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The lipid organisation in skin: an integrated approach of lipid model systems and clinical studies

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The skin barrier function is primarily located in the outermost layer of the skin, the stratum corneum (SC) and is comprised of corneocytes (dead cells) and intercellular lipids. The main lipid classes in the SC are ceramides, free fatty acids, and cholesterol. These lipids form two crystalline lamellar phases, with a repeat distance of 13 nm and 6 nm, respectively. The composition and organization of the SC lipid matrix are crucial for a proper skin barrier function. The 13 nm lamellar phase is very characteristic for the SC lipid matrix and is considered to play a crucial role in the skin barrier function.

For many years our group focusses on the lipid composition and organization in inflammatory skin diseases. These skin diseases are characterized by an impaired skin barrier function. A well-known example is atopic dermatitis (AD). AD is the most prevalent skin disease in children. Nowadays 15-20 % of the children in Western Europe are suffering from this disease and the lipids may be an underlying factor for the impaired skin barrier. We performed a clinical study aiming to determine the role of SC lipids in the impaired skin barrier function. We observed that changes in the lipid composition and organization correlated with the impaired skin barrier function. Using lipid model systems it appeared that the changes in lipid organization encountered in the clinical studies reduced the lipid barrier. This demonstrates that the changes in lipid properties are an underlying factor of the impaired skin barrier.

As the lipids are important for a proper skin barrier function, more detailed analysis using neutron diffraction focusing on the arrangement and configuration of the lipid subclasses in the unit cell of the 13 nm lamellar phase. By combining D₂O/H₂O contrast variation together with the use of (partly) deuterated lipids we were able to localize most of the lipid subclasses in the unit cell and revealed the configuration of an abundant ceramide subclass. These studies provided more details on the function of the various lipid classes in understanding the skin barrier function in healthy and diseased skin in more details.

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