SELF-ASSEMBLED VESICLES OF MONOCARBOXYLIC ACIDS AND ALCOHOLS: CONDITIONS FOR STABILITY AND IMPLICATIONS FOR A PREBIOTIC AQUEOUS ENVIRONMENT

Charles L. Apel, and David W. Deamer
Space Science Division
Mailstop 245
MASA/Ames Research Center
Moffett Field, CA 94035 USA
capel@mail.arc.nasa.gov

We tested the ability of saturated n-monocarboxylic acids ranging from eight to 12 carbons in length to self-assemble into vesicles, and determined the minimal concentrations and chain lengths necessary to form stable bilayer membranes. Under defined conditions of pH and concentrations exceeding 150 mM, an unbranched monocarboxylic acid as short as eight carbons in length (n-octanoic acid) self-assembled into vesicular structures. Nonanoic acid (85 mM) formed stable vesicles at pH 7.0, the pK of the acid in bilayers, and was chosen for further testing. At pH 6 and below, the vesicles were unstable and the acid was present as droplets. At pH ranges of 8 and above clear solutions of micelles formed. However, the addition of an alcohol (nonanol) markedly stabilized the bilayers, and vesicles were present at significantly lower concentrations (~20 mM) at pH ranges up to 11. The vesicles provided a selectively permeability barrier, as indicated by osmotic activity and ionic dye capture, and could encapsulate macromolecules such as DNA and a functioning protein. This model system proved sensitive to high salt concentrations, especially divalent cations, suggesting that life may have emerged in a fresh water rather than a saline environment.