Ring and tails: exploring the intimacy of cyclodextrin-membrane interactions

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Abstract

Cyclodextrins (CDs) are cyclic, ring-shaped molecules made of sugar moieties, consisting of a hydrophobic cavity and a hydrophilic outer part. Such a structure allows CDs to form inclusion complexes with hydrophobic molecules, where the guest molecule is physically entrapped in the host's (CD) cavity. This feature finds a wide range of applications in drug delivery, pharmaceutical and food industries[1,2], as inclusion complexes with CDs show enhanced bioavailability and longer circulation times.

Recently, αCDs have been reported to directly interact with aliphatic tails of phospholipids from biological[3] and model bilayer membranes[4]. As the tails are not directly accessible for molecules from the aqueous solution, this observation suggests complex interplays and possible membrane remodeling occurring at the CD/membrane/water interface. Interestingly, despite the wide applications of CDs, the essentials of this process and its possible consequences *in vivo* remain poorly understood.

Herein, we use a combination of complementary biophysical techniques to uncover the inner workings of interactions between CDs and model lipid membranes, focusing on CDs' membrane-perturbing properties. Specifically, we employ Quartz Crystal Microbalance (QCMB-D) to reveal variations in viscoelastic properties of a lipid membrane induced by the presence of αCD. Furthermore, the appplication of confocal microscopy and CryoTEM allows us to explore the role of membrane curvature-mediated interactions between αCD and the membrane.

Our studies contribute to the overall biomedical application of CDs as nanocarriers and drug delivery systems. Based on of their demonstrated effectiveness, further progress is warranted.

[1]Loftsson, T., Duchêne D. International Journal of Pharmaceutics 1;329(1-2):1-11. Epub 2006 Nov 9. (2007)
[2]Moya-Ortega, D. M., Alvarez-Lorenzo, C., Cincheiro, A. & Loftsson T. International Journal of Pharmaceutics 428, 152–163 (2012)
[3]Zidovetzki, R., Leviatan, I. Biochimica et Biophysica Acta 1768, 1311-1324 (2007)
[4]Huang, Z. & London, E. Langmuir 29, 14631–14638 (2013)