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Nicotine-Loaded Polyvinyl Alcohol Electrospun Nanofibers as Transdermal Patches for Smoking Cessation: Formulation and Characterization

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Abstract

Nicotine-loaded polyvinyl alcohol (PVA) nanofibers were successfully produced by the electrospinning technique. Nicotine-loaded PVA solutions of varying concentrations were prepared, and their chemical composition, conductivity, and viscosity were determined using attenuated total reflectance-Fourier transform infrared spectroscopy and a rheometer. The formulations were spun at flow rates of 0.4 mL/h with a fixed voltage of 11 kV. A scanning electron microscope was then used to characterize the morphology and diameters of electrospun mats. Differential scanning calorimetry and thermogravimetric analysis were used to investigate the thermal properties and structural changes during the oxidative stabilization process. From the result, conductivity and viscosity decreased with decreasing nicotine concentrations, resulting in smooth and nonbeaded nanofibers. In contrast, as the nicotine solution concentration increases, beaded nanofibers with smaller diameter fibers are produced, resulting in a smaller average fiber diameter. The average fiber diameter of different nicotine concentrations at 0%, 0.5%, 1.0%, 1.5%, and 2.0% solution were found to be 348.05 ± 71.42 nm, 439.73 ± 48.16 nm, 415.36 ± 41.41 nm, 348.07 ± 71.42 nm, and 317.42 ± 42.45 nm respectively. The release test exhibits Higuchi's release kinetics with about 95% nicotine released over 6 h at a monophasic flux of 0.152 mg/cm²/h^{1/2}. This study indicates that nicotine-loaded nanofibers are a potential candidate as a transdermal patch for smoking cessation. © Springer Science+Business Media, LLC, part of Springer Nature 2024. Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

Author Keywords

electrospinning; nanofibers; nicotine; polyvinyl alcohol

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