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Impact of Surface Chemistry on Insulin Agglomeration

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Abstract

With a global surge if diabetes cases, including in resource-poor stretches of the world with inadequate preservation facilities, the therapeutic relevance of insulin cannot be overstated. It is known that insulin is sensitive to fluctuations in its physico-chemical ambiance, including exposure to various surfaces that occurs within administration settings, such as plastic bottles and tubings. Many of these surfaces are synthetic and industrially manufactured with hydrophobic nature, and insulin is known to demonstrate agglomeration when exposed to such surfaces. To this end, a study was conducted to understand how surface chemistry, including surface charge, can influence insulin agglomeration, where fluorescein isothiocyanate (FITC)-labeled (human) insulin (degree of substitution 1 mole/mole) suspended in pH 3 solution (0.125 mg/mL, 0.25 mg/mL, and 0.5 mg/mL) was exposed to 100 µg/mL (final concentration) of fluorescent (emission in red region of the spectra) cationic (amine-terminated) and anionic (acid-terminated) polystyrene latex beads (1 µm) for t = 2 h, 4 h, 24 h, 48 h, and 72 h at 37°C followed by both confocal and fluorescence lifetime imaging microscopy (FLIM) in both 2D and 3D. The insulin showed excellent surface adsorption on both cationic and anionic particles. Moreover, the interfaces between the adsorbed insulin and particle (forming the core of insulin-particle constructs) were probed. Furthermore, with FLIM-based investigations, the impact of surface on localized acidity caused by the particle surfaces in immediate vicinity and spreading to nearby regions—noted as lowered fluorescence lifetimes (τ) of FITC—was investigated. This talk will showcase the obtained data and demonstrate how various surfaces can influence the physico-chemical attributes of insulin with impact on its stability with possible implications on bioactivity.