijk}$$

where

Y_{ijk} = experimental observation,
μ = overall mean,
a_i = treatment effect (untreated or bST),
b_j = stocking rate effect (low, 16 m^2/d per ewe; high, 8 m^2/d per ewe),
ab_{ij} = interaction of treatment and stocking rate, and
e_{ijk} = residual.

Least significant difference was used for mean comparisons.

RESULTS AND DISCUSSION

Milk Production and Composition

Pretreatment means for FPCM ranged from 700 to 850 g/d for the low stocking rate and from 600 to 850

TABLE 2. Least squares means of FPCM[1] and DMI of herbage.

Parameter and day of treatment	Untreated		bST		Significance			SE
	Low SR[2]	High SR	Low SR	High SR	T[3]	SR	T × SR	
FPCM, g/d								
d –1	761.2	781.2	757.4	762.4	NS	NS	NS	9.3
d 1	779.5	839.1	823.5	873.1	NS	NS	NS	21.4
d 4	829.4[b]	776.3[b]	1021.6[a]	1093.6[a]	**	NS	NS	23.4
d 7	818.0[b]	734.3[b]	1104.1[a]	1026.0[a]	**	NS	NS	31.7
d 10	766.8[b]	754.0[b]	984.1[a]	982.7[a]	**	NS	NS	25.2
d 13	673.7[b]	750.3[b]	890.9[a]	883.2[a]	**	NS	NS	22.3
d 16	643.0[b]	672.1[b]	967.5[a]	886.4[a]	**	NS	NS	20.3
d 19	563.8[b]	575.1[b]	893.0[a]	862.1[a]	**	NS	NS	22.1
d 22	550.3[b]	518.3[b]	746.5[a]	674.5[a]	**	NS	NS	16.2
DMI, g/d								
d –1	1010.0	956.0	990.0	980.0	NS	NS	NS	11.1
d 1	1050.0[a]	1020.0[ab]	980.0[b]	988.0[b]	*	NS	NS	10.0
d 4	1070.0[ab]	950.0[c]	1100.0[a]	1000.0[bc]	NS	**	NS	12.0
d 7	1039.0[b]	830.0[c]	1228.0[a]	1064.0[b]	**	**	NS	25.6
d 10	1026.0[b]	828.0[c]	1224.0[a]	1058.0[b]	**	**	NS	18.9
d 13	1071.0[a]	815.0[b]	1005.0[ab]	1090.0[a]	NS	NS	*	34.6
d 16	1019.0[a]	769.0[b]	912.0[ab]	907.0[ab]	NS	*	*	27.3
d 19	927.0[a]	685.0[b]	739.0[b]	755.0[b]	NS	NS	*	29.1
d 22	791.0	821.0	914.0	756.0	NS	NS	NS	24.9

[a,b,c]Means within the same row followed by no common superscript letter differ ($P < 0.05$).

[1]Milk corrected for fat (6.5%) and protein (5.8%); FPCM = 0.25 + 0.085 g/kg of fat + 0.035 g/kg of protein (26).

[2]Stocking rate: 16 m^2/d per ewe (low); 8 m^2/d per ewe (high).

[3]Treatment.

*$P < 0.05$.

**$P < 0.01$.

TABLE 3. Chemical composition of whole herbage.

	wk 1 (n = 3)	wk 2 (n = 3)	wk 3 (n = 3)
DM, %			
$\overline{X}$	20.8	24.3	25.3
SD	0.4	0.6	0.9
CP, % of DM			
$\overline{X}$	14.4	12.3	11.2
SD	0.6	0.2	0.6
NDF, % of DM			
$\overline{X}$	36.8	38.2	40.7
SD	0.8	0.4	0.3
ADF, % of DM			
$\overline{X}$	21.6	22.7	25.0
SD	0.6	0.1	0.9
Lignin, % of DM			
$\overline{X}$	4.0	4.4	4.6
SD	0.4	0.2	0.1
DOM,[1] % of DM			
$\overline{X}$	74.0	73.0	71.6
SD	0.8	0.5	0.6
NE_L, kcal			
$\overline{X}$	1520.2	1483.5	1465.6
SD	40.0	16.5	37.9

[1]Digestible OM.

for the high stocking rate. Increased production as a consequence of the bST treatment was noted beginning the 1st d after injection. The immediate response to sustained-release bST has been documented for cows (21), goats (14), and ewes (13).

Mean FPCM from d 1 to 22 (Table 2) increased from a minimum of 5.7% to a maximum of 58.5% at the low stocking rate and from a minimum of 4.1% to a maximum of 49.9% at the high stocking rate. These increases became significant ($P < 0.01$) for both stocking rates from d 4 to 22 after injection. The maximum production responses following treatment (on average, 310 g/d of increment) were similar to those reported by Fernandez et al. (13) and more marked than those reported by Chiofalo et al. (7). On average, during wk 3, productivity dropped substantially, probably because of climatic conditions characterized by a sudden rise in temperature (with peaks of 28 to 30°C), a common occurrence in Sicily in April. This temperature increase led to a rapid senescence of the pasture, shown by the increase in structural carbohydrates and the decrease in CP contents (Table 3). Moreover, control ewes seemed to be more sensitive to environmental variations than treated ewes and showed a more marked drop in productivity. Stocking rate did not modify milk production (Table 4).

The chemical composition of milk was not affected by treatment or by stocking rate (Table 4). Only during wk 3 of treatment, did fat content increase ($P < 0.05$) for the control group grazing at the high stocking rate because of the low production levels.

TABLE 4. Least squares means of milk production and composition.

Parameter and week of treatment	Untreated		bST		Significance			
	Low SR[1]	High SR	Low SR	High SR	T[2]	SR	T × SR	SE
Milk, g/d								
wk –1	762.4	765.7	759.3	778.1	NS	NS	NS	7.6
wk 1	860.7[b]	759.9[b]	1070.8[a]	1080.4[a]	**	NS	NS	31.0
wk 2	675.2[b]	672.7[b]	940.1[a]	888.8[a]	**	NS	NS	23.8
wk 3	568.0[b]	480.2[b]	808.1[a]	754.6[a]	**	NS	NS	18.2
Fat, %								
wk –1	6.10	6.30	6.26	6.24	NS	NS	NS	0.01
wk 1	6.22[b]	6.82[b]	6.16[b]	6.47[ab]	NS	*	NS	0.10
wk 2	6.57	7.18	6.39	6.78	NS	NS	NS	0.13
wk 3	6.53[b]	8.18[a]	6.63[b]	6.46[b]	**	*	**	0.15
Protein, %								
wk –1	5.55	5.63	5.65	5.61	NS	NS	NS	0.04
wk 1	5.41[b]	5.80[a]	5.77[a]	5.64[ab]	NS	NS	*	0.06
wk 2	5.54	5.83	5.80	5.65	NS	NS	NS	0.06
wk 3	5.72	6.13	5.90	5.85	NS	NS	NS	0.06

[a,b]Means within the same row followed by no common superscript letter differ ($P < 0.05$).

[1]Stocking rates: 16 m^2/d per ewe (low); 8 m^2/d per ewe (high).

[2]Treatment.

*$P < 0.05$.

**$P < 0.01$.

Published results on the effects of treatment on milk chemical composition are contradictory. Several researchers (5, 16, 24) did not detect significant differences, but others observed increases in fat content following treatment of cows (22, 33) and ewes (30), explaining the condition as being due to increased mobilization of deposited fat following a negative energy balance.

Herbage Intake and Selective Behavior

From the pretreatment period to wk 3, herbage intake decreased in all groups, probably as a consequence of the rapid senescence of herbage that occurred during wk 3.

Herbage DMI (Table 3) was affected by bST treatment and stocking rate. On average, hormone treatment caused an increase in intake capacity of 63.0 g/d, which was equal to about 7%. This increase reached statistical significance from d 7 of treatment. Again, results from the literature conflict. Some researchers did not observe significant changes in intake of cows (32), goats (8, 9), or ewes (10), but others noticed that increased intake occurred, but only some weeks after the beginning of treatment of cows (5, 23, 24, 31) and ewes (28).

The DMI decreased as stocking rate increased and reached significance on d 4, 7, 10, and 16. Response to treatment varied widely in relation to stocking rate: analysis of the interaction between treatment and stocking rate showed that, following treatment, the mean DMI increase was greater at the high stocking rate (14.0% vs. 1.5%). Moreover, at the low stocking rate, the increase in intake was significant only from d 7 to 10 after bST injection (on average about 190 g/d); then, intake decreased below the control levels (at d 19 the decrease reached significance). At the high stocking rate, significance was reached from the 7th to the 13th d after treatment (mean: 250 g/d), then intake achieved control levels; 250 g/d is similar to the maximum increases observed by Sandles et al. (28). Evidently, at the high stocking rate, the treated ewes were able to maintain the increase in intake longer consequent to bST treatment, probably because of increased voracity, which allowed the ewes to compensate for the lower availability of grass by grazing more intensely.

The botanical and chemical composition of selected diets changed markedly and could not always be linked to experimental factors (Tables 5 and 6). On average, for an initial botanical composition of 35% Graminaceae, 49% Fabaceae, and 6% Cruciferae, ewes selected 52% Graminaceae, 23% Fabaceae, and 16% Cruciferae. These percentages indicate a marked preference for Graminaceae and Cruciferae and a tendency to discard part of Fabaceae, although these were dominant over all other forages. The poor interest of the ewes in Fabaceae can probably be attributed, first, to the highly appealing taste of

TABLE 5. Least squares means of botanical composition of diets selected at pasture.

Parameter and week of treatment	Untreated		bST		Significance			
	Low SR[1]	High SR	Low SR	High SR	T[2]	SR	T × SR	SE
Graminaceae, %								
wk 1	61.4	59.2	67.4	50.4	NS	NS	NS	2.4
wk 2	35.0	50.5	37.3	40.3	NS	NS	NS	2.4
wk 3	66.0	56.4	42.6	62.5	NS	NS	NS	4.1
Fabaceae, %								
wk 1	29.4[ab]	20.7[b]	17.1[b]	42.3[a]	NS	NS	**	2.4
wk 2	25.3[ab]	27.4[a]	16.0[b]	34.1[a]	NS	*	NS	2.0
wk 3	22.3	17.9	12.0	17.9	NS	NS	NS	1.9
Cruciferae, %								
wk 1	7.5[b]	19.5[a]	10.3[ab]	6.0[b]	NS	NS	*	1.8
wk 2	12.4[b]	19.3[ab]	27.5[a]	22.2[ab]	NS	NS	NS	2.4
wk 3	11.7	24.1	21.7	14.6	NS	NS	NS	2.5

[a,b]Means within the same row followed by no common superscript letter differ ($P < 0.05$).

[1]Stocking rates: 16 m^2/d per ewe (low); 8 m^2/d per ewe (high).

[2]Treatment.

*$P < 0.05$.

**$P < 0.01$.

Graminaceae and Cruciferae, confirmed by previous research (2, 12), and, second, to the Fabaceae components, which were about 50% vetch (*Vicia sativa*) and 50% trigonella (*Trigonella phoenum graecum*). The vetch was generally selected by the ewes, but the trigonella, well known for being less preferred by ewes, was ignored by most. Only the ewes that were treated with bST and grazing at the high stocking rate were less selective during the 1st wk of treatment; those ewes selected a diet characterized by a botanical composition that was quite similar to that of the pasture. In fact, as we noticed during observations of grazing behavior, this group ate faster and did not always demonstrate the marked tendency to discard the less preferred feeds that had been observed for the other groups. This result could be explained, in part, by the reduced biomass availability in relation to the energy requirements of this group and, in part, by the more intense grazing activity probably induced by treatment, both of which led to less selectivity in sources of energy intake.

Net Energy Balance and BCS

The mean difference in total energy intake between the untreated and treated ewes accounted for 63.5% of the extra energy secreted in milk. This value is similar to those reported by McGuffey et al. (21) who noticed differences of 50 to 75%.

All of the ewes were in positive energy balance (mean, 315 kcal/d) at the beginning of the experiment. Treatment with bST, on average, decreased net energy balance (17.7 vs. 189.8 kcal). Differences were significant only at wk 3. In fact, at the end of the experimental period, the bST treatment had caused a negative energy balance. In other experiments also, energy balance is often negative during the initial days of treatment because intake does not increase rapidly enough to sustain the increased milk production (23). In our experiment, energy intake (Table 7)

TABLE 6. Least squares means of chemical composition of diets selected at pasture.

Parameter and week of treatment	Untreated Low SR[1]	Untreated High SR	bST Low SR	bST High SR	Significance T[2]	Significance SR	Significance T × SR	SE
DM, %								
wk 1	21.4	21.1	21.0	21.3	NS	NS	NS	0.3
wk 2	23.2[b]	24.3[a]	22.2[c]	23.9[ab]	*	**	NS	0.1
wk 3	26.5	26.3	25.2	26.8	NS	NS	NS	0.4
CP, % of DM								
wk 1	12.8	12.8	11.7	14.7	NS	NS	NS	0.5
wk 2	11.4	11.7	10.6	12.7	NS	NS	NS	0.3
wk 3	12.1	11.9	10.8	11.6	NS	NS	NS	0.4
NDF, % of DM								
wk 1	39.5	40.5	40.7	38.6	NS	NS	NS	0.4
wk 2	36.6	39.1	38.7	37.2	NS	NS	NS	0.8
wk 3	43.3[a]	43.0[a]	40.7[b]	43.8[a]	NS	NS	*	0.3
ADF, % of DM								
wk 1	22.1	22.0	22.4	22.0	NS	NS	NS	0.3
wk 2	22.5	22.5	23.6	22.1	NS	NS	NS	0.3
wk 3	22.7	23.1	23.6	23.5	NS	NS	NS	0.3
Lignin, % of DM								
wk 1	3.3	3.1	3.0	3.7	NS	NS	NS	0.1
wk 2	3.9	3.7	3.6	4.0	NS	NS	NS	0.2
wk 3	3.7	3.7	3.7	3.5	NS	NS	NS	0.1
DOM,[3] % of DM								
wk 1	74.0	74.5	74.0	74.1	NS	NS	NS	0.5
wk 2	73.4	73.4	73.0	73.7	NS	NS	NS	0.3
wk 3	71.6	71.6	71.4	71.6	NS	NS	NS	0.3

[a,b,c]Means within the same row followed by no common superscript letter differ ($P < 0.05$).

[1]Stocking rates: 16 m^2/d per ewe (low); 8 m^2/d per ewe (high).

[2]Treatment.

[3]Digestible OM.

*$P < 0.05$.

**$P < 0.01$.

had already increased during wk 1 of treatment (2741.4 vs. 2439.7 kcal/d; $P < 0.01$), returning to values that were almost identical to those of control ewes by the 3rd wk, thereby giving rise to the negative energy balance. A negative balance was observed also during wk 1 for the untreated group that grazed at the high stocking rate, evidently because the modest availability of grass was not sufficient to sustain the good production rates observed at the beginning of the experiment.

Mean BCS during the pretreatment period was 2.7, which, considering the lactation stage (wk 12), can be regarded as normal (Table 7). Mean BCS, in accord with energy balance results, increased 0.25 units from the pretreatment period to wk 3 in control groups; in treated groups, mean BCS increased by 0.3 units from the pretreatment period to wk 2 and then decreased by 0.35 units during wk 3. Also, McGuffrey et al. (21) found that the final BCS for cows receiving bST was lower than for untreated cows.

Net energy balance, calculated taking into account that a BCS loss of one point would translate into about 800 kcal of NE_L, or 0.3 to 0.4 L of milk (4), showed no statistical variation between means as a consequence of bST treatment (+521 kcal/d for the control group and +478 kcal/d for the treated group).

CONCLUSIONS

Treatment with sustained-release bST seems to improve productive performance of lactating ewes after peak lactation; no noteworthy effects on milk composition were observed. Forage intake increased during the first 2 wk after injection, in parallel with the rise in productivity caused by bST treatment, and then decreased despite the high production, probably because of the worsening of herbage quality that occurred during wk 3 of treatment. The intake response to bST was more marked when pasture availability diminished (high stocking rate). Under these grazing conditions, and contrary to the behavior of control ewes, the treated ewes, driven by increased nutritive requirements, seemed to activate a behavioral mechanism that results in intensifying useful grazing by reducing selective activity. Thus, ewes could reach production levels and lactation performance that were very similar to those of treated ewes grazing at a low stocking rate. During wk 3 of treatment, the positive production response to bST, which was not sustained by a corresponding rise in intake, was probably supported by a release of body reserves.

TABLE 7. Least squares means of net energy (NE) balance, total NE intake, and body condition score (BCS).

Parameter and week of treatment	Untreated		bST		Significance			
	Low SR[1]	High SR	Low SR	High SR	T[2]	SR	T × SR	SE
NE Balance,[3] kcal/d								
wk –1	360.8	306.8	328.3	262.6	NS	NS	NS	26.8
wk 1	274.6[a]	–25.8[b]	218.9[a]	–50.4[b]	NS	**	NS	45.5
wk 2	401.7[a]	46.4[b]	76.2[b]	93.0[b]	NS	NS	*	43.8
wk 3	293.4[a]	148.2[a]	–88.4[b]	–143.2[b]	**	NS	NS	41.3
Total NE intake, kcal of NE_L/d								
wk –1	2558.9	2538.2	2547.3	2510.2	NS	NS	NS	20.4
wk 1	2591.4[b]	2288.4[c]	2875.1[a]	2607.7[b]	**	**	NS	42.7
wk 2	2567.2[a]	2303.5[b]	2634.3[a]	2589.3[a]	*	NS	NS	41.5
wk 3	2288.6	2201.1	2320.2	2125.4	NS	NS	NS	41.1
BCS[4]								
wk –1	2.6	2.8	2.8	2.7	NS	NS	NS	0.06
wk 1	2.5[b]	2.7[ab]	2.8[a]	2.9[a]	*	NS	NS	0.05
wk 2	2.7	2.9	3.0	3.0	NS	NS	NS	0.06
wk 3	2.9[ab]	3.0[a]	2.7[bc]	2.6[c]	*	NS	NS	0.05

[a,b,c]Means within the same row followed by no common superscript letter differ ($P < 0.05$).

[1]Stocking rates: 16 m^2/d per ewe (low); 8 m^2/d per ewe (high).

[2]Treatment.

[3]Calculated as total NE intake – (NE for maintenance + milk energy production).

[4]Five-point scale where 1 = thin to 5 = fat (27).

*$P < 0.05$.

**$P < 0.01$.

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