

INFLUENCE OF SODIUM BUTYRATE AND TRIBUTYRIN ON MITOTIC INDEX IN SHEEP RUMINAL EPITHELIUM

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Introduction

The rapid intraruminal injection of sodium n-butyrate increased the mitotic index (MI) in the basal cells of the sheep ruminal epithelium at 24 hours after the infusion (Sakata and Tamate, 1978b). The daily same infusion increased MI but the daily continuous infusion of butyrate decreased MI although the high concentration of ruminal butyrate was recorded (Gálfi et al., 1986). Therefore, it is unclear whether butyrate itself stimulates or inhibits the cell proliferation in ruminal epithelium. In this study, butyrate decreased MI in the ruminal epithelium of sheep.

Materials and Methods

In Exp. 1, five adult male sheep (37-55 kg) were given 500 g of orchard grass hay and 350 g of concentrates once daily at 10:00. Sodium n-butyrate (18 mM/kg, 10% solution), tri-n-butytrin (6 mM/kg, 10% suspension) or saline was injected through a rumen fistula at 10:00. Ruminal papillae were taken at -1, 1, 4, 7 and 11 hours after the injection. In Exp. 2, two adult male sheep (35 and 43 kg) were fed 350 g of orchard grass hay and 150 g of concentrates twice daily at 6:00 and 18:00. Sodium n-butyrate (9 mM/kg BW, 10% solution) or saline was infused into rumen at 11:00. Ruminal papillae were taken at -0.5, 1, 4 and 7 hours after the infusion. Ruminal papillae were biopsied from *atrium ruminis* with a pair of forceps through the rumen fistula. The samples were fixed in buffered formalin and embedded in paraplast. Four-micron sections were stained with PAS-hematoxylin. The numbers of basal cell nuclei and mitotic nuclei in the epithelium were counted and MI was calculated.

Results

Results of Exp. 1 are illustrated in figure 1. At 1 hour after the intraruminal injection of sodium n-butyrate, the average MI decreased significantly to 0.15% from 0.45% at 1 hour before the injection. Then, the value returned at 4 hours (0.46%) and 7 hours (0.54%) after the injection to the

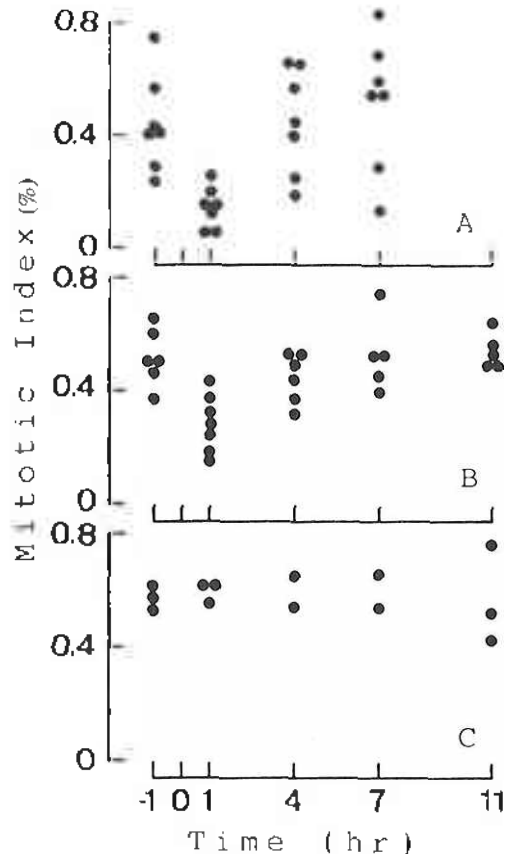


Figure 1. Mitotic index in sheep ruminal epithelium before and after the injection of (A) sodium n-butyrate, (B) tributyrin, or (C) saline.

level at 1 hour before the injection. Also, at 1 hour after the infusion of tri-n-butyrin, the average MI decreased significantly to 0.30% from 0.52% at 1 hour before the injection and then MI returned to the initial level at 4 hours (0.45%) and 7 hours (0.54%) after the injection. Saline injection did not change MI value.

Results of Exp. 2 are shown in figure 2. Sodium n-butyrate injection markedly depressed MI at 1 hour after the injection and then at 4 and 7 hours after the infusion MI returned to the regular level as shown in twice daily feeding (Ohwada and Tamate, 1983). Saline injection did not affect MI value.

Discussion

The rapid intraruminal infusion of sodium n-butyrate or tri-n-butyrin clearly decreased MI in the sheep ruminal epithelium at 1 hour after the injection (figure 1 and 2). Immediately after the injection, the intraruminal concentration of butyrate may show a temporary and unusual high value. MI showed a lower value when the daily continuous infusion of sodium n-butyrate caused an increase of the intraruminal concentration of butyrate (Gálfi et al., 1986). In the circadian rhythm of MI in the sheep ruminal epithelium, MI

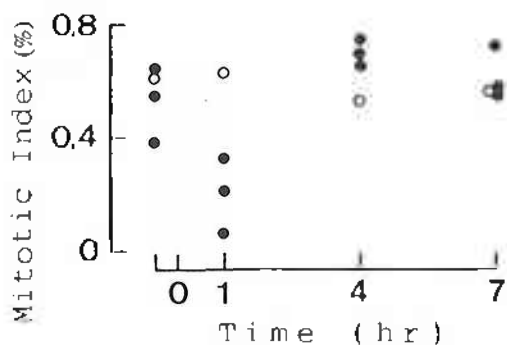


Figure 2. Mitotic index in sheep ruminal epithelium before and after the injection of sodium n-butyrate (●) or saline (○).

showed the lowest value at 1 hour after a feeding (Ohwada and Tamate, 1984; Sakata and Tamate, 1978a). Butyrate inhibited DNA synthesis of the epithelial cells of bovine rumen in primary cell culture (Gálfi et al., 1981). We think these results suggest that butyrate itself should inhibit the cell proliferation in the ruminal epithelium.

When the ruminal epithelium showed the increased MI, there was the temporary increasing to the unusual high level and the returning to the common level of the concentration of intraruminal butyrate (Gálfi et al., 1986; Sakata and Tamate, 1978b). And there was a long time lag, 24 hours or more, between the peak of butyrate concentration and the peak of MI (Sakata and Tamate, 1978b). We think the increase of MI after the intraruminal infusion of butyrate may show the reaction of the ruminal epithelium against to the temporary and unusual high concentration of intraruminal butyrate.

(Key Words: Butyrate, Cell Proliferation, Ruminal Epithelium)

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