Abstract

Among the metals nanoparticles, gold and silver nanoparticles have some unique characteristics such as high stability, low toxicity, bio-compatibility and ability of surface modification which make them an attractive tool for biomedical applications. In present work, gold and silver nanoparticles have been prepared and successfully applied mainly in four major areas including pH sensitive drug release, biocatalysis, biosensor and diabetes management.

pH-sensitive doxycycline gold nanoparticles (doxy-AuNPs) are reported here to act as an effective drug nanocarrier and as a biocatalyst. The AuNPs were synthesized with doxy as the reducing and capping agent. Various parameters were optimized to find the best conditions for synthesis of doxy-AuNPs and these were characterized with UV-vis., x-ray diffraction (XRD), FT-IR and transmission electron microscopy (TEM). Doxy-AuNPs were then loaded with the anticancer drug doxorubicin (DOX) where 70% of the initially available drug was loaded within 24 hours. Furthermore, pH-dependent drug release was measured at 60% with *invitro* measurements in phosphate buffer saline (PBS). In addition, the doxy-AuNPs were applied as a biocatalyst. Oxidation of dopamine was taken as a model reaction to determine the catalytic activity of doxy-AuNPs. Almost complete oxidation of dopamine occurred in 5 minutes which indicates the fast response of synthesized doxy-AuNPs as a biocatalyst.

In clinical chemistry, frequent monitoring of drug levels in patients has gained considerable importance because of the benefits of drug monitoring on human health, such as the avoidance of high risk of over dosage or increased therapeutic efficacy. In present work, an ultra sensitive surface plasmon resonance (SPR) biosensor was developed for the detection and quantification of doxycycline. SPR analysis revealed the high sensitivity of doxy-AuNPs towards the detection of free doxycycline. More specifically, doxy-AuNPs bound with protease activated receptor-1 (PAR-1) immobilized on the SPR sensing surface yield the response in SPR, which was enhanced following the addition of free doxy (analyte) to the solution of doxy-AuNPs. This biosensor allowed for doxycycline detection at concentrations as low as 7 pM. The study also examined the role of colloidal stability and growth of doxy-AuNPs in relation to the response enhancement strategy based on doxy-AuNPs. Thus,

the doxy-AuNPs based SPR biosensor is an excellent platform for the detection of doxycycline and demonstrates a new biosensing scheme where the analyte can provide enhancement.

Diabetes is a life-threatening disease and chronic diabetes affects liver, kidney and pancreas in human. The root cause of diabetes is mainly associated with oxidative stress produced by reactive oxygen species. The minocycline is a polyphenolic drug with excellent antioxidant activities. The objective of this study was to investigate the antidiabetic potential of minocycline modified silver nanoparticles (Mino/AgNPs) against alloxan induced diabetic mice. The Mino/AgNPs were synthesized using minocycline as reducing and stabilizing agents. UV-vis., FT-IR, XRD and transmission electron microscopy were applied for the characterization of synthesized Mino/AgNPs. The DPPH free radical scavenging assay was conducted to compare the antioxidant potential of Mino/AgNPs with that of minocycline and ascorbic acid. The Mino/AgNPs showed higher radical scavenging activity (IC_{50} = 19.7 µg/mL) as compared to the minocycline (IC_{50} = 26.0 µg/mL) and ascorbic acid (IC_{50} = 25.2 µg/mL). Further, these Mino/AgNPs were successfully employed for the treatment of Alloxan induced diabetic mice. Thirty-two mice were divided into four groups: normal control group; diabetic group left untreated; diabetic group treated with the standard drug glibenclamide; diabetic group treated with Mino/AgNPs. The administration of Mino/AgNPs to the diabetic mice showed higher antidiabetic potential as compared to the drug glibenclamide. Hematological results showed that the diabetic mice treated with Mino/AgNPs showed significant decrease in fasting blood glucose level and lipid profile as compared to the diabetic mice left untreated. Histopathological examination further confirmed the effectiveness of Mino/AgNPs as an antidiabetic agent. The liver of diabetic mice showed a distorted central hepatic vein along with distortion in arrangement of cells around the central vein. The diabetic kidney showed distorted histo-morphology as compared to the kidney of normal control mice. The pancreas of diabetic mice showed distorted islet cells. However the treatment of diabetic mice with Mino/AgNPs showed significant recovery and revival of histo-morphology of kidney, central vein of liver and islet cells of pancreas. Hence Mino/AgNPs is an excellent antidiabetic agent to overcome the diabetic disorders.