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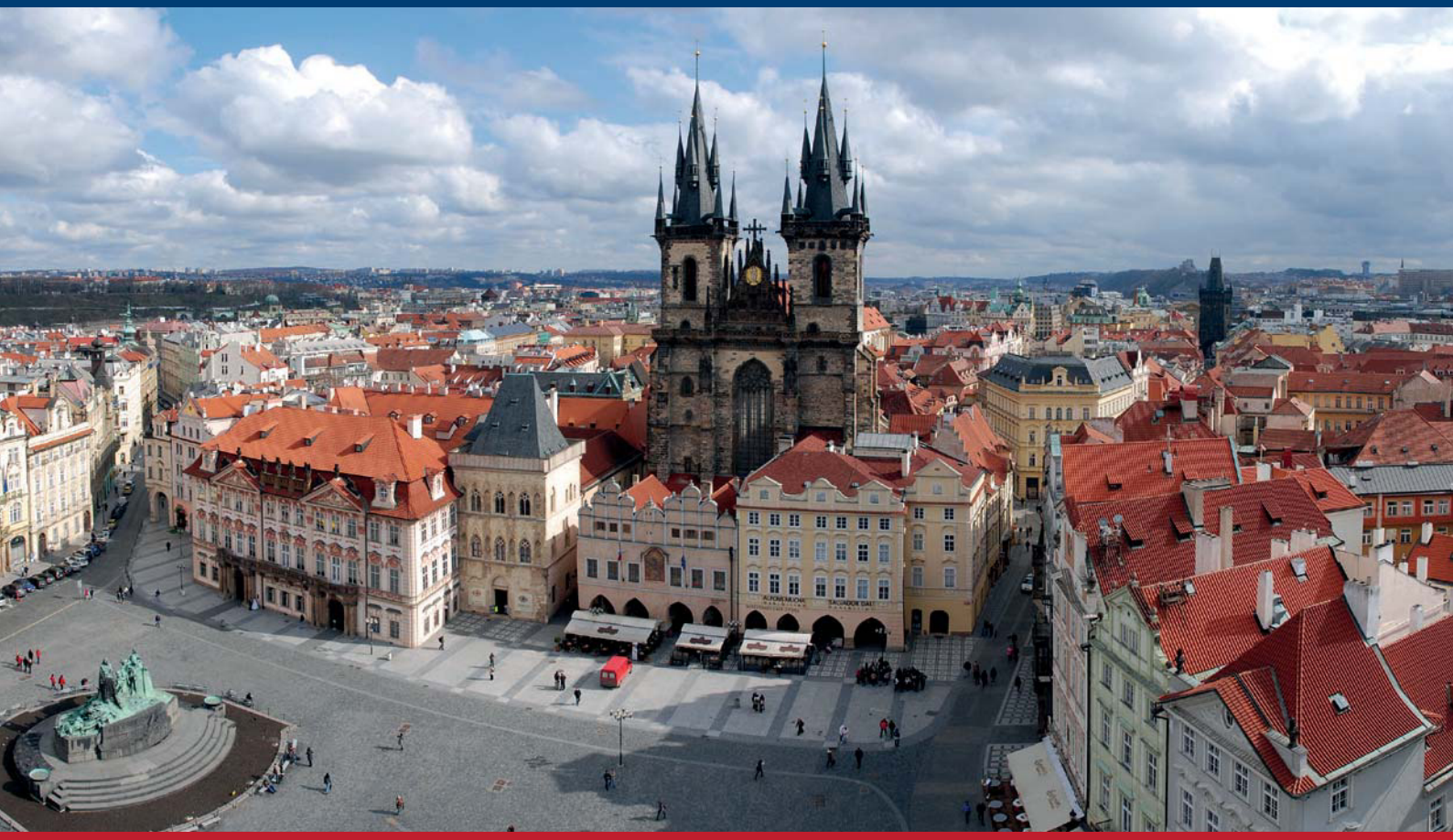

ABSTRACT BOOK

Partnerships: Masaryk University, Faculty of Medicine, Brno; Institute of Health Information and Statistics; Czech Wound Management Association; Ministry of Health of the Czech Republic

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Molecular dynamics simulation and thermodynamical approaches to predict and model the barrier function of skin lipids

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Introduction: Understanding the barrier properties of the intercellular lipids of stratum corneum (SC) is pivotal to better design of transdermal drugs and skin care products. The current state of the art is that the inter-keratinocyte space is occupied mainly by waxy acids (ceramides), free-fatty acids, and cholesterol, organized geometrically as a series of stacked bilayers in a roughly equal molar ratio1. The exposure of skin to dermatological relevant molecules can affect the lipid bilayers' features, consequently altering skin's barrier properties and structural integrity2.

Several in silico approaches have been developed to investigate the mechanisms underpinning skin barrier hallmarks. Among these, molecular dynamics (MD) simulations have been employed to predict the SC lipid properties3. Similarly, a combinations of quantum chemistry and thermodynamical calculations4 has been developed for fast barrier properties prediction. The aim of this study is to exploit both these tools to investigate and rationalize the effect of selected chemicals on SC lipid bilayer's geometrical and barrier properties.

Methods: The systems are being simulated via GROMACS with the CHARMM36 forcefield. Systems containing different concentrations of ethanol, glycerol or urea are simulated to extract their geometrical information. From this information, structural effects are quantified by measuring lipid structural parameters and the corresponding barrier properties are predicted via quantum/thermodynamical approaches.

Results: Ethanol is the molecule that majorly disturbs the lipids bilayers, inducing extraction of lipids and partitioning of ethanol molecules into the bilayers. Increasing the temperature lowers the ordering of the lipid bilayers in all cases investigated, gradually compromising the integrity in systems containing ethanol. Barrier properties are not affected by urea and glycerol, while the partitioning of ethanol eases the partitioning of other solutes through lipids.

Conclusions: Results show that ethanol disturbs the SC lipid bilayers, enhancing the partition of solutes into the lipid systems, while glycerol and urea have limited effect, suggesting that these molecules affect other SC permeation routes.

References

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