Impact of Storage on the Structure Stability of Starch-Based HPP Hydrogels Loaded with Natural Extracts

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Abstract

Starch-based hydrogels have garnered significant interest in recent years due to their potential applications in various fields. Their characteristic stable structure enables functionalization, allowing their use as smart carriers of the bioactive compounds of natural extracts. In this study, the physical stability of starch-based hydrogels loaded with natural extracts produced via high-pressure processing (HPP) was evaluated. For this purpose, stability measurements, including swelling power, texture, pH, and organoleptic properties, were determined at various time intervals during storage at 5°C and 25°C. The results showed that during storage, a decrease was observed in swelling power, indicating a reduction of the hydrogel's ability to retain water, likely due to structural rearrangements of polymer chains. Additionally, texture analyses revealed an initial decrease of hardness, cohesiveness, and springiness values at 15 days, followed by their increase after 30 days. These changes may be related to hydrogel reorganization, where initial relaxation reduces texture properties, but longer-term polymer chain rearrangement or crosslinking enhances stability. Moreover, changes in pH and color further suggest ongoing chemical transformations during storage. Based on these findings, it can be concluded that more work is needed to better understand the molecular mechanisms governing the behavior of these biomaterials during storage for both fundamental research and practical applications.