The Impacts of Dual Variation of pH and Passage Rate on Methane Production

Author: Logan Morris

Major: Animal Science

Project Advisor: Jeff Firkins

Methane is a greenhouse gas that is produced in large quantities by dairy cattle. Decreased rumen pH and high solid matter passage rate (k_p) impacts microbial populations by decreasing substrate digestibility, resulting in a shift of metabolic pathways in favor of propionate production. A regeneration of NADH occurs when propionate is produced; thus, a decrease in the formation of hydrogen (H_2) and a substrate ensues for methanogens to produce methane. In this experiment, the impact on gas production of variation in two variables pH and k_p, when controlled jointly, were studied. It is expected that methane production will be greatest when rumen pH is high and k_p is low. In a 4x4 Latin square continuous culture fermenter trial, gas data were measured. Treatments were normal pH (6.3-6.9), low pH (5.8-6.4), high k_p (5%/h) and low k_p (2.5%/h). Methane production was greatest when k_p was low ($P<0.05$), but a further increase in production occurred when pH was increased ($P<0.05$). A review of results demonstrates that pH and k_p endure a positive associative effect on methane production thus supporting that substrate digestion has the greatest impact. The co-variable relationship displays that pH effects outweigh those of k_p. When pH is inhibitive to substrate digestion, methane production levels sink at 6-8 hours post feeding, but compensatory digestion of the inhibited cultures occurs later in the day. The effects of pH are greatest 6-8 hours post feeding when VFA production peaks and pH levels reach their minimum, whereas k_p impacts occur throughout the day. These experimental results allow us to better predict the production of methane gas when dietary conditions cause variation in rumen pH and passage rate.