

outer leaflet of the bilayer membrane increases the lipid vesicle curvature, whereas Tween surfactant exposure to the inner leaflet does the opposite. Therefore, adding Tween surfactants reduces the initial lipid vesicles size, since more Tween surfactants exist in the outer leaflet than in the inner leaflet of the bilayer membranes of lipid vesicles.²⁰

Figure 1 illustrates that the Tween-PC lipid vesicles (with or without Tween surfactants) expanded at 298 K as a function of incubation time. The experimental results imply that Tween-PC lipid vesicles can hold electrostatic repulsive forces and can temporarily pause in the secondary minimum state (or reversible aggregation). Finally, Tween-PC lipid vesicles reached the primary minimum state (or irreversible aggregation) due to effective collisions among lipid vesicles, which may be promoted by oxidation of the lipids. There are 2 continuous steps for lipid vesicles to fuse: (i) the lipid vesicles must be aggregated, and (ii) the intermediate structures of the aggregated lipid vesicles

such as inverted micelles or inverse hexagonal structures must occur after the close juxtaposition and local perturbation in the bilayer packing of lipid vesicles. Our experimental results show that incorporating Tween surfactants into the PC bilayer enhanced the PC vesicle particle size changes at 298 K. This result can be attributed to the incorporation of Tween surfactants into the PC bilayer which decreases the PC lipid vesicle interaction repulsive potential according to the b_2/B_0 value obtained. In other words, incorporating Tween surfactants into lipid vesicles decreases the lipid vesicle energy barrier of aggregation or fusion from the interaction potential.

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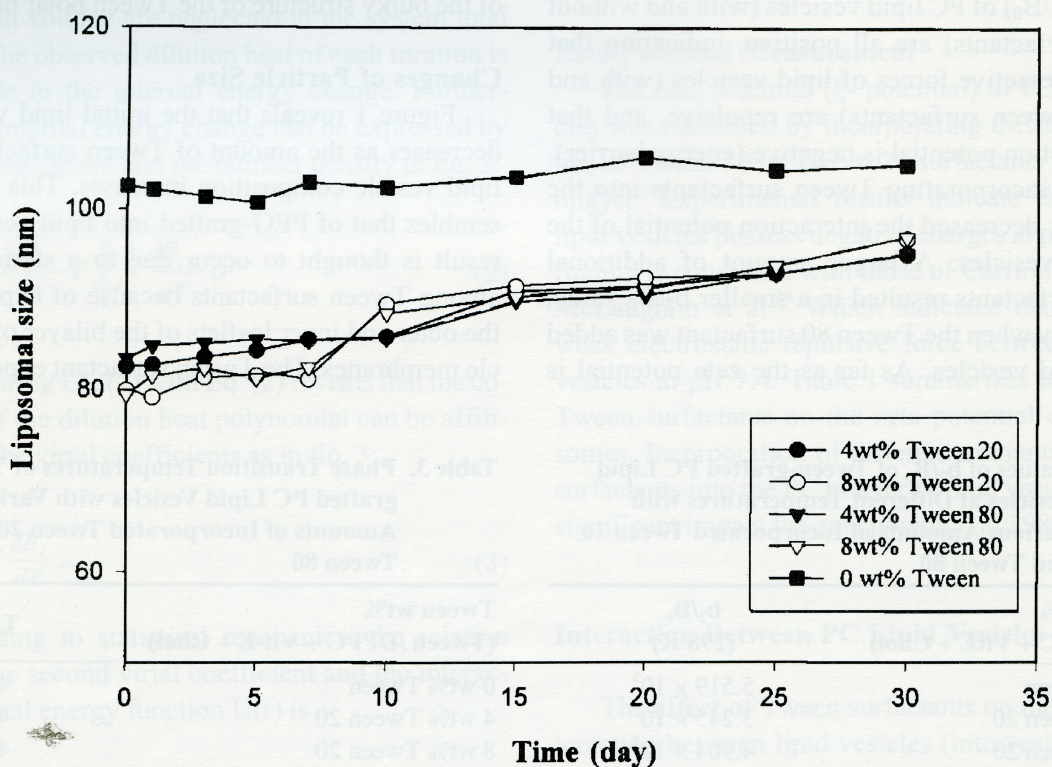


Fig. 1. Sizes of PC lipid vesicles with various amounts of incorporated Tween 20 and Tween 80 at 298 K with time. The number density of the lipid vesicle suspension was 10^{13} lipid vesicles/mL (each point value is the average of t_3 measurements).