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Curcumin Protects Lipid Membranes

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Curcumin is the main ingredient in turmeric, a common Indian spice. Curcumin has been used for centuries in traditional medicine, and has been speculated to have anti-inflammatory and anti-oxidant abilities. Modern medicine has also identified a potential anti-Alzheimer's benefit. However there is no good theory of a common molecular mechanism to describe all these benefits. This has led to speculation that curcumin interacts with and protects lipid membranes. However, even the details of this interaction are debated, as researchers observe two kinds of interactions. Curcumin has been observed lying flat on lipid head groups (a carpet model), where it provides a physical barrier to entry into the membrane. Curcumin may also embed deeper in the membrane and stiffen the tails, thereby providing protection.

Using X-ray diffraction and molecular dynamics (MD) simulations, we observe curcumin interacting and binding with lipid bilayers [1]. Most importantly, we observed both the carpet and insertion models. In both simulation and experiment, the hydration water thickness was varied and we found that the insertion model is preferred in fully hydrated environments, whereas the carpet model is preferred in low hydration. In a physiological environment, lipid hydration is controlled by osmotic pressure, i.e. by the concentration of solutes such as proteins and salts. Our results demonstrate that curcumin can be found in both locations, inserted or in carpet, tissue dependent.

[1] R.J. Alsop, A. Dhaliwal, M.C. Rheinstadter. Curcumin protects membranes through carpet or insertion model depending on hydration. Submitted.

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