Development and Characterization of a Novel Laponite-Enhanced Tannic Acid-Based Hydrogel

Introduction

- Hydrogels have received significant attention over the past 30 years in the fields of tissue engineering and drug delivery
- However, they still have limitations: poor mechanical properties, weak adhesive strength, no tissue regenerative properties
- Purpose of this study was to study the effect of laponite (nanoclay) on hydrogels and develop/characterize a new hydrogel system that would address these limitations

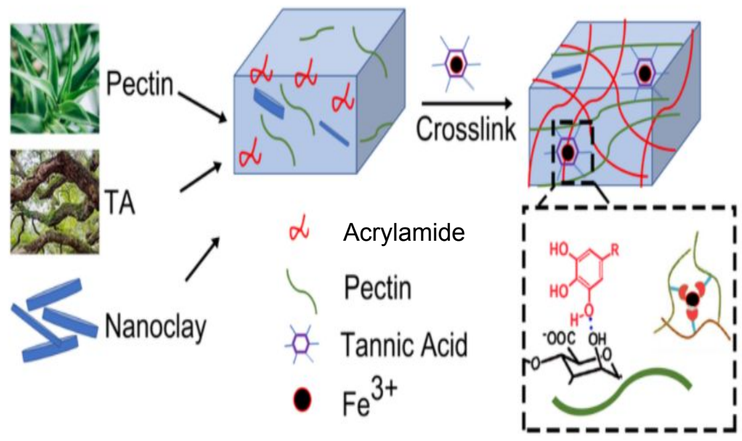

Figure 1. Schematic representation of the hybrid hydrogel used in this study.

Properties

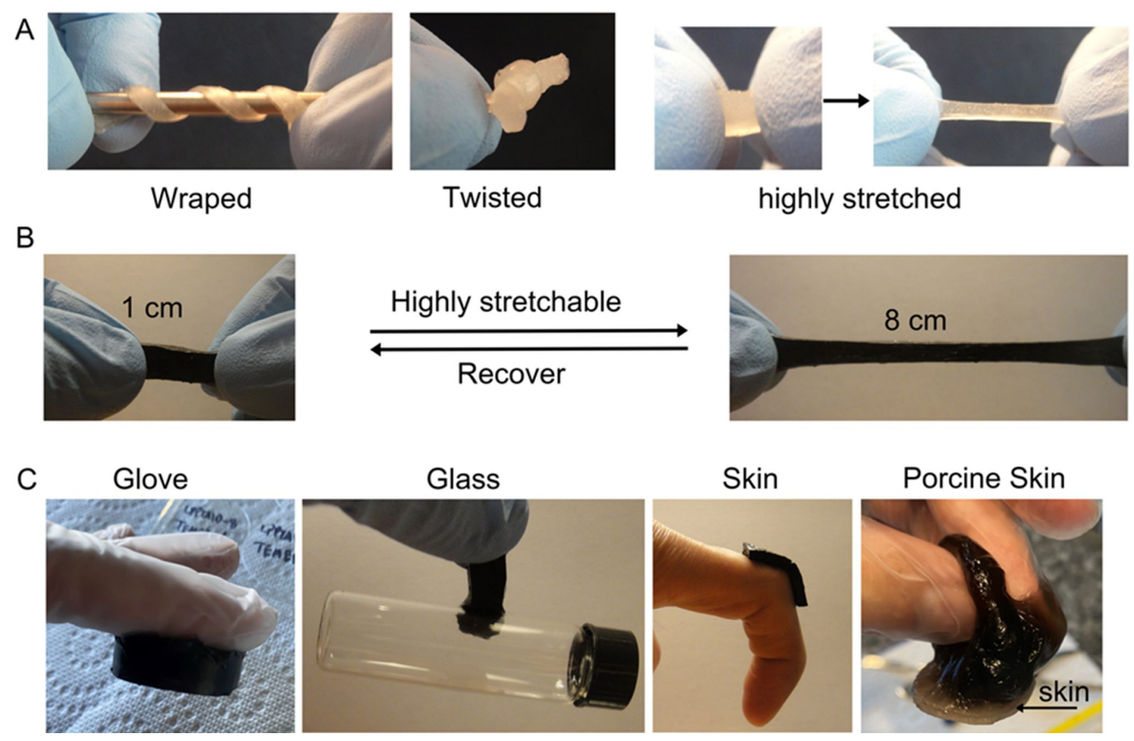

Figure 2. A representative hydrogel shows that the new hydrogel is flexible and stretchable (A,B). The TA-Fe based hydrogel can adhere to many different substrates (C).

Results

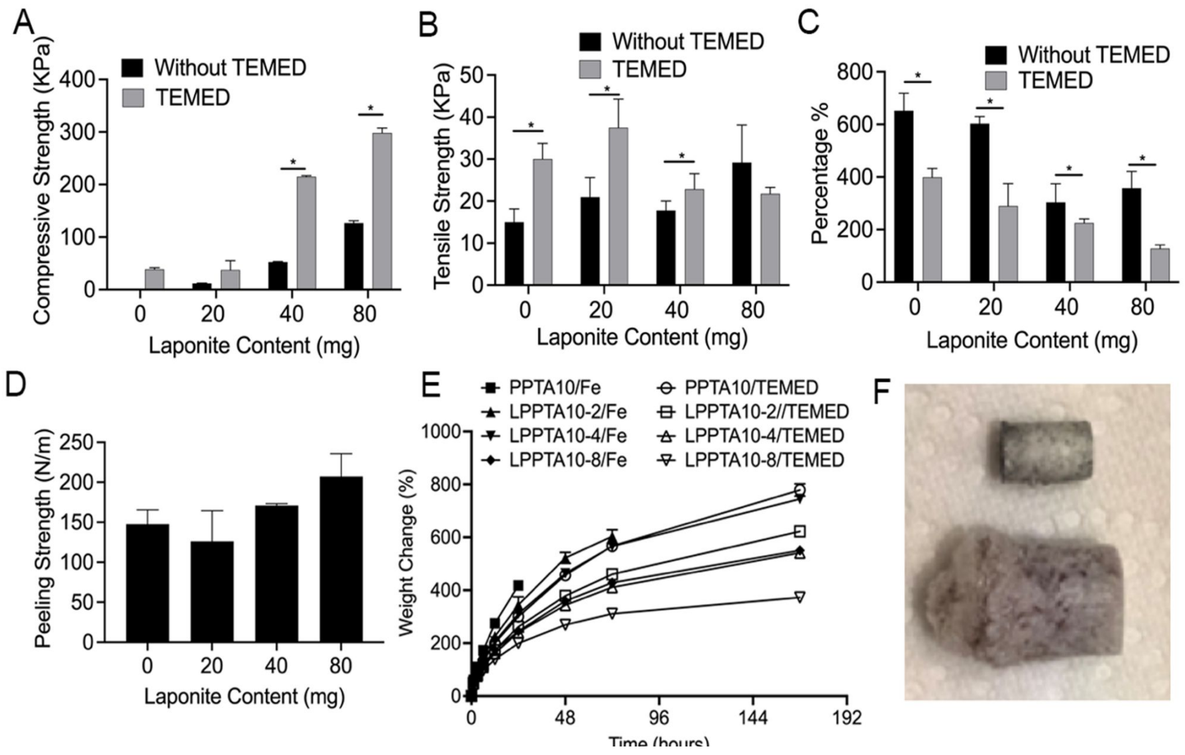

Figure 3. Effect of laponite content and crosslinker TEMED on compressive strength (A), tensile strength (B), elongation (C), and peeling strength (D). Water intake as a function of incubation time in PBS at 37°C (E) and a picture of lyophilized LPPTA10-4/TEMED samples before and after swelling (F).

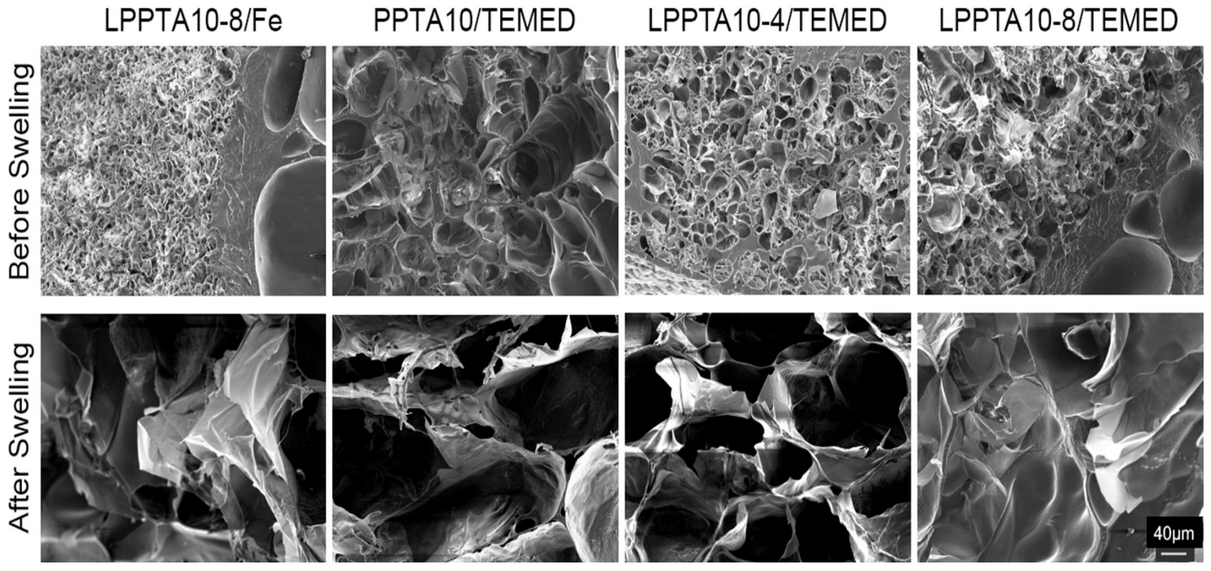

Figure 4. SEM images of the lyophilized hydrogel samples before and after the swelling test for 7 days

*All uncited photos/figures belong to the researcher

Conclusion

Both laponite and TEMED had significant effects on physical and mechanical properties and microstructure of the novel PAM-Pectin-TA based hybrid hydrogel system. Higher concentration of laponite and the inclusion of TEMED were associated with increased compressive strength and structural stability. The improved adhesiveness and the formation of interconnected porous structure after swelling could be beneficial for applications in the fields of wound healing, tissue regeneration and controlled drug delivery.

Abstract

Hydrogels have received significant attention due to their potential biomedical applications. The purpose of this study was to develop and characterize a new hydrogel system with tunable stretchability and adhesive properties. The hydrogel was prepared with a one-pot method with acrylamide and natural plant derived materials (pectin and tannic acid) crosslinked with ammonium persulfate, N, N'-methylene -bisacrylamide, and iron chloride with or without tetramethylethylenediamine (TEMED). Results showed that the incorporation of laponite powders significantly increased compressive strength and stability of the hydrogel but reduced its stretchability. The newly developed hydrogel formulations show tunable mechanical properties and good adhesion, which bring great potentials in various biomedical applications.