Changes in cecal environment and forage intake of horses fed increasing amounts of starch

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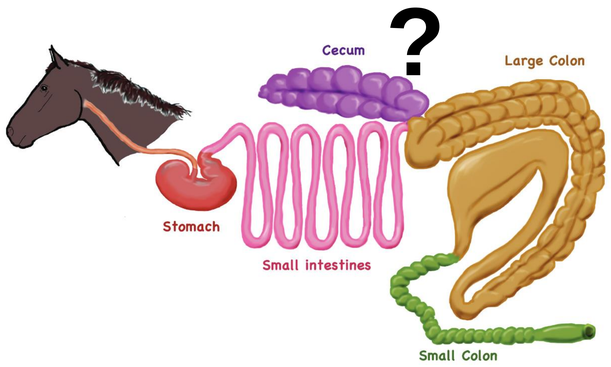
Introduction

- Limited research suggests the upper limit of small intestinal starch digestion is 2 to 4 g starch/kg BW/meal.
- Rapid fermentation of large quantities starch may lead to severe health issues such as acidosis and laminitis. However, the effect of increasing starch on the cecal environment remains relatively unknown.



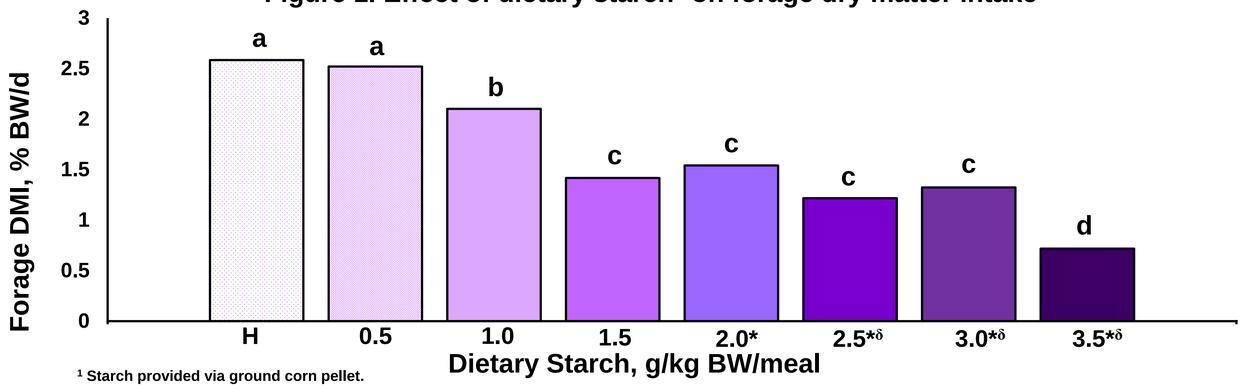
Huguet and Duberstein, 2015.

Objective: Determine effect of increasing levels of dietary starch on the cecal environment and voluntary forage dry matter intake in horses.

Materials and Methods

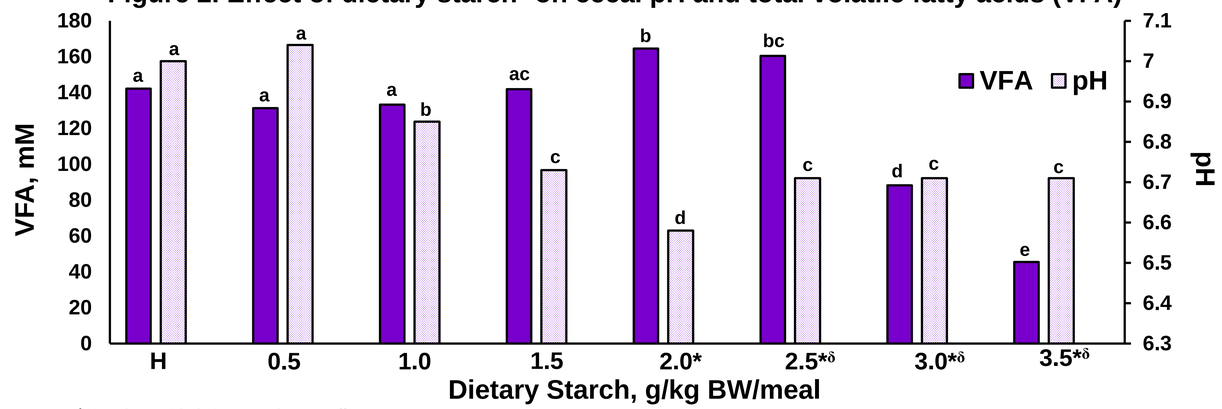
- Six cecally cannulated Quarter horses (8 to 13 yr; 524 ± 65.5 kg BW) were used in a dose titration style design.
- On d -14, horses were provided *ad libitum* Smooth Bromegrass hay and a ration balancer (0.0125% BW 4 times/d).
- On d 1, pelleted corn (69.4% starch) was offered at 0.5 g starch/kg BW/meal with meals fed 4 times every 24-h at 0600, 1200, 1800, and 2400 h.
- Fed refusals were measured on d 6 and 7 of each treatment period to determine forage dry matter intake (DMI).
- Body weights were obtained on d 6 of each period to calculate the amount of starch to feed next treatment period.
- Cecal samples were obtained on d 7 of each treatment period. Cecal digesta was analyzed for pH upon collection. Cecal fluid was then strained through 4 layers of cheesecloth, deproteinized with 25% m-phosphoric acid at a ratio of 4:1, and stored at -20ºC until analysis. Cecal fluid was analyzed for volatile fatty acid (VFA) using an Agilent 7890 gas chromatograph (Agilent Technologies, Santa Clara, CA).
- Daily vitals (heart rate, respiratory rate, body temperature, and capillary refill time) as well as hoof temperature using a thermal camera were used to monitor health of horses.
- Data were analyzed as a randomized complete block design using SAS (Version 9.4) with fixed effect of treatment and random effect of horse. Significance was declared at $P < 0.05$ and a tendency declared when $0.05 < P < 0.01$.

Figure 1. Effect of dietary starch[1] on forage dry matter intake[2]



[1] Starch provided via ground corn pellet.
[2] Feed refusals were recorded on d 6 and 7 of each treatment period.
[abcd] Means without a common superscript differ, P < 0.05.
[*] For treatment 2.0 n=5, for treatment 2.5 n=4, and for treatments 3.0 and 3.5 n=3.
[δ] Horses did not consume the full meal for treatments 2.5, 3.0, and 3.5 g starch, and on average consumed 2.1, 2.72, and 2.68 g starch (respectively).

Figure 2. Effect of dietary starch[1] on cecal pH and total volatile fatty acids (VFA)[2]



[1] Starch provided via ground corn pellet.
[2] Total VFA represents the sum of acetate, propionate, butyrate, isobutyrate, isovalerate, valerate, isocaproate, caproate, and heptanoate.
[abcd] Means without a common superscript differ, P < 0.05.
[*] For treatment 2.0 n=5, for treatment 2.5 n=4, and for treatments 3.0 and 3.5 n=3.
[δ] Horses did not consume the full meal for treatments 2.5, 3.0, and 3.5 g starch, and on average consumed 2.1, 2.72, and 2.68 g starch (respectively).

Results

- As starch intake increased, forage DMI decreased ($P < 0.0001$).
- Greatest VFA concentration ($P < 0.05$) and a lower pH ($P < 0.05$) was observed in horses consuming 2.0 g starch/kg BW.
- Total VFA concentration decreased ($P < 0.05$) and pH increased ($P < 0.05$).when horses consumed > 2.0 g starch/kg BW.

Conclusions

- As previously described in ruminants, voluntary forage DMI decreases as starch supplementation increases.
- Contradictory to prior belief, cecal acidosis was not observed for horses consuming ≥ 2.0 g starch.
- Starch consumption ≥ 2.0 g/kg BW/meal may lead to dysbiosis and impaired fermentative activity, as suggested by decreased total VFA concentrations.