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Physical properties of model membranes: From membrane asymmetry to vitamin E (I)

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Despite almost 90 years of study the physiological role of vitamin E is still muddied by controversy. Research, both fundamental and clinical, has generated conflicting and contradictory results throughout literature.
Deficiency in α-tocopherol (aToc), the physiological relevant form of vitamin E, has been show to lead to a multitude of conditions including infertility and neuromuscular dysfunctions. Many theories have been brought forward regarding the biological function of vitamin E, these include its being a ligand for some unknown receptor, and an antioxidant. Recent investigations present evidence of an antioxidant mechanism for vitamin E that correlates strongly with its physical location in a model lipid bilayer.
The proposed mechanism addresses the position of aToc in the membrane, how aToc partitions between lipids is lacking. Although assertions have been made, to the best of our knowledge, no direct experimental evidence exists on this topic. We have begun testing the partitioning of aToc into different lipid species and antioxidant hypothesis is reinforced. The data suggest that aToc preferentially resides in disordered membrane systems; those typically susceptible to oxidation. Initial experiments have observed aToc partitioning into fluid (disordered) membranes from ordered gel phase membranes.
We bring our models closer to biological membranes by investigating aToc in membrane "rafts". Lipid-only domains are well-established mimetic systems for membrane "rafts", enabling the study of their physical properties under strictly controlled conditions. We will apply a variety of experimental techniques to study the influence and partitioning of aToc into membrane "raft"compositions (coexisting liquid-ordered (Lo) and liquid disordered (Ld) phases). Preliminary investigations on lipid "raft"forming systems have shown that the introduction of aToc to the membrane increases the amount of the liquid ordered phase. This behaviour is characteristic of aToc driving cholesterol from the disordered phase, furthering demonstrating aToc preferentially partitioning into the oxygen sensitive disordered environments. These insights will help answer the question "does vitamin E partition into lipid domains which are appropriate for an antioxidant function?"

Author: Dr MARQUARDT, Drew (University of Windsor)

Co-authors: Mr DIPASQULAE, Mitchell (University of Windsor); Mr NGUYEN, Michael (University of Windsor); Mr RICKEARD, Brett (University of Windsor)

Presenter: Dr MARQUARDT, Drew (University of Windsor)

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