Chapter 8
Overall Conclusion

In surfactant solutions, various aggregated morphologies can be obtain depending upon nature, concentration and chemical structure. Gemini surfactants, with added structural features (more than one alkyl tail and head group and head group joining group (spacer)) shows lower CMCs and different morphologies than observed with conventional surfactants. Blending of geminis produces mixed micelles even at lower concentrations due to synergistic interactions between counter charged gemini components. ǀ Interaction ǀ can be correlated with interaction parameter (β) whose higher negative value is indicative of synergistic interactions. This may be due to the presence of oppositely charged head groups in individual components of blended mixtures. Such mixings were carried out with various cationic geminis, having varied alkyl chains and different spacers (both hydrophobic and hydrophilic), component of the blend. However, anionic gemini (12-4-12A) was kept same in the blend.

A charge neutralization is expected with the consequences of blending which is ascertained by variation of zeta potential (ζ) from positive to negative with the continuous addition of 12-4-12A to cationic gemini solution. Above studies allow to fix total gemini concentration (10 mM) for structural studies. Various morphologies have been found in solutions when mole fractions of two components blended in the mixture. This may be due to the variation of surfactant packing parameter (P) which is expected maximum when the composition of the two components is near to same (x = 0.4 or 0.6). Variation in P is the reason of forming different types micellar and vesicular aggregate which were confirmed by DLS and TEM studies.

So obtained various morphologies, owing the strategy of surfactant blending, are utilized to check their solubilization potential towards water insoluble material (drugs or PAHs). It has been observed that aqueous solubility of water insoluble hydrophobic material can be enhanced in surfactant-based formulations. Further, gemini mixtures show better potential over conventional one. Among various blended gemini mixtures, solubility performances were found better with blends having nearly equal composition of the two components (x = 0.4 or 0.6). Depending upon the nature and chain length of the cationic geminis (containing hydrophobic or hydrophilic spacer), solubilities were enhanced and the magnitude of MSR was found maximum with vesicular aggregates. Multilamellar vesicles have been formed with cationic gemini containing equal alkyl tails (m =12) as of 12-4-12A and polymethylene spacer (hydrophobic). It has been further observed that above composition and structural variation can also be used to tune microenvironment of the blended aggregates which may contribute towards solubilization potential of a typical system. Above observation was found with both raloxifene hydrochloride (RLX) and curcumin (CUR). The entrapment of drug and it sustain release has been found to follow Higuchi model. This shows blending of appropriate geminis may control drug release and work towards treating cancerous cells. Blended mixtures show better IC_{50} values than reported in literature for similar types of formulations. This effect found superior with isosorbide (Isb) spacer present in cationic gemini (m =12) as one component of the blend (x = 0.4).

Above observations were corroborated by solubilizing another class of hydrophobic material (PAHs). It has been observed that similar solubility potential towards PAH solubilization was found. Therefore, one can conclude that blended mixtures have capability to enhance significantly solubilization of water insoluble material in general. This can further be maximized by choosing right kind of components of the blend with proper molecular architecture and composition.