World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:9, No:10, 2015

Antimicrobial Nanocompositions Made of Amino Acid Based Biodegradable Polymers

Authors : Nino Kupatadze, Mzevinar Bedinashvili, Tamar Memanishvili, Manana Gurielidze, David Tugushi, Ramaz Katsarava

Abstract : Bacteria easily colonize the surfaces of tissues, surgical devices (implants, orthopedics, catheters, etc.), and instruments causing surgical device related infections. Therefore, the battle against bacteria and the prevention of surgical devices from biofilm formation is one of the main challenges of biomedicine today. Our strategy to the solution of this problem consists in using antimicrobial polymeric coatings as effective “shields” to protect surfaces from bacteria’s colonization and biofilm formation. As one of the most promising approaches look be the use of antimicrobial bioerodible polymeric nanocomposites containing silver nanoparticles (AgNPs). We assume that the combination of an erodible polymer with a strong bactericide should put obstacles to bacteria to occupy the surface and to form biofilm. It has to be noted that this kind of nanocomposites are also promising as wound dressing materials to treat infected superficial wounds. Various synthetic and natural polymers were used for creating biocomposites containing AgNPs as both particles' stabilizers and matrices forming elastic films at surfaces. One of the most effective systems to fabricate AgNPs is an ethanol solution of polyvinylpyrrolidone(PVP) with dissolved AgNO3–ethanol serves as a AgNO3 reductant and PVP as AgNPs stabilizer (through the interaction of nanoparticles with nitrogen atom of the amide group). Though PVP is biocompatible and film-forming polymer, it is not a good candidate to design either "biofilm shield" or wound dressing material because of a high solubility in water – though the solubility of PVP provides the desirable release of AgNPs from the matrix, but the coating is easily washable away from the surfaces. More promising as matrices look water insoluble but bioerodible polymers that can provide the release of AgNPs and form long-lasting coatings at the surfaces. For creating bioerodible water-insoluble antimicrobial coatings containing AgNPs, we selected amino acid based biodegradable polymers(AABBPs)–poly(ester amide)s, poly(ester urea)s, their copolymers containing amide and related groups capable to stabilize AgNPs. Among a huge variety of AABBPs reported we selected the polymers soluble in ethanol. For preparing AgNPs containing nanocompositions AABBPs and AgNO3 were dissolved in ethanol and subjected to photochemical reduction using daylight-irradiation. The formation of AgNPs was observed visually by coloring the solutions in brownish-red. The obtained AgNPs were characterized by UV-spectroscopy, transmission electron microscopy(TEM), and dynamic light scattering(DLS). According to the UV and TEM data, the photochemical reduction resulted presumably in spherical AgNPs with rather high contribution of the particles below 10 nm that are known as responsible for the antimicrobial activity. DLS study showed that average size of nanoparticles formed after photo-reduction in ethanol solution ranged within 50 nm. The in vitro antimicrobial activity study of the new nanocomposite material is in progress now.

Keywords : nanocomposites, silver nanoparticles, polymer, biodegradable
Conference Title : ICBT 2015 : International Conference on Bioengineering and Technology
Conference Location : Barcelona, Spain
Conference Dates : October 26-27, 2015