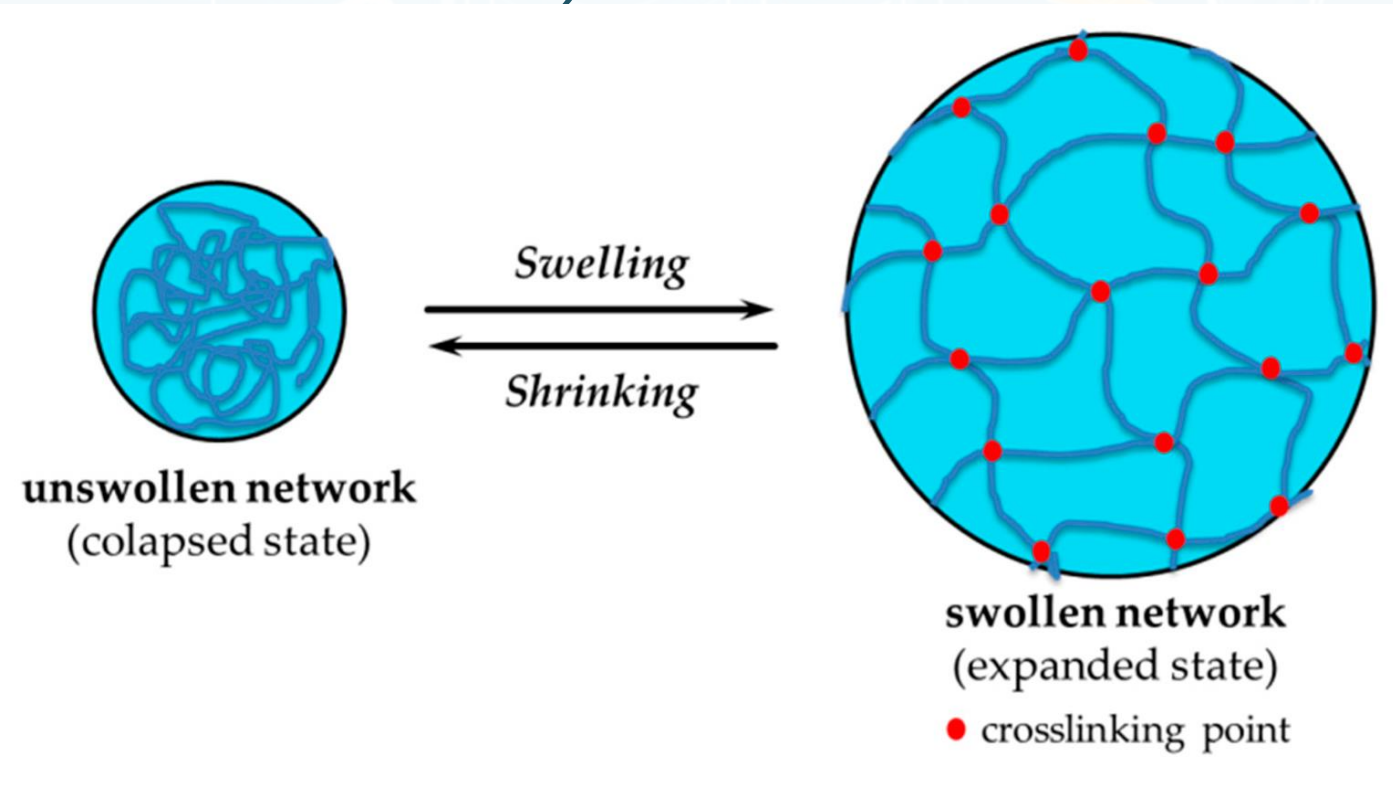
BME 174 – Hydrogels for Cultured Fat

Spring, 2023

https://new-harvest.org/

What are Hydrogels?

- Loose network of polymers
- Crosslinked (physical or chemical)
- Trap fluid



M. Bercea, “Bioinspired Hydrogels as Platforms for Life-Science Applications: Challenges and Opportunities,” *Polymers*, vol. 14, no. 12, Art. no. 12, Jan. 2022, doi: 10.3390/polym14122365.

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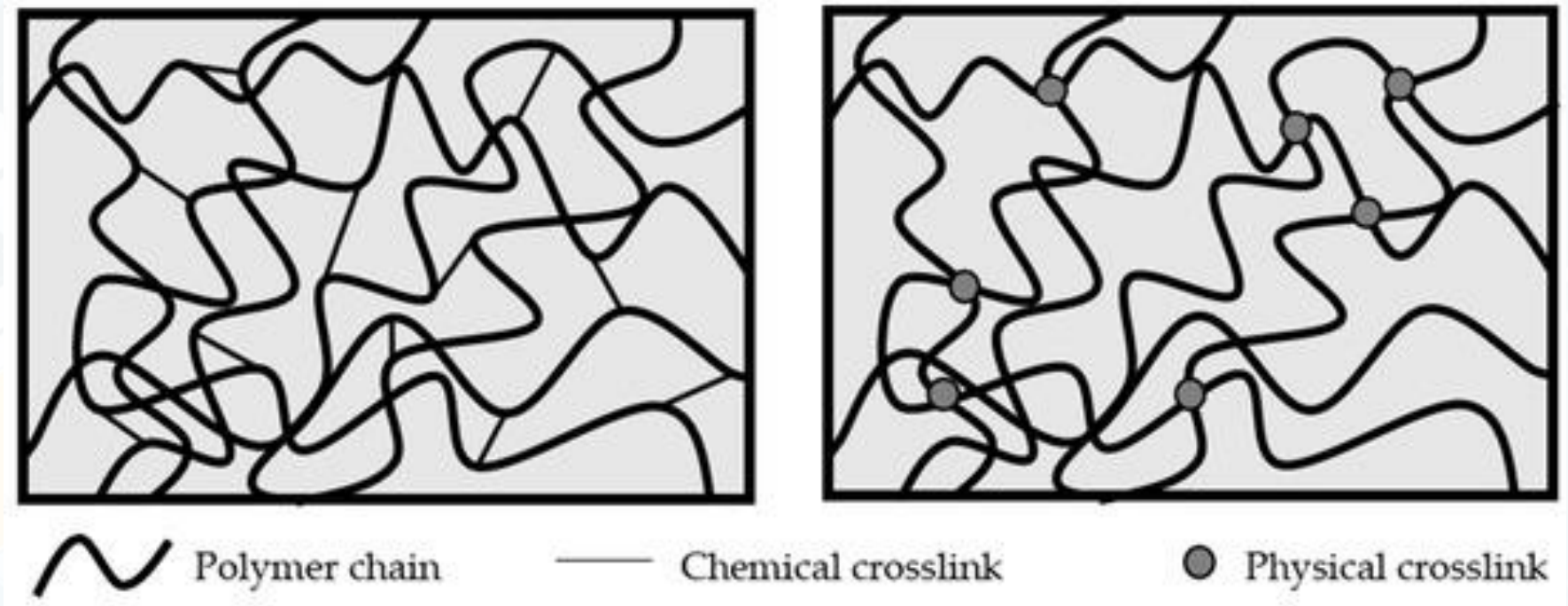

C. Echeverria, S. N. Fernandes, M. H. Godinho, J. P. Borges, and P. I. P. Soares, “Functional Stimuli-Responsive Gels: Hydrogels and Microgels,” *Gels*, vol. 4, no. 2, Art. no. 2, Jun. 2018, doi: 10.3390/gels4020054.

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Chemical

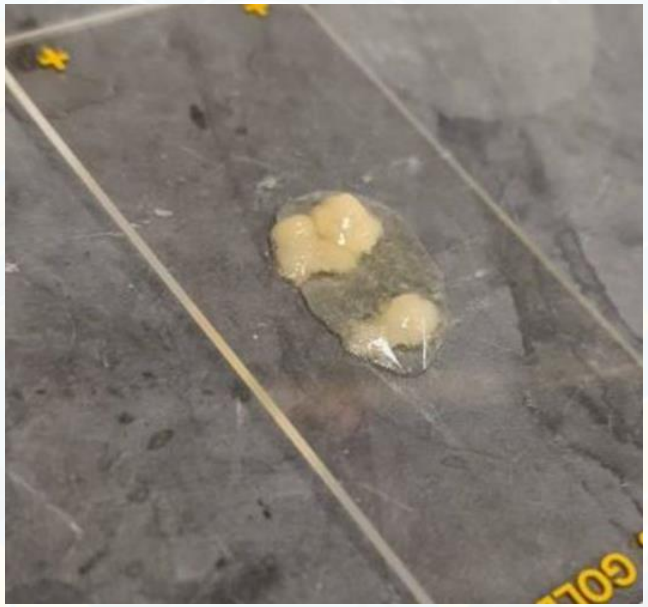
Physical

Why use them for Cell Ag?

- Native fat has ECM
  - Solid structure
- Cultured fat missing binder
  - Mushy and sad

J. S. Yuen *et al.*, “Macroscale Adipose Tissue from Cellular Aggregates: A Simplified Method of Mass Producing Cell-Cultured Fat for Food Applications.” bioRxiv, p. 2022.06.08.495192, Jun. 18, 2022. doi: 10.1101/2022.06.08.495192.

Native Pig Fat

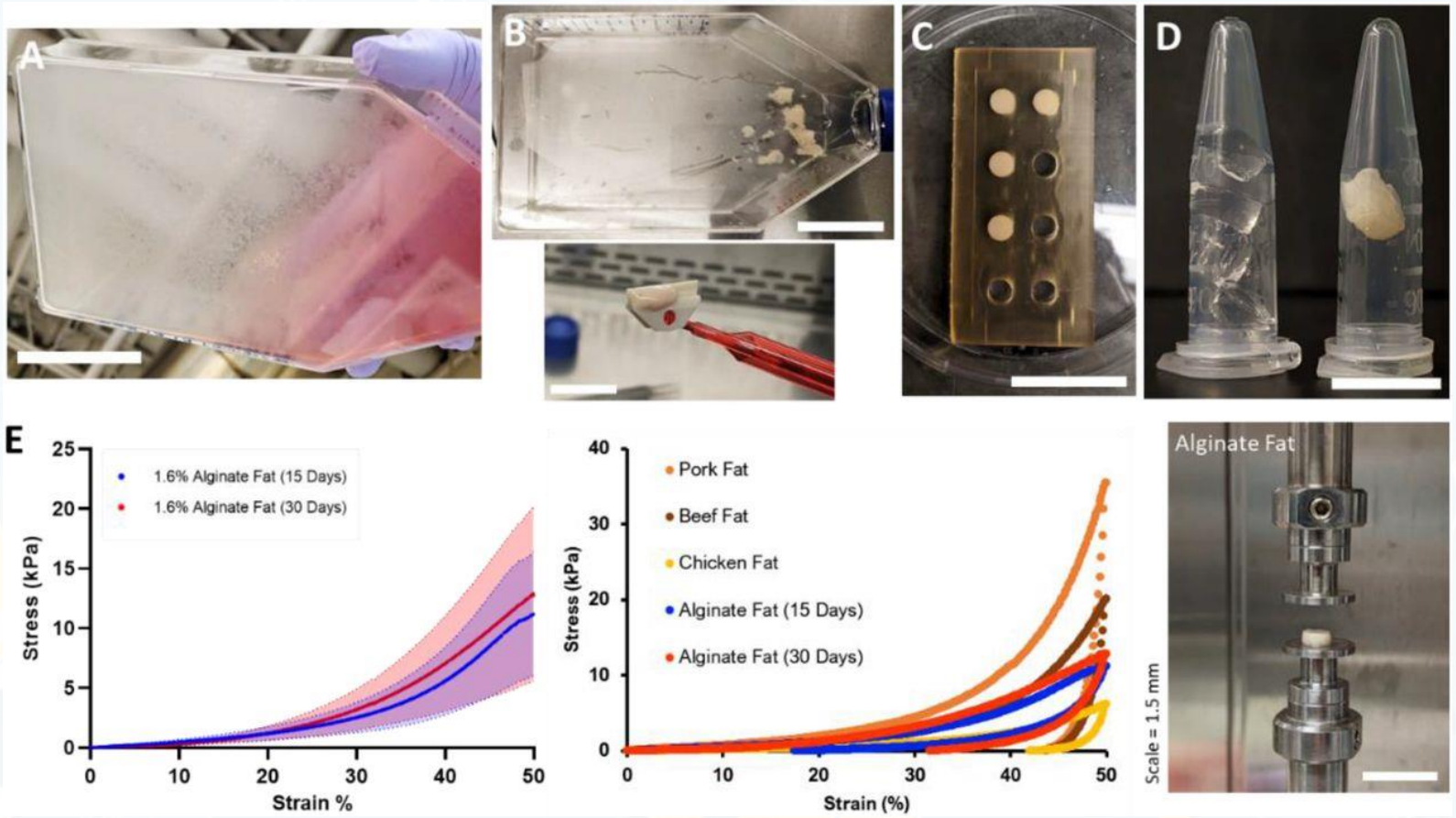


Cultured Pig Fat

(colorized) c.2022

Why use them for Cell Ag?

- Hydrogel is a binder option
- Encapsulate fat and improve mechanical properties



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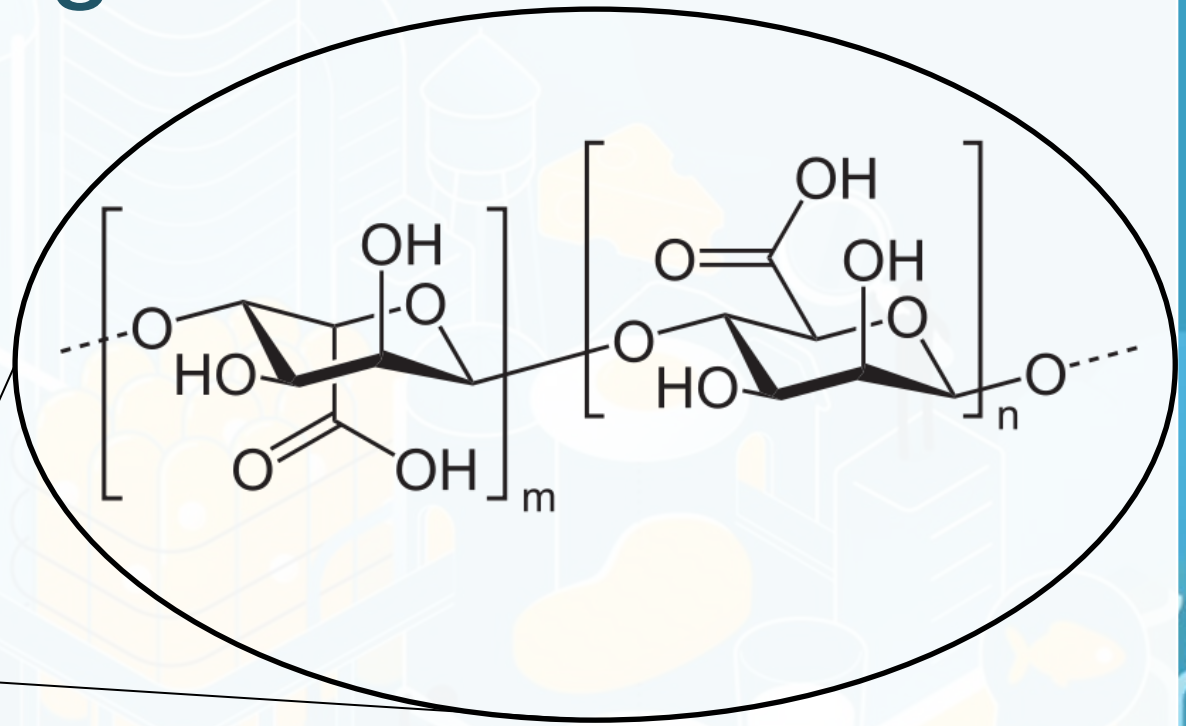
Material of interest: alginate

- Linear polysaccharide
- Natural polymer
- Super-absorbent

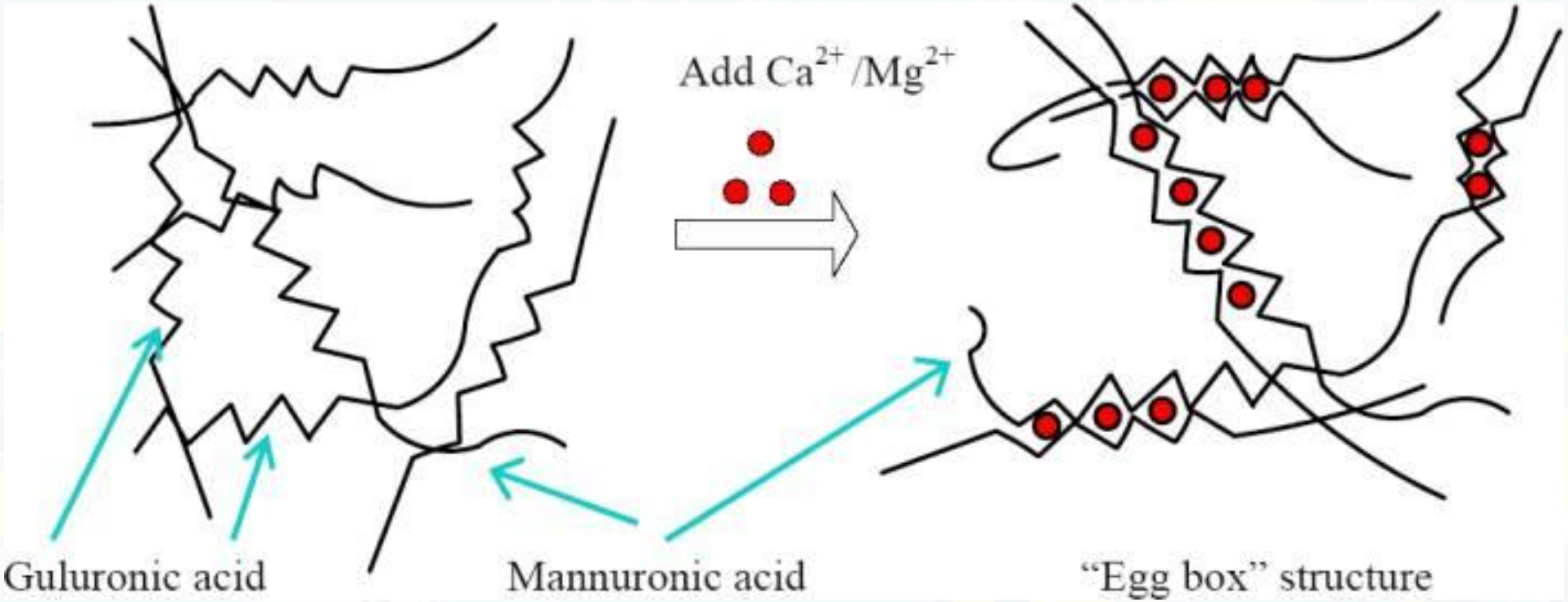


Why use alginate for cultured food?

- Biocompatible
- Edible
- Low cost
- Easy gelation
- Animal-free
- Neutral flavor
- History of use in food
  - Even in plant-based meat!

Alginate gelation mechanism

- Ionic crosslinking



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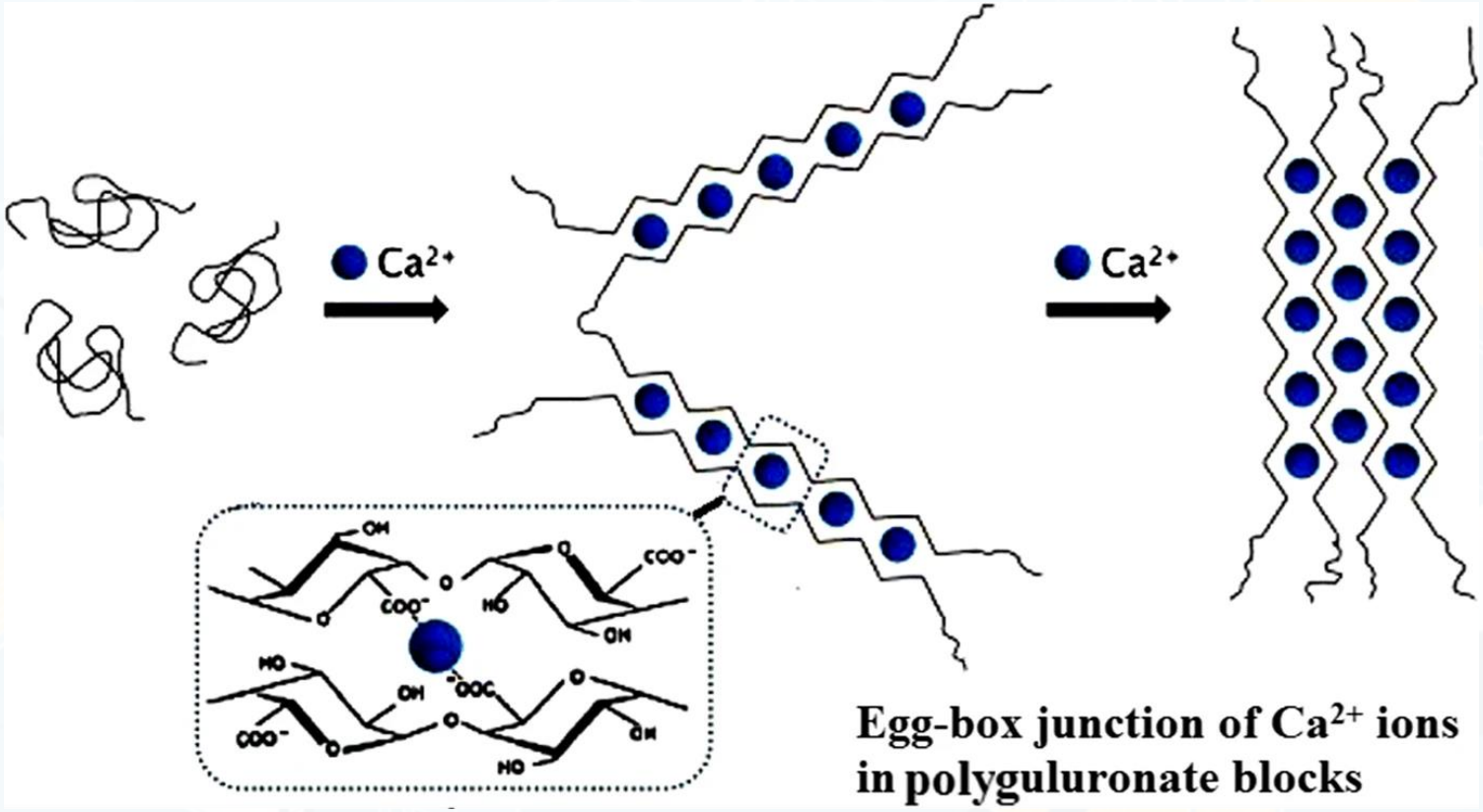
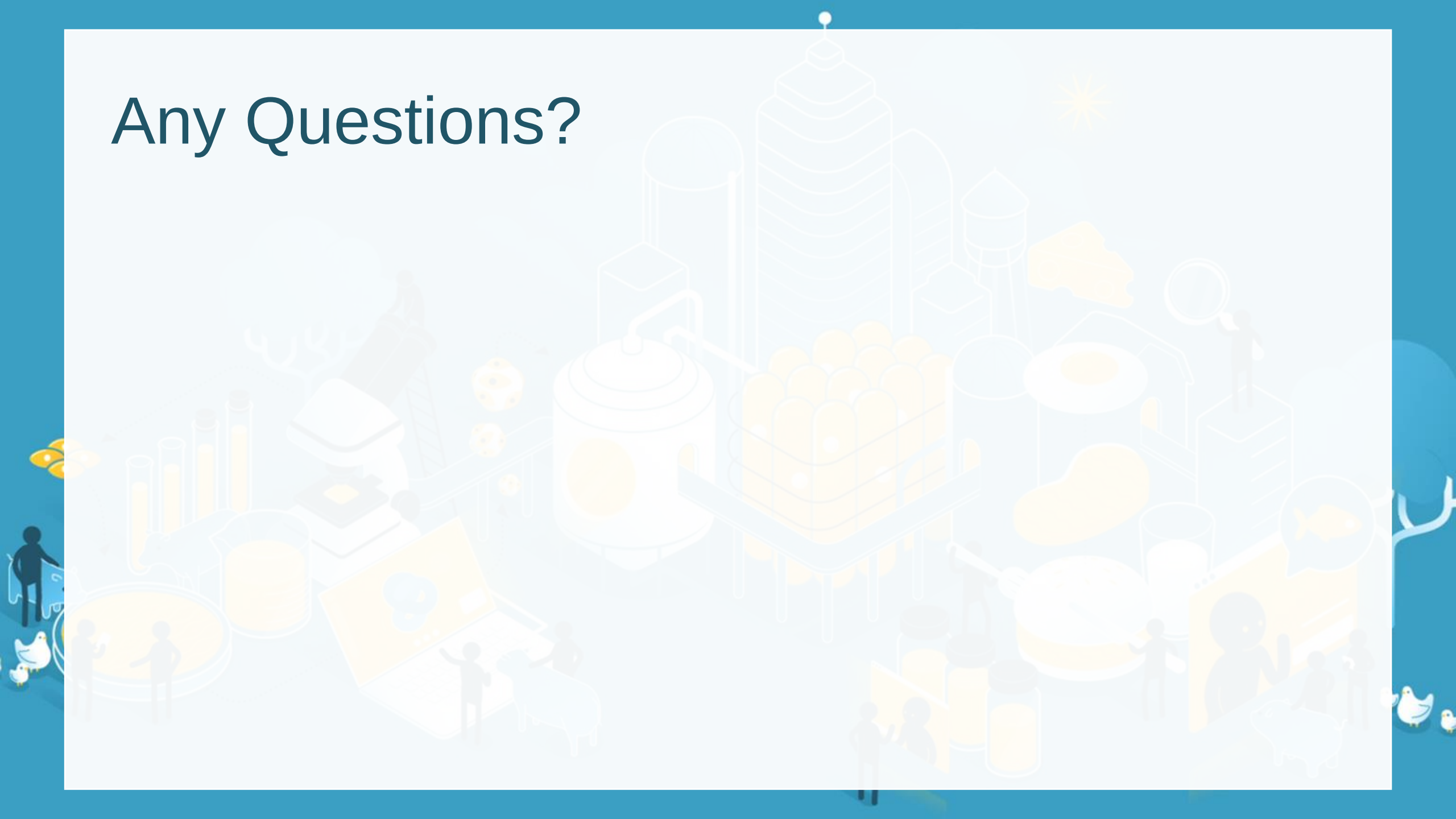
Alginate gelation mechanism

- Increase ion concentration to change mechanical properties



A. Merakchi, S. Bettayeb, N. Drouiche, L. Adour, and H. Lounici, “Cross-linking and modification of sodium alginate biopolymer for dye removal in aqueous solution,” *Polym. Bull.*, vol. 76, no. 7, pp. 3535–3554, Jul. 2019, doi: 10.1007/s00289-018-2557-x.

Any Questions?



Today's Plan

- Feed fat cells
- Experiment with hydrogel formation
  - Different variables to investigate
    - $CaCl_2$ concentration
    - Time spent in $CaCl_2$
    - Post processing (store in water, media, PBS)
    - Vessel in which to form hydrogel
    - Temperature of reagents
- Decide on hydrogel protocol for next week
  - Which protocol most mimics fat?
  - Or, which is most appetizing?

Next Week

- ORO to compare different fat media
- Form fat/hydrogel complex
  - Scrape differentiated fat off flask surface
  - Mix fat with alginate
  - Follow gelation process determined in class today