Recovery of resources from wastewater to synthesise nutrient-loaded slow-release hydrogel: Release characteristic and mechanism

Room 3 Session III
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This work is done by Dr Bu Jie

Background

Figure 1. Closed loop farming without soil and non-renewable resources.

Background

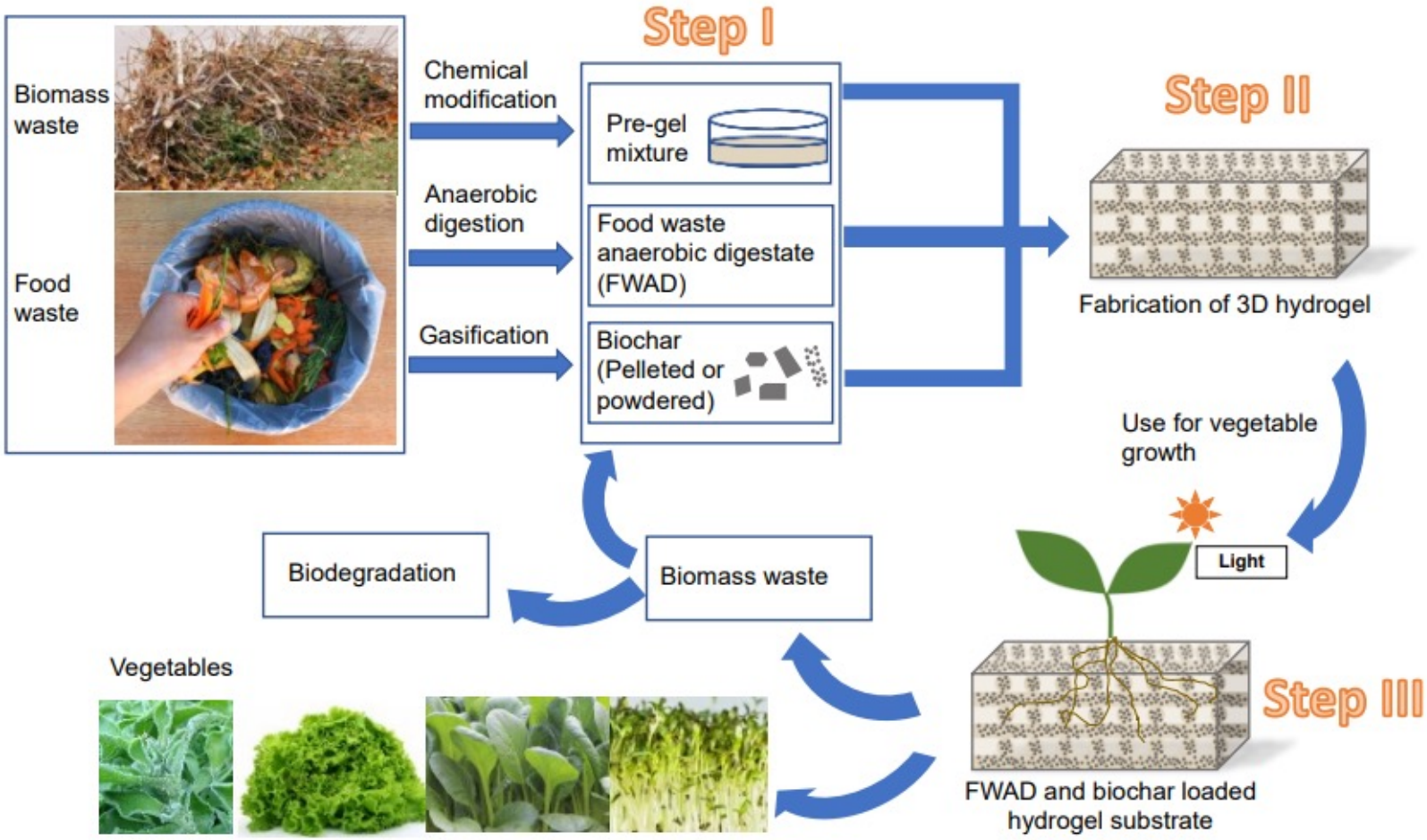


Figure 2. Schematic illustration of the proposed upcycling of food and biomass wastes, including: Theme 1; minor chemical modifications of biomass wastes; anaerobic digestion; gasification. Theme 2; fabrication of wastes-based hydrogels, and Theme 3; application as vegetables growing modules, and degradation in soil

Background

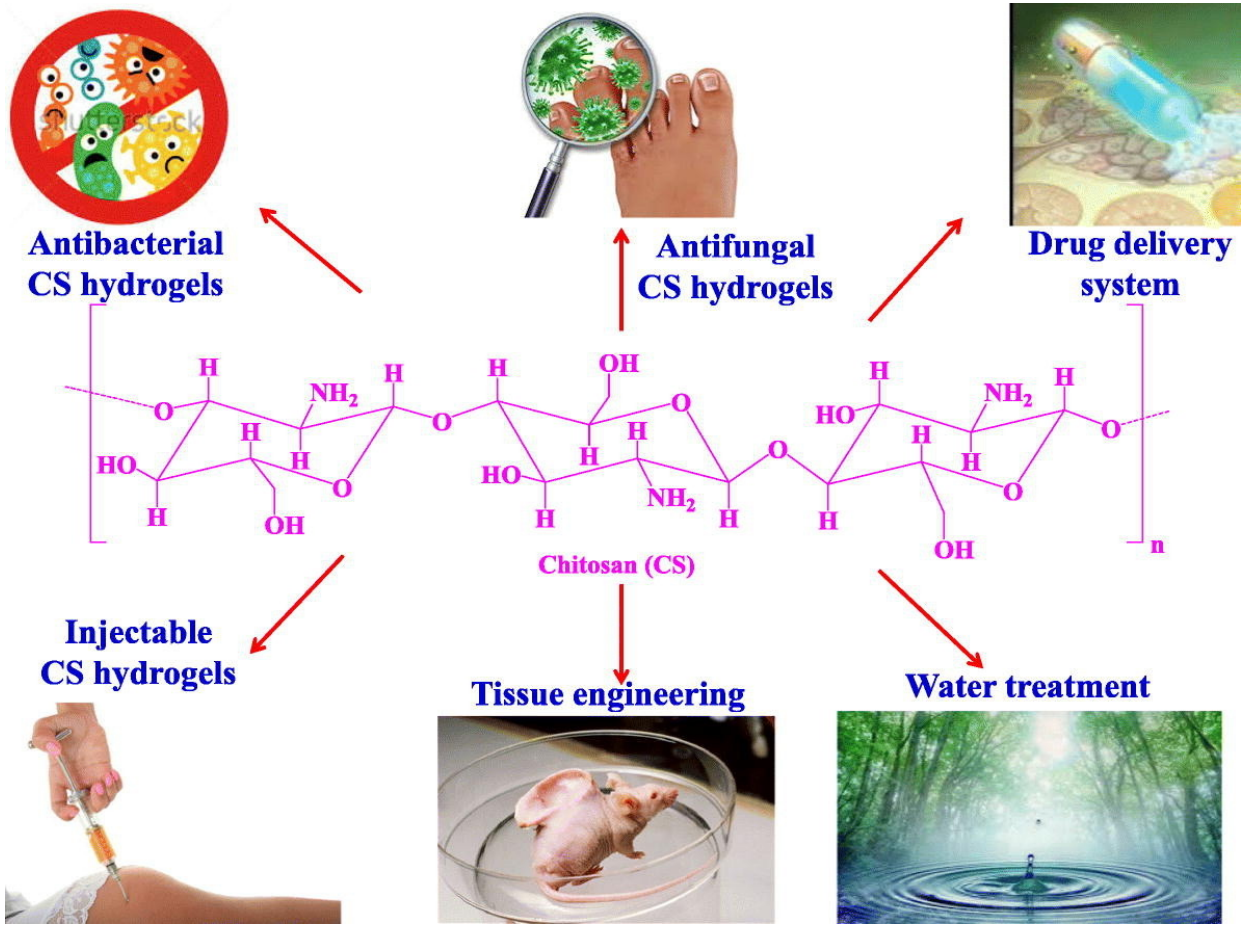


Figure 3. The antibacterial/antifungal activities of chitosan-based hydrogels and applications in controlled drug delivery/release systems, tissue engineering, preparation of injectable hydrogels and water treatment

Shariatinia Z, Jalali A M. Chitosan-based hydrogels: Preparation, properties and applications[J]. International journal of biological macromolecules, 2018, 115: 194-220.

Background

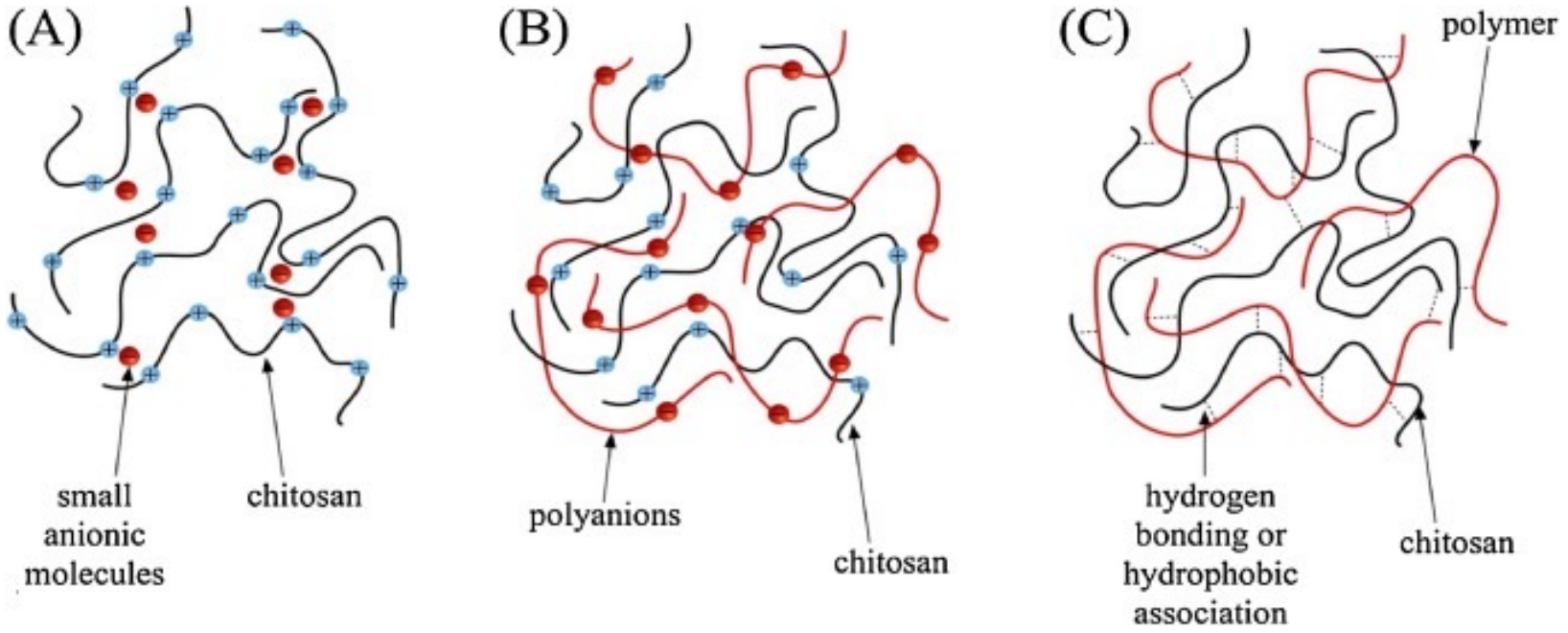


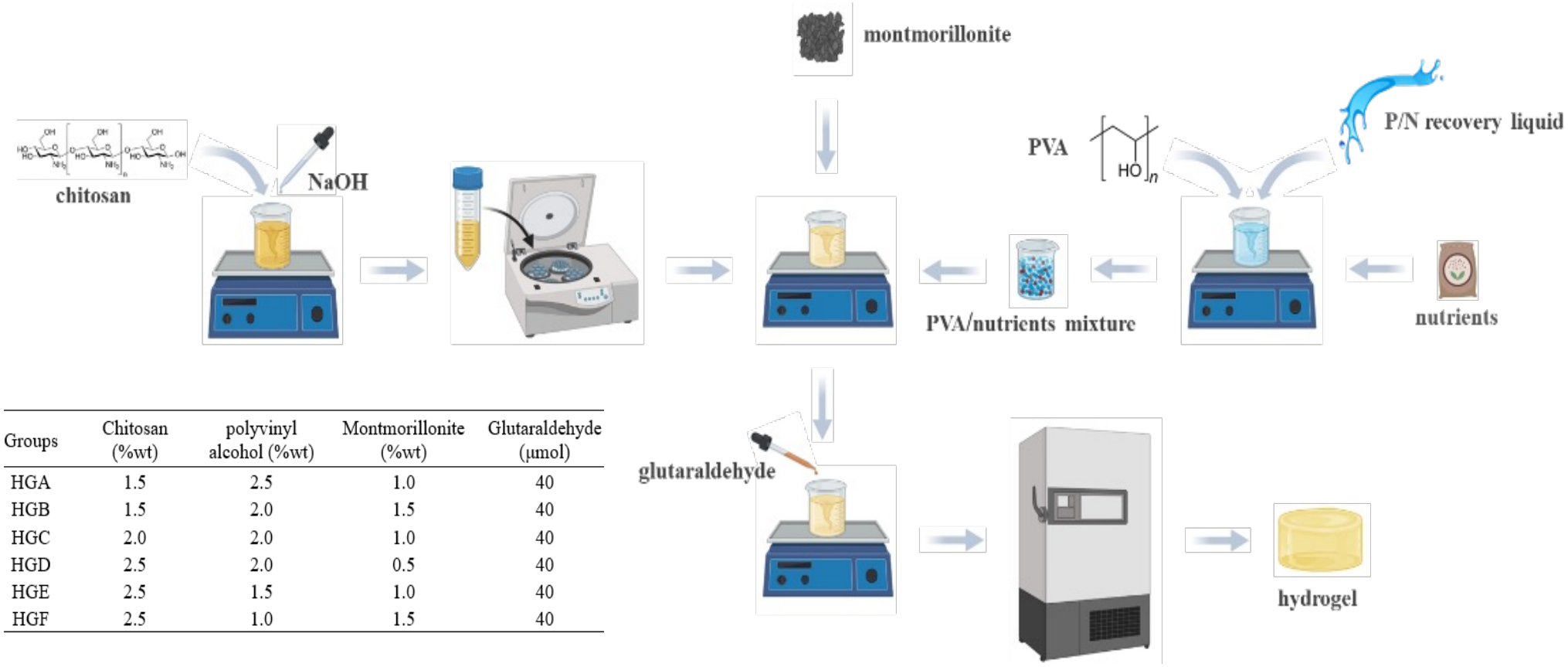
Figure 4. Schematic representation of physical crosslinking in of chitosan-based hydrogels.

Pella, et al. "Chitosan-based hydrogels: From preparation to biomedical applications." Carbohydrate Polymers: Scientific and Technological Aspects of Industrially Important Polysaccharides 196(2018):233-245.

Challenges

- Wastewater and digestate that contains recyclable nutrients are not fully utilized
- The hydrogel preparation and binding mechanism of nutrients need to be studied
- The controlled release of nutrients for vegetables growing is still not realized

Approach & Methodology



Groups	Chitosan (%wt)	polyvinyl alcohol (%wt)	Montmorillonite (%wt)	Glutaraldehyde (μmol)
HGA	1.5	2.5	1.0	40
HGB	1.5	2.0	1.5	40
HGC	2.0	2.0	1.0	40
HGD	2.5	2.0	0.5	40
HGE	2.5	1.5	1.0	40
HGF	2.5	1.0	1.5	40

Figure 5. Schematic diagram of recovery nutrients to prepare chitosan-based hydrogel with different compositions.

PVA: Adjusting the structural strength of hydrogel
Montmorillonite: Supporting and adsorbing cations

Findings

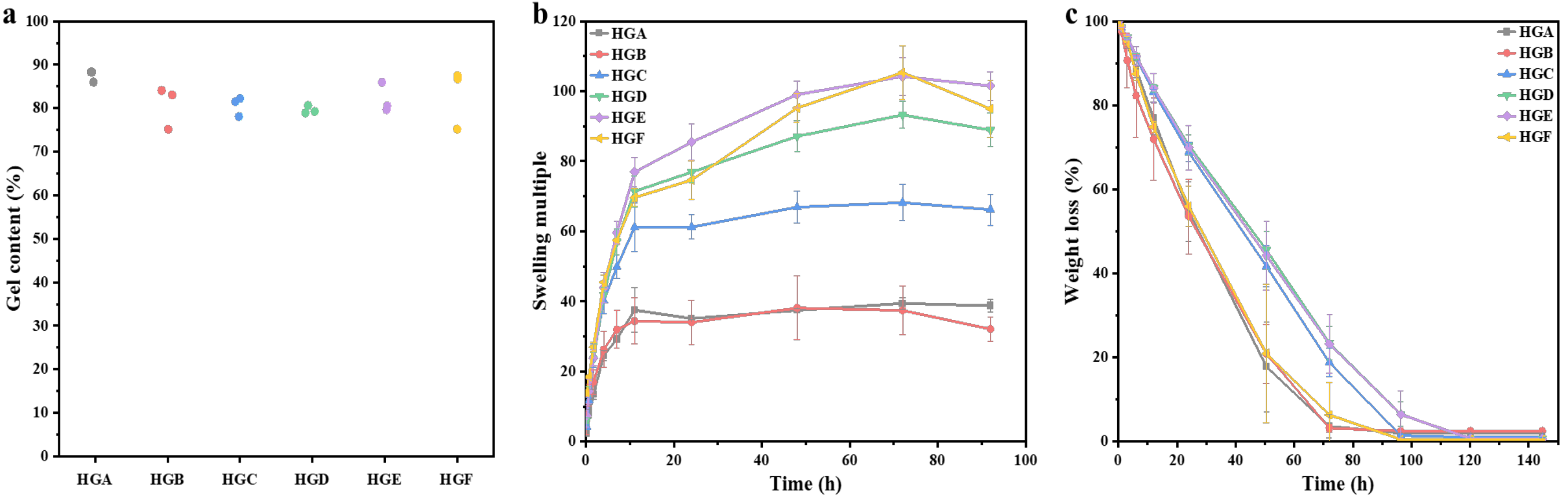


Figure 6. The gel content of synthesized hydrogel(a); Swelling capacity(b) and the water holding ability (c) of different kinds of hydrogel.

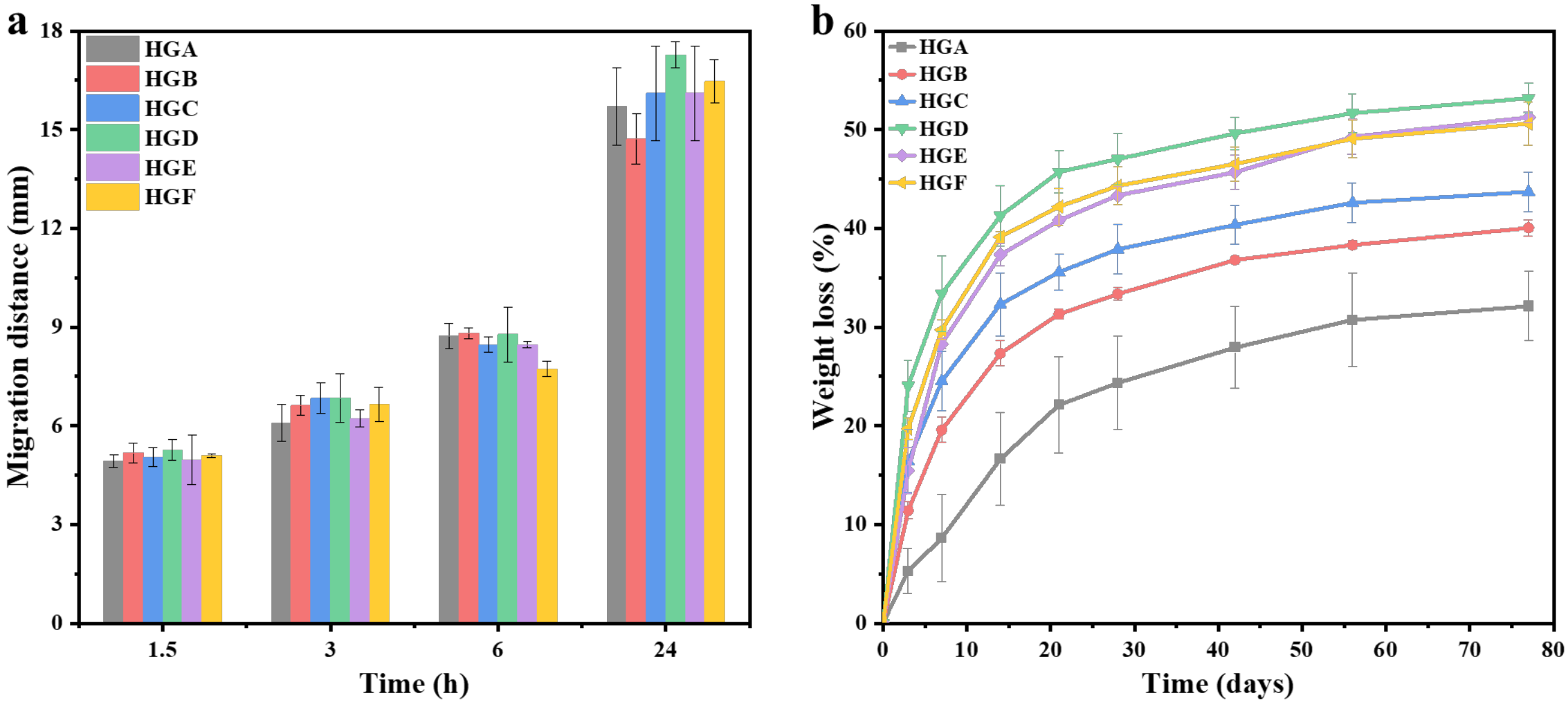


Figure 7. The nutrient migration performance (a) and biodegradation of different kinds of hydrogel (b).

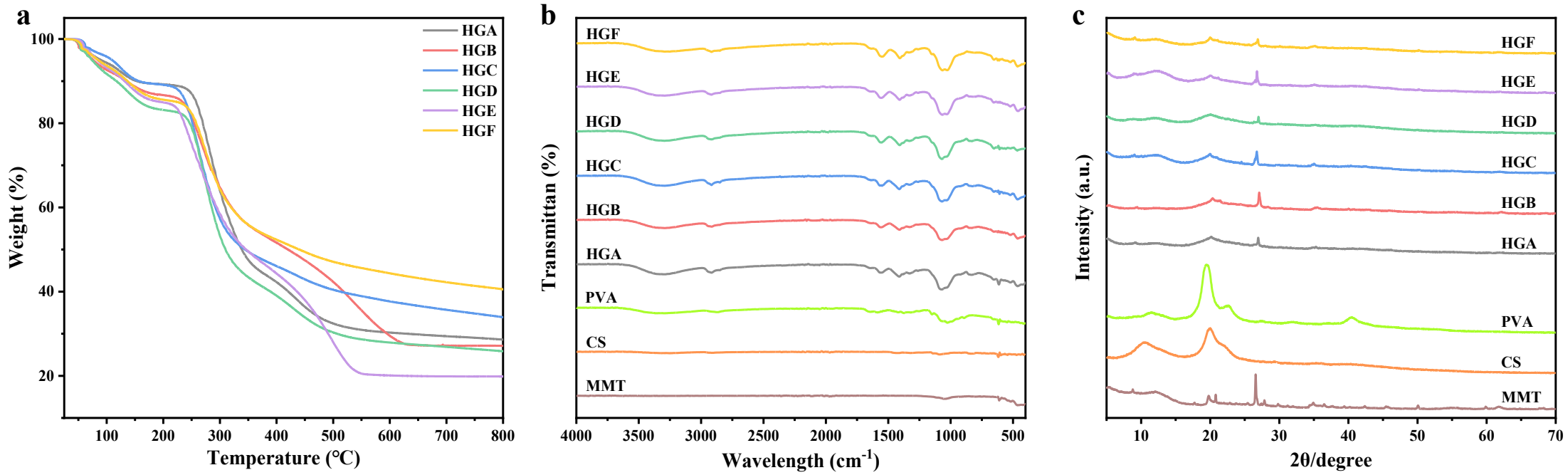


Figure 8. (a) Thermogravimetric analysis; (b) FTIR spectra and (c) X-ray diffraction spectra of hydrogel.

Summary

- The prepared hydrogels have similar gel contents, which accounted for about 80% of the solid content.
- As the chitosan content increased, the water absorption capacity of the hydrogels gradually increased.
- Each raw material was successfully cross-linked and that the nutrients were effectively loaded onto the hydrogels.

Future work: Optimizing hydrogel preparation technology for vegetable cultivation.

Thank you!

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