Revolutionizing Diabetes Care: Optimizing Hydrogel Beads for Pancreatic Islet Viability

D'Souza, Megan (School: Community School of Naples)

Over 8 million people worldwide have type 1 diabetes. Encapsulation of pancreatic islets is an experimental treatment that allows islets to avoid contact with immune cells, allowing for transplantation without the use of immunosuppressants. These capsules must be strong to protect the islets over a long period of time and permeable to allow nutrients to enter and insulin to exit into the bloodstream. The purpose of the study is to test the compressive strength and permeability of hydrogels made with different alginate polymers such as pure sodium alginate, 1:1 chitosan-alginate blend, and 1:2 chitosan-alginate blend crosslinked in either calcium chloride or calcium lactate. To measure compressive strength, a penetrometer was used to apply pressure to the bead until failure of the hydrogel. Permeability was measured through diffusion of dyed alginate beads in a PBS solution, which simulated the portal vein transplant site. The absorbance of the solution was taken at t=1,3,5,7,10 minutes to determine the increasing concentration, which is directly proportional to the hydrogel release rates. The sodium alginate in calcium chloride was the strongest and most permeable hydrogel combination. As chitosan concentration increased, mechanical strength and permeability decreased. Beads cross-linked in calcium chloride were stronger than those created in calcium lactate. The salt solution did not have a consistent effect on permeability. The hydrogel most suitable for islet encapsulation was the sodium alginate in calcium chloride due to its strength and permeability.

Awards Won: