

PROCEEDINGS



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Posters

D1 – P107

Curcumin-loaded GelMA/PCL-MEW hybrid scaffolds: Assessing long-term release, antioxidant defense, and cytocompatibility

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Introduction

Successful tissue regeneration requires multifunctional composite scaffolds that combine synthetic polymeric frameworks for structural integrity with bioactive hydrogels to provide a supportive microenvironment.

Aim

This study aimed to develop a hybrid hydrogel scaffold as a synergistic approach by combining Melt Electrowriting (MEW) of Polycaprolactone (PCL) for mechanical reinforcement with a Curcumin-loaded Gelatin Methacryloyl (GelMA) to create a multifunctional microenvironment for tissue regeneration. The biological functionality of the developed scaffolds was evaluated, focusing on their capacity for sustained drug delivery, antioxidant activity, and high cytocompatibility.

Materials and Methods

The hybrid scaffolds were fabricated by integrating a PCL-MEW structural framework into Curcumin-loaded GelMA hydrogels (GelMEW) with three different concentrations of Curcumin (30, 45, and 60 µg/ml). Curcumin release profile was analyzed over a 14-day period in physiological conditions. Antioxidant capacity was evaluated by quantifying free radical scavenging activity. Furthermore, to confirm the cytocompatibility of the scaffolds, *in-vitro* cell viability test and cellular morphology analysis were performed using L929 line of fibroblasts.

Results

The developed GelMA/PCL-MEW hybrid scaffolds demonstrated a sustained curcumin release profile over 14 days, reaching cumulative release up to 60% depending on the loading concentration (Fig.1). Moreover, the scaffolds exhibited radical scavenging activity in a dose-dependent manner, where it increased from 18% to 54% corresponding to higher curcumin content, providing antioxidant capacity. Additionally, cytocompatibility assays confirmed high cellular viability across all scaffolds, with cell viability above 92%. No morphological signs of cytotoxicity were observed in fluorescence microscopy imaging even at the highest curcumin concentration.

Conclusion

In conclusion, these results revealed that curcumin incorporated Gelma/PCL-MEW hybrid system is a promising multifunctional platform for tissue engineering. It provides a sustained curcumin release with a potent oxidative stress protection while maintaining high cytocompatibility. As part of an extensive ongoing research, further characterizations including mechanical properties and degradation profiles are being conducted to fully evaluate the long-term performance and structural stability of these hybrid scaffolds for tissue regeneration.

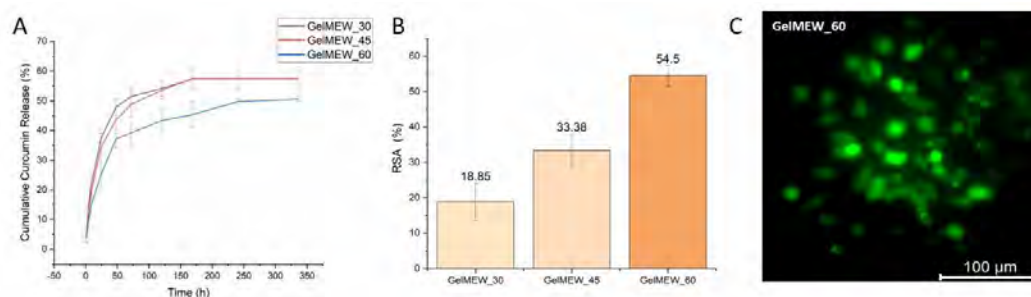


Figure 1. Multifunctional performance of hybrid scaffolds: (A) Sustained curcumin release over 14 days; (B) Dose-dependent radical scavenging activity (RSA); (C) Fluorescence image showing high cell viability and spreading on scaffolds with highest curcumin concentration.

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