

VERSATILE BIOMATERIAL PLATFORMS: XYLAN-HYDROGEL HYBRID FOR BIOMEDICAL APPLICATIONS

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The use of scaffolds in tissue engineering facilitates tissue regeneration by acting as templates. They promote cell and growth factor synergy for effective regeneration [1].

Polysaccharides are excellent candidates for the preparation of hydrogels due to their high hydrophilicity, biocompatibility and structural similarity to the extracellular matrix, as well as their biodegradability and non-toxicity [2]. The tequila industry produces 9.15×10^5 tons of waste per year, and only 30% of this waste is composted, posing a significant environmental problem [3]. The utilization of bagasse as a renewable source to obtain Xylan-type HC (XylHC) biomaterial represents a promising solution. In this study, hybrid materials based on xylan polysaccharide crosslinked with poly(N-vinylcaprolactam) (PNVCL), poly(2-isopropenyl-2-oxazoline) (PIPOx) and 2-hydroxyethyl methacrylate (PHEMA) were developed. Mesoporous silica nano- and microparticles have been incorporated into hydrogels to create hybrid scaffolds for fibroblast growth and drug delivery control. XylHC offer biocompatibility but suffer from poor mechanical properties due to water absorption. Hybrid materials, which combine organic biopolymers with inorganic ones, offer advantages over traditional materials [4].

Extensive analysis was performed on the 3D scaffolds obtained. IR spectroscopy and NMR confirmed the chemical composition of the scaffolds. The SEM showed a uniform distribution of silica particles in the hydrogel network (up to 20 wt.%). Additional analyses (nitrogen adsorption-desorption, SAX scattering, TEM) showed that the particle framework was preserved and physically cross-linked with the organic hydrogels. Rheological test showed significant mechanical enhancement with 20% w/w mesoporous silica.

The hybrid scaffolds showed a good capacity to load and release of ciprofloxacin ($9.5-8.4 \times 10^{-3}$ mg/mL), and Levofloxacin ($4 - 21 \times 10^{-3}$ mg/mL), above the minimum inhibitory concentration requirements for gram-positive and gram-negative bacteria [5]. The systems inhibited the growth of E. coli, S. aureus, and P. aeruginosa. In addition, we demonstrate that fibroblast L929 cells grew and spread on hydrogel.

References

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