### 2.1.2. Instruments

The prepared polymers were dried using a Hetopower dry PL 9000 freeze dryer (Thermo Fisher Scientific-Inc, Waltham-MA, USA). Centrifugation was carried out using a Sorvall Super Speed RC2-B centrifuge (Ivan Sorvall-Inc, Norwalk-CT, USA). The pH of the solutions was modulated by using pH/Conductivity Meter (Model number MPC227, Mettler-Toledo International Inc). The Viscosities of samples were measured by using a Sine-wave Vibro-viscometer (Vibro-Viscometer SV-10/SV-100, A&D Company, Japan). The chitosan powder was identified by Nicolet Avatar 360 FT-IR ESP Spectrometer (Nicolet, USA). To agitate the solutions for speeding up reactions or improving mixtures a heating magnetic stirrer was used (ARE F20520162, VELP Scientific-Inc, Italy). Vortex mixers (ZX3 F202A0176, VELP Scientific-Inc, Italy) were used for mixing purpose. Particle size measurements were performed using a Malvern Zetasizer nanoparticles analyzer with 633nm red laser light (Model number ZEN 3600, Malvern nano series, Malvern, UK).

Insulin measurement was performed by insulin electrochemiluminescence immunoassay, using Elecsys® 2010 analyzer (Roche Diagnostics, Mannheim, Germany). While anti-insulin antibodies present in the serum of rats either insulin-treated diabetic rat, even when they are treated with biosynthetic human insulin, and may also be found in the serum of type 1 diabetic rats before insulin administration. These antibodies interfere in competitive and noncompetitive insulin immunoassays. Glucose level was measured by blood glucose meter (GluChec®, D Vision, Ltd, UK).

The *in situ* perfusion apparatus consist of the following components: incubation of Krebs-bicarbonate buffer bottle at 40 °C was performed using water bath (Memmert Company, Germany). The oxy-life oxygen concentrator (JAY-6, Longfian Scitech