REPORT:

INTERACTION SKIN-VEHICLES (16-02 57)

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The experiment consisted in determining the structure of stratum corneum (SC, the outermost layer of mammalian epidermis) tissue post-treatment with bicelles (small disks of bilayers). The aim of the experiment was to determine the structural and packing changes in the SC lipid phase promoted by the bicelar systems.

Bicelles were formed with 1,2-Dimyristoyl-*sn*-Glycero-3-Phosphocholine (DMPC) and 1,2-Dihexanoyl-*sn*-Glycero-3-Phosphocholine (DHPC), or 1,2-Dipalmitoyl-*sn*-Glycero-3-Phosphocholine (DPPC) and DHPC. The samples were measured by SAXS (1.4 m of sample-detector distance, λ=0.9795 Å) and WAXS (0.35 m), at room temperature, using a kapton window.

RESULTS:

The SC treated with bicelles showed structural differences related to the thickness and the order of the lipid phase. It means that bicelles are able to penetrate into the skin and to modify the lipid phase of the SC.

The curves corresponding to the integrations of the 2D spectra from SAXS are showed in Figure1. In this figure two defined peaks appear at 1 and 1.7 nm^{-1} for SC treated, and a band or shoulder at ~0.5 nm^{-1} for all the samples. These peaks are compatible with the bilayer spacing[1]. The peak for the SC treated with DPPC/DHPC bicelles associated to the bilayer thickness appeared a lower Q than the peak for DMPC/DHPC treatment, and the SC native.

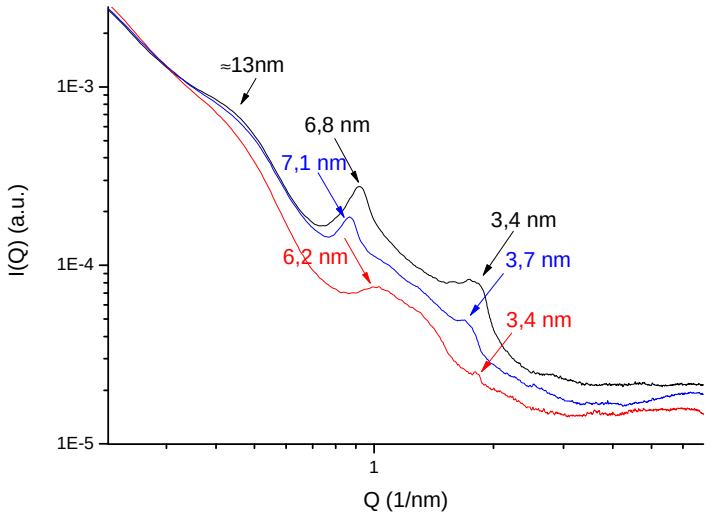

Figure 1. Curves corresponding to the SAXS experiments: SC native (red), SC treated with DMPC/DHPC bicelles (black), SC treated with DPPC/DHPC bicelles (blue).

The curves corresponding to the integrations of the 2D spectra from WAXS experiments are drawn in Figure 2. This figure shows a peak at 16 nm^{-1} for the SC treated and a band around 22 nm^{-1} for all the samples.

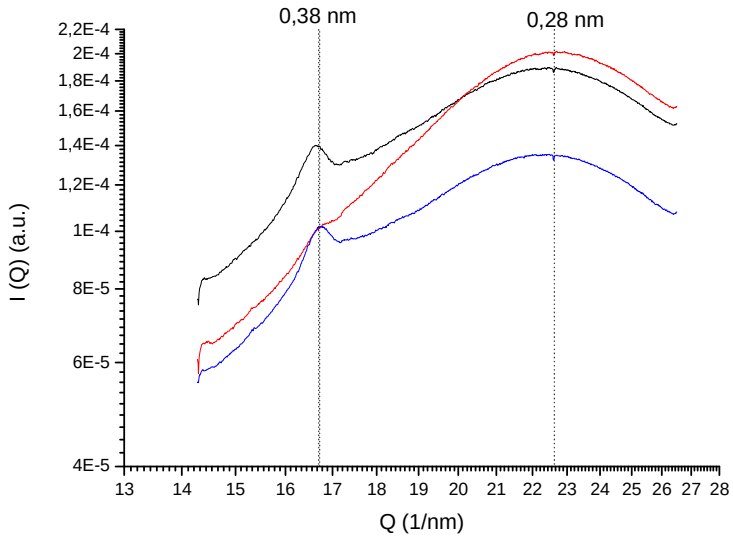

Figure 2. Curves corresponding to the WAXS experiments: SC native (red), SC treated with DMPC/DHPC bicelles (black), SC treated with DPPC/DHPC bicelles (blue).

DISCUSSION:

The bicelle treatment modifies the lipid structure of the SC. These modifications could be related to the contribution of water into the tissue, promoting the lipid swelling. The spacing associated to the bilayer thickness is higher for the DPPC/DHPC treatment (7.1 nm) in comparison with the DMPC/DHPC treatment (6.8 nm), and the SC native (6.2 nm). It is probably due to the longer acyl chains in DPPC molecule than in DMPC molecule. The shoulder at 0.5 nm^{-1} could be compatible with the SC spacing (around 13 nm), associated to the long spacing lamellar phase[2]. In this case, this structure remains in all samples and the treatment doesn't affect it.

Bicelles promote also changes in the WAXS spectra of the tissue. A peak corresponding to 0.38 nm distance appears in the SC treated. Some authors have described an orthorhombic lateral packing of the lipids with this characteristic spacing[1]. The study of the samples at different temperatures could help us to elucidate transitions associated at the different packing of lipids in the future.

In summary, bicelles penetrate into the SC and modify the lipid phase. The modifications could be related to a water contribution, but also to the lipid structure. The thickness of bilayers depends on the lipid composition of vehicles. Bicelles are able to alter the lipid organization, probably promoting changes in the lateral packing of the lipids. For all of these reasons, bicelles are very good candidates as topical drug delivery systems into or across the skin.

REFERENCES:

[1] J.A, Bouwstra, Colloid and Surf. A: Physicochemical and Engineering Aspects, 123-124 (1997) 403-413
[2] M.W. de Jager et al. Journal of Lipid Research, 46 (2005) 2649-2656