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

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Hydrogels have received significant attention over the past 30 years due to their potential applications in tissue engineering and drug delivery; however, they still have limitations: poor mechanical properties and the lack of tissue-regenerative ability and adhesiveness. The purpose of this study was to develop and characterize a new hydrogel system with tunable stretchability, mechanical 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'-methylenebisacrylamide, and iron chloride with or without tetramethylethylenediamine (TEMED). Different weight percentages of laponite were added before crosslinking. The hydrogels were subjected to compressive, tensile, and adhesion (porcine skin) tests. The swelling tests were conducted in phosphate buffered saline up to 168 hours. The freshly prepared hydrogel samples and their swelling tested counterparts were freeze-dried for scanning electron microscopy morphological examination and energy dispersive X-ray spectroscopy elemental analysis. Results showed that the hydrogels containing tannic acid had significantly higher stretchability than the polyacrylamide-pectin control group. The incorporation of laponite significantly increased compressive strength and stability of the hydrogel but reduced its strechability. A higher laponite concentration resulted in a more profound effect on these properties. TEMED also showed similar effects. In addition, the microstructure of the hydrogel became much more porous after swelling. All in all, the newly developed hydrogel formulations showed great promise in various medical applications such as drug delivery, wound dressing, and tissue regeneration.

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