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Original

Thermal Investigation of the Interaction of Polysorbate Surfactants with Phosphatidylcholine Vesicles

ABSTRACT

Background. Previous studies have shown that PEG-DSPE lipid enhances the physical stability of lipid vesicles. However, there is no study investigating the effect Tween surfactants on the interactive potential of PC-lipid vesicles.

Aims. To evaluate the interaction between Tween-PC lipid vesicles, we developed a new method of obtaining the second virial coefficient of the interaction potential and interactive force between lipid vesicles. Furthermore, we investigated the effect of aggregation and fusion phenomena on the physical stability of Tween-PC lipid vesicles from the perspective of interactive forces and the potential between Tween-PC lipid vesicles.

Methods. Lipid vesicles containing egg-PC, α -tocopherol, and various quantities of polysorbate surfactants (Tween 20 and Tween 80) were prepared using the probe sonication method; the stability of these lipid vesicles was monitored by examining changes in size with time. The zeta potential and the interaction potential between the lipid vesicles were obtained by photon correlation spectroscopy (PCS) and isothermal titration calorimetry (ITC).

Results. Adding Tween surfactants to pre-formed small unilamellar lipid vesicles decreased the net repulsive interaction potential between the lipid vesicles, whereas, the zeta potential of lipid vesicles with the Tween surfactants did not differ much from those without surfactants at 298K. As to the physical stability of lipid vesicles, the experimental results demonstrate that adding Tween surfactants accelerated the change in lipid vesicle size. Furthermore, the differential scanning calorimeter (DSC) spectrum revealed that adding Tween surfactants caused no differences in intravesicle interactions. Therefore, in this work, we demonstrate that Tween surfactants target the intervesicle interaction aspect of the physical stability of lipid vesicles.

Conclusions. These results demonstrate that incorporating Tween surfactants into the PC bilayer accelerates changes in lipid vesicle size. This phenomenon can be explained by the incorporation of Tween surfactants into the PC bilayer decreasing the PC vesicle interaction potential (energy barrier) between lipid vesicles. Furthermore, the Tween surfactants appear to have little effect on the electrostatic potential between lipid vesicles since the zeta potential of the vesicles with the incorporated Tween surfactants was not very distinct from that without surfactants at 298K. Indeed, the decreased repulsive interaction potential can be attributed to an increase in hydrophobic interactions between the $(\text{CH}_2\text{-CH}_2\text{-O})_n$ groups on the headgroup of the Tween surfactant.
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