Title: Polysaccharide Gum Enhanced Porous Biomaterials for Bone Tissue Regeneration

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Introduction: Porous scaffolds are essential in bone tissue engineering, as they mimic the extracellular matrix, facilitate nutrient transport, and support cellular adhesion, proliferation, and migration. Emulsion polymerization offers a promising route to fabricate scaffolds with highly interconnected pores and tunable properties, addressing limitations of other conventional methods [1].
This study aims on synthesis and characterization of emulsion polymerised scaffolds fabricated via a medium internal phase emulsion (PolyMIPE) method. The base formulation comprised of poly (ethylene glycol) diacrylate (PEGDA), as a monomer with incorporating two variants of polysaccharide gums, gellan gum (GG) and gum arabic (GA) for comparative analysis to evaluate their contribution in developing the pore morphology and overall scaffold properties.
Materials and Methods: Scaffolds were synthesized using PolyMIPE method with PEGDA as the base polymer. Two variants were prepared by incorporating GG and GA at three different concentrations (0.1%, 0.5%, and 1%). Degradation was assessed under enzymatic (lysozyme, pH 4), alkaline (NaOH, pH 9), and hydrolytic (PBS, pH 7.4) conditions. Swelling behaviour was evaluated in PBS at pH 4, 7.4, and 9 over six weeks.
Results: The scaffolds exhibit good porosity, as observed through visual examination. PEG Basic scaffolds showed minimal degradation and retained the highest mass over time. GG and GA variants exhibited concentration dependent degradation, with higher concentrations degrading less. Swelling was most pronounced at pH 4, particularly in PEG GG 0.5% and PEG GA 1%. PEG GG 0.1% demonstrated consistent swelling across all pH levels, indicating reduced pH sensitivity.
Discussion and Conclusions: Polysaccharide incorporation significantly affected degradation and swelling, enabling application specific scaffold tuning. PEGDA based PolyMIPE scaffolds with GG and GA offer a versatile platform for osteochondral regeneration, biological evaluation, clinical translation, and sensor applications.
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