6 SUMMARY

Time course of rumen epithelium adaptation to an energy rich diet

In the present study the time course of rumen epithelial adaptation to a dietary change from hay (low energy) to concentrate-supplementation (high energy) was studied for a group of sheep using different approaches. *In vivo,* changes in ruminal fluid parameters and the concentration of IGF-1 in plasma were measured. *In vitro,* the transport of sodium and acetate using the Ussing-chamber-method were determined and the mRNA copy number of different genes was studied. In regard to sodium-transport studies, the regulation of the sodium-transporting proteins NHE1, NHE3, Na-K-ATPase and the NHE regulating factor were the major points of interest. These studies were extended by the examination of further proteins and enzymes known to be important for the pH-regulation and the metabolism of the ruminal epithelial cell.

The *in vivo*-experiments exhibited the following effects:

- In ruminal fluid, the time course of pH, NH_4^+-concentration and osmolality depends on the feed intake.
- The mean daily value of osmolality remained constant throughout the study, while pH and NH_4^+-concentration varied with the feeding regime.
- The concentration of IGF-1 in plasma showed a feed-dependent slow rise up to the 35th day of concentrate-supplementation.

In vitro, the following results were obtained:

- In the Ussing-chamber experiments, a marked increase of the sodium-flux rates in the first week after a change of diet was observed as in previous studies. Subsequently, flux rates remained constant until the last measurement after 6 weeks.
- The absorption of acetate did not rise with energy-intake, and showed a tendency of decrease during the first week after diet change.
- The genes for the sodium-transporting proteins NHE1, NHE3 und Na-K-ATPase and NHE 3 regulating factor 1 (NHERF1) showed no significant increase in relative mRNA copy number. Furthermore, no change in mRNA-level was observed for the other transport-proteins studied (AE2, MCT1), the vacuolar H-ATPase and the enzymes CA1, CA2 and ACS2.

These results do not uncover the mechanisms at cellular level, which are responsible for the diet-dependent increase in sodium-flux rates. The observed increase in activity of NHE has

the capability to extrude H^+, which might be the first line of defence after a rapid uptake of undissociated SCFA at high rates of rumen fermentation. The increase in the absorption of fatty acids in *in vivo*-experiments as reported in the literature can probably be explained by the well-known adaptational increase in size and number of ruminal papillae (enlarged surface-area). Conversely, the acetate-absorption per area as measured in Ussing-chamber experiments remained unchanged, suggesting an uptake mostly via diffusion. The increase in the IGF-1 concentration in plasma could imply a (gene-) regulative mechanism.