SFB 1078

Protonation Dynamics in Protein Function

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Colloquium

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Water and protons in narrow membrane channels

Proton channels fulfill diverse functions. For example, they contribute to cellular immune defense and sperm motility. According to one model, a “frozen” water-wire grants proton selectivity because it prevents other ions from entering the narrow channel while protons may move in a Grotthuss-like fashion over the frozen water molecules. In an attempt to identify structural requirements for intraluminal water immobilization, we monitored water passage through various narrow membrane channels by scanning electrochemical microscopy, light scattering, and vesicle microaspiration. The observed water permeability was determined by the number, N_H, of residues in the channel wall that may form a hydrogen bond with the intraluminal waters. In sharp contrast to the frozen water model, the N_H-criteria predicts a substantial water permeability for the active mammalian voltage-sensitive channel H_v1. However, the reconstituted and functionally active H_v1 did not facilitate water transport. The result is in line with an alternative selectivity model - the shuttle model. This model ascribes proton selectivity to a physical occlusion of the channel lumen by one or more titratable amino acids.

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