# Molecular mobility of solvents, lipids and proteins in intact stratum corneum

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Solvents are commonly utilized in dermal and transdermal formulations, as well as in sanitary products and cleansers. Apart from dissolving active compounds, the solvent itself can penetrate the skin. The uptake of solvent can lead to changes in the molecular organization of skin lipids and proteins, which, in turn, may alter macroscopic properties of the skin, such as the elasticity, softness and barrier function.

The aim of the present study is to examine the molecular effects of ten different solvents on the outermost layer of skin barrier, stratum corneum (SC). We use polarization transfer solid-state NMR [1-2] on natural abundance $^{13}C$ intact SC. From these experiments, we are able to monitor changes in molecular dynamics of the solvent molecules inside SC, enabling us to draw conclusions on interactions and partitioning of solvents in SC. Simultaneously, we obtain atomically resolved information on changes in molecular dynamics on the lipid and protein components SC induced by the addition of the solvents. In particular, we obtain resolved information on changes in the minor fraction of fluid SC components. SC differs from most other biological membranes in that the main fraction of both lipids and proteins are solid at ambient conditions, although the minor fluid fractions are considered crucial to its barrier and mechanical properties. The present NMR experiments provide simultaneous information on fluid and solid SC components with a molecular detail that have not been achieved with other methods. We previously applied the same approach to study the effects of moisturizers and penetration enhancers on intact SC [3-4].

All solvents investigated are incorporated in SC, influencing molecular mobility of both the solvent molecules and SC components. Our results show variations in solvent molecular dynamics, interactions between solvents and SC components and effects of solvents on SC lipids and proteins, depending on solvent identity and hydration conditions. The findings can be directly related to practical utilization of solvents in skin products. All solvents investigated fluidize SC lipids. Comparing the results obtained from different solvents reveals the essential role of water in the mobility of keratin proteins.

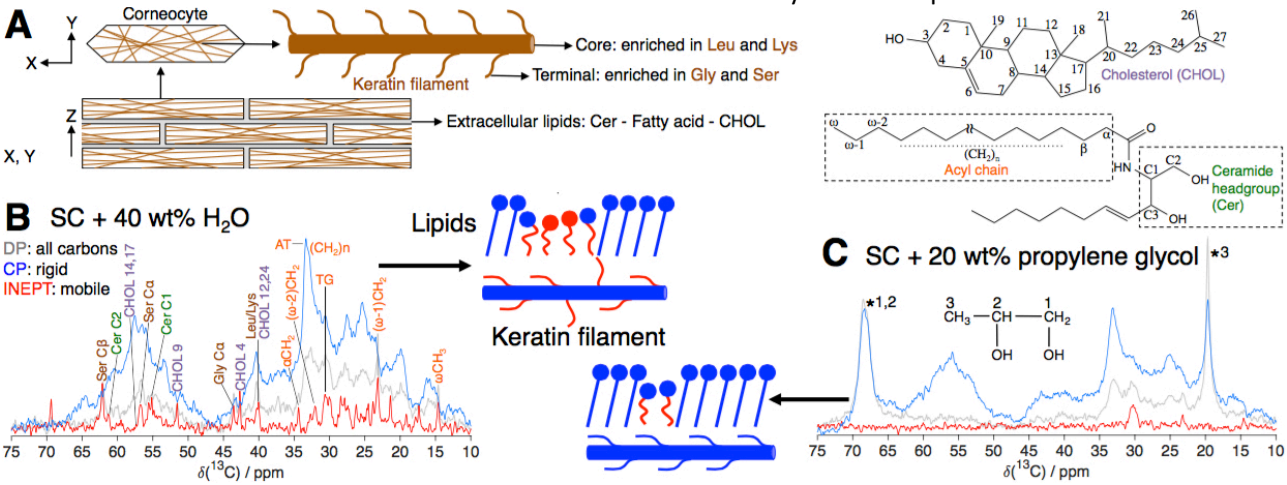


**Figure 1** (A) The schematics illustrate the brick-and-mortar model of SC with corneocytes filled with keratin filaments, surrounded by a multilamellar lipid matrix. $^{13}C$ MAS NMR spectra (DP: grey, CP: blue, INEPT: red) of the SC with 40 wt% water (B) and 20 wt% propylene glycol (C) shown together with schematic interpretations of the molecular mobility of the SC protein and lipid components .

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