Friesian cow experimentally treated with recombinant somatotropin (r-bST): effects on productive and reproductive parameters

G. M. Terzano¹, F. La Regina¹, G. Grifoni², R. Rosati², A. Borghese¹

¹ Istituto Sperimentale per la Zootecnia. Consiglio per la Ricerca e la Sperimentazione in Agricoltura, Monterotondo, Italy
² Istituto Zooprofilattico Sperimentale del Lazio e Toscana. Roma, Italy

Corresponding author: Giuseppina Maria Terzano. Istituto Sperimentale per la Zootecnia. Consiglio per la Ricerca e la Sperimentazione in Agricoltura. Via Salaria 31, 00016 Monterotondo, Roma, Italy - Tel. +39 06 900901 - Fax: +39 06 9061541 - Email: marinella.terzano@isz.it

ABSTRACT: The study examined the effect of recombinant somatotropin (r-bST) on production and reproduction. Twenty cows were randomly divided in two treatment groups: r-bST (n=10), treated, starting at the eighth postpartum week by injections of r-bST every 14 days; control (n=10), untreated. Cows were milked twice a day, recording milk production. Body condition scores (BCS) were monthly determined for each cow. Blood samples were collected twice a week from jugular vein and assayed by IGF-1 immunoassay. At the fifth r-bST injection, an estrous cycle was synchronized by two intramuscular injections of 0,15 mg of PGF2α analogue (dcloprostenol; Dalmazin, Fatro, Italy) given 11 days apart and ovaries were daily examined by ultrasonography. Follicles were classified as small, medium, large. Milk yield significantly increased after r-bST treatment (P ≤ 0.05), remaining higher than control group. At the fourth postpartum month, BCS significantly increased in control group and at the end of the trial it was 2.30 in r-bST and 2.52 in control group (P ≤ 0.05). Treated cows had more serum concentration of IGF-1 and more small and medium follicles vs control ones. The first wave dominant follicle growth was similar. The start of the second follicular wave was earlier in r-bST treated cows.

Key words: r-bST, IGF-I, Cow milk production, Follicles.

INTRODUCTION – Bovine somatotropin is a peptide hormone secreted by the anterior pituitary gland and its recombinant form (r-bST) is used for artificially boosting milk yield in cows. As a result of its cellular actions, r-bST also alters ovarian function. Looking at experimental papers, there is evidence for marked variations in milk production (Chilliard et al., 1998; Etherton et al., 1998), milk composition (Kronfeld, 1997), animal growth (Wells, 1995), IGF-I concentration (Kronfeld, 1994) and reproductive performance (Jimenez-Krassel et al., 1999). Therefore, the objective of this study was to examine the effect of r-bST on some productive and reproductive characteristics.

MATERIAL AND METHODS – This study was carried out during a 14-months period, between December 2003 and February 2005. Twenty lactating Holstein cows (60 days postpartum) were used and randomly assigned to one of two treatments before trial starting. Cows in group r-bST (n=10) were treated, beginning at the eighth postpartum week, by injections of r-bST (Hilac®, LG Life Science, 500 mg/dose), administered subcutaneously into the tailhead region, using 16-gauge needles. Hilac® is a sustained-release form of recombinant bST that is administered once every 14 days. Ten untreated cows were as controls. Cows were milked twice daily and milk production was recorded. Body condition scores (0= thin and 5= fat) for each cow were determined at monthly intervals. Blood samples were collected twice a week (3,7,11,14 days after every injection) from jugular vein immediately before the administration of meal and stored at -20°C until assayed by validated immunoassay for IGF-1 (Sigma-Aldrich, S. Luis, MO, US). Beginning at the fifth injection cycle, an estrous cycle was
synchronized by two intramuscular injection of 0.15 mg d-cloprostenol (PGF2α analogue; Dalmazin, Fatro, Italy) given 11 days apart. Starting at the synchronized estrus, ovaries were examined daily by ultrasonography for a single estrous cycle. Ultrasound examinations were performed by an ultrasound scanner (Aloka SSD-500, Aloka CO. Ltd., Tokyo, Japan) equipped with a 7.5-MHz linear rectal probe. follicles were classified in three categories according to their size: small (3<diameter<5 mm), medium (6<diameter<9 mm), large (>10 mm). The number of all follicles and the number and the diameter of medium and large follicles were recorded each day. Data were analyzed by a standard statistical analysis (SAS, GLM Procedures). The start of a follicular wave was defined as the day of increasing in the number of medium follicles that was preceded by a day with an increase in the number of small follicles. Dominant follicles were identified as a follicle >10 mm in diameter and persisting for at least 5 days. Daily ultrasound records ended on the day of subsequent estrus and cows were inseminated 12 hours after the onset of estrus with frozen semen from a single sire.

RESULTS AND CONCLUSIONS – Milk yield significantly (P ≥ 0.05) increased after r-bST treatment, remaining higher than control group for the whole treatment period (Fig. 1). Average daily milk yield during the weeks of the study was 24.5 kg/d and differed (P ≤ 0.001) between r-bST and control cows (26.32 kg/d vs 22.63 kg/d, respectively). The dairy curve was similar in both groups but r-bST cows had a peak milk yield of 31.4 kg/d during week 10 of lactation compared with 28.2 kg/d during week 4 for control cows.

Average monthly body condition score during the weeks of the study was 2.0 (range 1.63 to 2.52) and did not differ (P ≤ 0.38) between r-bST and control cows (1.95 vs 2.05, respectively). Beginning at the fourth postpartum month, BCS significantly increased in control group (Fig. 2) and at the end of the trial it was 2.30 in r-bST and 2.52 in control group (P ≤ 0.05). Plasma concentrations of IGF-I significantly increased in treated cows (Fig. 3). Most cows had more than two follicular waves: in this study we report data for the first and second follicular waves because all cows had at least two follicular waves. At the start of the synchronized estrous cycle (d 1 to 3), i.e. throughout the first follicular wave, small follicles increased (Fig. 4); a second increase of small follicles number was observed dur-

![Figure 1. r-bST effect on milk production (kg; mean ± s.d.).](image)

![Figure 2. r-bST effect on BCS (mean ± s.d.).](image)

![Figure 3. r-bST effect on IGF-1 serum concentration (mean ± s.d.).](image)

![Figure 4. Small follicles number (mean ± s.e.) in treated (r-bST) and in control (C) cows.](image)
ing the second follicular wave (d 8 to 12; fig. 4). The number of small follicles was significantly (P ≤ 0.001) higher in r-bST cows than in control ones (10.1 mm vs 7.2 mm). Following increase in small follicles, the number of medium follicles increased about at 4th and 14th day of the estrous cycle (Fig. 5) and this increase was in association with the first and second ovarian follicular waves. r-bST cows showed a significantly (P ≤ 0.001) higher number of medium follicles than control ones (5.7 mm vs 3.7 mm; Fig. 5).

Treatment showed no effect on number of large follicles in treated (r-bST) and in control (C) cows (1.8 mm vs 1.6 mm; fig. 6). Particularly the number of large follicles increased between day 4 and 9, associated with a period of dominance during the first follicular wave; a second increase was observed around day 15, corresponding at the second wave dominant follicle.

No difference was observed on diameter of the first wave dominant follicle in r-bST and in control cows (11.8 mm vs 11.8 mm). Particularly, the first wave dominant follicle grew from 4.2 mm (day 1 of the estrous cycle) to a maximum diameter of 16.2 mm (day 10 of the estrous cycle), without significant differences between groups. Mean diameter of the dominant follicle of the second follicular wave (day 10 to 21) was higher (P ≤ 0.05) in treated cows (9.8 mm) than in control ones (8.5 mm). As determined by ultrasound, the growth of the first wave dominant follicle was unaffected by r-bST treatment (De La Sota et al., 1993) but the start of the second follicular wave was significantly (P ≤ 0.001) earlier (Lucy et al., 1994) in treated cows than in control ones. There was no difference in interval to estrus, in length of the estrous cycle and in the percentage of cows that conceived.

In conclusion, treatment with r-bST increased the milk production (+15.0%), the BCS and the concentration of serum IGF-I. Cows had a similar pattern of follicular development, but treated cows tended to have more small and more medium follicles than did the control ones. The growth of the first wave dominant follicle was unaffected by r-bST treatment; however, the onset of the second follicular wave was earlier in treated cows. This suggests that numerous unknown factors, including concentrations of IGF-I, can modify the timing of the second follicular wave.

REFERENCES – Chilliard, Y., Collereau J.J., Disenhaus, C., Lerondelle, C., Mouchet, C., 1998. Paris A, L’hormone de croissance recombinante: intérêt er risques potentieis de son utilisation pour la production laitière bovine, INRA Prod Anim, 11, 15-32. **De la Sota**, R.L., Lucy, M.C., Staples, C.R., Thatcher, W.W., 1993. Effects of recombinant bovine somatotropin (sometribove) on ovarian function in lactating and non lactating dairy cows, 76, 1002-1013. **Etherton**, T.D., Bauman, D.E., 1998. Biology of somatotropin in growth and lactation of domestic animals. Physiological Reviews 78, 745-760. **Jimenez-Krassel**, F., Binelli, M., Tucker, H.A., Ireland, J.J., 1999. Effect of Long-Term Infusion with Recombinant Growth Hormone-Realising Factor and Recombinant Bovine Somatotropin on Development and Function of Dominant Follicles and Corpora Lutea in Holstein Cows. J. Dairy Sci., 82. 1917-1926. **Kronfeld**, D.S., 1994. Health management of dairy herds treated with bovine somatotropin. Journal of the American Veterinary Medical Association 204(1), 116-130. **Kronfeld**, D.S., 1997. Recombinant bovine somatotropin: ethics of communication and animal welfare. Swedish Veterinary Journal 49, 157-165. Lucy, M.C., Curran, T.L., Collier, RJ, Cole, W.J., 1994. Extended function of the corpus luteum and earlier development of the second follicular wave in heifers treated with bovine somatotropin. Theriogenology; 41:561-572. **Wells**, S.J., Trent, A.M., Collier R.J., Cole, W.J., 1995. Effect of long-term administration of aprolonged release formulation of bovine somatotropin (sometribove) on clinical lameness indairy cows, Am J Vet Res, 56, 992-996.