Is the permeability of the skin influenced by a transition from orthorhombic to hexagonal lateral packing?

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Introduction

The lipid organization in the stratum corneum (SC) plays an important role in the barrier function of the skin. SC lipids form two lamellar phases with a predominantly orthorhombic packing (see figure 1). In previous publications a lipid model was presented, referred to as the stratum corneum substitute (SCS) that closely mimics the SC lipid organization and barrier function. Therefore, the SCS serves as a unique tool to relate lipid organization with barrier function. With increasing temperature, between 30°C and 40°C the lipid packing in human SC changes from orthorhombic (tight) to hexagonal (less tight), see figure 2. In the present study we examine the effect of the orthorhombic to hexagonal phase transition on the barrier function of human SC and the SCS. Diffusion studies are performed during a step-wise increase in temperature from 28°C to 46°C, sampling the temperature of the orthorhombic to hexagonal phase transition. From the permation data Arrhenius plots were constructed to visualize the influence of the phase transition on the flux.

Remarkably, we found that the permeability of SCS to benzoic acid closely mimics that of human SC at all temperature steps from 31°C to 43°C. Furthermore, the linear relationship of the flux data with temperature as observed in the Arrhenius plots, suggests that the change from orthorhombic to hexagonal packing in human SC and the SCS does not have an effect on the barrier function. These results are in contrast with those of a recent study focusing on the permeation of water through human SC [2]. In this study it is reported that the water transport is influenced by the relative population of lipids forming an orthorhombic packing. Perhaps the difference in physical properties of the solute (water versus benzoic acid) or the difference between inside-out permeation (TEWL) and outside-in permeation (benzoic acid permeation) can account for the different observations.

Discussion & Conclusion