5. Effect of different levels of soluble carbohydrates in hay on ruminal fermentation, microbial profile and plasma acute phase protein concentration in dairy cows

Einfluss von unterschiedlichen Gehalten an löslichen Kohlenhydraten in Heu auf die Fermentation und die mikrobielle Zusammensetzung im Pansen sowie die Konzentration an Akutphasenproteinen im Plasma von Milchkühen

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In spring and autumn, the content of water soluble carbohydrates (WSC) in fresh and preserved forage can increase to an extent that the recommended intake of WSC (75 g/kg DM, (1)) for dairy cows is exceeded by far with a forage based diet. High intake of WSC can cause ruminal acidosis and lead to associated health problems like laminitis (2). The objective of the present study was, therefore, to determine the impact of two different levels of WSC in a hay based diet on ruminal fermentation and microbial profile, and plasma acute phase proteins in dairy cows.

Methods: The experiment had a crossover design with eightHolstein cows which were 74 ± 18 d in milk and produced 37 ± 4.3 kg/d of milk. The two experimental periods consisted of a 14 d adaptation period and a 7 d data collection period each. The cows were offered diets which consisted of hay (containing a high percentage of perennial ryegrass) with either a high (WSC-H, 354 g/kg dry matter (DM)) or a moderate content of WSC (WSC-M, 128 g/kg DM). All cows were supplemented with a cereal based and a soybean expeller based concentrate to meet their predicted nutrient requirements. The diet was divided into two equal parts which were offered at 0700 and 1630 h. During each collection period milk yield, milk composition and feed intake were determined daily. Ruminal pH was measured continuously for 2 × 3 d using an indwelling pH probe. The minimum, maximum and mean pH were determined as well as the duration of time when pH dropped below 5.8, 5.5 and 5.2. On d 2 and 5 of each collection period volatile fatty acids and bicarbonate were analysed in ruminal fluid sampled at 0600 and 1400 h and selected microbial populations were identified using real time PCR. At the same times blood was taken from the jugular vein to determine acute phase proteins. Data were evaluated by analysis of variance with dietary treatment and sampling time (only for ruminal fluid and blood traits) as fixed effects in the model.

Results: At similar DM intake (hay, 16.4 kg/d; concentrate, 5.3 kg/d) WSC-H cows ingested, as expected, more (P<0.01) WSC (6.2 vs. 2.4 kg) and produced more (P=0.01) milk with a higher (P<0.01) protein but a similar fat content compared to WSC-M cows. The minimum pH was lower (5.19 vs. 5.28; P=0.02) and the maximum pH tended to be higher (6.59 vs. 6.48; P=0.07) in WSC-H cows compared to the WSC-M cows. Time periods below ruminal pH threshold values of 5.8 and 5.5 did not differ but time period below 5.2 tended to be longer (P=0.09) for WSC-H cows compared to WSC-M cows. Feeding WSC-H hay increased ruminal populations of lactate producing bacteria *S. bovis* (P<0.01), *Lactobacillus* (P<0.01) and the lactate consuming *M. elsdenii* (P=0.02) and decreased the populations of fibrolytic bacteria *F. succinogenes* (P<0.01) and *R. albus* (P<0.01). Concomitantly, ruminal lactate concentration was higher (P=0.02) in WSC-H cows compared to WSC-M cows. Furthermore, ruminal acetate concentration decreased (P<0.01) in favor of those of propionate and butyrate when WSC-H hay was fed. Bicarbonate concentration did not differ between treatments. Overall, concentrations of ruminal fermentation products were lower (P<0.05) at 0600 compared to 1400 h. Concentration of plasma acute phase proteins did not differ between treatments and between sampling times. Solely, haptoglobin tended to be higher (P=0.06) at 0600 compared to 1400 h.

Conclusion: High intake of WSC altered ruminal microbial profile and pattern of fermentation but had no effect on plasma acute phase proteins. The increasing population of *M. elsdenii* indicates that the microbial community can contribute to the ruminal pH regulation capacity.

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