Absorption capacity of the rumen of dairy cows during transition

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The reticulo-rumen of ruminant species is an ingenious system able to degrade the complex carbohydrates present in diets of herbivores, such as cellulose and hemicellulose by microbial fermentation. The volatile fatty acids (VFA) produced during fermentation are the main source of energy for ruminants. To be able to absorb these VFA from the voluminous mass and fluid in the rumen, the rumen wall is covered for about 80% with rumen papillae. These rumen papillae realize a four to tenfold increase in absorption surface as compared with the bare rumen wall. Furthermore, ruminal contractions help to mix and redistribute the rumen contents, to improve the absorption of the VFA at the papilla surface. The size and number of papillae vary as a result of a dynamic process, affected by the concentration of VFA, ammonia, pH and osmotic pressure in the rumen as well as by internal factors such as glucose and insulin concentration (Sakata, 1980).

Independent of age or lactation stage, changes in ration composition or dry matter intake level can affect papilla dimensions. Generally, during the transition period of dairy cattle from a dry period to lactation, both ration and animal physiology change. The ration switches from a dry cow diet to a lactation diet with increased energy density and digestibility, and simultaneously the dry matter intake increases about twofold in the first weeks of lactation. These changes result in adaptation processes in the rumen wall by papilla growth for increased absorption. The rate of change is influenced by the increase in dry matter intake as well as feeding strategy; changes in feed intake and strategy will need at least four weeks to reach a new equilibrium (Bannink et al., 2008). A strategy to reduce the need for ruminal adaptation in the transition period may be to feed continuously a lactation diet, pre- and postpartum. This would result in severe overfeeding during the dry period, with an increased risk for health problems postpartum (Rukkwamsuk et al., 1999). By omitting the dry period, energy requirements remain relatively high in the last weeks prepartum and the health risks of overfeeding are reduced. Also shortening the dry period to four weeks may affect rumen adaptation, because the duration of the period when less fermentable dry cow diet is offered to the rumen is reduced.

To evaluate the effect of dry period length on rumen papillae dimensions of dairy cows around parturition we performed a trial with twelve rumen-cannulated first parity Holstein dairy cows. Cows were assigned to a dry period length of 60 (G60), 30 (G30) or 0 (G0) days. The experiment started 60 days before expected calving date and lasted until wk8 postpartum. Cows received ad libitum forage mixtures of corn silage, grass silage and straw (dry cow diet containing 12% CP, 5.3 MJ NEL/kg DM and lactation diet containing 15% CP, 6.4 MJ NEL/kg dry matter). Concentrates were fed individually starting 10 days antepartum with 1.0 kg/d until calving, gradually increasing up to 8.5 kg/d at d17 postpartum. Milk yield and dry matter intake were recorded daily. The rumen contents of each cow were evacuated at wk-9, wk-6, wk-2, d3, d7, d14, d28 and d56 relative to parturition. At each time, biopsies were taken to determine papillae dimensions at 3 locations: the right dorsal sac cranially of the dorsal coronary groove.
(DS), the right wall of the caudodorsal blind sac (DB) and the ventral wall of the caudoventral blind sac (VB). Treatment effects were tested by mixed model analysis using REML procedure. Data are presented as means ± SE.

After calving, mean dry matter intake was 21.2, 22.2 and 23.7 (±0.6 kg/d) for G60, G0 and G30 respectively (P<0.05). The average daily milk yield postpartum was significantly lower for G0 (P<0.05) compared with G30 or G60 (35.1 vs. 41.4 and 41.8 ±3.1 kg/d, respectively). At the start of the experiment, there were already some individual differences in papillae dimensions as was also shown in a study with transition dairy cattle by Bannink et al. (2010). For cows with a dry period (G30 and G60), papillae surface area decreased prepartum (P<0.05) when they were fed the dry cow diet. More importantly, during the first two weeks postpartum the papillae growth was significantly delayed for G60 compared with G30. Mean papillae surface in the first two weeks was 42.5, 58.6 and 60.6 (±7.1, P<0.05) mm² for G60, G30 and G0 respectively. Irrespective of treatment, rumen papillae were largest at VB and smallest at DS and papilla surface increased approximately 50% postpartum (P<0.05).

In conclusion, a shortened dry period of 30 vs. 60 days increases the rate of papilla growth in the first weeks of lactation and herewith may improve absorption capacity of volatile fatty acids, without a negative effect on milk yield as found with 0 days dry.

**Literature cited:**

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