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Functionalisation of Polymeric Patches for Skin Tissue Engineering Applications with Plant Oil Additives

Didem Demir
Tarsus University
Chemistry and Chemical Process Technologies Department, Mersin Tarsus Organized Industrial Zone Technical Sciences Vocational School, Mersin, Türkiye
didemdemir@tarsus.edu.tr

Extended Abstract

Polymeric patches, which can be designed in different forms using biocompatible and biodegradable polymers, have the potential to be used in skin tissue engineering applications to reconstruct the structural and functional components of the skin, reduce scar formation, and improve the quality of wound healing. Recent studies have focused on the functionalization of these flexible, mechanically stable, and easily applicable biomaterials with the addition of biologically active agents. In this context, the aim is to increase biological activities in terms of healing ability and antimicrobial features by preserving the existing characteristics of the biomaterials.

In this study, polymer patches were prepared by solvent casting method using a combination of chitosan (2% wt. in acetic acid solution), polyvinyl alcohol (10% wt. in distilled water) and pectin (5% wt. in distilled water) with some modifications as described in our previous studies [1], [2]. For the functionalization of polymeric structures, studies were carried out with grape seed oil at different ratios (25%, 50% and 100% wt. of total polymer amount), which is a bioactive agent known for its wound and scar healing activity, delaying the aging process and preventing the occurrence of some chronic diseases in medicine for many years [3], [4].

Uniform thin films, slightly yellowish in colour due to the presence of chitosan and pectin, transparent and easily peelable without tearing from the mould were successfully obtained. The film thickness was measured as 0.085±0.01, 0.087±0.01, 0.011±0.02 and 0.013±0.02 for blank and increased amounts of oil added polymer films, respectively. Basic physicochemical characterization, mechanical stability, water vapour permeability, liquid absorption capacity, and biodegradability properties of patches prepared were analysed for use as dressing for skin tissue engineering. The ability of the materials to retain their existing properties after the addition of seed oil was also discussed in the same analyses and the release of the bioactive substance from the patches was monitored in a time-dependent manner. There was no change in the physical appearance of the films after the oil additive. Moreover, the polymeric films showed extreme flexibility at high oil concentrations, which made them more adhesize. It can also be said that grape oil acts as a plasticizer, making the polymer film more flexible. Among the all samples, the highest amount of oil added films exhibited a slower initial swelling rate and subsequently a higher equilibrium value (approximately 700%), indicating an important sustained release property necessary to provide a long-lasting antibacterial, antifungal and antiviral environment.

Finally, the contribution of the oil additive to the biological properties of the materials was demonstrated by antimicrobial activity studies. Polymeric patches with oil additive decreased colony numbers of both E. coli and S. aureus under 50 from blank sample having 325 and 470 colony numbers, respectively. These results indicate that incorporation of seed oil into polymeric patches effectively enhances the antibacterial property. In light of the obtained results, a new flexible, easy-to-use, inexpensive, and highly effective biodegradable product functionalized in the presence of a bioactive agent can be nominated for both cosmetic and skin tissue engineering applications.

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