Influence of particle size of liposomal dispersions on layer by layer electrostatic disposition and osmotic dehydration

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I. Introduction

Liposomes are used as delivery systems for bioactives. Physical and chemical instability in aqueous state limits their application.[1] The size of liposomes influences physical properties such as stability, curvature of the bilayer membrane and optical properties of the dispersions.[2,3] Spray- and freeze drying has been used to stabilize liposomes. It has been shown that liposomes subjected to dehydration are susceptible to fusion and leakage.[4] Layer by layer electrostatic dispositioning is when polyelectrolytes adsorb to the liposome surface to form a monolayer. It has been shown that it increases the physical stability of liposomal dispersions.[5,6]

II. Aim

- To coat liposomes with cold water fish gelatin
- To study the influence of liposome sizes on layering properties and physical stability during dehydration

III. Materials and methods

Primary liposomal dispersions

Soy lecithin (Ultralec®P, ADM) was dispersed in 10 mM acetate, pH 3.8 and stirred overnight. Then a) extruded through a 3.0 µm polycarbonate membrane (0.5 bar x 10) b) extruded through a 3.0 µm polycarbonate membrane (0.5 bar x 10) then 0.8 µm polycarbonate (1.0 bar x 10) c) passed through high pressure homogeniser (EmulsiFlex-C3, Avestin Inc.) (1500 bar x 5).

Secondary liposomal dispersion

Primary liposomal dispersion was titrated into cold water fish skin gelatin (Sigma Aldrich co.) dispersion, pH 3.8.

Osmotic dehydration

10 mL dispersion in dialysis tubes (MWCO 100-500 kDa, Biotech) immersed in 0.5 M sugar solution.

Particle size determination

Static light scattering analyser (Horiba LA-950, Fukuoka, Japan) measured mean volume diameter ($d_{4,3}$).

ζ-potential

Malvern Zetasizer Nano-Zs Nanoseries (Malvern, UK) measured ζ-potential.

Acknowledgements

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References

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IV. Results

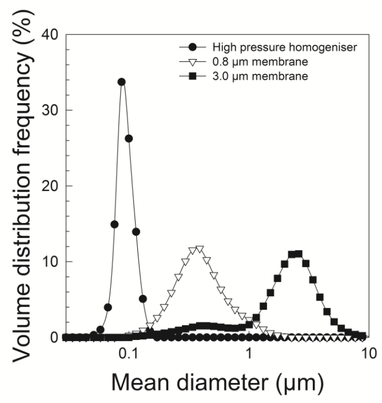


Fig. 1. Volume based particle size distribution. All preparations have a monomodal distribution.

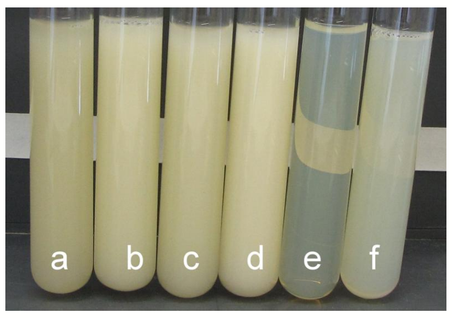


Fig. 4. (a) Primary and (b) secondary liposomal dispersions produced with extrusion through 3.0 µm membrane, (c) primary and (d) secondary liposomal dispersions produced with extrusion through 0.8 µm membrane and (e) primary and (f) secondary liposomal dispersions produced with high pressure homogenisation.

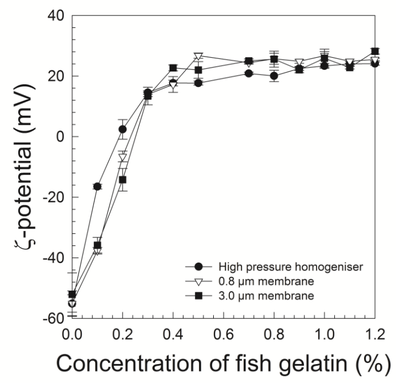


Fig. 2. Effect of concentrations(0 - 1.2%) of fish gelatin on the ζ-potential. ζ-potential goes from -55 mV for primary liposomes to 25 mV for secondary liposomes.

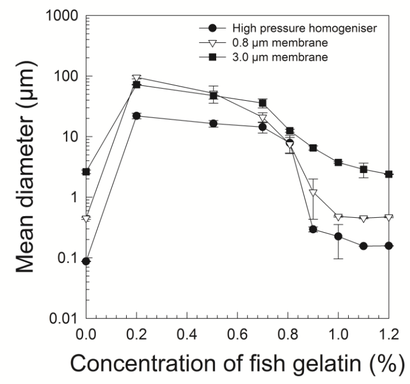


Fig. 3. Effect of concentration (0 - 1.2%) of fish gelatin on mean volume diameter ($d_{4,3}$). A large mean diameter (0.1 – 1.0% fish gelatin) indicates bridging flocculation.

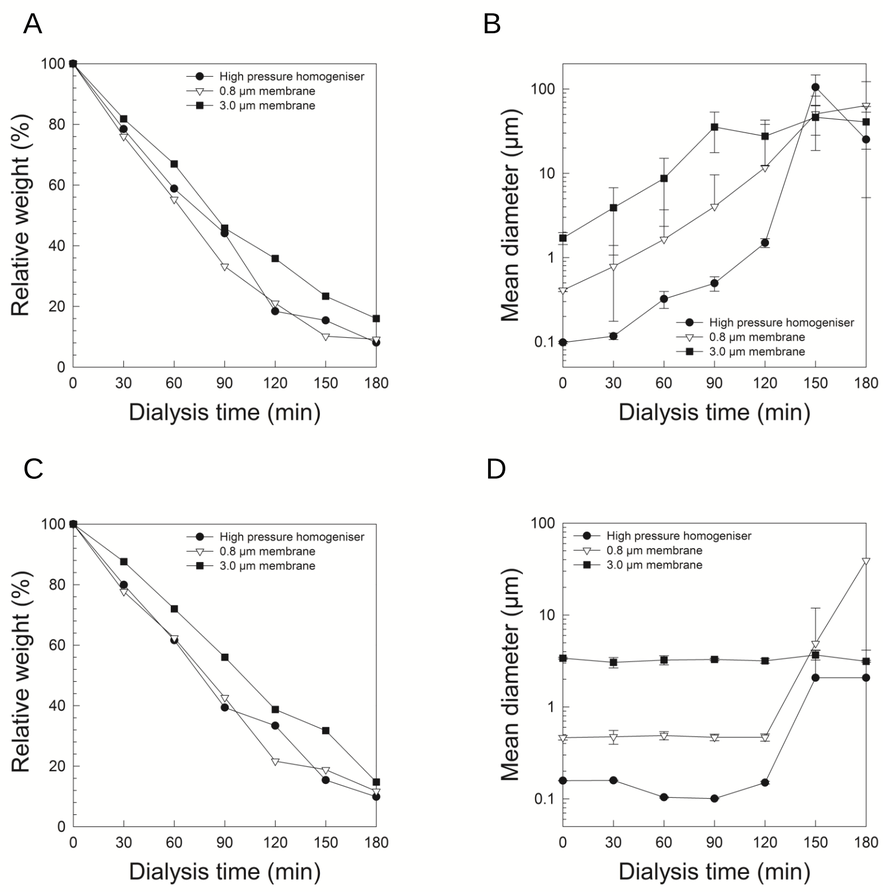
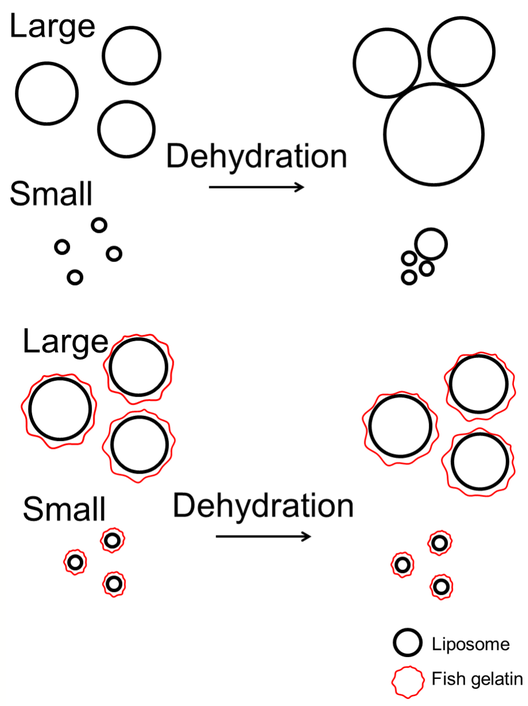


Fig. 5. Effect of dialysis time (0-180 min) with 0.5M sugar 10 mM acetate pH 3.8 on (A) relative weight (w_t/w_0) and (B) mean volume diameter ($d_{4,3}$) of primary liposomes and (C) relative weight and (D) mean volume diameter of secondary liposomes.

V. Conclusion

- Saturation concentration of fish gelatin is 1.1% for 1.0% liposomal dispersion (w/w) for the three liposome sizes (90 nm, 450 nm and 2.7 µm)
- 90 nm primary liposomes are more stable towards aggregation than the the other two size groups.
- Secondary liposomes with fish gelatin layer are more stable during osmotic dehydration.
- The interfacial membrane protects the liposomes from aggregation and fusion during dehydration.



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