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Understanding the effects of essential amino acid on phospholipid membranes

A biological cellular membrane is the semipermeable surrounding of a cell that controls its physiological activities. It is comprised of various components, including lipids, cholesterol, proteins and ions. L-Phenylalanine (Phe), an essential amino acid for protein synthesis, is often found in food and dietary supplements. Elevated Phe levels in the body can be dangerous and are associated with diseases such as phenylketonuria and hyperphenylalaninemia. Therefore, understanding its interaction with the cell membrane is important. This biophysical study quantifies physical alterations in a model cellular membrane induced by L-Phe. Here, a brain sphingomyelin lipid monolayer with and without a few mol% of cholesterol deposited at the air-water interface is used to mimic one of the leaflets of a cellular membrane. The area occupied by the lipid molecules in the monolayer and its elasticity are found to change significantly following the insertion of L-phe into the lipid monolayer. Interestingly, the uptake of Phe is restricted in the presence of cholesterol. X-ray reflectivity provides structural details of the lipid monolayer and a supported bilayer in the presence and absence of Phe. Modelling the electron density profile of the lipid layer allows us to quantify the difference. We discuss the modified structure and physical properties of the model membrane in the presence of Phenylalanine along with the role of cholesterol.

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Biological membranes and interfaces

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