Water Permeability of Artificial Lipid Bilayer Membranes

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The water permeability of artificial lipid bilayer membranes has been measured in the past using osmotic pressure gradients.In these experiments, the hydraulic permeability L_p of water for lipid bilayer membranes has been found to be in the order of 2 10^{-6}cm b^{-1} s^{-1} (1,2).In this communication we describe an alternative method for the measurement of the water permeability of artificial lipid bilayer membranes.L_p was measured for the application of a hydrostatic pressure gradient across the membrane.For this purpose the membranes were immobilized on one side by a matrix (thin layers of agarose).Then a hydrostatic pressure gradient of 20 mb to 1 b was established across membrane and matrix.The water flow through the membrane was used to calculate the hydraulic permeability L_p of the membrane.

Under the condition described here L_p was found to be in the order of 10^{-5}cm b^{-1} s^{-1}, a value which is a factor of 5 higher as has been published earlier fof the osmotic pressure (1,2).The volume flow through the membranes was a linear function of time and was almost independent on the type of lipid used for membrane formation.Only cholesterol added to egg-lecithin in a 1:1 molar ratio lowered L_p by a factor of about two.

The difference between the old data for L_p measured with an osmotic pressure gradient and the data reported here for a hydrostatic pressure gradient across the membranes is discussed.According to theoretical considerations (3) it is very likely that the high water permeability of lipid bilayer membranes lowers the osmotic gradient across the membranes. In this case the water transport across the membranes is unstirred layer limited for an osmotic pressure in the order of 1 to 10 b.

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