Kurzgefasst

• Membranprotein Cytochrom-c-Oxidase “veratmet” Sauerstoff mit Hilfe von Protonen zu Wasser
• Protonen gelangen durch zwei wechselwirkende Kanäle in das Zentrum des Proteins
• Welchen genauen Weg (Transferpfad) nehmen die Protonen in den Kanälen?
• Wie ist der Protonttransport reguliert?

Cytochrom c-Oxidase ist ein Protein der Atmungsstrange, das Sauerstoff reduziert mit Wasserstoffionen. Die Energie dieser Reaktion wird genutzt, um weitere Protonen durch die Membran zu transportieren. Wie gelangen diese Protonen von außerhalb des Proteins durch den Membranprozess?

Abbildung 1: The D and K channel in Cytochrome-c-Oxidase.

An important ingredient in the regulation of the proton uptake through the two channels is a “gate” formed by two asparagine residues in the D channel. This “asparagine gate” shows an open conformation, allowing water and the protons to pass through, only in cases in which the proton still has to be transported. This is further coupled to the hydrogen bond dynamics within the channels. As an additional means for control, the two channels likely “communicate” with each other. Our Simulations show that, for example, the lifetime of hydrogen bonds between residues of the “asparagine gate” and water in the D channel depends on the protonation state of the K channel.

Channel hydration is highly regulated by the presence of local charges. Accordingly via a proton transfer mechanism in particular the D-channel gets hydrated if an access proton is near the entrance. When the proton has passed the asparagine gate the channel gets dehydrated. Due to the correlation of hydrogen bond communication and channel hydration the inter channel communication is indirectly affected by proton transfer. Within the D-channel itself dihedral conformations and hydrogen bonds play an important role just like the presence and location of an access proton at the entrance. They interplay with different protonations of the key residues of the D-channel and regulate the gating zone. Hydrogen bonds formed close to the asparagine gate are highly influenced by the local present of charges (short-range interaction) as well as the protonation of E286 (long-range interaction). But also the spatial fluctuations of water molecules ready to enter the channel as well as those already contained in the channel are strongly mediated by these means.

Weitere Informationen


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Abbildung 2: The conformation in the channels depends on the protonation state.