Modeling and Experimental Validation of Drug Diffusion Through PDMS-Based Transdermal Patches

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Research question:

How can altering the composition of PDMS (polydimethylsiloxane) membranes—through changes in base-to-curing agent ratios and additive content—be used to tune drug diffusion rates so that they closely match the permeability of human skin for transdermal drug delivery applications?

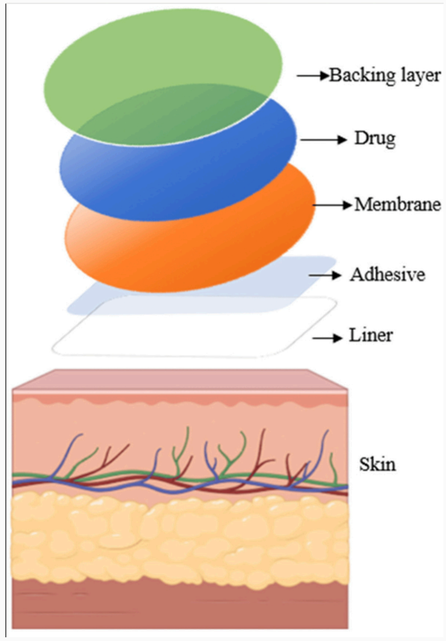

Figure: Structure diagram of a typical transdermal drug delivery system (TDDS)

Methods:

PDMS membranes ("patches") are being fabricated to emulate the diffusion characteristics of human skin. To achieve this, PDMS base and curing agent are mixed at different ratios (5:1, 10:1, and 20:1), with silicone oil added up to 15% v/v to further tune diffusivity. The mixtures are degassed under vacuum to remove bubbles, then cast into 6-well plate molds to ensure consistent circular geometry and controlled thickness (1–2 mm). Following a 2-hour curing period at 70°C, the membranes are extracted, trimmed to size, and reserved for use as skin analogs in drug diffusion testing. These tailored PDMS formulations will enable the development of a controlled and reproducible model for transdermal drug permeability studies.

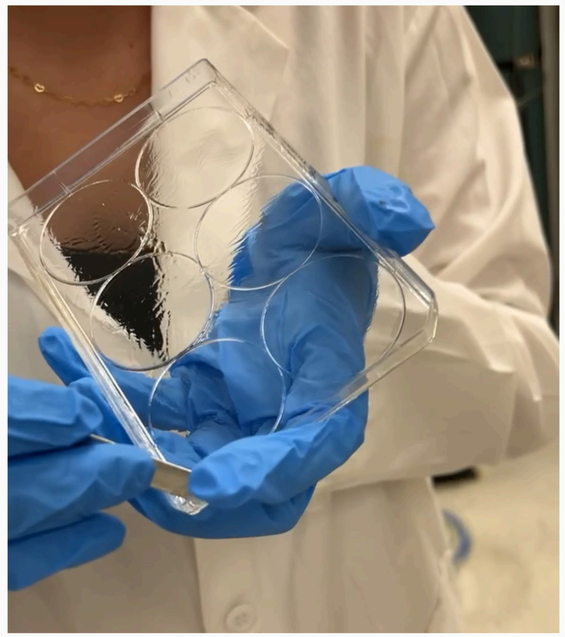

Figure: Transdermal patches prepared for use as model transdermal delivery systems in skin-mimicking diffusion experiments.

Results:

PDMS membranes with different formulations are currently being fabricated and prepared for testing as skin analogs. Franz cell diffusion studies will be conducted next, followed by UV-Vis analysis to calculate diffusion coefficients. Final data and comparison to skin permeability values will be added once testing is complete.

Conclusion:

This project is developing PDMS membranes with skin-like diffusion properties to support controlled testing of transdermal drug delivery systems. Membrane fabrication and testing are in progress. Upcoming work includes completing Franz cell diffusion studies and comparing results to computational models and known skin permeability values. The goal is to identify the PDMS formulation that best mimics skin to improve in vitro drug delivery research.

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