

## **Polysaccharide-derived hydrogel matrix-based platform for beverage quality monitoring**

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The detection of contaminants in beverages is essential for safeguarding consumer health and ensuring product quality. In this study, a polysaccharide-derived hydrogel matrix was developed as an eco-friendly sensing platform for colorimetric monitoring of beverage quality. The hydrogel was fabricated under mild, green conditions using renewable biopolymers and incorporated with selective reagents capable of producing visible color responses upon interaction with target analytes. The hydrogel displayed excellent porosity and water-retention capacity, allowing efficient diffusion of analytes and rapid colorimetric response. Distinct and reproducible color transitions were observed when the hydrogel matrix was exposed to BPA, a model contaminant. For quantitative assessment, color changes were captured using a smartphone camera and analyzed through digital image colorimetry. The platform demonstrated good sensitivity, with detection in the low micromolar range, and high reproducibility across multiple measurements. To validate real-world applicability, the system was tested with real beverage samples, including bottled consumables and drinking water. The sensor exhibited reliable performance, with consistent responses and minimal sample pretreatment requirements. The inclusion of a cellulose support enhanced the stability and handling of the hydrogel, further contributing to its practical usability. Overall, the polysaccharide-based hydrogel platform provides a sustainable, low-cost, and user-friendly approach for beverage quality monitoring. Its integration with smartphone-assisted analysis offers strong potential for portable and on-site contaminant detection.

**Keywords:** Polysaccharide hydrogel; Sensor; Colorimetry; Digital analysis; Sustainability