Abstract

Cholesterol is a substance of a steroidal nature that has a number of functions in the human body. One of them is also an irreplaceable role in the proper functioning of the skin barrier. Cholesterol is an integral part of the lipid matrix, together with ceramides and free fatty acids in an equimolar ratio (1: 1: 1), and 5% cholesterol sulfate, which fills the intercellular space between stratum corneum cells and is responsible for the barrier properties of the skin. Cholesterol is therefore necessary for epidermal homeostasis, but its role in SC permeability is unknown.

The aim of this work was to study the influence of cholesterol concentration on the permeability and microstructure of model lipid membranes of the skin barrier. Eight sets of model membranes with decreasing cholesterol concentrations (100%, 80%, 70%, 60%, 40%, 20%, 0%) and cholesterol alone were studied for which permeability and microstructure were monitored.The study of permeability of membranes was carried out in the Franz diffusion cells by measuring four permeation parameters: water loss, electrical impedance measurement, and the cumulative amount of two model drugs (theophylline and indomethacin). The microstructure of these model membranes was verified by X-ray powder diffraction.

X-ray powder diffraction measurements confirmed that approximately half of the equimolar amount of cholesterol in the stratum corneum is incorporated into the lamellar phases, and the remainder is the phase of the separated cholesterol as predicted. An interesting finding was that various cholesterol losses in model membranes did not prevent the formation of a long periodic phase since these lamellar phases were found in all the membranes studied.

From our permeation experiments, the best combination of barrier properties is demonstrated by a model lipid membrane with 40% cholesterol that has low permeability for model drugs and for water. Thus, the 0.4:1:1 molar ratio of cholesterol, ceramide and fatty acids appears to be sufficient to prevent water loss and penetration of harmful substances, thus maintaining the barrier function of the skin.