

N,N'-Methylenebisacrylamide cross-linked poly-N-vinylpyrrolidonepolyacrylic acid hydrogels

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Hydrogels possess the remarkable ability to undergo reversible swelling in aqueous environments while maintaining their three-dimensional network structure. The natural pH gradient existing throughout the gastrointestinal tract provides a unique opportunity for developing advanced enterosorbent platforms. The selective removal of toxins, excess ions, or specific molecular species can be enhanced, thereby improving therapeutic interventions while minimizing systemic interactions.

Poly-N-vinylpyrrolidone (PVP) and polyacrylic acid (PAA) are two significant synthetic polymers with diverse applications across pharmaceutical, biomedical, and industrial fields. PVP is recognized for its excellent film-forming abilities, biocompatibility, and binding properties [1], while PAA features carboxylic acid groups that provide pH-responsive behavior and strong adhesive characteristics. The copolymerization of these two polymers produces a hybrid material that synergistically combines their individual strengths while mitigating their respective limitations.

N, N'-Methylenebisacrylamide (MBA) serves as a cross-linking agent in the fabrication of these smart hydrogel systems. As a bifunctional molecule containing two acrylamide moieties connected by a methylene bridge, MBA creates covalent connections between adjacent polymer chains during the polymerization process.

The objective of this thesis was to synthesize MBA cross-linked PVP/PAA hydrogels for potential application as enterosorbents. We aimed to develop an efficient synthesis method and evaluate its potential for biomedical applications.

During the reaction, a PVP solution was initially prepared at a concentration of 5% w/v. For this, 2.5 g of PVP was dissolved in 50 ml of distilled water. After PAA was added to the solution in equal proportion to the PVP (5ml). The reaction was carried out using a 1:1 ratio of PVP to PAA. Then, MBA was added at 5% of the total polymer weight (0.25 g, which is 5% of the combined 5 g of PVP and PAA). The reaction mixture was stirred continuously at room temperature. Following the reaction, the resulting material was washed thoroughly to remove unreacted components and then dried. Finally, the dried material was cured under UV light for 4 hours to complete the crosslinking process.

The result was verified by FTIR. Analysis of the FTIR spectrum showed that the PVP/PAA (1:1) copolymer was successfully synthesized. A band belonging to the carbonyl group at $\sim 1700\text{ cm}^{-1}$, a broad band of the hydroxyl group in the range of $\sim 2900\text{ cm}^{-1}$, and a C-N stretching vibration in the range of $\sim 1300\text{ cm}^{-1}$ were observed. These results confirm that a chemical interaction between PVP and PAA occurred.

This experiment contributes to the development of novel polymeric materials with promising applications in biomedical fields, particularly for toxin removal.

References

- 1) Teodorescu, M., & Bercea, M. (2015). Poly(vinylpyrrolidone) – A versatile polymer for biomedical and beyond medical applications. *Polymer-Plastics Technology and Engineering*, 54(9), 923-943.