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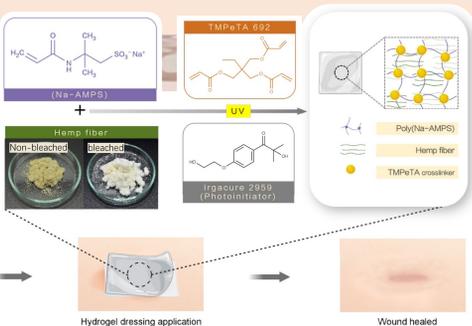
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Abstract

This research aims to study the preparation of hydrogel sheets for wound dressing applications. The hydrogels were synthesized from sodium 2-acrylamido-2-methylpropane sulfonate (Na-AMPS) combined with bleached and non-bleached hemp fibers at amount of 1, 2, 3, and 4% by weight of Na-AMPS. The synthesis was carried out through free radical polymerization under ultraviolet (UV) radiation, using 2-hydroxy-4'-(2-hydroxyethoxy)-2-methylpropiophenone as the photoinitiator and trimethylolpropane triacrylate as the crosslinking agent. The structure of the synthesized hydrogel sheets was confirmed using Fourier-transform infrared (FTIR) spectroscopy. The water-related properties of the hydrogels were examined by evaluating water content and swelling ratio. The results indicated that increasing the fiber content did not affect the water content of the hydrogel sheets. However, it led to a reduction in swelling ratio for both fiber types. The mechanical properties of the hydrogel sheets were analyzed through tensile testing, revealing that increasing the content of bleached fibers resulted in higher strain values. However, increasing bleached and non-bleached fiber contents increased stress and modulus values. Additionally, rheological shear testing indicated an increase in storage modulus, suggesting that hydrogels containing bleached hemp fibers exhibited improved stiffness and elasticity. Therefore, hydrogels containing bleached hemp fibers was swollen in 1 g diclofenac solution to determine its drug retention capacity. It was found that the hydrogel sheets containing 1% bleached hemp fibers by weight of Na-AMPS were further incorporated with diclofenac drug. After 60 minutes, the 3 cm x 3 cm x 0.6 cm hydrogel sheet absorbed 54.73 mg of diclofenac. Additionally, an application suitability test using a fluid affinity test confirmed that the synthesized hydrogel sheets were appropriate for use on dry wounds. It can be concluded that the bleached hemp fibers can enhance the mechanical properties of the hydrogel. In addition, the prepared hydrogel can be incorporated with diclofenac drug and has the potential for further development as wound dressing materials.

Introduction

Wound dressing protects the wounds from further damage during healing process to keep wounds clean and provide a moist environment conducive to healing. Hydrogel is one of the appropriate wound dressing materials because it has the ability to absorb excess exudate, moisture, non-toxic and can be peeled off without sticking to the wound. Hemp fiber is a high quality natural fiber, flexible and has good thermo-regulating properties. The hydrogel wound dressings in this study were synthesized from sodium 2-acrylamido-2-methylpropane sulfonate (Na-AMPS) and hemp fiber. P(Na-AMPS) has a good absorption capacity, good properties and non-toxic. Therefore, this study aims to combine the advantages of P(Na-AMPS) and hemp fiber to develop an effective and environmentally friendly wound healing activities with polymeric materials.



Results and Discussion

Physical Appearances

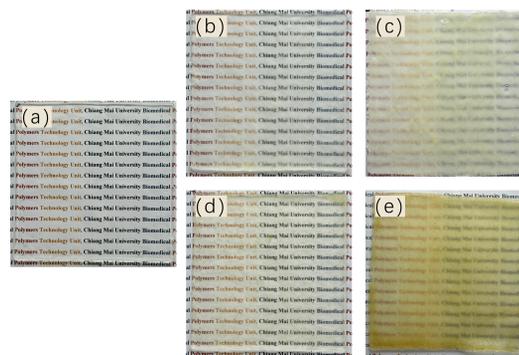


Fig.1 Comparison of the physical appearances of the hydrogels sheet in different hemp fiber amounts (a) P(Na-AMPS), (b) HB1, (c) HB4, (d) HNB1, (e) HNB4.

FTIR Spectra

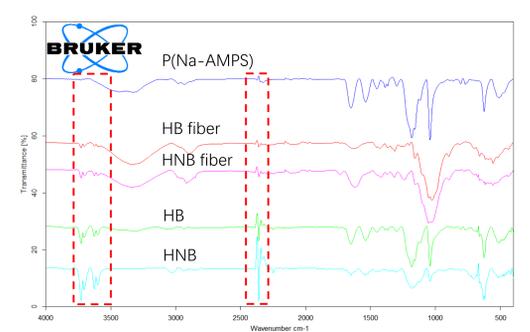


Fig.2 FT-IR spectra of P(Na-AMPS), HB fiber, HNB fiber, HB and HNB hydrogels.

Water Transport

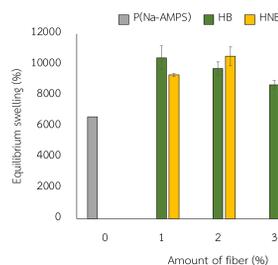


Fig.3 Percentage equilibrium swelling of the hydrogels at different amounts and types of hemp fiber.

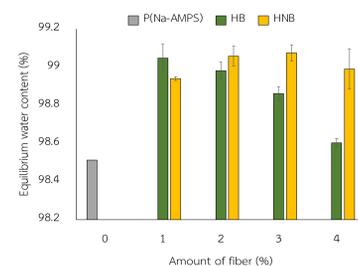


Fig.4 Percentage equilibrium water content of the hydrogels at different amounts and types of hemp fiber.

Mechanical Properties

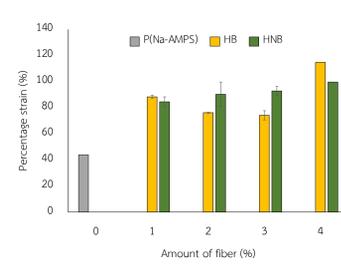


Fig.5 The strain of the hydrogels at different amounts and types of hemp fiber.

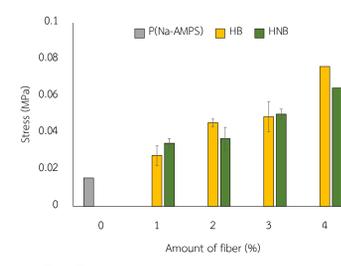


Fig.6 The stress of the hydrogels at different amounts and types of hemp fiber.

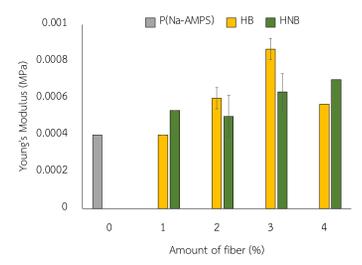


Fig.7 Young's Modulus of the hydrogels at different amounts and types of hemp fiber.

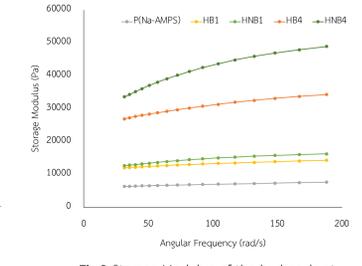
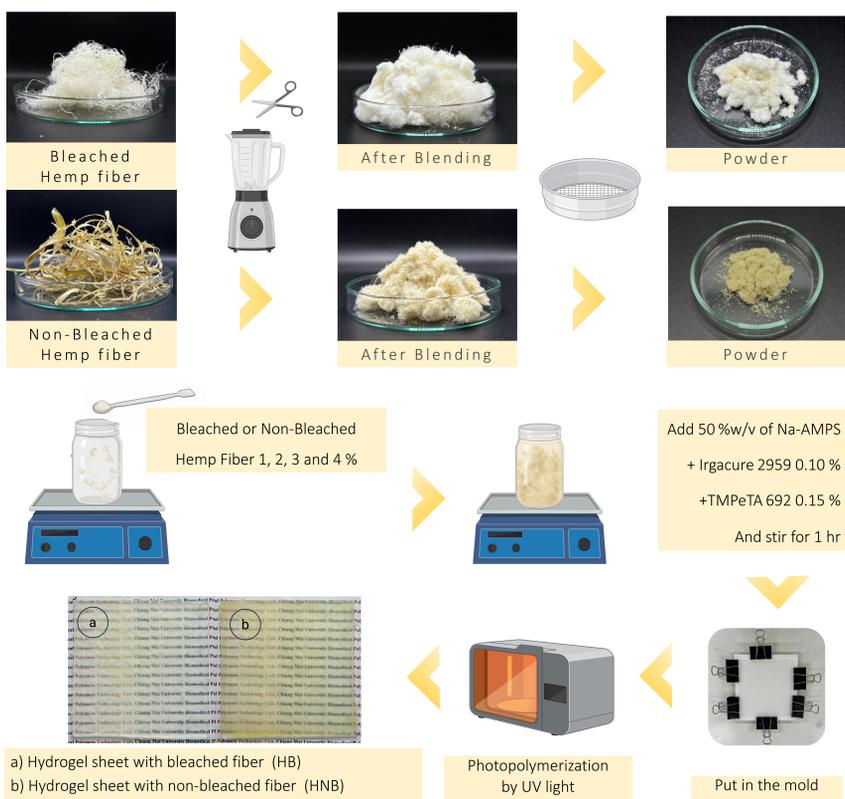


Fig.8 Storage Modulus of the hydrogels at different amounts and types of hemp fiber.

Experiment



Preliminary study of hydrogel hemp bleached fiber with Diclofenac drug

Drug contents

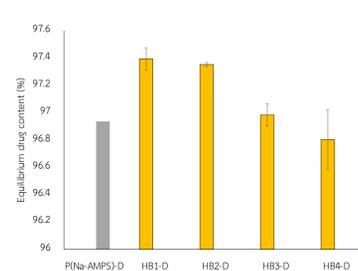


Fig.9 Percentage equilibrium drug content of the hydrogels at different amounts of hemp bleached fiber.

Fluid affinity Test

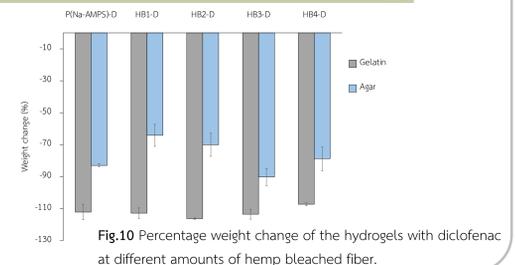
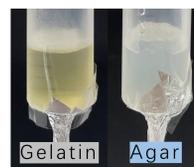


Fig.10 Percentage weight change of the hydrogels with diclofenac at different amounts of hemp bleached fiber.

Acknowledgement

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References

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Conclusions

The study shows that P(Na-AMPS)/Hemp fiber hydrogels have suitable properties for use as wound dressing materials, including good mechanical strength, high water content and an optimal swelling ratio. From fluid affinity test, it suggested the hydrogels are suitable for dry wounds. Hemp fiber enhances turbidity, stiffness, stress, and modulus without affecting the water content while reducing swelling. The bleached fiber hydrogels are softer and more suitable for use as wound dressing than the non-bleached. From the preliminary study of hydrogel with bleached hemp fiber and diclofenac drug, it was found that hydrogels containing 1% bleached hemp fiber absorbed the maximum amount of diclofenac solution and have the potential for use as hydrogel wound dressings with drug delivery capabilities.