Effect of poloxamer (F127 and F68) on size and zeta potential properties of BSA nanoparticles loaded with Nicardipine

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Introduction

- Albumin is a potential substance for use in preparing controlled drug delivery systems due to its biodegradability, biocompatibility and the ease of its preparation. [1]
- Poloxamer, a surfactant, can lower the interfacial tension and act as a dispersant, helping to overcome aggregation of the nanoparticles and improve the entrapment efficiency of hydrophobic drugs such as Nicardipine hydrochloride in Bovine Serum Albumin (BSA) nanoparticles.
- Nanoparticles are usually characterized for their size, polydispersity index (PDI) and zeta potential properties.
- Zeta potential is a measurement of surface charge which is the determinant of a nanoparticle's stability. It is a measure of the electrostatic potential between the Stern layer and Diffuse layer of a particle. [2]

Materials & Methods

Preparation

- Desolvation technique was used to prepare the BSA nanoparticles using ethanol (95%) as the desolvating agent.
- Ethanol is added gradually to the aqueous albumin solution until the solution becomes turbid which is then stabilized using glutaraldehyde. [1]

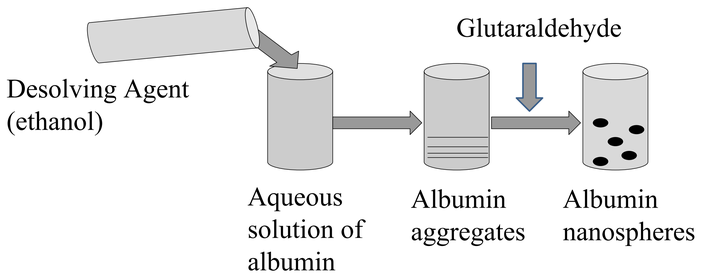


Figure 1.0: Preparation of albumin nanospheres through desolvation

- Poloxamer 127 is more hydrophobic than poloxamer 68 as it has a higher molecular weight of poly propylene oxide and lower percentage of poly ethylene oxide.

Zeta Potential

- Vials of the drug loaded BSA nanoparticles are prepared with either poloxamer F127 or F68. These samples are then put into folded capillary cells, and placed in a Zetasizer Nano, which measures the zeta potential.

Size

- Drug loaded BSA nanoparticles are prepared and put in disposable cuvettes. These cuvettes are placed in a Zetasizer Nano, which utilizes the dynamic light scattering (DLS) technique in measuring particle size.

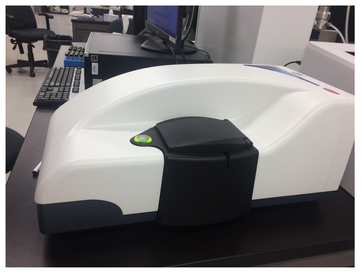


Figure 2.0: Zetasizer Nano-ZS used for measuring nanoparticle size

Theory

- DLS measurement depends upon the Brownian motion, the random movements of particles. The correlation between the random movement and the particle size is defined by Stokes-Einstein equation.

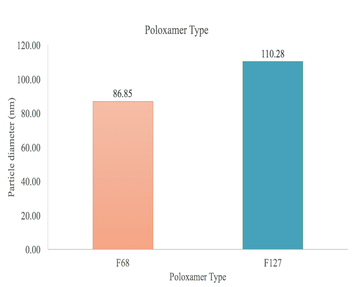
$$D = \frac{\mu_q \ K_\beta \ T}{6 \ \pi \ \eta \ r}$$

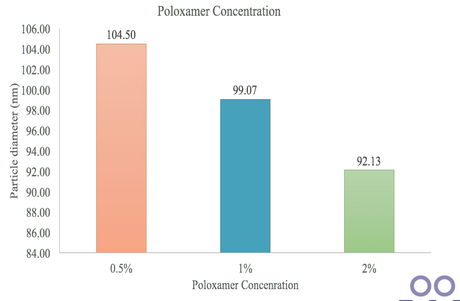
Where; D is the diffusion constant , μ_q is the electrical mobility of charged particles, K_β is the Boltzmann's constant, T is the absolute temperature, η is the dynamic viscosity and r is the radius of spherical particles.

- This is done by shining a laser at the sample and detecting the scattered light, which comes in the form of a speckle pattern. [2]
- As the particles are in constant motion, the speckle pattern will fluctuate and according to Stokes-Einstein equation larger particles move slower than smaller particles; therefore, the larger particles will fluctuate slower than smaller particles.[2]

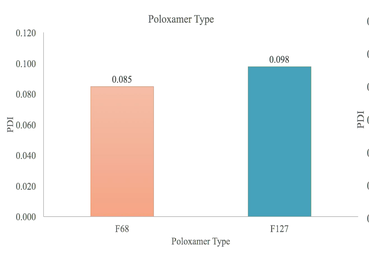
Results

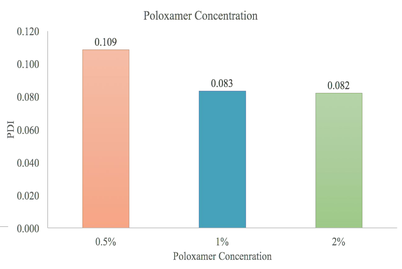
Size



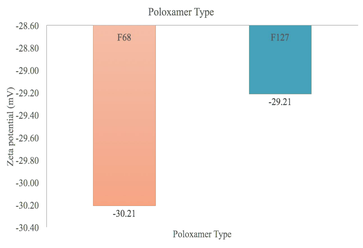


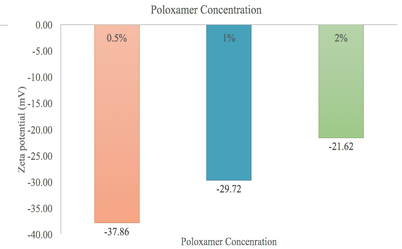
Polydispersity Index





Zeta Potential





Conclusion

- Nanoparticles prepared with Poloxamer F68 had significantly lower size and PDI than that prepared with poloxamer F127.
- Increasing poloxamer concentration (F68 or 127) leads to significant reduction in the size and PDI of nanoparticles.
- Zeta potential is significantly changed with the change in poloxamer concentration and insignificantly with poloxamer type

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References

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2. Malvern Instruments LTD. (2003, 2004). *Zetasizer Nano Series User Manual*. Retrieved from http://www.biophysics.bioc.cam.ac.uk/files/Zetasizer_Nano_user_manual_Man0317-1.1.pdf

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