CHAPTER V

CONCLUSION

Nanoparticles could be prepared by simple cooling the warm o/w microemulsion template under mild stirring which was a simple and potentially scalable method. In this study, the warm microemulsion was achieved by varying the oil phase (non-ionic emulsifying wax or Brij® 72) and surfactant phase (Brij® 78 or Tween® 80) to optimize the suitable system. The selected microemulsion was composed of non-ionic emulsifying wax (the blend of cetostearyl alcohol and cetomacrogol at a weight ratio of 4:1) and Tween® 80 since its ability to form the small (below 100 nm), uniform (PI 0.3-0.4) and stable nanoparticles over a period of 24 hours. The influence of rate of cooling warm microemulsion template was also studied and the rapid cooling method could provide a superior result.

The selected formulation was used to incorporate Coenzyme Q_{10} by addition of Coenzyme Q_{10} to oil phase. The Coenzyme Q_{10}-loaded nanoparticles was studied by varying in their compositions and evaluated for particle size and size distribution. It was found that the presence of Coenzyme Q_{10} had no effect on the nanoparticles formation. However, the lower sizes of Coenzyme Q_{10}-loaded nanoparticles were obtained by using the higher concentration of Tween® 80 and lower amounts of wax. The nanoparticles composed of Coenzyme Q_{10} (1-4 mg/mL), wax (2-6 mg/mL) and Tween® 80 at concemtration of 24, 48 and 72 mM were further evaluated in their entrapment efficiency with the aid of ultrafiltration technique. As the results, the formulations which were in the nanosize-range with high entrapment efficiency, was composed 4mg/mL wax and 48 mM Tween®80. The entrapment efficiency of those systems incorporating 2 and 4 mg/mL CoenzymeQ_{10} were 80.19% and 78%, respectively.

The TEM micrograph showed the spherical shape of Coenzyme Q_{10}-loaded nanoparticles and the diameter in similar range as that derived from PCS measurement. The DSC thermogram showed the absence of melting peak of Coenzyme Q_{10}-loaded nanoparticles indicated that Coenzyme Q_{10} was dispersed in matrix as an amorphous state and not a simple physical mixture of their individual component. The *in vitro* release profile of Coenzyme Q_{10} from core material exhibited a biphasic pattern characterized by a rapidly initial release in the first ten hours, followed by a slower release up to 120 hours. The storage temperature had influence on the stability of Coenzyme Q_{10}-loaded nanoparticles. The systems stored at room temperature (25°C) was found to significant increase in particles size while those stored at 4°C had the same size as the freshly prepared nanoparticles. Similarly, the loss of potency of Coenzyme Q_{10} after 8-week storage at 4°C was less than that stored at room temperature. Freeze-dring process was performed and the results showed that freeze-dried Coenzyme Q_{10}-loaded nanoparticles had greater chemical and physical stability over extended period of time at room temperature since it could prevent Ostwald ripening and avoid hydrolysis. The mannitol at a concentration of 2% w/w was selected as a cryoprotectant for freezing and drying process because it was able to maintain the nanoparticles size and provided the desirable puffy dry product. Finally, the cream base mixed with the freeze-dried Coenzyme Q_{10}–loaded nanoparticles offered a good physical stability during freeze-thaw test for at least 6 cycles and showed great stability after 4-week storage at room temperature. The mixed cream also showed the homogeneous appearance and no gritty effect. From the point of view, the Coenzyme Q_{10}–loaded nanoparticles mixed cream provide alternative formulation for pharmaceutically and cosmetically topical use.

The further studied will be the assessment of the topically applied Coenzyme Q_{10}–loaded nanoparticles mixed cream on the potential as a safe and effective anti-tumor agent for treating and preventing recurrence of skin cancer.