

# The Effects of Hydration on Permeability in Human Stratum Corneum

Nina Bordeaux, Lucia Cheung, Abbygail Palmer, Kathleen Wang, Eric Young, and Nancy Lape

## Background

The skin's role as a selectively protective barrier against foreign substances is largely fulfilled by the stratum corneum (SC), the outermost layer of the epidermis. The SC is composed of flat, impermeable, keratin-filled cells called corneocytes in a lipid bilayer matrix. The rate of molecular transport through the lipid matrix depends on the tortuosity of the pathway (path a), chemical interactions between the molecules and hydrophobic lipid tails, and solute size. Hydration of the SC can cause a swelling of the corneocytes, which results in a thicker SC and a greater distance for permeating molecules to travel; this change affects the permeability of the SC.

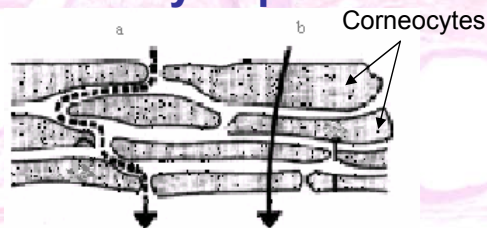
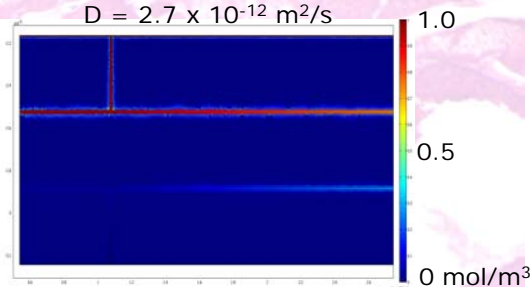


Figure from Barry, B.W. "Drug Delivery Routes in Skin: a Novel Approach." *Advanced Drug Delivery Reviews*. 54 Suppl. 1 (2002) S31-S40.

## Objectives

This study explores hydration effects on the SC in terms of solute permeation. In-vitro experiments are performed to determine the flux of methyl paraben through the stratum corneum. Finite Element (FE) models of the SC are also created to validate the experimental results.

SC Concentration at 4000 s  
 $D = 2.7 \times 10^{-12} \text{ m}^2/\text{s}$

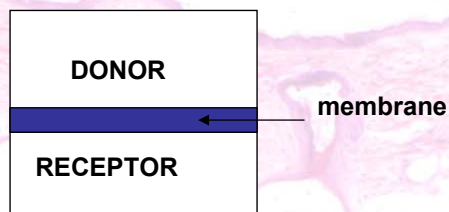


Funding: HHMI and Rose Hills

## Experimental Procedure

Silicone membranes were initially tested in place of stratum corneum to validate experimental procedures and establish the reproducibility of the flux results. An oversaturated solution of methyl paraben (MPB) was placed on one side of the silicone membrane (in the donor chamber) and the solution on the opposite side (in the receptor chamber) was sampled at set intervals to measure the concentration of MPB exiting the membrane.

## Simplified Diffusion Cell



## Results

The figure on the right shows the change in concentration exiting the silicone membrane at 30-minute intervals. Notice that not all the cells in the plot display the same trend. It is hypothesized that cell 1 had a faulty seal during the experiment, which caused a leak in the donor chamber; cell 6 could have had a hole in its seal, causing the cell to immediately equilibrate; and the receptor solution in cell 2 could have been contaminated with methyl paraben. More testing however, is needed to verify these results and the problems hypothesized.

## Future Work

We plan to perform in-vitro experiments with human skin once reproducible results are obtained using silicone. The SC results can then be compared with those of the FE model.

