“Hydro-Tops” - W/O/W Nanoemulsion for dermal Drug Delivery

Gabriele Blume[1], Katinka Jung[2], Dagmar Fischer[3]

[1]Sopharcos, Steinau, Germany; [2]Gematria TestLab, Berlin; [3]Institute of Pharmacy, Department of Pharmaceutical Technology, Friedrich-Schiller-University Jena

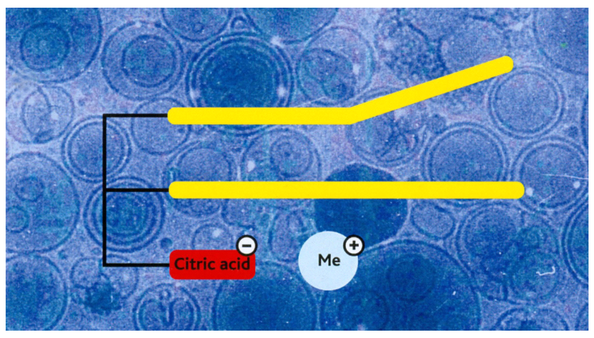
Introduction

Multiple water-in-oil-in-water nanoemulsions (W/O/W emulsion) achieve new interest in dermal application since hydrophilic, amphiphilic and lipophilic actives can be encapsulated in these vesicles. Here water droplets are protected in the inside of the vesicles by a lipophilic environment. In most instances for the production of such multiple emulsions a hydrophilic and lipophilic emulsifier are combined and the vesicles are manufactured by a two-step emulsifying [M.Hoppel et al. (2014) J. Pharmacy and Pharmacology 66, 658-66]).

The Hydro-Tops carrier system is only based on a skin friendly membrane building emulsifier coming from the food industry which contains a high amount of unsaturated fatty acids (vitamin F).

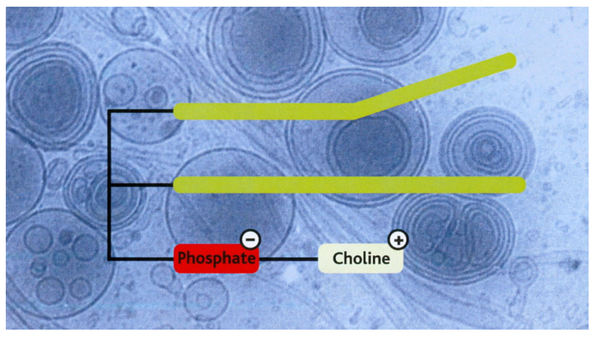
Furthermore in a clinical study an increase in skin moisturisation and a decrease in wrinkle formation was achieved by topical application of the pure vesicles [K. Heinrich (2012) PhD Thesis University Witten/Herdecke]

Hydro-Tops



Sunflower
Glyceryl Citrate / Lactate / Linoleate / Oleate

Liposomes



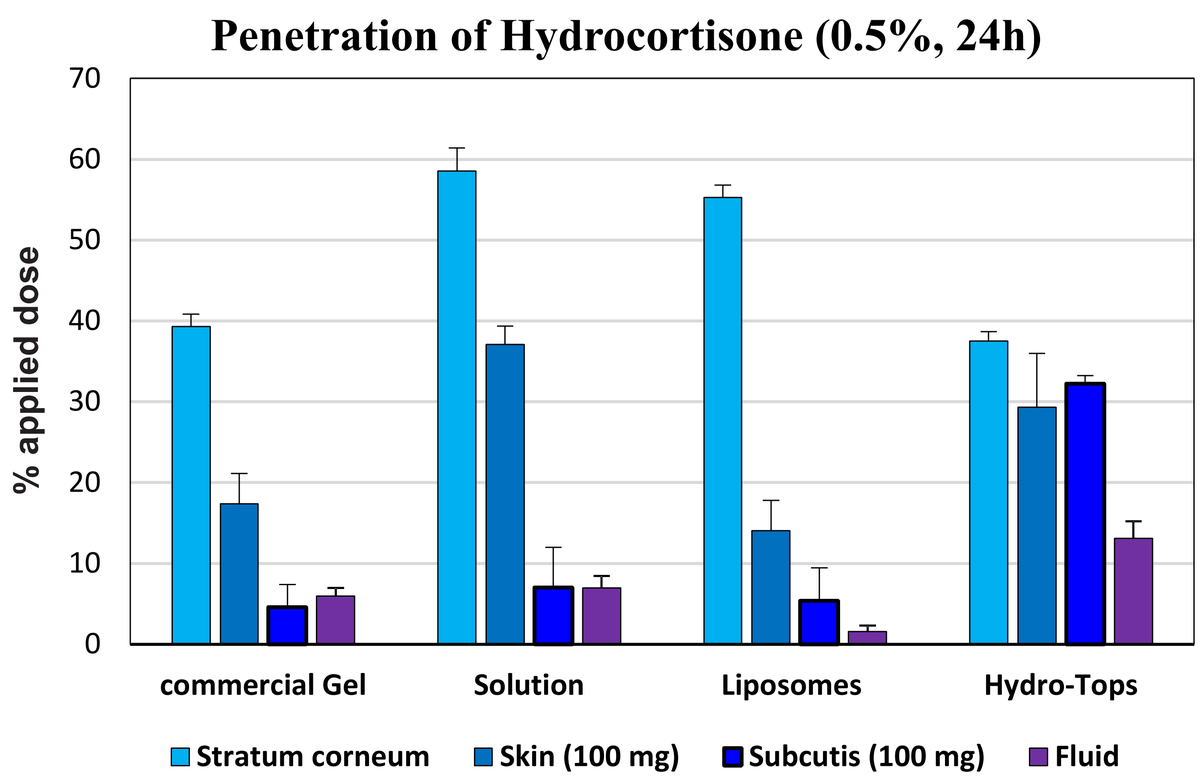
Soy Bean
Phosphatidylcholine

High Penetration Efficiency

Glucocorticosteroids were introduced in 1949 to treat rheumatoid arthritis. Most of the corticosteroid dermatological formulations contain skin penetration enhancers to promote the drug absorption. Therapeutic benefit of liposome-based corticosteroid formulations in humans was found to be inconsistent [H.C. Korting et al. (1990); Eur. J. Clin. Pharmacol. 39, 349-351]

The distribution of hydrocortisone in human skin was tested ex vivo by using different formulations containing 0.5% hydrocortisone.

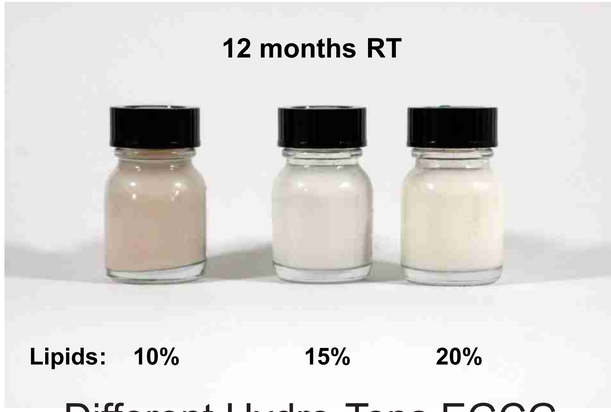
When hydrocortisone is encapsulated in the lipid based carrier system Hydro-Tops, the drug overcomes the skin barrier in the stratum corneum and is distributed even in the deeper skin.



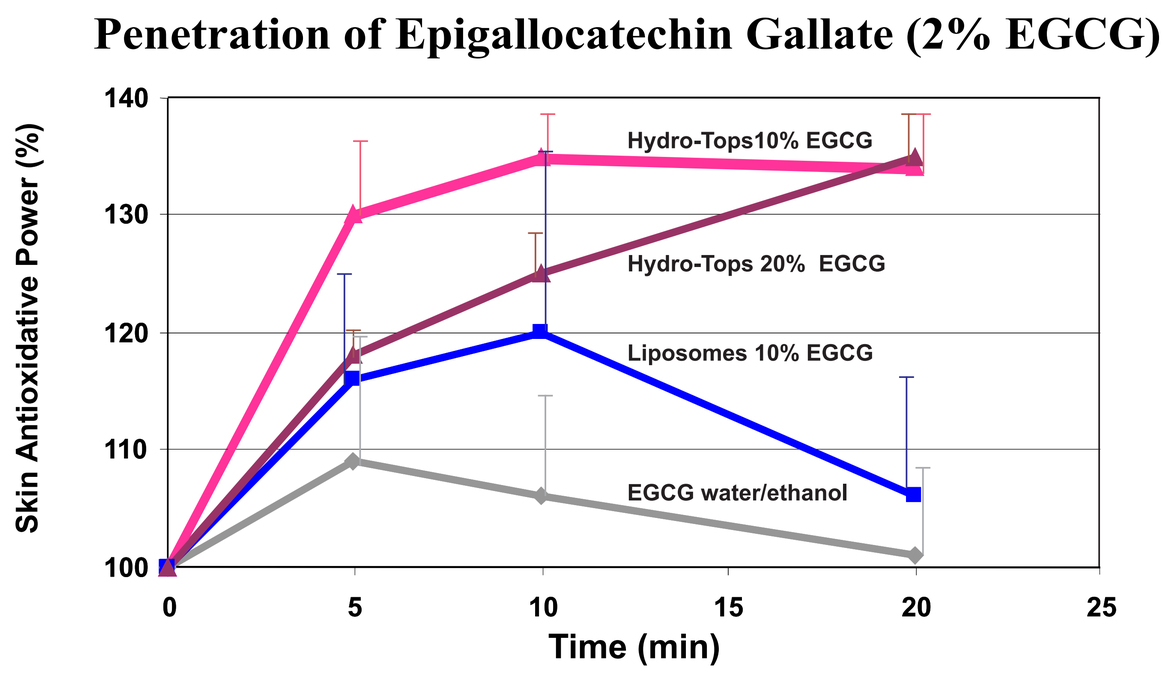
Strong biological Effects

Green tea is one of the most widely consumed beverages and has gained attention due to its relevant content of antioxidant components like the polyphenol epigallocatechin gallate (EGCG). Studies have shown that EGCG has properties in the skin like antioxidative and anticarcinogenic effects [S.K. Katiyar et al (2000); Clinical Cancer Research 6, 3864-3869].

A green tea extract containing more than 95% of EGCG was encapsulated in Hydro-Tops as well in flexible liposome. The new multiple nanoemulsion allows to use higher concentrations of emulsifier which then offers higher encapsulation efficiency of EGCG compared to liposomes. Also this encapsulation technology prevents changes of actives in colour and odour over the time. The antioxidative power of 2% EGCG in the epidermis was proven by ESR measurements [K. Jung et al.(2006) SÖFW Journal 132:38-44].

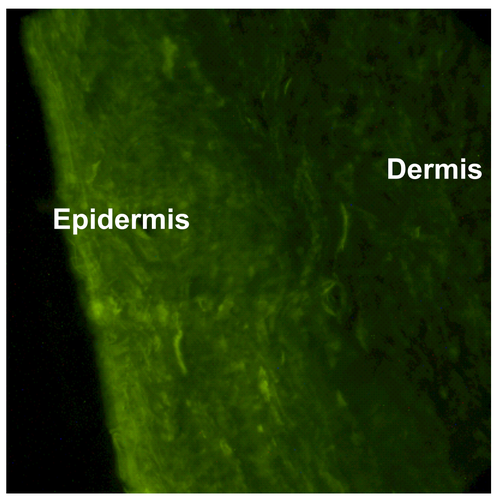


Different Hydro-Tops EGCG

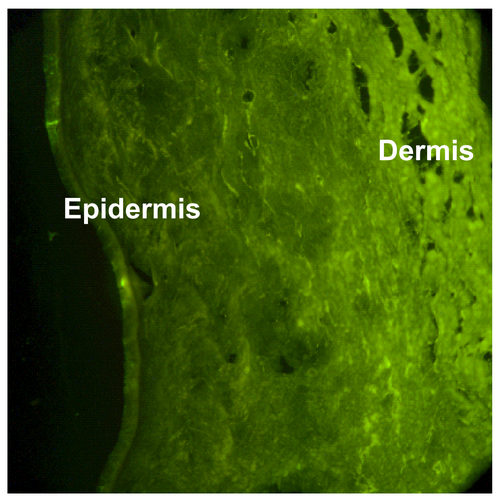


... even with high molecular Weight

A fluorescently labeled protein BSA (bovine serum albumine) having a molecular weight of 70.000 Da was encapsulated in flexible liposomes as well in Hydro-Tops. In contrast to the liposomes the new carrier system is characterized by smaller vesicles and very homogenous size distribution. Penetration of FITC-BSA in human skin was determined by confocal laser scan microscopy (0.5% FITC-BSA / 24 h).



Liposomes



Hydro-Tops

Conclusion

The Sopharcos technology opens the chance to encapsulate a huge variety of different components and to enhance their solubility (e.g. polyphenols), their stability (e.g. vitamins) and their penetration depth into the skin (e.g. proteins or antioxidants) or hair follicles.

In comparison to conventional flexible “Liposomes” this novel multiple nanoemulsion (80-200nm) exhibits unique homogenous size distribution, higher encapsulation efficiency and better bioavailability of APIs in the skin.

Hydro-Tops are patented in Europe and the USA.