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Dynamic Schiff-base Crosslinked Injectable Hydrogels for Controlled Drug Release and Effective Haemostasis

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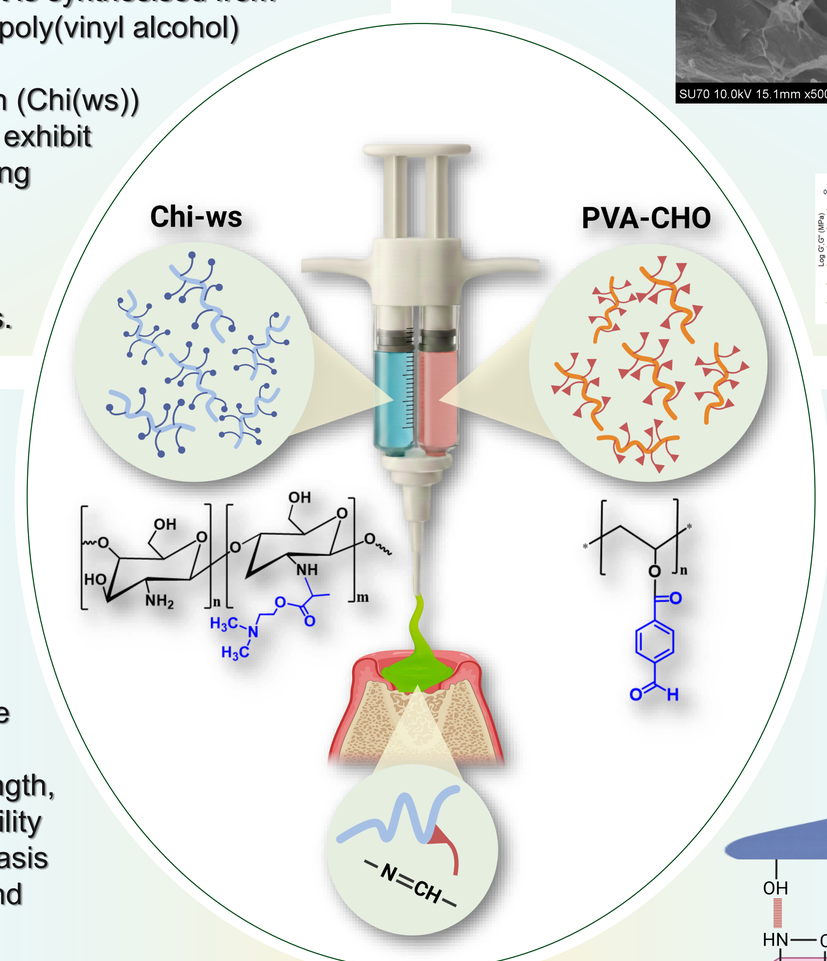
Introduction

Uncontrolled internal haemorrhage in emergency, surgical, and battlefield situations remains a major clinical challenge, underscoring the urgent need for advanced endoscopic haemostatic technologies. To address this, we have developed an innovative injectable hydrogel incorporating drug-loaded micelles. This hydrogel provides sustained release, rapid and tunable gelation, strong tissue adhesion, biocompatibility, and biodegradability. It is synthesised from aqueous solutions of 4-carboxybenzaldehyde-modified poly(vinyl alcohol) (PVA-CHO) via a Steglich esterification reaction, and [(2-dimethylamino)ethyl methacrylate]-modified chitosan (Chi(ws)) via a Michael addition reaction. The resulting hydrogels exhibit self-healing and excellent haemostatic properties, offering significant benefits for haemorrhage control in medical applications. This system effectively addresses key limitations in current approaches, enhancing the management of internal bleeding in critical care settings.

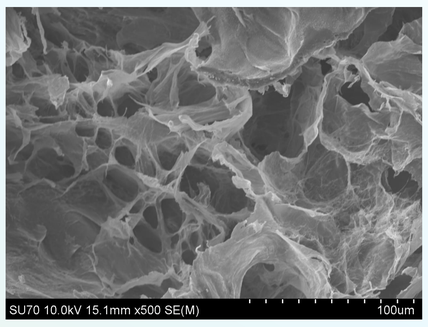
Objectives

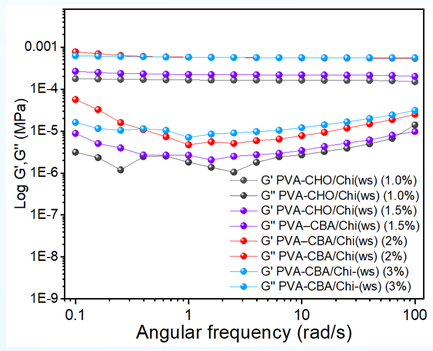
To overcome the limitation of uncontrolled bleeding, which becomes the cause of preventable death in trauma and surgical settings. This highlights the urgent need for rapid and effective haemostatic interventions.

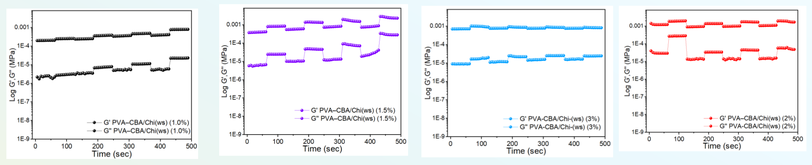
To engineer an advanced hydrogel system with superior adhesion, burst pressure, tunable gelation, mechanical strength, and biocompatibility for rapid hemostasis in emergency, and controlled drug release.



Results, Con.,



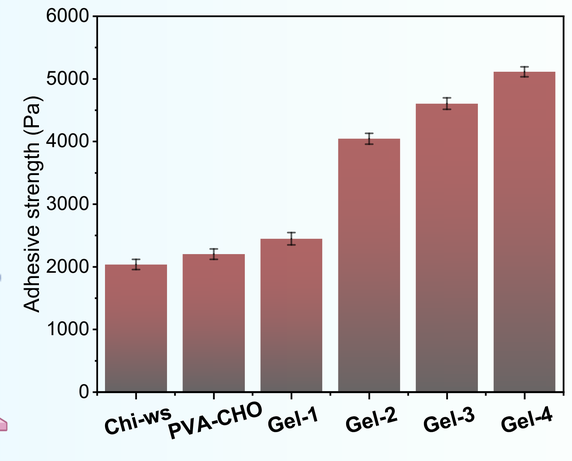




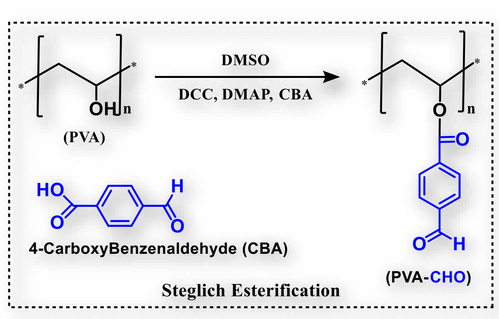
Adhesion Analysis

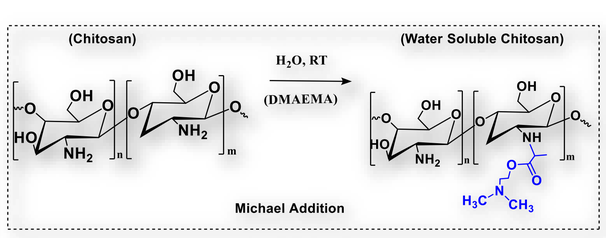


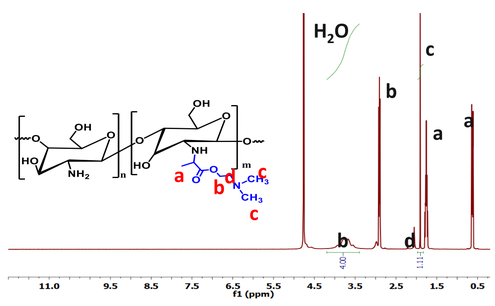


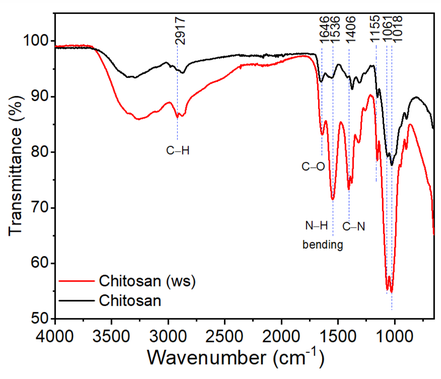


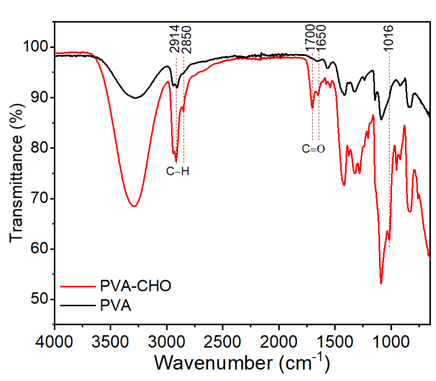
Methods and Results



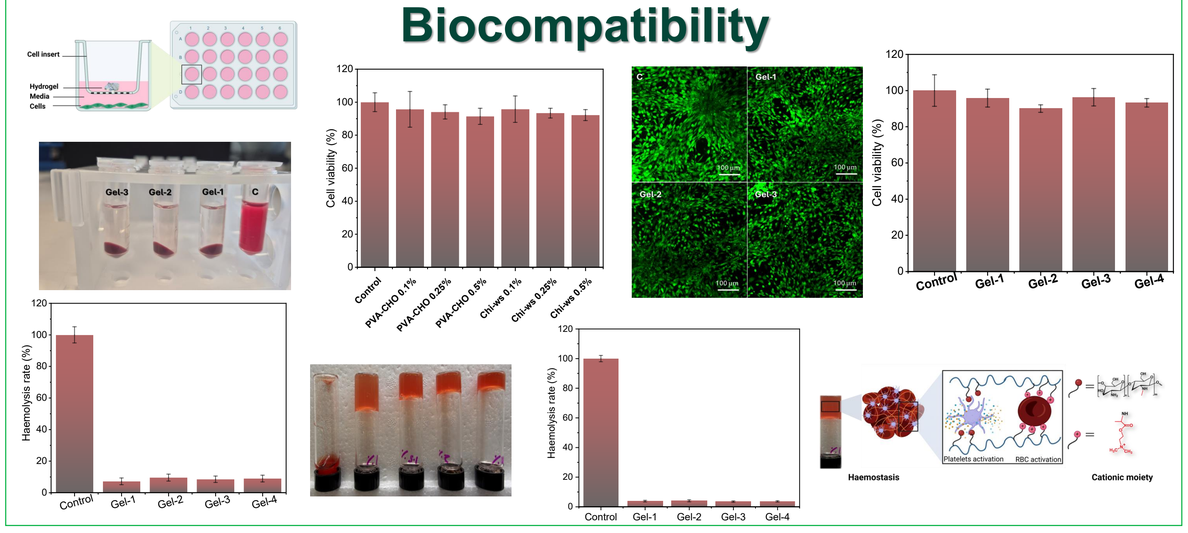








Biocompatibility



Conclusion

This study presents tunable endoscopically deliverable hydrogels featuring adjustable gelation times and robust mechanical/adhesive properties for effective hemostasis. Achieving an adhesion strength of 5.1 kPa, and excellent hemocompatibility and cytocompatibility, these hydrogels ensure safe and efficient control of internal and external bleeding. They address critical needs in emergency, surgical, and battlefield settings, with promising potential for clinical translation. Future work will evaluate in vivo hemostasis using a mouse liver haemorrhage model.

References

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Acknowledgments

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Department of Agriculture, Food and the Marine