

Amount and Type of Dietary Fatty Acids Affect Fatty Acid Composition of the Ruminal Epithelium and Short-chain Fatty Acid Absorption

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Dietary fatty acids (FA) have been reported to alter the fatty acid composition of muscle and adipose tissue; however, it is not clear if FA composition of the rumen epithelium changes and whether FA supply affects nutrient absorption. The objective was to evaluate the effect of FA supply and FA composition on FA profiles of the rumen epithelium and absorption of short-chain fatty acids (SCFA).

Twenty-one Holstein steers (194 ± 10.7 kg) were randomly assigned to 1 of 3 treatments. The control (CON) contained 2.9% ether extract whereas the FA treatments contained 6.2% ether extract with the lipid coming from saturated (SAT; tallow and palmitic acid) or unsaturated sources (UNSAT; flax and Megalac). All calves were fed at 3% body weight. After 30-d, samples of ruminal digesta, blood, and ruminal tissue were collected for FA analysis. Ruminal tissue was also used to evaluate SCFA uptake and flux in Ussing chambers.

Supplemental FA increased ($P < 0.01$) the concentration of FA in ruminal fluid from 0.30 for CON to 0.54 g/100 g, but SAT and UNSAT did not differ. Feeding UNSAT decreased the proportion of saturated FA and increased the proportion of mono and polyunsaturated FA in ruminal fluid. The ruminal concentration of FA tended to be greater for FA calves ($P = 0.10$) and tended to be greater for UNSAT vs. SAT ($P = 0.06$). Ruminal tissue from UNSAT had greater omega-3 and polyunsaturated FA ($P \leq 0.03$) and tended to have greater monounsaturated FA ($P = 0.08$) than SAT. Calves fed supplemental FA tended ($P = 0.05$) to have greater propionate uptake and had greater ($P = 0.03$) butyrate uptake than CON. Uptake of propionate tended to be greater (0.73 vs. 0.49 nmol/mg protein/min; $P = 0.08$) for SAT than UNSAT due to greater passive diffusion (0.48 vs. 0.38; $P = 0.02$). Butyrate uptake was 44% greater for SAT than UNSAT ($P < 0.01$). Calves fed FA tended to have greater propionate flux than CON (0.65 vs. 0.56 $\mu\text{mol}/\text{cm}^2/\text{h}$; $P = 0.07$). The flux of acetate, propionate, and butyrate did not differ between UNSAT and SAT.

Implications: Providing supplemental fatty acids alters ruminal epithelial FA composition and may enhance SCFA absorption relative to non supplemented calves. In addition, the provision of saturated fatty acids may enhance SCFA absorption thereby contributing to improved energetic efficiency.