

How Fast Does the Rumen Adapt?

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Weaning and parturition are two critical stages where dairy cattle are at high risk for rumen acidosis; partially caused by abrupt dietary change. Recent studies have suggested that the severity of rumen acidosis could be minimized if the absorptive capacity of the rumen wall is promoted. Adaptation of the rumen wall involves both increases in the functional activity of the cells and increases in surface area. However, some studies suggest that adaptation occurs within 3 to 4 weeks compared to others indicating that adaptation takes place within 6 to 8 weeks.

The objectives of this study were to determine the rate of adaptation of the rumen wall following an abrupt change to a highly fermentable diet. Twenty-five weaned Holstein bull calves were randomly assigned to 1 of 5 treatments. Calves were either fed the control diet (**CON**; 91.5% hay and 8.5% vitamin and mineral supplement) or were fed a diet consisting of 41.5% barley grain, 50% hay, and 8.5% vitamin and mineral (DM basis) for 3 (**G3**), 7 (**G7**), 14 (**G14**), or 21 d (**G21**). All calves were fed at 2.25% BW at 0800 h. Rumen pH was recorded every 5 min for 48 h prior to killing (1000 h). Rumen tissues were analyzed for papillae density and dimensions, and the absorption rate of acetate and butyrate (two important energy substrates) were measured in vitro.

Mean rumen pH decreased (quadratic $P < 0.01$) from 6.90 for CON to 6.59 for G7 but increased thereafter. The proportion of mature papillae decreased cubically ($P = 0.04$) from 67.7 for CON to 63.2% for G21, with the lowest being 48.8% for G14. Papillae surface area (mm^2) and total surface area (mm^2/cm^2) was not affected ($P > 0.05$). Epithelial tissue weight was also not affected ($P > 0.05$) whereas muscle tissue weight increased on d 7 and 14 and then decreased (quadratic $P = 0.02$). The absorption rate of acetate increased cubically ($P = 0.045$; greatest rate on d 14) and the absorption of butyrate increased linearly ($P < 0.01$; greatest rate on d 21).

Implications: This study indicates that functional adaptation (increased rates of absorption) of the rumen wall occurs rapidly with measurable changes apparent within one week after a change in diet fermentability. Comparatively, increases in the absorptive surface area were not observed within 21 d. Future work is required to fully develop dietary adaptation strategies that minimize the risk of rumen acidosis.