Gelatin-alginate semi-interpenetrating network for controlled release of scent molecules

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CONTROLLED RELEASE SOCIETY
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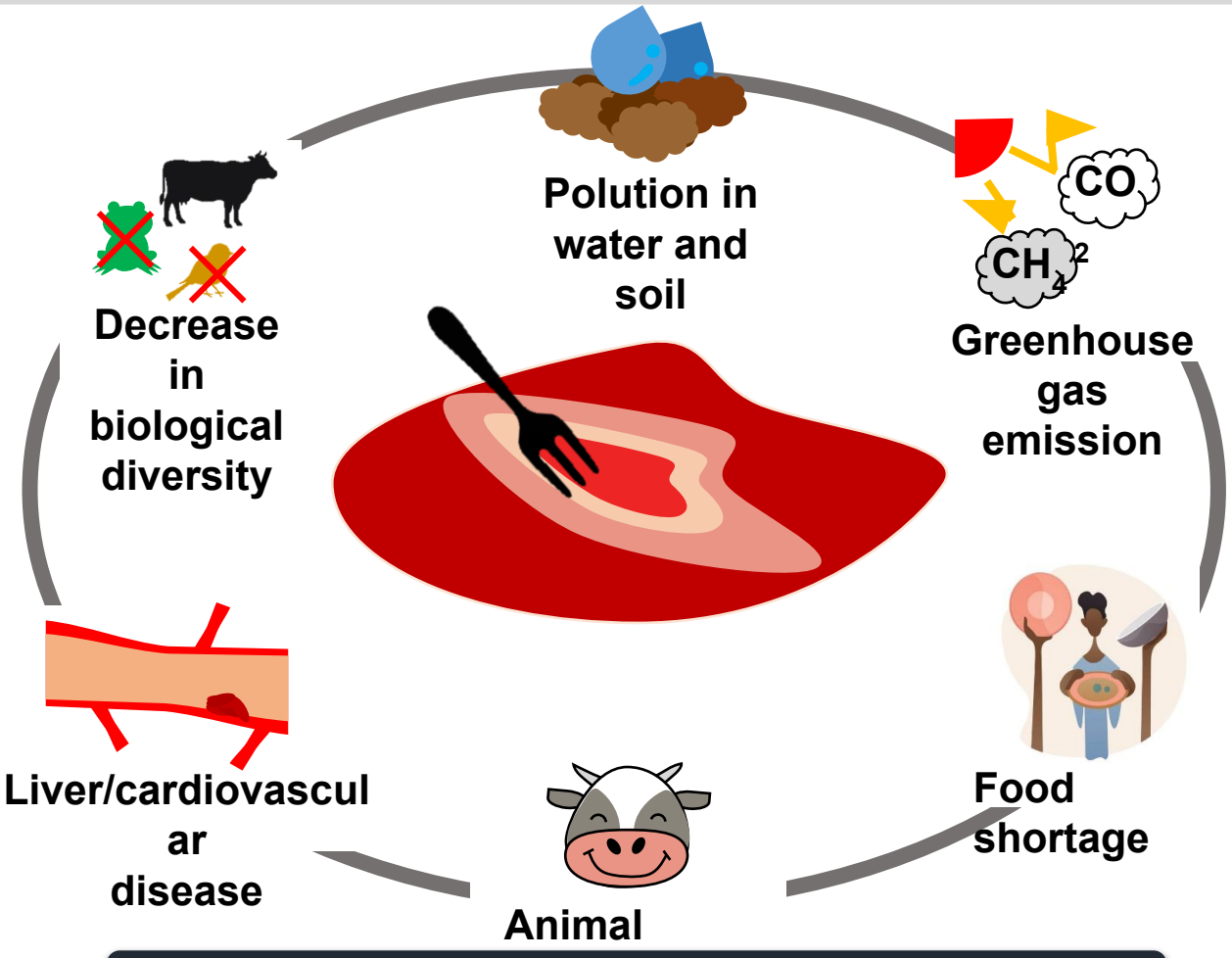
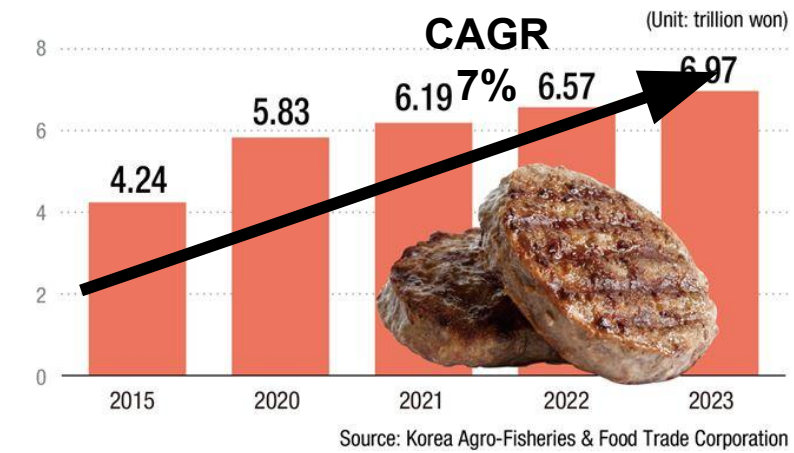
THE FUTURE OF DELIVERY SCIENCE

Emerging Market of Meat Alternatives



Meat consumption-related problems

Van der Weele et al., *Trends in Food Science & Technology*, *88*, 505-512 2019.



Market growth in meat alternatives

Development of Meat Alternatives

Fungi-based meat

Insect meat

Cultured meat

Plant-based meat

Pros

- Higher cost efficiency than cultured meat
- Ease of scale-up process
- Accessible and acceptable ingredients

Cons

- Difficulties in mimicking real meat flavors
- Additives for color and flavor

Wheat protein

Soybean

Van der Weele et al., *Trends in Food Science & Technology*, *88*, 505-512 2019. Rubio et al., *Nature Communications*, *11*(1), 6276, 2020. Lim, X. (2022). Bugs and the Future of Meat. *ChemMatters*, *2021*.

Approaches for Sustained Scent Release

Enhancing satisfaction of plant-based meat

- **Prevent scent leaking of uncooked product**

⇩

Controlled release of scent molecules

- **Introduce temperature responsive materials**

⇩

Screening edible materials

- **Most of reported thermo-responsive matrices are not edible (synthetic polymer or chemically modified)**

⇩

Precise control of responsiveness

- **By combining biomaterials pool, secure the thermo-responsiveness without chemical modification**

Our research scope,

- **Biomaterials science and engineering**
  - –Nucleic acid nanotechnology
  - –Biomaterials (peptides, lipids, carbohydrates, and metal NPs)
  - –Combining their properties
- **Formulation techniques**
  - –Nanoparticles
  - –Microcapsules
  - –Hydrogel and 3D-printing
- **Potential applications**
  - –Drug delivery
  - –Tissue engineering/cell culture
  - –Food industry

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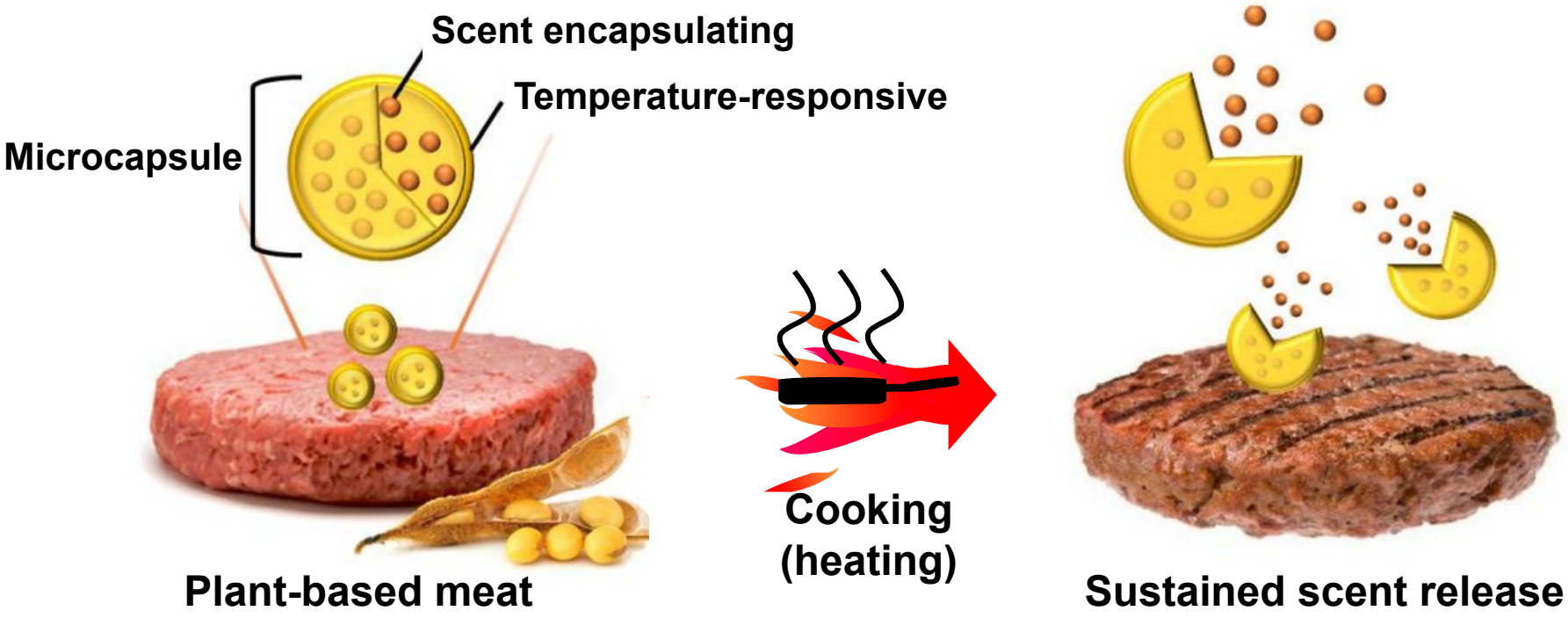
Objectives

Research focus

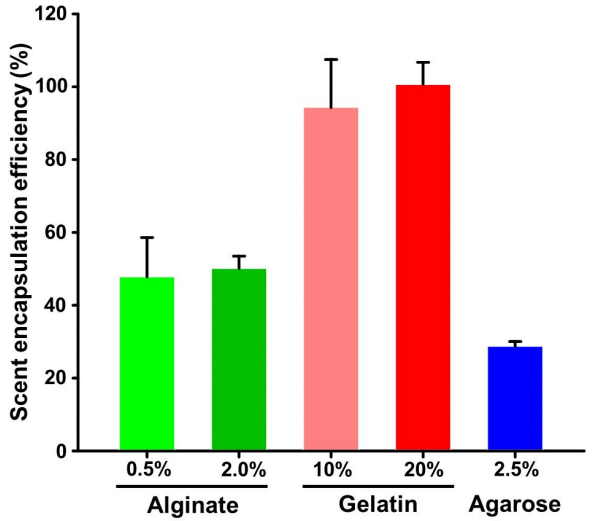
- Sustained release of scent during cooking
- Using edible materials
- Corresponding formulation

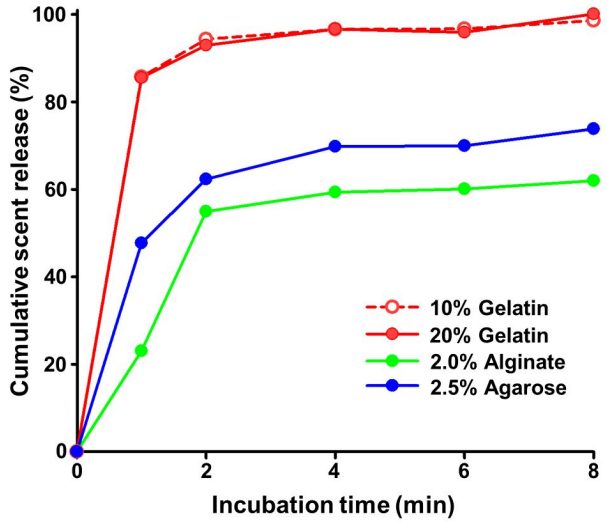
Approaches

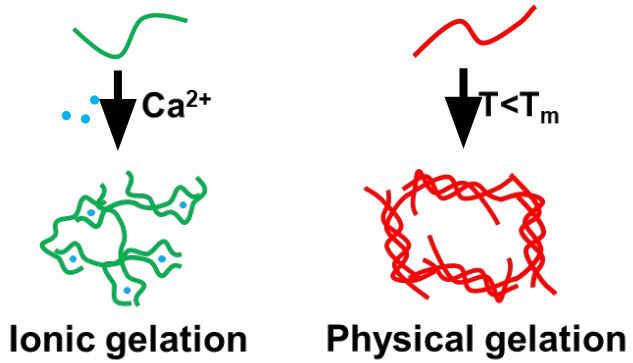
- Using biopolymers and their combinations
- Using microencapsulation

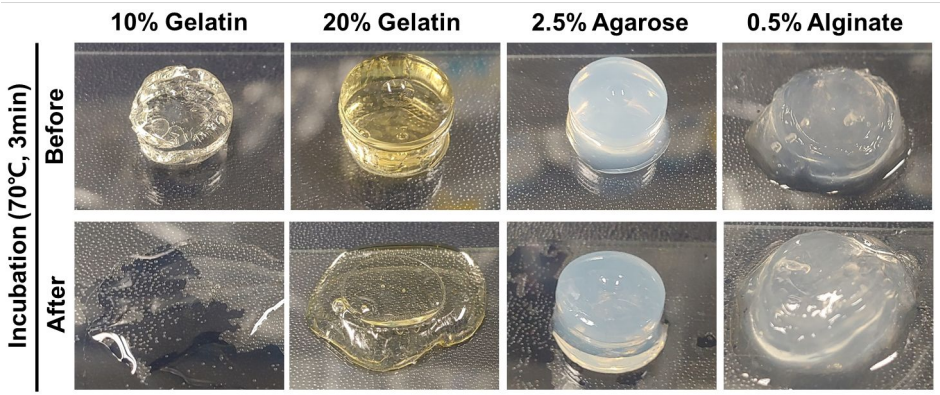


Biopolymer Screening





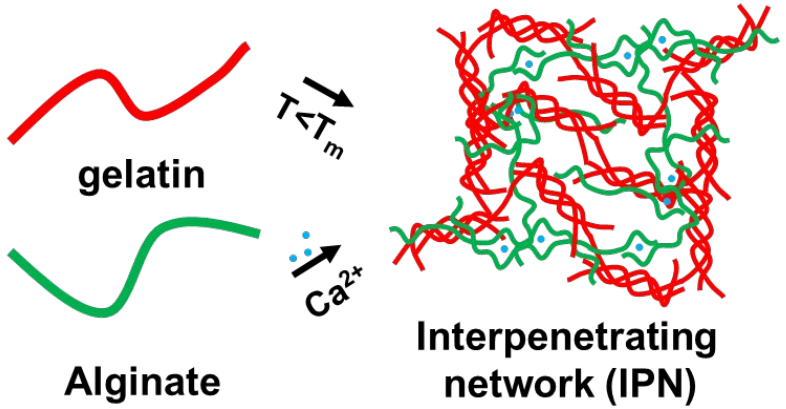




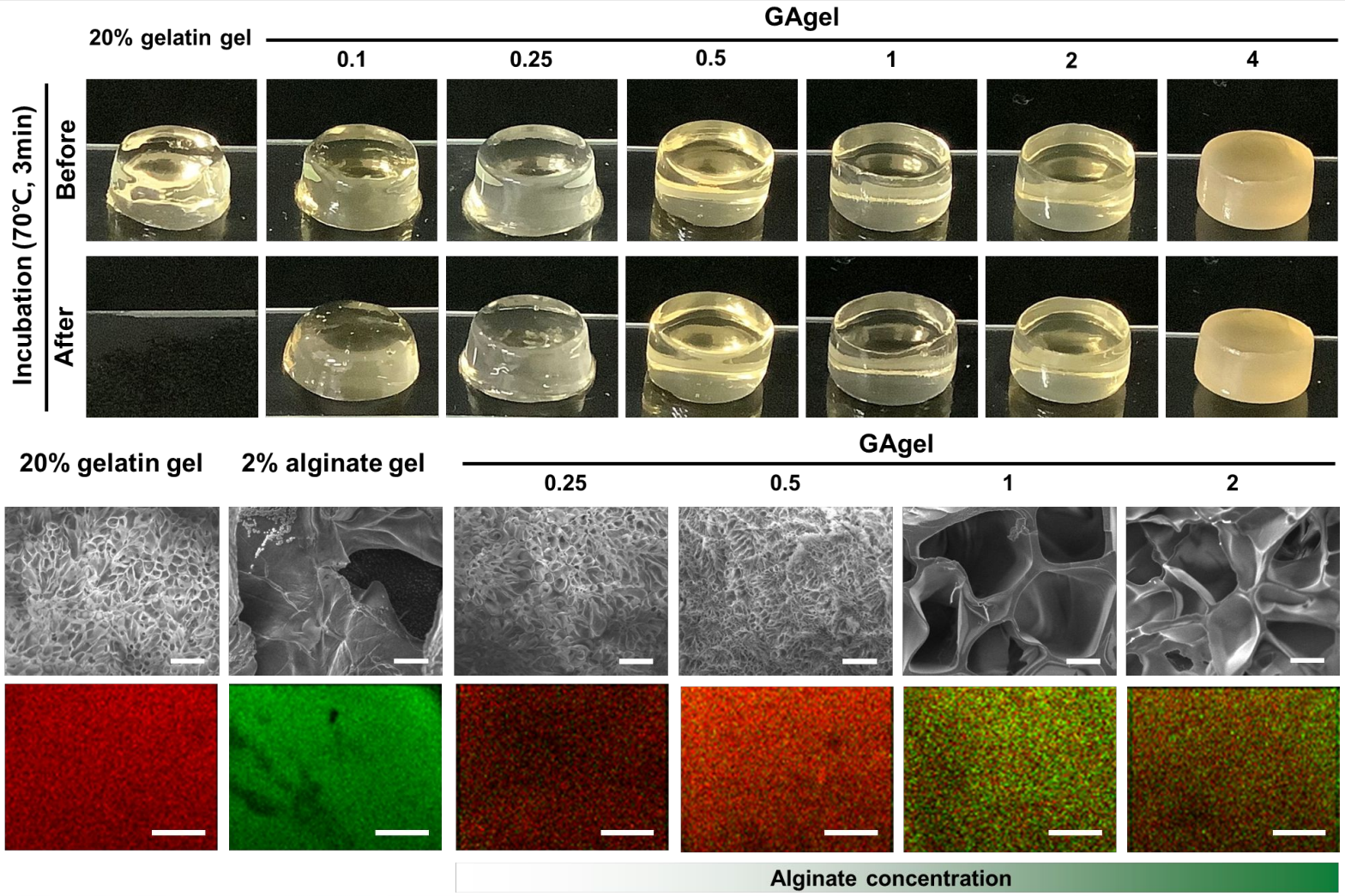
- Using 2,5-dimethylpyrazine as standard scent molecule
- Considering gelation mechanism, accessibility, and cost, biopolymers narrowed down to alginate, gelatin, and agarose
- Gelatin revealed higher scent encapsulation efficiency, while alginate and agarose showed decreased cargo release rate

Kim et al., *International Journal of Biological Macromolecules*, *208*, 2022.

Gelatin-Alginate Interpenetrating Network (IPN)

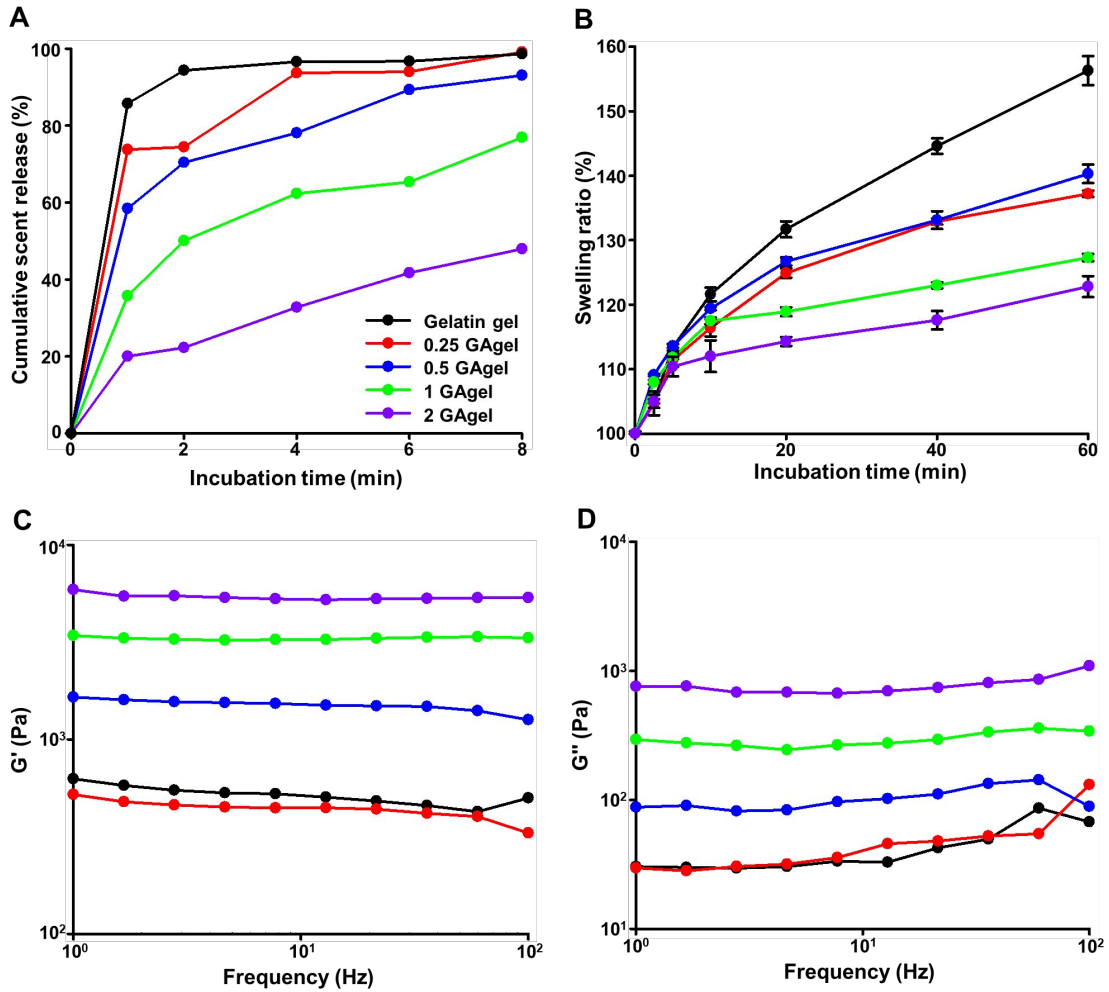


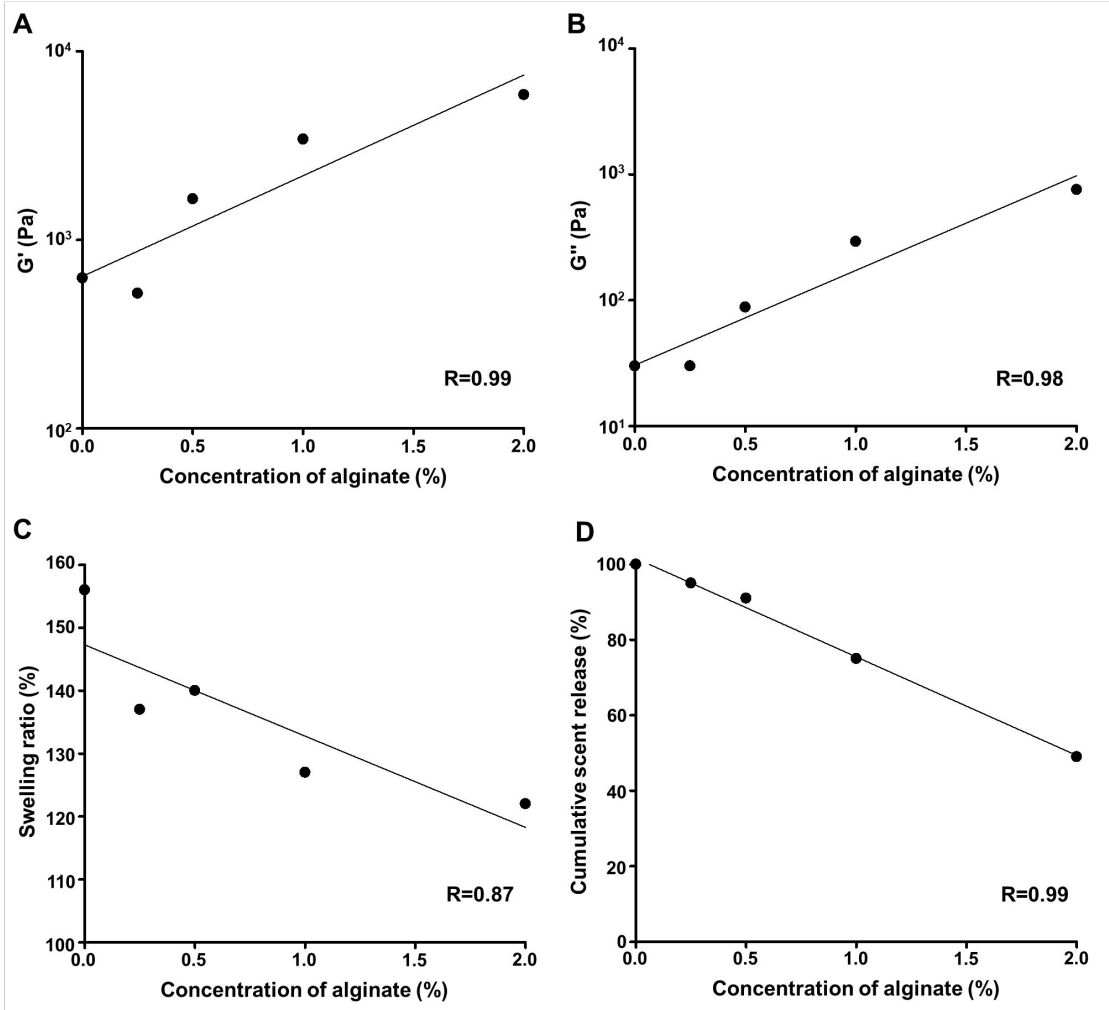
- Gelatin network (physical entanglement) was enhanced by fabricating interpenetrating network (IPN) with alginate (ionic crosslinking).
- The gelatin-alginate IPN was homogeneously formulated, and their hydrogel was not disrupted in cooking condition (70℃).



Kim et al., *International Journal of Biological Macromolecules*, *208*, 2022.

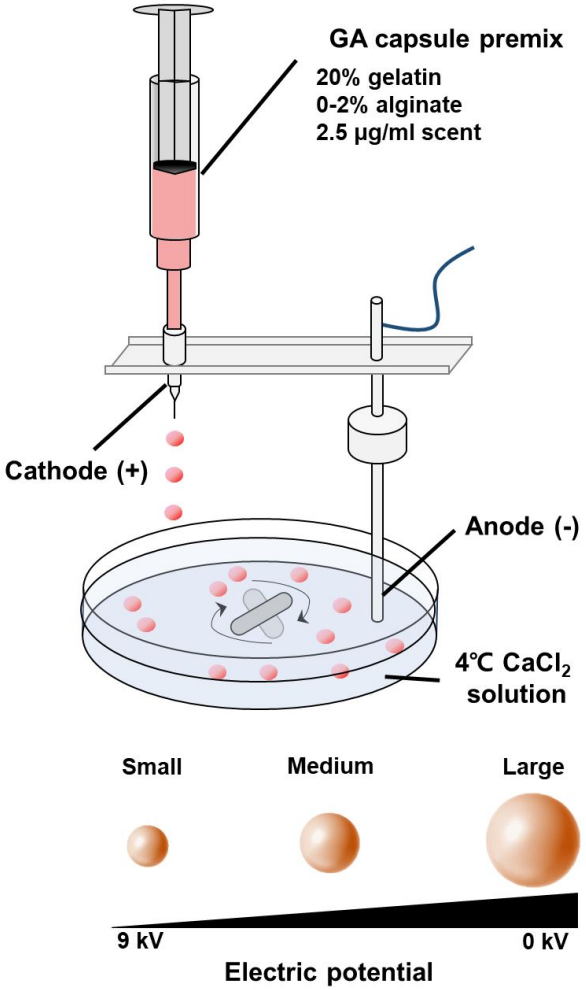
Physicochemical Properties of Gelatin-Alginate IPN

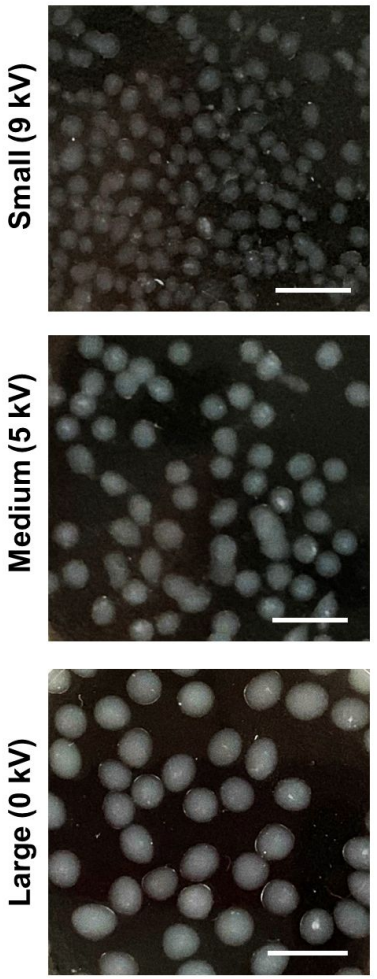


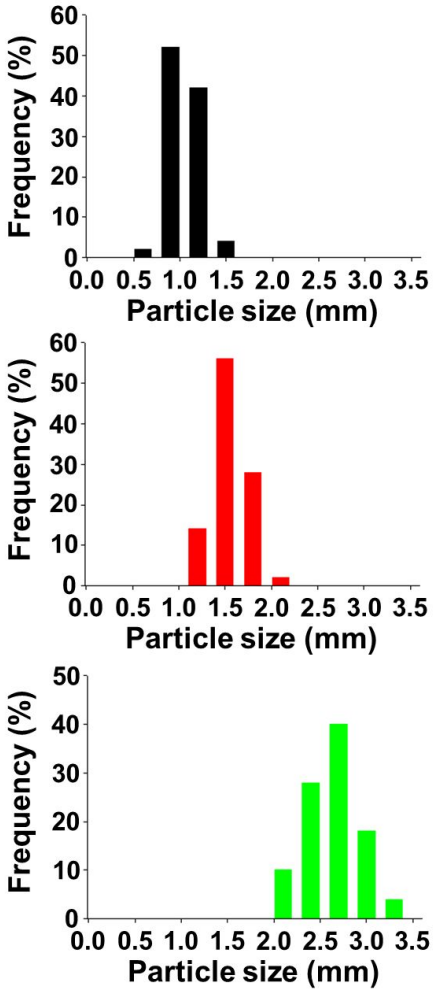


Kim et al., *International Journal of Biological Macromolecules*, *208*, 2022.

Microcapsulation of Gelatin-Alginate IPN







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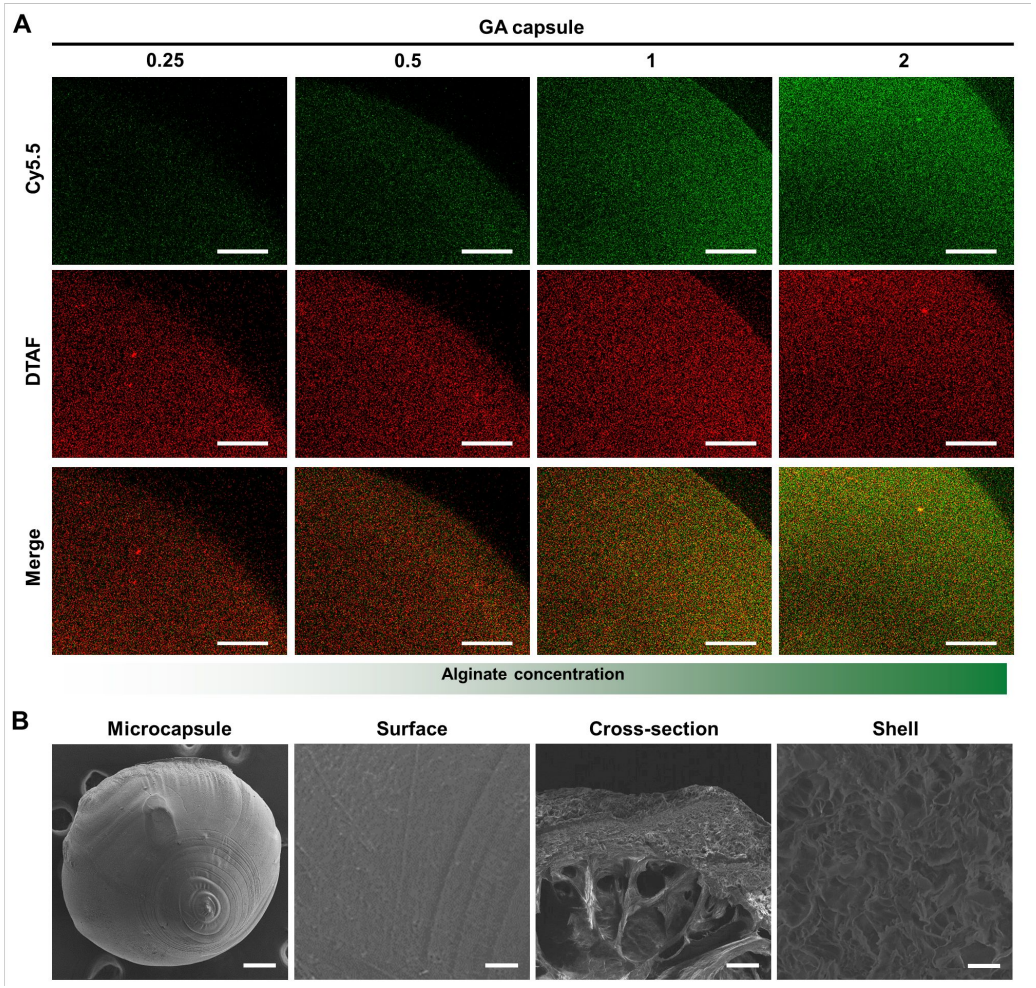
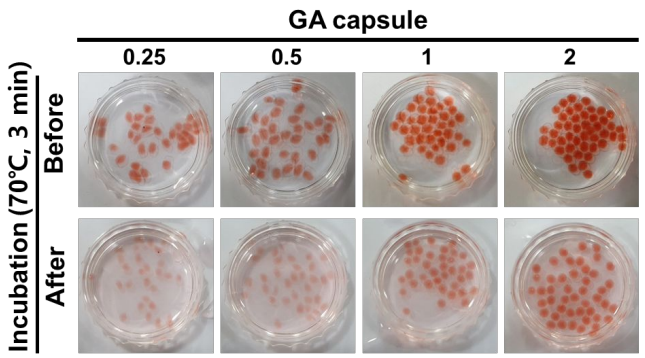
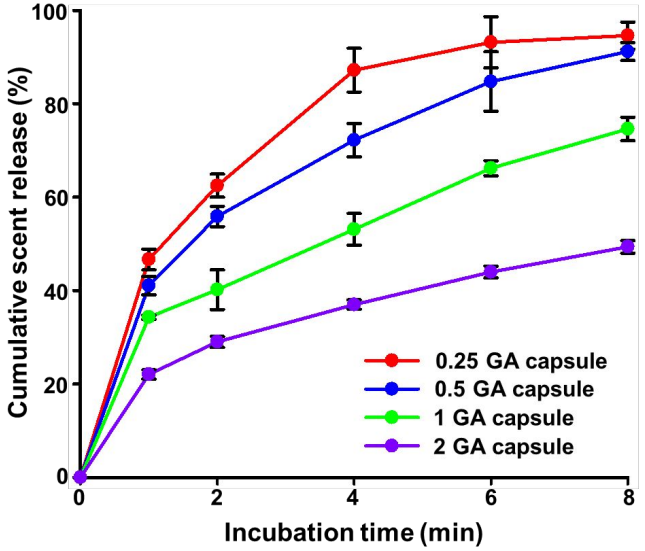
Characteristics of Gelatin-Alginate Microcapsule







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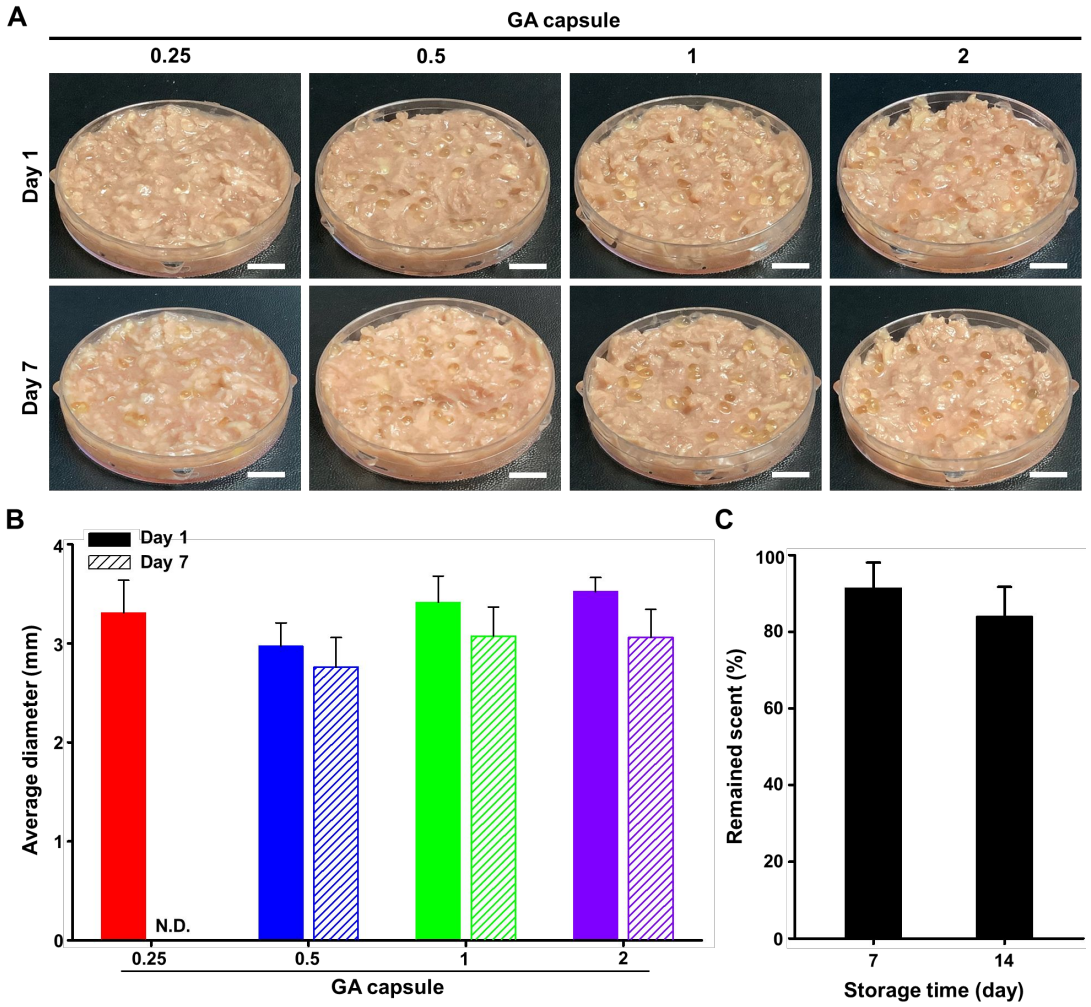
Applicability of GA Microcapsule in Meat Alternatives



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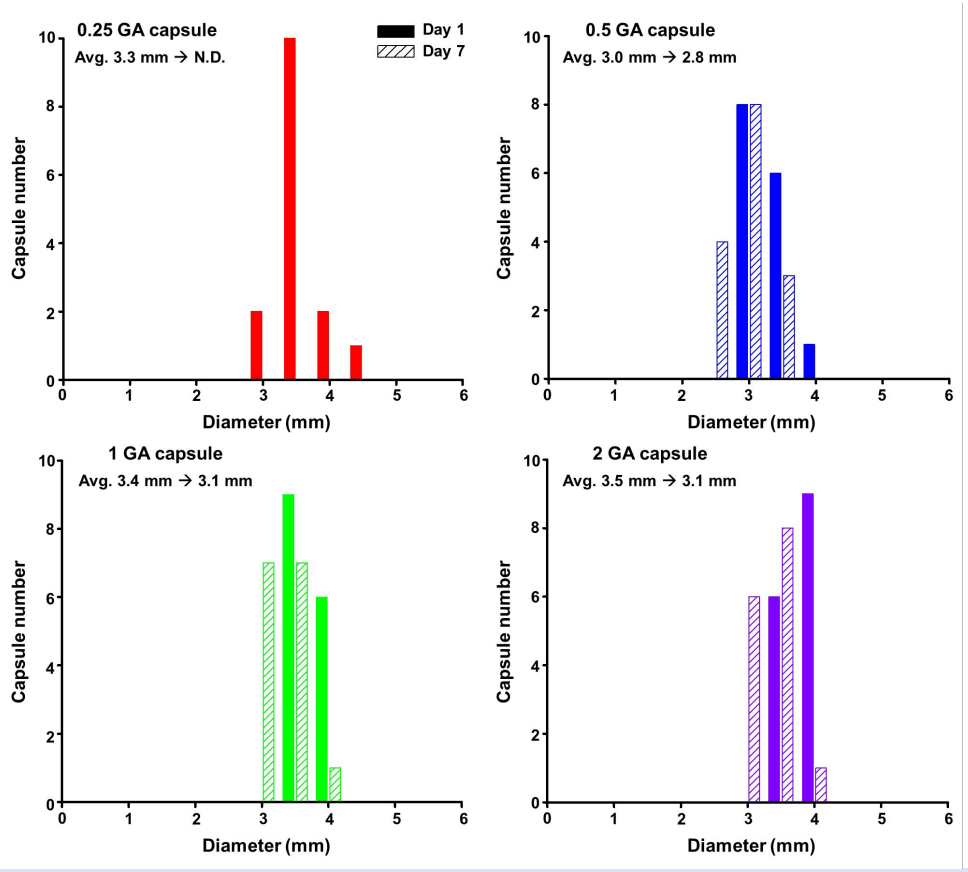
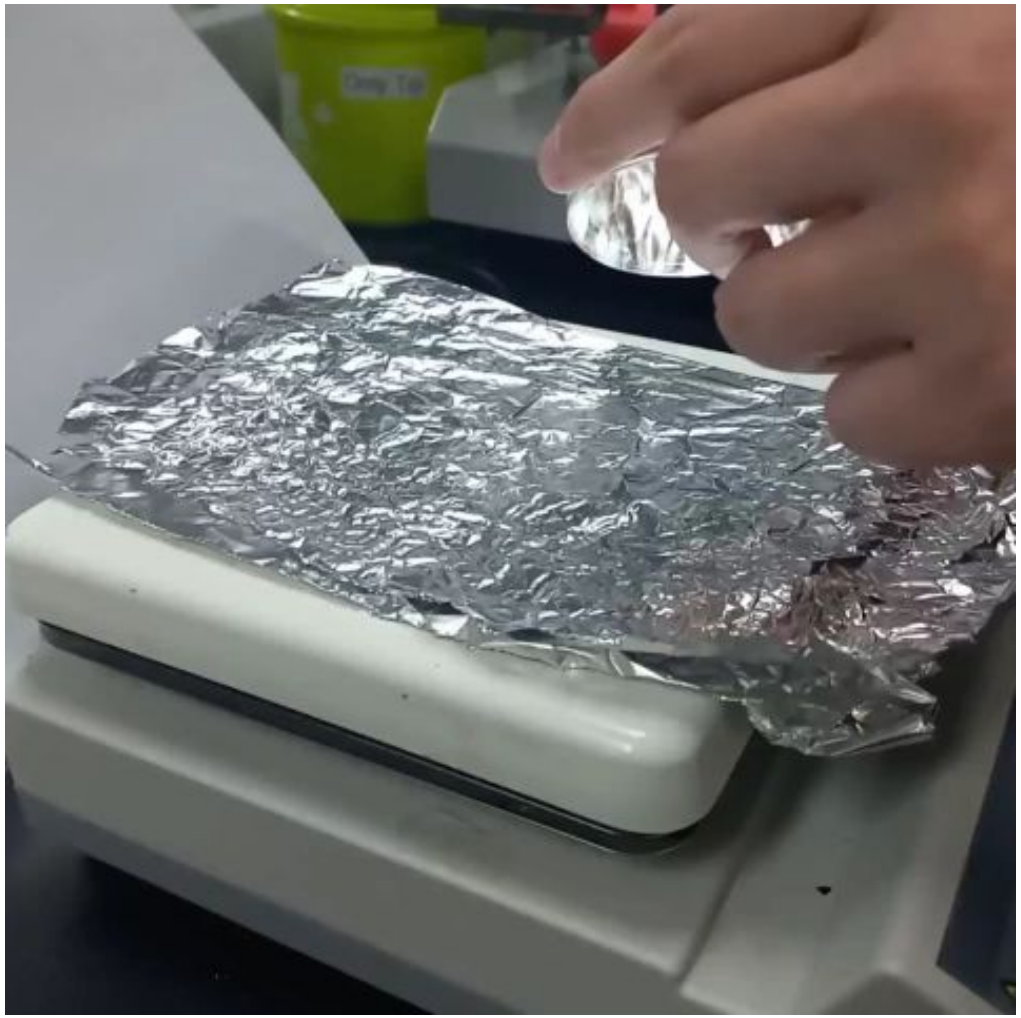
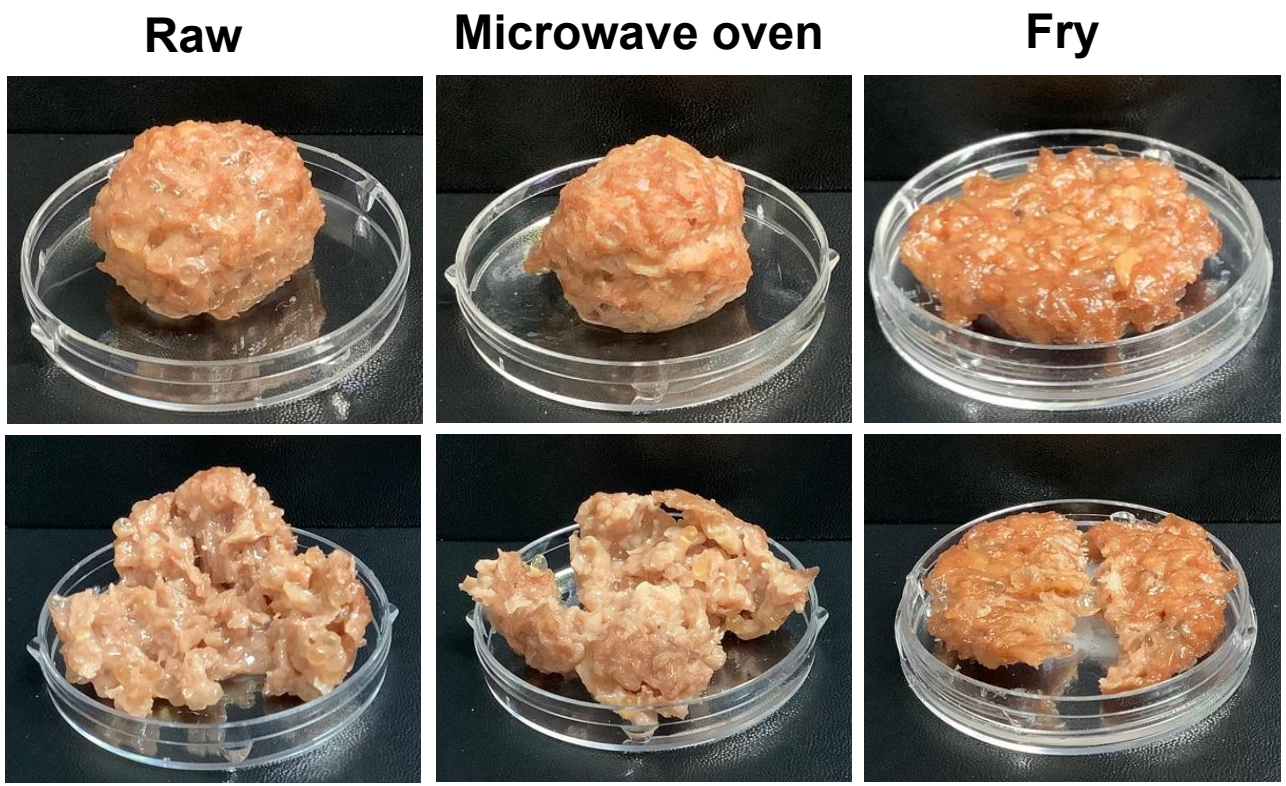


- **Applying GA capsule on plant-based meat alternatives for evaluating homogeneity and storage ability**

Evaluation in Cooking Condition



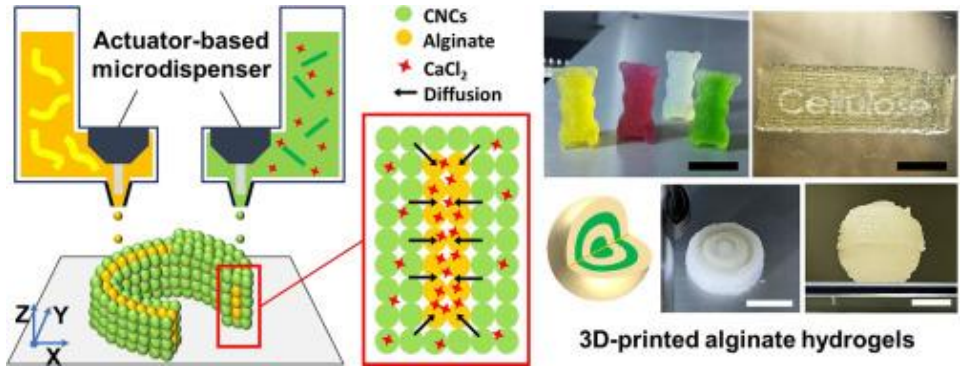


Conclusion

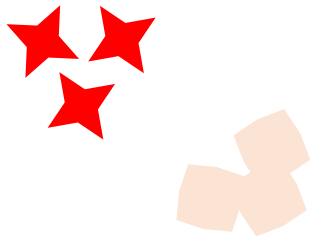
1. Fabricating ‘edible’ temperature-responsive microcapsule for sustained release of scent molecules using biopolymers, alginate and gelatin

2. Reducing heterogeneity using electrostatic extrusion-based microcapsulation

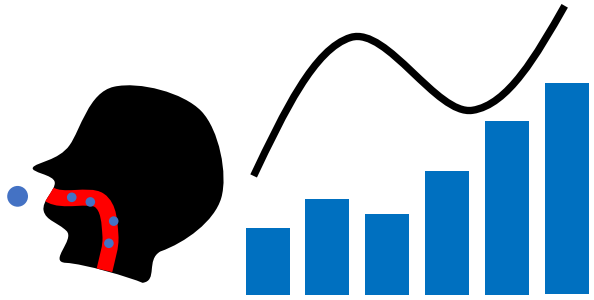
3. Considering availability in food industry



Microformulation techniques



Other bioactive compounds



Sensory test/scale up

Acknowledgement

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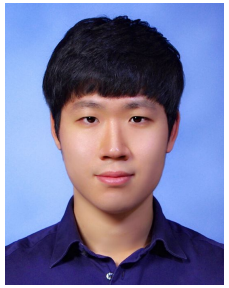
Experimental design

Kyungsene Lee
Pennsylvania state university

Release profiling

Yuyeon Lee
Yonsei University

Micro-encapsulation



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Physicochemical analyses

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