Evaluating the Viability of an Asymmetric Electrospun Nanofiber Composed of Polycaprolactone, Chitosan, and Curcumin To Promote Chronic Wound Healing

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Chronic wounds are a growing medical issue around the world, with 2.4 - 4.5 million people afflicted in the United States alone. The condition currently makes up 2-3% of healthcare costs for developed countries, and this number is expected to increase as chronic wound-causing problems, like diabetes, grow in prevalence. Due to the lack of effective wound dressings, chronic wounds face a higher risk for bacterial infection and express high morbidity and mortality rates. Many current dressings are homogeneous and fail to account for the complexities of the different layers of skin. Alternatively, asymmetric electrospun nanofibers have a bilayer design that corresponds to the skin's dermis and epidermis. We intend to demonstrate that an asymmetric electrospun nanofiber composed of polycaprolactone (PCL), chitosan (CS), and curcumin (Cur) can be utilized as a chronic wound dressing. These three biodegradable and biocompatible components were applied in an asymmetric design to mimic the protective epidermis and porous dermis. Upon electrospinning our asymmetric nanofiber and running it through a scanning electron microscope, we found that our hydrophobic PCL layer had small pores (8.33 nm2) and thin nanofibers (281.82 nm), while our hydrophilic PCL/CS/Cur layer had large pores (55.33 nm2) and thick nanofibers (425.54 nm). Our asymmetric nanofiber was also more effective at resisting bacterial permeation than the homogeneous PCL nanofiber. Our results highlight the superiority of asymmetric membranes for resisting bacterial infection and suggest that with further experimentation, we can establish our nanofiber as a viable wound dressing.