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Challenging the hydrophilicity of natural bacterial nanocellulose for dermal applications

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Introduction

The current advanced research demonstrated a high potential of the biopolymer bacterial nanocellulose (BNC) in a wide range of applications in medical and pharmaceutical fields due to its outstanding physiochemical and biological properties. BNC consist of a unique structure of a three-dimensional network of nanostructured cellulose fibres, with over 90% water, a high purity, excellent biocompatibility and unique mechanical stability that provides an excellent basis as a biomaterial for dermal applications [1]. Although many attempts were made using BNC as drug carrier material, incorporation of lipophilic substances is still considered as an unsolved task. In this study, the encapsulation of the lipophilic coenzyme Q10 (Q10) into the hydrophilic BNC utilizing dermal friendly and flexible colloidal carrier systems was investigated.

Materials and Methods

As carrier systems to encapsulate Q10 Hydro-Tops (w/o/w nanoemulsion), Lipo-Tops (o/w emulsion) and liposomes were produced using a high pressure homogenizer. Stability of the carrier systems, hydrodynamic diameter and zeta potential were investigated over 90 days. BNC fleeces were produced by strains of Komagataeibacter xylinus (DSM 14666) in Hestrin-Schramm medium in 24-well plates, harvested and alkaline purified [2]. Standard sorption method [3] and other post synthetic loading techniques were used. Release was studied at 32 °C using the Franz cell diffusion system. Penetration studies using porcine skin samples were preformed.

Results and Discussion

Production of different carrier systems containing 0.5% Q10 was successfully performed with negative zeta potentials and hydrodynamic diameters of about 65-130 nm with an excellent stability over 90 days. BNC fleeces were efficiently loaded with these systems by different post synthesis loading techniques. Q10 release could be controlled depending on the type of carrier system, the BNC condition (native or freeze dried), and the loading technique.

Conclusion

Successful loading of lipophilic substances into the hydropolymer BNC was achieved which opens a variety of applications in the pharmaceutical field. Moreover, drug release for custom-designed applications could be adjusted by variation of different parameters.

References

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