The Compressibility of Bimolecular Lipid Membranes

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The compressibility of bimolecular lipid membranes (BLM) was studied by the application of hydrostatic pressure (p=1...5 bar) on the hole membrane cell. Under special precautions BLM could be made which withstand alternating pressure without bulging. Capacitance measurements were performed with a resolution of $2 \cdot 10^{-5}$ in $\Delta C/C$. The alternating capacitance change in phase with the alternating pressure gives an estimate for the compressibility of the BLM. For membranes made from dioleoyl-lecithin/ n-decane the result is

$$\frac{\Delta C}{C \cdot \Delta p} = 1.65 \cdot 10^{-4} \text{ bar}^{-1} \qquad \text{at } 20^{\circ} \text{ C}$$

Considering the changes in thickness and polarizability the theory gives

$$\frac{\Delta C}{C \cdot \Delta p} = (1 + (\varepsilon+2)(\varepsilon-1)/(3\varepsilon)) \cdot \kappa$$

$$= 1.81 \cdot \kappa \quad \text{for } \varepsilon = 2.3 \text{ (dielectric constant)}$$

From the experiment follows then $\kappa = 0.91 \cdot 10^{-4}$ bar^{-1}.

Liu & Kay (1977) reported for the disordered phase of DPL the molar compressibility 0.1 ml$\cdot$mol^{-1} bar^{-1}, which corresponds to $\kappa = 1 \cdot 10^{-4}$ bar^{-1}. It can also be compared with the compressibility of n-octane $\kappa = 1.2 \cdot 10^{-4}$ bar^{-1} at 23° C.

1. Liu, N. and Kay, R.L. (1977) Biochemistry 16, 3484