

Selective Permeability Function of Lysenin Channels

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Abstract:

All living cells create and maintain electrochemical gradients across their membranes by the means of selective permeability, which is paramount for fundamental physiological processes ranging from energy production to communication. Any attempt of constructing an artificial cell-like structure must provide such capabilities for powering the cell. In our search for a transmembrane transporter able to create and maintain electrochemical gradients we focused on lysenin, a pore-forming protein able to self-insert large and extremely stable conductance channels in artificial and natural membranes. With respect to the ability of creating and maintaining electrochemical gradients and the implicit transmembrane voltages, a selective permeability function more complex than molecular sieving must be observed. Unfortunately, this feature has been overlooked in previous reports on lysenin. We set out to conclusively add selectivity to the list of intriguing features of lysenin channels. Our electrophysiology measurements consisted of measuring in non-symmetrical ionic conditions the transmembrane potentials across planar Bilayer Lipid Membranes containing a large population of inserted lysenin channels. The fit with the Goldman Hodgkin Katz equation clearly demonstrated an enhanced permeability of lysenin channels for cations over anions, which translated to yielding strong transmembrane voltages when the channels were exposed to asymmetrical ionic conditions. Potential applications exploiting not only this function, but also the versatility of the lysenin protein in general, could lead to advancements in the understanding of ion channels and permeability functions for use in modes of drug delivery, cell batteries, and any device that requires modulation of ion transport.