ELECTROSPINNING SILK WITH SELENIUM NANOPARTICLES IMPROVES THE ACTIVITY OF MAMMALIAN CELLS WHILE DECREASING BACTERIA GROWTH

Stanley Chung\textsuperscript{1} and Thomas J. Webster\textsuperscript{1-3}

\textsuperscript{1}Department of Chemical Engineering, Northeastern University, Boston, MA, \textsuperscript{2}Department of Bioengineering, Northeastern University, Boston, MA, \textsuperscript{3}Center of Excellence for Advanced Materials Research, King Abdulaziz University, Jeddah, Saudi Arabia

Silk possesses many beneficial wound healing properties, and electrospun scaffolds are especially applicable for skin applications, due to their smaller interstices and higher surface areas. However, purified silk promotes microbial growth. Selenium nanoparticles have shown excellent antibacterial properties. Here, electrospun silk scaffolds were doped with selenium nanoparticles, and \textit{in vitro} tests were conducted to assess cellular activity on these nanocomposites.

Silk was extracted from \textit{Bombyx mori} while selenium nanoparticles were synthesized by a reaction with sodium selenite, glutathione, and sodium hydroxide. Extracted silk was dissolved in formic acid at 8\% w/v and spun at a flow rate of 0.75 mL/hr, with a distance to a collector of 10 cm and at a voltage of 20kV. The scaffold was characterized by SEM, XPS, and goniometry to determine its physical properties. Human dermal fibroblasts (HDFs, ATCC PCS-201-012) at passage numbers 3 – 12 were seeded to determine cellular metabolic activity on these scaffolds (Promega MTS). \textit{Staphylococcus aureus} (ATCC 12600) was seeded onto the electrospun scaffolds for 24 hours to measure ATP activity (Promega BacTiter Glo). All experiments were conducted in triplicate and repeated at least three times. Differences between means were assessed via ANOVA, followed by student t-tests.

Electrospun scaffolds possessed fiber diameters of 100-200 nm and pore sizes of ~2\textmu m. Surface contact angles were 50\textdegree, showing a hydrophilic surface. Selenium nanoparticles were between 50 and 100 nm. XPS results showed that the amount of selenium deposited increased with increasing diameter of selenium nanoparticles. Results of this study showed that the addition of selenium nanoparticles, especially 50 nm nanoparticles, greatly enhanced the metabolic activity of HDFs. ATP assays showed a significant reduction in the activity of \textit{Staphylococcus aureus} grown on these nanocomposites. Results demonstrated that the addition of selenium nanoparticles successfully improved the activity of HDFs and reduced bacterial activity on silk scaffolds.

Keywords: Electrospinning, Silk, Bacteria

Presenting author’s email: chung.st@husky.neu.edu