

Synthesis and Properties of Amorphous Hydrogels Composed of Bacterial Cellulose and Iodine for Application as Antibacterial Wound Dressing

Pornnapas Janprem and Runglawan Somsunan*

Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

* E-Mail : runglawan.s@cmu.ac.th

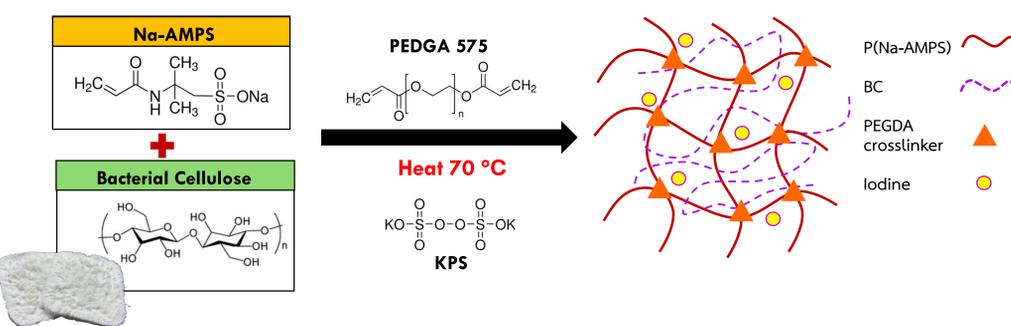


Abstract

Currently, hydrogels are another type of wound dressing material that is commonly used in medical applications due to their excellent absorption properties and moisture retention. Additionally, they can be infused with natural materials, additives, or drugs to enhance the properties of the hydrogel. This study synthesis of amorphous hydrogels from sodium 2-acrylamido-2-methyl propane sulfonate (Na-AMPS) and bacterial cellulose (BC) at different weight percentages of 0, 0.1, 0.3, and 0.5, using potassium persulfate as the initiator and poly (ethylene glycol) diacrylate (PEGDA 575) as the crosslinker through a free radical polymerization reaction. The synthesis of amorphous hydrogels exhibited a viscous, opaque white appearance. From the viscosity test results of the amorphous hydrogel using a viscometer, it was found that the viscosity of the amorphous hydrogel increased with the amount of BC, revealing a maximum viscosity of 7,884 mPa/s. This indicates that BC can enhance the mechanical properties by increasing the strength of the amorphous hydrogel. In this study, iodine was added at different percentages by weight to volume of 38.5, 58.0, and 77.0 to improve wound healing efficiency. The iodine diffusion properties were tested using the agar disc diffusion technique, revealing a maximum diffusion distance of 35 mm. The water content and water retention tests have reached maximum values of 367.6 % and 14.8 %, respectively. This indicates that the amorphous hydrogel can provide moisture. This demonstrates that the amorphous hydrogel can release iodine externally. Release iodine externally, indicating that this amorphous hydrogel has good properties for application as a wound dressing material.

Introduction

Wound dressing materials play a crucial role in promoting the wound healing process. Hydrogel is a commonly used wound dressing in medical applications, helping to prevent excessive drying while providing softness, flexibility, and effective absorption of wound fluids. Amorphous hydrogel, a semi-solid and viscous gel, spreads easily and can be applied or injected directly onto wounds, making it particularly suitable for cavity-type wounds. The hypothesis of this research is that the hydrogel synthesized from sodium 2-acrylamido-2-methylpropane sulfonate (Na-AMPS) and bacterial cellulose (BC), with iodine incorporation, will enhance wound healing properties by improving water absorption, mechanical strength, and overall wound healing efficacy.



Experiment



Table.1 Compositions of the synthesized hydrogels

Na-AMPS (%w/v)	BC (%w/w)	PEGDA 575 (%mole Na-AMPS)	KPS (%mole Na-AMPS)	Iodine solution (%w/v)
20	0	0.15	0.10	Concentration of 0, 38.5, 58 and 77
20	0.1	0.15	0.10	
20	0.3	0.15	0.10	
20	0.5	0.15	0.10	

Acknowledgement

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References

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Results and Discussion

Physical appearances

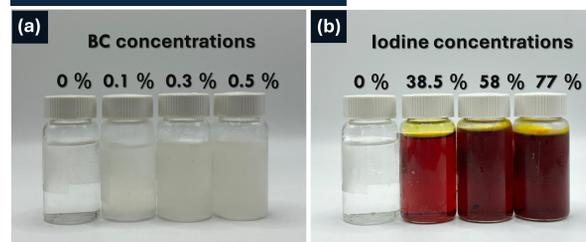


Fig.1 Comparison of the physical appearances of amorphous hydrogel in different concentrations of BC (a) and iodine (b).

FTIR Spectra

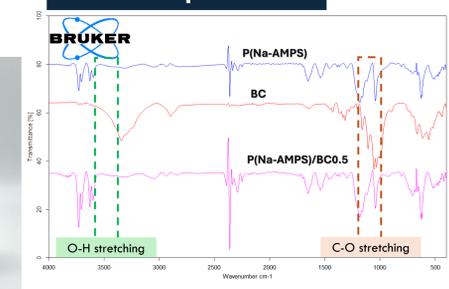


Fig.2 The FTIR spectra of P(Na-AMPS), BC and P(Na-AMPS)/BC0.5

Viscosity Test

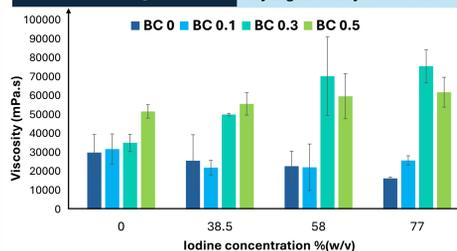


Fig.3 Viscosity of amorphous hydrogel at different BC and iodine concentrations

Complex viscosity

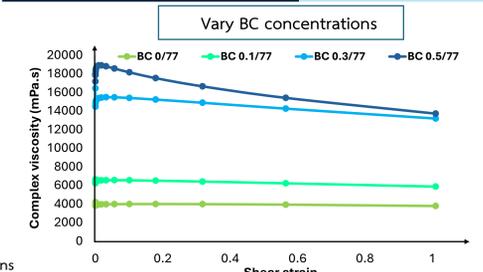


Fig.4 Complex viscosity of amorphous hydrogel at different BC concentrations and iodine 77 %w/v.

Water content

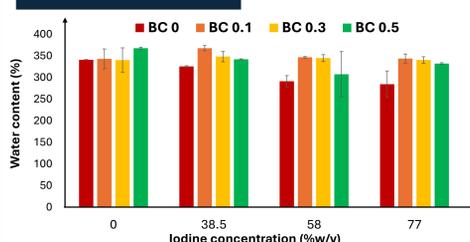


Fig.6 Water content of amorphous hydrogel at different BC and iodine concentrations.

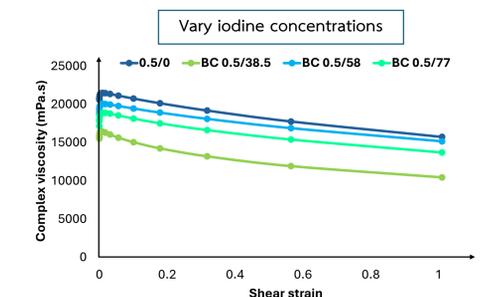


Fig.5 Complex viscosity of amorphous hydrogel at different iodine concentrations and BC 0.5 %w/v.

Water retention

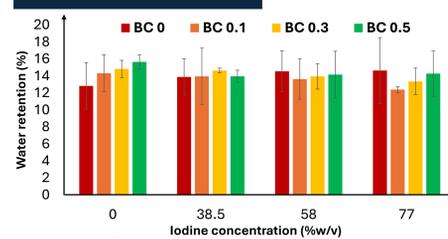


Fig.7 Water retention of amorphous hydrogel at different BC and iodine concentrations.

Diffusion Test

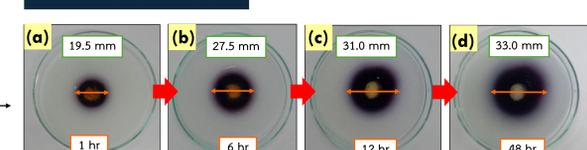


Fig.8 Zone diffusion of amorphous hydrogel at concentration BC 0.5%w/w and iodine 77% w/v.

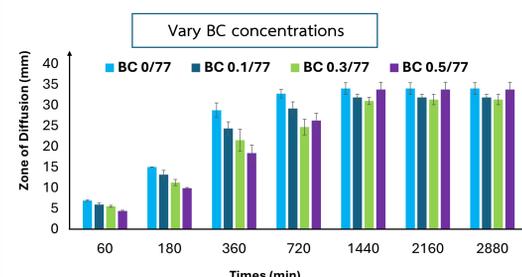


Fig.9 Zone of diffusion of amorphous hydrogel with iodine concentration of 77 %w/v.

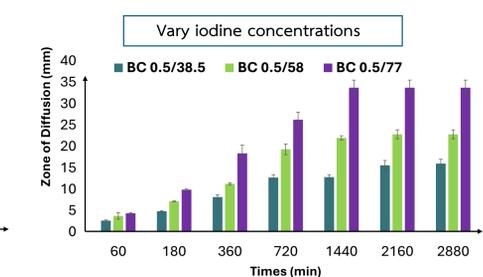


Fig.10 Zone of diffusion of amorphous hydrogel with BC concentration of 0.5 %w/v.

Conclusions

The synthesis and testing of the P(Na-AMPS)/BC/iodine amorphous hydrogel demonstrated that bacterial cellulose (BC) enhances both mechanical properties and water absorption. The optimal BC concentration for use as a wound dressing material was determined to be 0.5% w/w. Additionally, the incorporation of iodine enabled controlled external release, with a 77% w/v iodine concentration achieving the highest diffusion distance. These findings suggest that the synthesized hydrogel has potential for use as a wound dressing, offering improved water absorption, mechanical properties, and antimicrobial properties to support the wound healing process.