Pharmaceutical Regulatory Affairs 2012: Supramolecular biovectors: Novel nanopolymers for drug delivery and gene therapy Brain targeting potential of carbamazepine SNEEDS- Biju Patanaik University of Technology ,INDIA

Suryakanta Swain

Biju Patanaik University of Technology ,INDIA , E-mail: swain_suryakant@yahoo.co.in

Abstract

Supramolecular biovectors (SMBVs) are the polymers made from intrinsic nutrient carrier systems of the body such as lipoproteins by repeating units held together with noncovalent bonds. The SMBVs are nanosized virus like particular system comprising of polysaccharide core surrounded by phospholipid layer. These polymers combine good material properties with low viscosity and easy to handle makes them advantageous for drug delivery applications. By an elegant combination of dynamic/reversible structures with exceptional functions, functional supramolecular polymers are attracting increasing attention in various fields. In particular, functional supramolecular polymers offer several unique advantages, including inherent degradable polymer backbones, smart responsiveness to various biological stimuli, and the ease for the incorporation of multiple biofunctionalities (e.g., targeting and bioactivity), thereby showing great potential for a wide range of applications in the biomedical field. In this Review, the trends and representative achievements in the design and synthesis of supramolecular polymers with specific functions are summarized, as well as their wide-ranging biomedical applications such as drug delivery, gene transfection, protein delivery, bio-imaging and diagnosis, tissue engineering, and biomimetic chemistry. These achievements further inspire persistent efforts in an emerging interdisciplin-ary research area of supramolecular chemistry, polymer science, material science, biomedical engineering, and nanotechnology. The purpose of this review is to listing various applications of them in site-specific drug delivery and gene therapy. Apart from this review is highlighted on the chemistry, mechanism, fabrication, design and various approaches supramolecular hydrogels. Further the developments of the supramolecular polymers using Cyclodextrin have widened the arena of drug delivery, non-viral gene delivery due to the strong DNA-binding ability has expected to provide a new paradigm for biomaterials. These different types of SDPs possess distinct morphologies, unique architectures, and specific functions. Benefiting from their versatile topological structures as well as stimuli-responsive properties, SDPs have displayed not only unique characteristics or advantages in supramolecular self-assembly behaviors (e.g., controllable morphologies, specific performance, and facile functionalization) but also great potential to be promising candidates in various fields. In this Account, we summarize the recent progress in the synthesis, functionalization, and self-assembly of SDPs as well as their potential applications in a wide range of fields. A variety of synthetic methods using non-covalent interactions have been established to prepare different types of SDPs based on varied mono- or multifunctionalized building blocks (e.g., monomer, dendron, dendrimer, and hyperbranched polymer) with homo- or heterocomplementary units. In addition, SDPs can be further endowed with excellent functionalities by employing different modification approaches involving terminal, focal-point, and backbone modification. Similar to conventional dendritic polymers, SDPs can self-assemble into diverse supramolecular structures such as micelles, vesicles, fibers, nanorings, tubes, and many hierarchical structures. Finally, we highlight some typical examples of recent applications of SDP-based systems in biomedical fields (e.g., controlled drug/gene/protein delivery, bioimaging, and biomimetic chemistry), nanotechnology (e.g., nanoreactors, catalysis, and molecular imprinting), and functional materials. The current research on SDPs is still at the very early stage, and much more work needs to be done. We anticipate that future studies of SDPs will focus on developing multifunctional, hierarchical supramolecular materials toward their practical applications by utilization of cooperative non-covalent interactions.