Using lipids from algal biomass to obtain multicompartment nanocarriers for curcumin delivery

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Lipids are macromolecules with rich polymorphism that results in a wide range of possible supramolecular aggregates, mainly influenced by the lipid class and packing parameter which determine the possible values of interfacial curvature, and thus the attainable supramolecular symmetries. Such systems can be broadly differentiated in two large categories, lamellar and nonlamellar lipid structures. Lamellar aggregates are characterized by the presence of one or multiple bilayers self-assembling with vesicular morphology. Nonlamellar mesophases are lyotropic liquid crystalline systems which differ from liposomes and other globular aggregates in dilute regimes due to their inner ordering. It is known that a rich variety of biocompatible nanosystems can be obtained from natural lipids, to be exploited as delivery agents for bioactive compounds. Here are presented novel nanosystems obtained with lipids extracted from the marine microalga *Nannochloropsis* sp in two different growth conditions. This led to two chemically affine but structurally distinct nanovectors series, one exhibiting complex nonlamellar symmetry, the other a more commonly found lamellar phase (Figure 1). The structures were investigated and the two series were evaluated as potential carriers for natural lipophilic antioxidants (i.e. curcumin, tocopherol, piperine), whose commercial use is traditionally hindered by their poor water solubility. The overall structural arrangement was studied by Dynamic Light Scattering, Small Angle X-Ray Scattering and Cryogenic Transmission Electron Microscopy. The cargo entrapment and localization properties were investigated by spectroscopic techniques (UV–Vis and Nuclear Magnetic Resonance, respectively), and the carrier efficacy was compared taking into account their different structures and following an integrated chemical and biological approach.

The physico-chemical characterization of the vectors evidenced coexisting multicompartment mesophases, the most predominant one being of cubic symmetry for nonlamellar nanosystems and globular-shaped for lamellar ones. Investigation of cargo localization showed that the loaded molecules played an active role in driving the interactions which characterize the supramolecular structure of the aggregates. Indeed, such compounds can intercalate in lipid bilayers and interact with each other in this environment, generating synergist effects and interesting structure-function properties related to potential drug delivery with high efficiency.

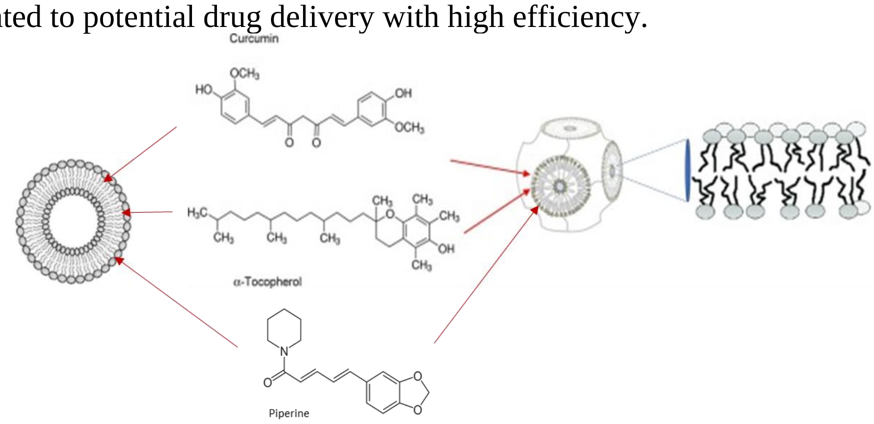

Figure 1. Graphical representation of the two series of nanocarriers and the encapsulated molecules

References

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