Interactions of lipidic cubic phase nanoparticles with lipid membranes

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Phospholipid monolayers and bilayers have been used as model systems for biological membranesin studies of the effect of drug and drug carriers on the properties of the biomembranes.
The interactions of liquid-crystalline monoolein (GMO)cubosome nanoparticles with various model lipid membranesspread at the air-solution interface by the Langmuir technique were investigated. Cubosomes have attracted attention as potential biocompatible drug delivery systems, and thus understanding their mode of interaction with membranes is of special interest. Cubosomes spreading at the air-water interface as well as interactions with a monolayer of 1.2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC) compressed to different surface pressures were studied by monitoring surface pressure-time dependencies at constant area. Progressive incorporation of the nanoparticles was shown to lead to mixed monolayer formation. The concentration of cubosomes influenced the mechanism of incorporation, as well as the fluidity and permeability of the resulting lipid membranes.
Brewster angle microscopy images reflected the dependence of monolayer structure on the cubosomes presence in the subphase. A parameter Csat was introduced to indicate the point of saturation of the lipid membrane with the cubosomal material. This parameter was found to depend on the surface pressure showing that the cubosomes disintegrate in prolonged contact with the membrane, filling available voids in the lipid membrane. At highest surface pressures when the layer is most compact, the penetration of cubosomal material is not possible and only some exchange with the membrane lipid becomes the route of including GMO into the layer. Comparative studies of the interactions of lipids with various head group charges with cubosomes suggest that at high surface pressuresthe exchange of lipid component between the monolayer and the cubosome in its intact form may occur.