Effects of ruminal short-chain fatty acids and pH on performance and hindgut fermentation of pre-weaned dairy calves

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While the importance of pH and short-chain fatty acids on rumen development are well-known, their impact on the intestine is unclear. We investigated the effects of ruminal SCFA concentrations and pH on calves' performance and hindgut fermentation. Holstein bull calves (n=32) were individually housed and fed milk replacer (900g/d) twice daily and calf starter *ad libitum*. At 10 ± 3 days of life, the rumens were fistulated and cannulated. On days 21, 35, and 49, feces were sampled to calculate apparent total tract digestibility (ATTD), digesta pH, as well as SCFA, BCFA, and lactic acid concentrations. Afterward, the rumen was evacuated and washed for 4h with one of four treatment buffers, assigned in a 2×2 factorial arrangement of high or low SCFA (285 vs. 10 mM) and high or low pH (6.2 vs. 5.2). The four treatment groups were: High SCFA, high pH (HS-HP); high SCFA, low pH (HS-LP); low SCFA, high pH (LS-HP); and low SCFA, low pH (LS-LP). After completion of rumen wash on d49, calves were harvested, and the tissue weight, length, and digesta pH of the rumen, cecum, colon, and rectum were recorded along with the digesta pH of duodenum, jejunum, and ileum. Data were analyzed with main factors as fixed effects and repeated measures for weekly measurements. Treatment and age did not affect ATTD, feed intake, body weight, and hindgut length and weight**.** In the duodenum, jejunum, and ileum, HS-HP had a greater digesta pH than LS-HP ($P = 0.05$, $P = 0.04$, $P < 0.01$, respectively). In comparison, only the high SCFA groups had a greater digesta pH in the colon and rectum ($P < 0.01$) and tended to have the same effect in the cecum digesta pH ($P = 0.06$). Colonic acetic acid ($P = 0.05$) and fecal lactic acid ($P < 0.01$) concentrations were lowest in the HS-LP group. Fecal SCFA and BCFA increased on d35 ($P < 0.01$). In summary, 4 hours of buffer infusion in the rumen did not change feed intake, body weight, ATTD, and hindgut weight and length. However, hindgut digesta organic acid concentrations and pH were changed by ruminal infusion.
Take home message: changes in the rumen environment can affect the hindgut fermentation in pre-weaned dairy calves.

Genetic engineering of a mycobacteriophage such that it is a better candidate for phage therapy against *Mycobacterium avium* subsp *paratuberculosis*

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Bacteriophages, viruses that infect bacteria, could be allies in our fight against Johne's disease. This disease has no effective treatments nor any completely protective vaccines. In addition to animal welfare concerns, it is a major cause of economic losses in the meat and dairy industries in Alberta and around the world. The infection is caused by a bacterium called *Mycobacterium avium* subsp. *paratuberculosis* (MAP). The De Buck laboratory has already tested the efficacy of using bacteriophages as a preventative treatment for this disease in an experimental infection trial. Calves were given a cocktail of nine different bacteriophages along with being exposed to MAP. The results of that trial indicated that the phages provided near complete protection against any of the calves developing Johne's disease after exposure, compared to calves that did not receive the phage cocktail. To conclude the trial, the calves were tested for any phages that remained in their digestive tracts long after the last time the cocktail was administered. Building on these advancements, I will be sequencing the genomes of phages that were found at the end of the trial to try to elucidate the reasons why these species persisted over others. The result of the sequencing is expected to result in a genome map of each phage and an analysis of persistent phages. I will then use the latest techniques to bioengineer these phages so that they adhere to the standards that are set for most phage applications in the agriculture sector. Phage bioengineering may help bring us closer to a future in which the development of Johne's disease can be prevented before it even has a chance to establish in calves.
Take home message: A cocktail of different viruses that infect bacteria (phages) were administered in a calf trial by the De Buck Laboratory and successfully prevented the establishment of Johne's disease. Next, the viruses will be bioengineered to improve their suitability for further explorations in phage therapy that aims to prevent Johne's disease establishment in calves.