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# Enzymes Immobilized into Starch and Gelatin Based Hydrogels: Applications, Advantages and Challenges

**Myles Carlie***

*Department of Genetics and Genomics, University of Nottingham, Nottingham, UK*

**Abstract**

Enzyme immobilization within hydrogel matrices offers a promising avenue for enhancing enzyme stability, reusability, and activity retention. Starch- and gelatin-based hydrogels have emerged as versatile matrices for enzyme immobilization due to their biocompatibility, biodegradability, and ease of fabrication. This article provides an overview of the methods for immobilizing enzymes into starch- and gelatin-based hydrogels, explores their applications across various industries, discusses the advantages and challenges associated with this approach, and highlights recent advances in the field.

**Keywords:** Hydrogel matrices • Gelatin based hydrogels • Versatile matrices

## Introduction

Enzymes play a crucial role in numerous industrial processes, including food and beverage production, pharmaceuticals, textiles, and environmental remediation. However, their application is often limited by issues such as low stability, limited reusability, and susceptibility to harsh operating conditions. Immobilization of enzymes within hydrogel matrices offers a solution to these challenges by providing a protective environment that enhances enzyme stability while allowing for easy separation and reuse. Starch and gelatin, being natural polymers, have gained significant attention as matrices for enzyme immobilization due to their biocompatibility, biodegradability, and versatility [1,2].

## Literature Review

Starch-based hydrogels can be prepared through various methods, including physical crosslinking, chemical crosslinking, and enzymatic crosslinking. Physical crosslinking involves the use of physical interactions such as hydrogen bonding or crystalline domains to form the hydrogel network. Chemical crosslinking utilizes chemical agents such as glutaraldehyde or epichlorohydrin to covalently link the starch molecules. Enzymatic crosslinking involves the use of enzymes such as transglutaminase to catalyze the formation of crosslinks between starch molecules, Gelatin-based hydrogels are typically formed through physical or chemical crosslinking of gelatin molecules. Physical crosslinking methods include temperature-induced gelation or the use of physical agents such as ions or Ultraviolet (UV) radiation. Chemical crosslinking involves the use of crosslinking agents such as glutaraldehyde or genipin to form covalent bonds between gelatin molecules [3,4].

## Discussion

Enzyme-immobilized hydrogels find applications in various processes within the food and beverage industry, including enzyme-assisted extraction of bioactive compounds, flavor enhancement, and modification of food texture. For example, amylase-immobilized starch-based hydrogels are used for the hydrolysis of starch into sugars, facilitating the production of sweeteners or improving the texture of baked goods. Starch- and gelatin-based hydrogels have been explored for biomedical applications such as drug delivery, tissue engineering, and wound healing. Enzyme-immobilized hydrogels can be utilized for localized and controlled release of therapeutic agents or growth factors, improving the efficacy and safety of drug delivery systems.

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## Conclusion

Enzyme immobilization into starch- and gelatin-based hydrogels represents a promising approach for enhancing enzyme stability, reusability, and activity retention across various industrial and biomedical applications. Advances in hydrogel fabrication techniques and enzyme immobilization methods continue to drive innovation in this field, offering sustainable and efficient solutions for biocatalytic processes. Further research and development efforts are warranted to overcome existing challenges and unlock the full potential of enzyme-immobilized hydrogels in real-world applications.

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***Address for Correspondence:** Myles Carlie, Department of Genetics and Genomics, University of Nottingham, Nottingham, UK, E-mail: mylescarlie11@unige.ch*



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## Conflict of Interest

None.

## References


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