Prevention of Massive Blood Loss in Traumatic Lacerations: Is Hagfish Slime the Answer?

Tyler Calvert, Tori Erickson, Ricky Vila, Sarah Nunes

Chapman University Grand Challenges Initiative

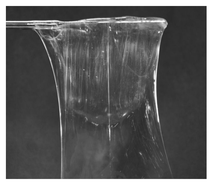
Why Hagfish Slime?

Hagfish slime is a small and strong absorptive material with interesting mechanistic properties:

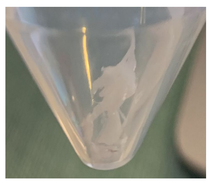
- 40 mg exudate → **1 L of slime**
- Strand filaments **100x thinner** than a strand of human hair but **10x stronger** than nylon
- **1 tsp** expands 1000 times

What are the main goals?

1. Retain hagfish slime properties with long term storage
   - Freeze Drying
2. Identify valuable hagfish properties
   - Expansion and Integrity
3. Determine procedures that will provide quantitative data on hagfish properties
   - Universal Test Machine
   - Microscope analysis



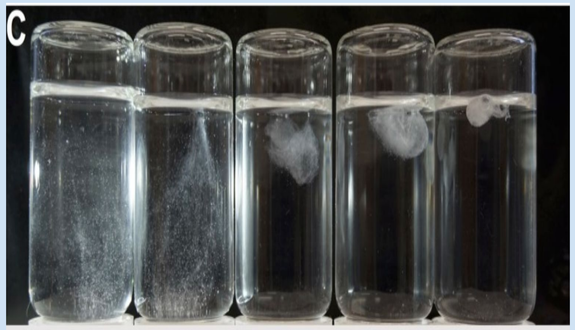
Expanded



Freeze Dried

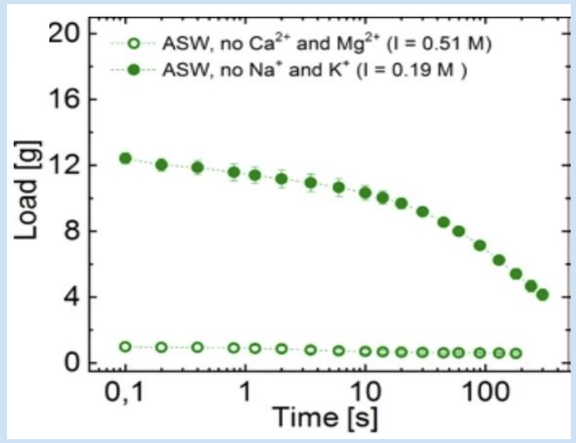
Factors affecting storage:

SKEIN UNRAVELING IS PH DEPENDENT



The **higher the pH** of storage buffer the **decrease in functionality** in slime.

SALINITY AND IONS INDUCE EXPENAION

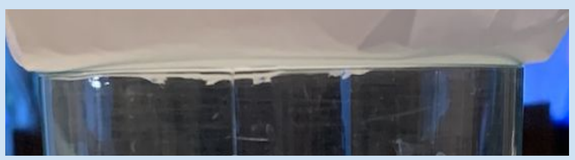


Either **calcium** or **magnesium ions** are **necessary** for **expansion**

LENGTH OF STORAGE TIME

2 minutes into drip test

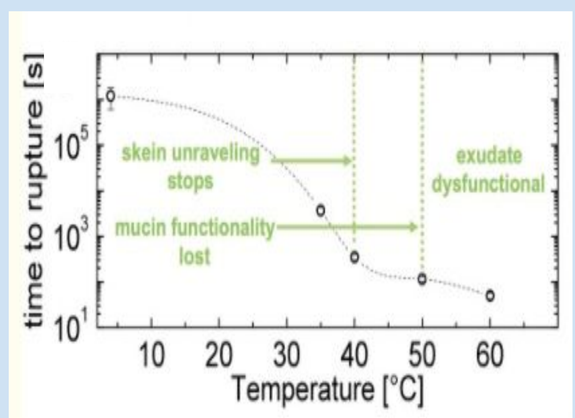
1 Month Post Freeze Dry



2 Months Post Freeze Dry

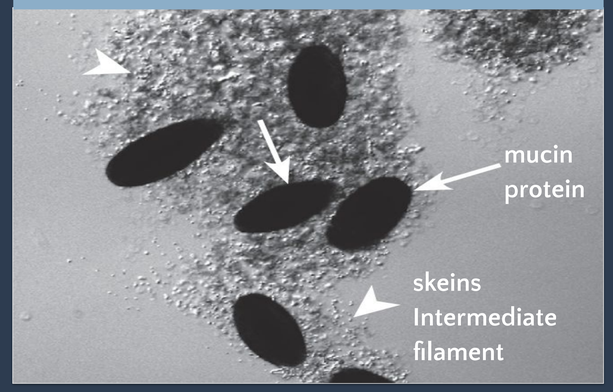
Increased time stored causes **increased viscosity** of expanded slime

SKEIN UNRAVELING IS TEMPERATURE DEPENDENT



The **higher the temperature** the **less unraveling of skeins.**

Slime Components



Why Store Slime?

1. Blood Loss Prevention
   Much more convenient in powder form to apply
   - EMT / first responders
   - Home first aid kits
2. Environmentally friendly strong materials
   - could replace Nylon
   - could be used in protective equipments

References

1. Fudge Herr, inegard, 2011. Hagfish slime **Encyclopedia of Fish Physiology** From Genome to Environment
2. .Dalit Shental-Bechor and Yaakov Levy*. 2008. Effect of glycosylation on protein folding: a close look at thermodynamic stabilization. National Institutes of Health's National Library of Medicine
3. Boni LJ, Zurfluh R, Widmer M, et al. Hagfish slime exudate stabilization and its effect on slime formation and functionality. *BIOLOGY OPEN*. 6(7):1115-1122. doi:10.1242/bio.025528.
4. Fudge, D. S.; Hillis, S.; Levy, N.; Gosline, J. M. Hagfish Slime Threads as a Biomimetic Model for High Performance Protein Fibres. *Bioinspiration & Biomimetics* **2010**, *5* (3), 035002. https://doi.org/10.1088/1748-3182/5/3/035002.