Food Waste-derived Medical Textiles via Electrospinning for Healthcare Apparel and Personal Protective Equipment

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Abstract

Development of sustainable and eco-friendly non-woven textiles is essential to produce environmentally friendly personal protective equipment (PPE) for reduction of risk in transmission and infection of bacteria and virus This paper will demonstrate fabrication of medical textile from a substitute of food waste derived Polylactic Acid (PLA) via electrospinning process. Solvent systems from single and binary solvents in different ratios and electrospinning parameters, i.e. voltage, solution flow rate and distance to collector were studied to investigate the influence on nanofiber morphology, diameter and electrospinnability. Effects of substrates and electrospinning techniques such as multi-spinneret and wire spinneret electrospinning were further investigated for scale-up textile production. Thermal properties were characterized by differential scanning calorimetry (DSC). Viscosity and conductivity of polymer solutions were measured. Nanofiber morphology and diameter were investigated by scanning electron microscopy (SEM). The results showed binary-solvents DMF/acetone (4:6 v/v) and DMAc/acetone (2:8 v/v) gave finest defect-free fibers and electrospinnability. Polymer concentration of 10-12.5% w/v resulted in defect-free nanofibers. Electrospinning parameters were optimum at a voltage of 25KV, collector distance of 250 mm and flow rate of 1mL/hr. Electrospinnability of the dope solution on substrates was also investigated. Although the morphology was unaffected but increase in nanofiber diameter was observed with decrease in conductivity. In summary, DMF/ acetone solvent system was considered as optimized candidate for PLA electrospinning, effective on non-woven substrates and high textile productivity with both multi-spinneret and wire spinneret systems.