Ikram Ullah Khan et al., Pharmaceut Anal Acta 2014, 5:3
http://dx.doi.org/10.4172/2153-2435.S1.020

OMICS Group Conferences
Accelerating Scientific Discovery

4th International Conference and Exhibition on
Pharmaceutics & Novel Drug Delivery Systems
March 24-26, 2014 Hilton San Antonio Airport, San Antonio, USA

Droplet microfluidics: A tool to fabricate polymeric drug microcarriers with complex morphologies for new delivery strategies

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Microencapsulation is used for protection of drug, controlled release, reduced administration frequency, patient comfort and compliance. In comparison with conventional techniques for encapsulation, microfluidics offers a new route to precise control over microcarriers' size, shape, morphology, composition and release properties.

Off-the-shelves capillary-based microfluidic droplet generators, assembled within minutes, were used to produce size-controlled Janus and Trojan polymeric microparticles. A two side-by-side capillaries-based device was employed to prepare poly(acrylamide)/poly(methyl acrylate) Janus microparticles from the emulsification into droplets of the two respective monomer phases that were downstream polymerized by UV irradiation. On the opposite, a single capillary-based device was used to obtained poly(acrylamide) Trojan microparticles embedded with poly(ethyl acrylate) nanoparticles obtained previously from the nano-emulsification of the monomer phase within an elongation flow micromixer.

Two model drugs, with quite different hydrophobicity properties, namely ketoprofen (hydrophobic) and sodium fluorescein (hydrophilic), were incorporated in poly(acrylamide)/poly(methyl acrylate) Janus particles that were obtainedby UV irradiation at 365 nm far away from maximum absorption wave length of drugs thus insuring their integrity. By varying the flow rate of the hydrophobic monomer phase while keeping the flow rate of the hydrophilic monomer constant, different morphologies were obtained from core-shell to bi-compartmental Janus structures. Similarly at same flow rate for the two monomer phases, change in concentration of the surfactant (SDS, admixed with the hydrophilic solution) changes the morphology of the microparticles.

This lecture proposes to study the production, the release properties and new release strategies (e.g. sequential, synergetic, nanoparticle delivery to GIT etc) arising from these uncommon morphologies. As preliminary results, it was found that a bi-compartmental Janus structure is quite efficient in releasing two different drugs over 24 h thus allowing synergetic effect in sustained drug delivery.

Biography

Ikram Ullah Khan obtained his Bachelor's in Pharmacy from college of pharmacy, Punjab University Lahore Pakistan in 2005 and Masters in Pharmaceutics from faculty of Pharmacy Bahauddin Zakariya (BZ) University Multan, Pakistan in 2008. In the same year, he joined College of Pharmacy, Government College University, Faisalabad, Pakistan as lecture of Pharmaceutics. He is interested in formulation and development of micro and nanocarriers for drug delivery applications. Currently he is doing Ph.D. from University of Strasbourg France (CAMB and ICPEES) focusing on microfluidic technique to obtain multiple morphologies for pharmaceutical applications. He holds a scholarship from Government College University Faisalabad Pakistan.

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