Quatsomes: Promising Highly Stable Nanovesicles for Drug Delivery

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Abstract

There is a large interest in finding non-lipid building-blocks or tectons, which self-assemble into stable vesicles, and which satisfy the quality standards required in pharmaceutical formulations.[1]
Here we show the ability of quaternary ammonium surfactants and sterols to self-assemble forming stable amphiphilic bimolecular building-blocks with the appropriate structural characteristics to form, in aqueous phases, closed bilayers, which we named quatsomes. Phase behavior analysis of different aqueous mixtures of the quaternary ammonium surfactant CTAB and cholesterol (Chol) have shown that a pure vesicular phase is only formed at equimolar proportions of both components[4]. Molecular dynamic simulations revealed that the cholesterol and CTAB pair works as a unique supramolecular architecture for the formation of more complex colloidal phases such as vesicles. Many functionalities can be implemented simultaneously in quatsomes, either by covalent attachment to sterol like molecules, by electrostatic interaction with the cationic ammonium head of surfactant units or by hydrophobic interaction with the bilayer. These possibilities open a broad range of applications in pharmacy[5], cosmetics and materials synthesis.

When prepared by using compressed fluids (DELOS-SUSP method)[2], these colloidal structures are stable for periods as long as several years, their morphology do not change upon rising temperature or dilution, and show outstanding vesicle to vesicle homogeneity regarding size, lamelarity and membrane supramolecular organization.[3]

It is worth to say, that all these structural attributes are relevant quality data, fulfilling requests of EMA and FDA to support a marketing authorization of any new nanomedicine candidate. Quatsomes have the appropriate physico-chemical and biological characteristics to be used as topical drug delivery systems[3,4].

References

1. M. Antonietti et al., Adv. Mater. 2003, 15, 1323.
2. I.Cabrera et al. Nano Lett. 2013, 13, 3766−3774
3. E. Elizondo et al., J.Am.Chem. Soc. 2012, 134, 1918
4. L. Ferrer-Tasies et al, Langmuir 2013, 29, 6519−6528
5. N. Ventosa et al., Patent Appl. WO2014/019555