

Background

- Bacterial vaginosis is a prevalent condition commonly treated with localized gel therapeutics.
- Efficacy depends on formulation interaction with the complex vaginal environment.

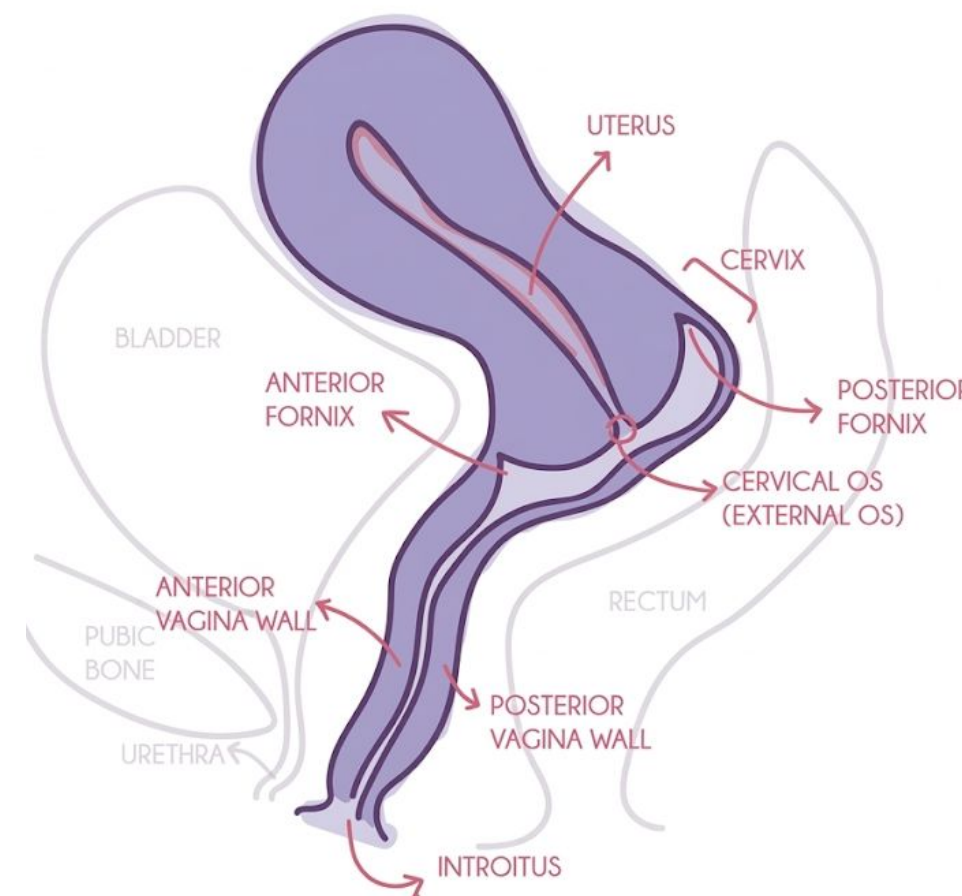


Figure 1. Physiological Site

Problem Statement: There is no benchtop model that integrates the anatomical, thermal, and fluid-based conditions of the vaginal environment.

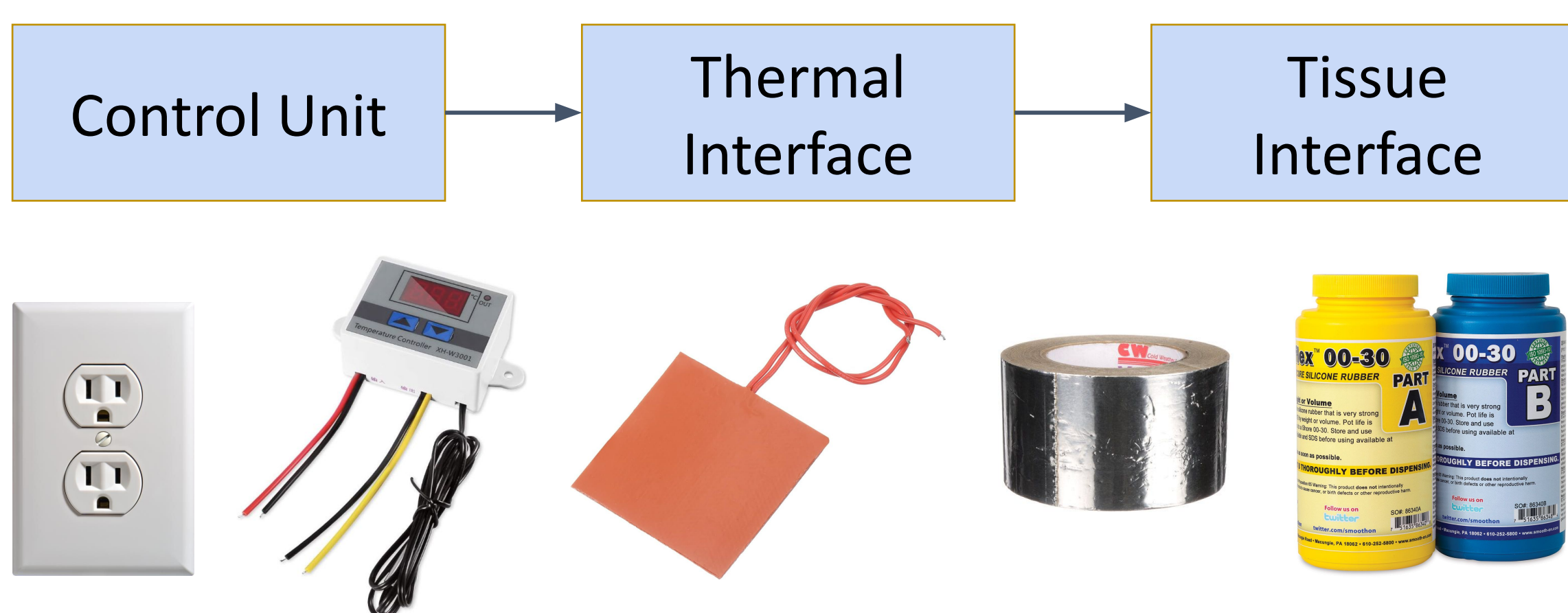
Objectives & Design Criteria

Develop a benchtop platform for intravaginal gel evaluation by integrating anatomical, thermal, and fluidic variables.

Table 1. Design criteria and benchmarks for success.

Category	Benchmark of Success	Specification
Anatomy	Visualization	Enlarged Geometry
Tissue	Tissue mimicry	EcoFlex 30 silicone
Thermal	Stability	37 ± 0.5°C
Material	Durability	Heat-resistant PLA
Fluidic	Chemical Stability	SVF Compatibility

Thermal & Material Architecture



Section A: Design & Fabrication

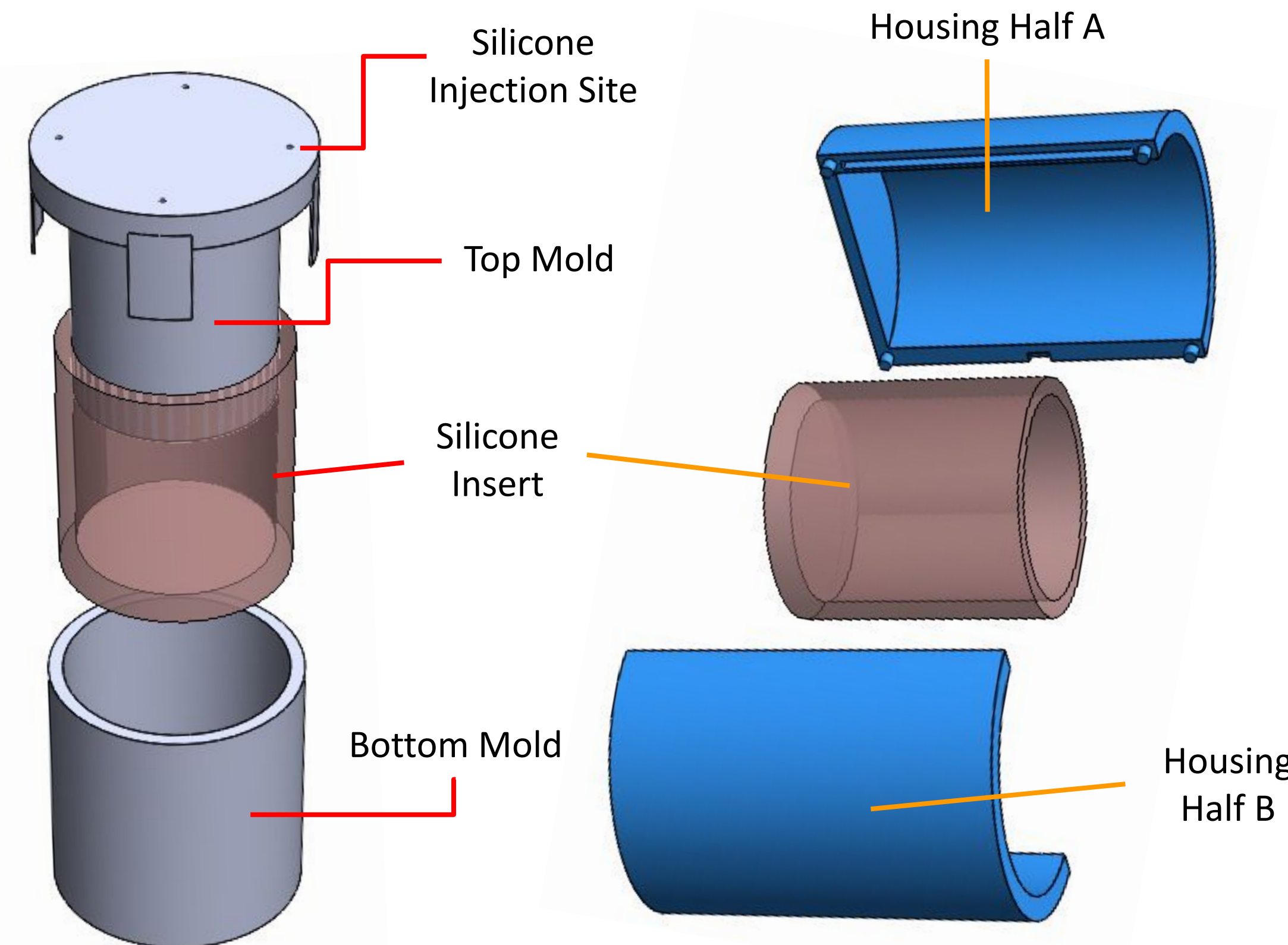


Figure 2. Exploded View of Modular Casting Assembly

Figure 3. Exploded View of Benchtop Testing Platform

Section B: Experimental Validation

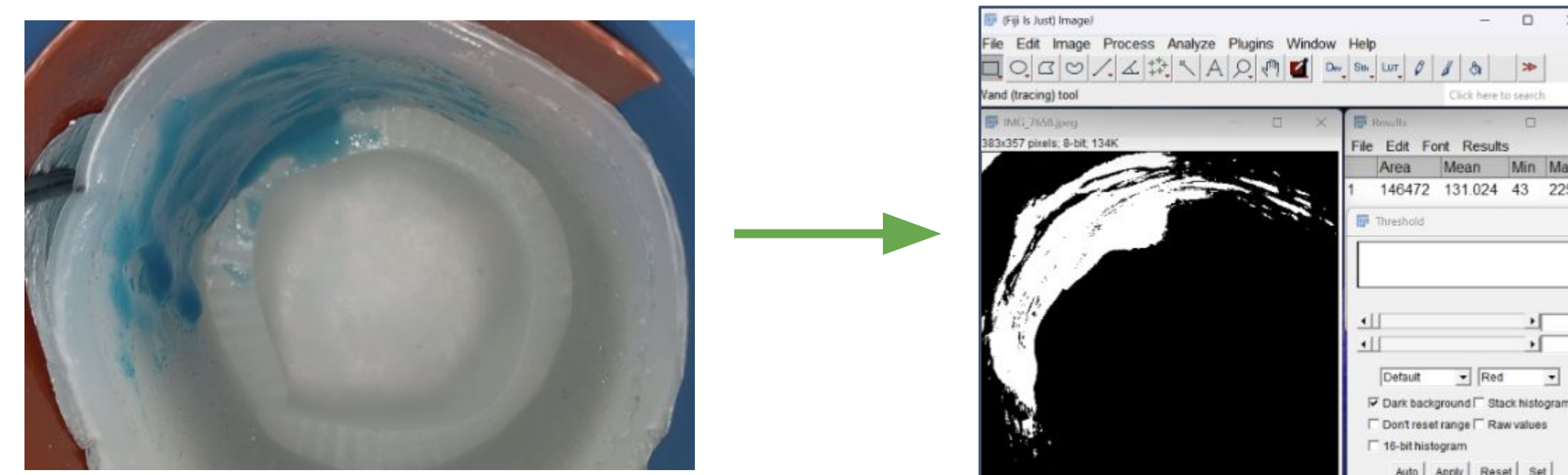


Figure 4. (Left) Original experimental photo of gel distribution; (Right) Binary thresholding and area measurement using ImageJ to quantify surface coverage.

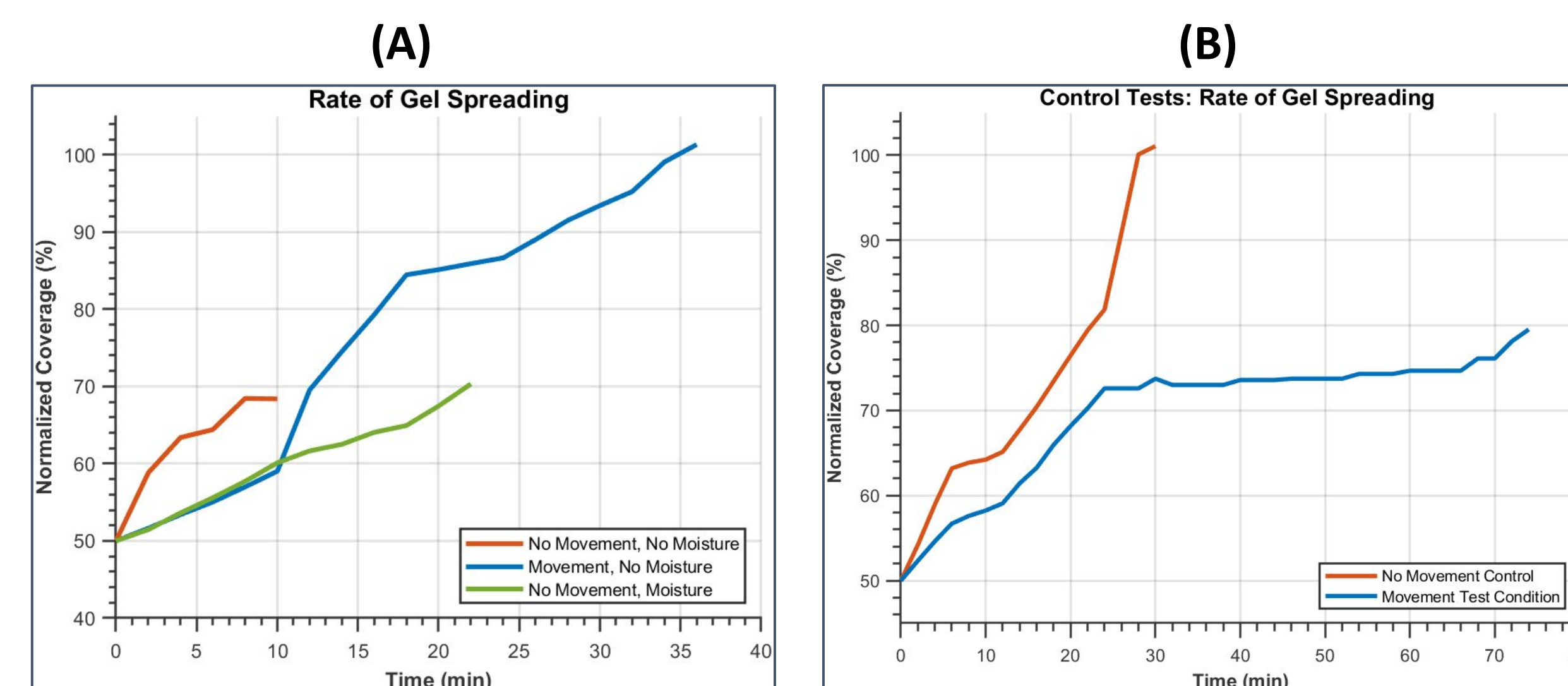
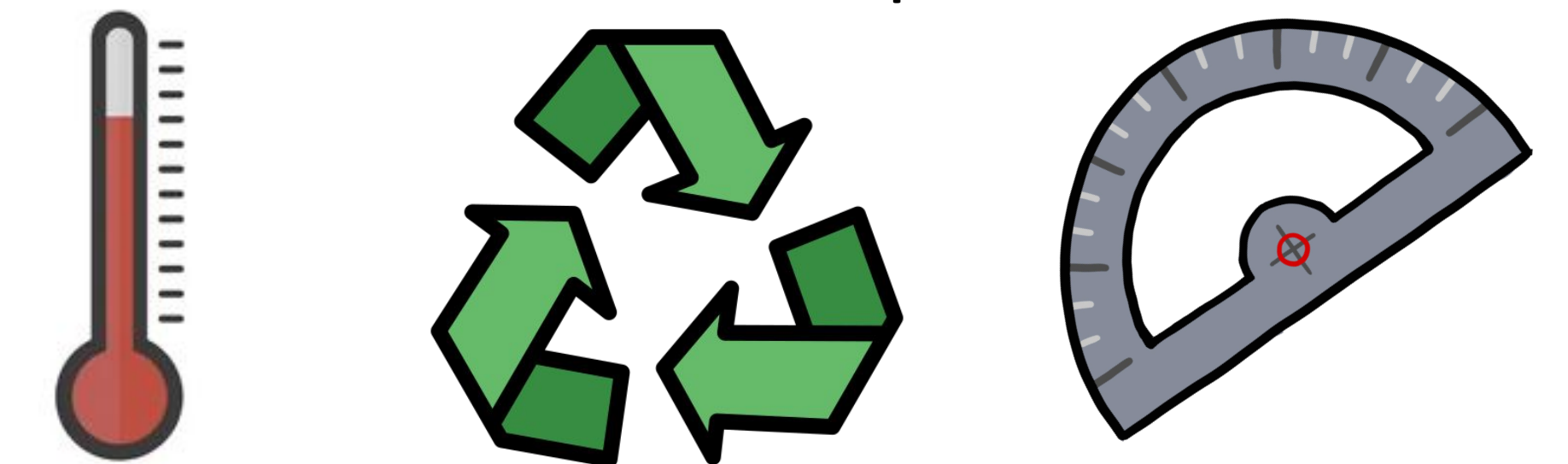


Figure 5. Normalized Gel Spreading Rates. (a) Performance under varying environmental parameters and (b) device-driven movement versus static control conditions.

Expected Outcomes

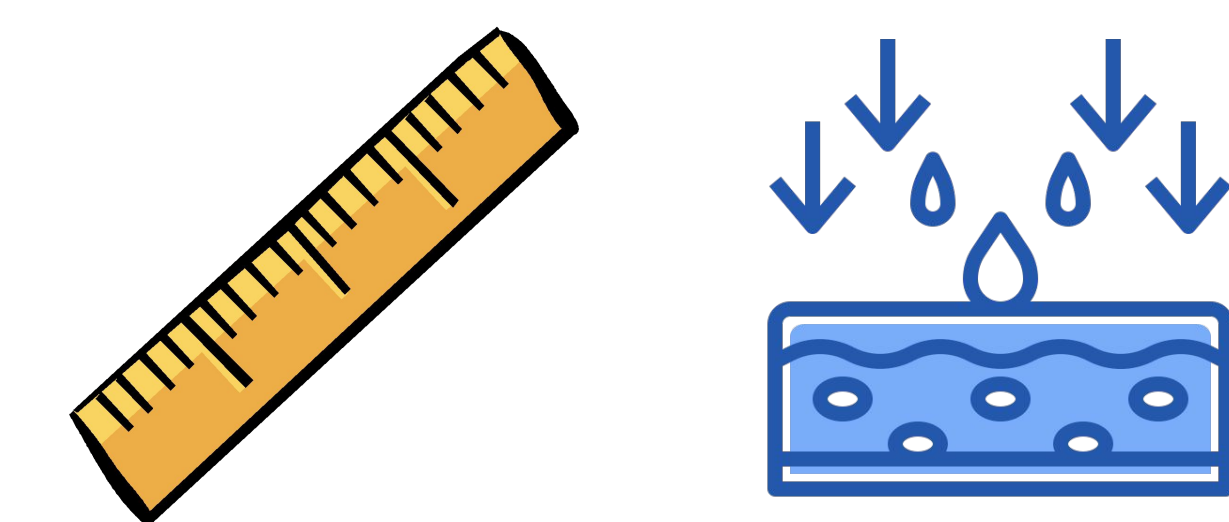
- Thermal Control: Platform maintains a stable 37°C environment for physiological testing.
- Visualization: 1.5x scale geometry ensures clear internal viewing of gel behavior.
- System Reusability: Modular clamshell design allows for rapid insert swapping.
- Dynamic Rotation: Simulates body angles to track movement effects on internal processes.



Conclusions & Future Directions

Benchtop Validation: Successfully built a low-cost platform for heat, moisture, and rotation testing.

Lab Utility: Provides a reusable tool for rapid testing of various gel formulations.



Future directions include miniaturizing the 1.5x geometry and integrating moisture/humidity controls to better mimic the human body while maintaining clear visualization.

Acknowledgements & References

I would like to thank Dr. Erika Cyphert and Yumie Lee for their invaluable mentorship, technical guidance, and support throughout this project.