Archives of Clinical Pathology

Short Communication

A SCITECHNOL JOURNAL

AucoreAgshell nanoparticles with potent antibiofilm activity as novel nanomedicine

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Abstract

Background: Medicinal plants serve as a rich source of diverse bioactive phytochemicals that might even take part in bioreduction and stabilization of phytogenic nanoparticles with immense therapeutic properties. Dioscorea bulbifera is a potent medicinal plant used in both Indian and Chinese traditional medicine owing to its rich phytochemical diversity. Herein, we report the rapid synthesis of novel AucoreAgshell DBTE). AucoreAgshell NPs synthesis was completed within 5 hours showing a prominent peak at 540 nm. The bioreduced nanoparticles were characterized using high resolution transmission electron microscopy (HRTEM), energy dispersive spectroscopy (EDS), dynamic light scattering (DLS), X-ray diffraction spectroscopy (XRD) and Fourier transform infrared spectroscopy (FTIR). The particles were further checked for antibiofilm activity against bacterial pathogens. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) was employed to study the mechanism behind antibiofilm activity. HRTEM analysis revealed 9 nm inner core of elemental gold covered by a silver shell giving a total particle diameter up to 15 nm. AucoreAgshell NPs were comprised of 57.34±1.01% gold and 42.66±0.97% silver of the total mass. AucoreAgshell NPs showed highest biofilm inhibition up to 83.68±0.09% against Acinetobacter baumannii. Biofilms of Pseudomonas aeruginosa, Escherichia coli and Staphylococcus aureus were inhibited up to 18.93±1.94%, 22.33±0.56% and 30.70±1.33%, respectively. Scanning electron microscopy (SEM) and atomic force microscopy (AFM) confirmed unregulated cellular efflux through pore formation leading to cell death. This is the first report of synthesis, characterization, antibiofilm and antileishmanial activity of AucoreAgshell NPs synthesized by D. bulbifera.

Keywords

Nanomedicine, AucoreAgshell.

Background

Ongoing advances in the field of nanotechnology envelop the improvement of safe and ecofriendly course towards the blend of nanoparticles to assist human wellbeing. Gold nanoparticles (AuNPs) with interesting physicochemical and optical properties are accounted for to have strong applications in photonics, substance detecting just as biomedical applications like photothermal treatment and medication conveyance. Silver nanoparticles (AgNPs) are viewed as better than other nanostructured inorganic metal particles because of their notable electrical conductivity, optical properties, and oxidative catalysis. AgNPs are utilized in various fields in medication because of their wide range antimicrobial impact [7–10]. Thusly, AgNPs have discovered their applications in different drug items, for example, water cleansing frameworks, copy dressings, and clinical gadgets. Consequently, blend of both gold and silver to combine bimetallic AucoreAgshell is of most extreme logical reasoning. In any case, till date there are no all-around characterized natural courses for orchestrating AucoreAgshell with restorative potential.

Among different restorative plants utilized in Ayurveda, Indian arrangement of conventional medication, Dioscorea bulbifera is essential attributable to its various helpful potential. It is accounted for to display antimicrobial, plasmid restoring, pain relieving, calming, antihyperglycemic, antihyperlipidemic, antinociceptive, and antitumor exercises. As of late, we have detailed its antidiabetic and cell reinforcement potential. Furthermore, we have announced the capability of D. bulbifera in combining both AgNPs and AuNPs inferable from its rich phytochemistry containing both lessening specialists and settling specialists. Notwithstanding, there are no reports cutting-edge on union of bimetallic nanoparticles utilizing D. bulbifera. Multidrug safe (MDR) Gram negative and Gram positive microorganisms like Acinetobacter baumannii and Staphylococcus aureus,respectively, have arisen as profoundly irresistible nosocomial microbes attributable to their amazing protection from anti-infection agents, metal salts, parching, and disinfectants. Such sort of pathogenesis among the fundamentally sick and safe bargained patients is portrayed by the biofilm arrangement that include an unpredictable, coordinated bacterial network sticking to the surface framing microcolonies made out of exopolymeric lattice of sugars, proteins, and nucleic acids. Thus, the microorganisms pick up capacity to avoid the host safeguards, protection from anti-toxin treatment and purposeful delocalization of planktonic microscopic organisms bringing about implantation, and colonization at more up to date locales, causing early intense contaminations in the host. Presently, there are no reports on the utilization of bimetallic nanoparticles made out of gold and silver, in controlling the biofilm development which can end up being a ground-breaking remedial methodology.

Taking into account the above foundation, we report unexpectedly the union of AucoreAgshell by D. bulbifera tuber remove (DBTE) trailed by portrayal utilizing UV-obvious spectroscopy, high goal transmission electron microscopy (HRTEM), energy dispersive spectroscopy (EDS), and dynamic light dissipating (DLS). Bioreduced AucoreAgshell were checked for the biofilm inhibitory action against A. baumannii,

Note: This work is partly presented at 5th International Conference on Pathology (May 09-11, 2016| Chicago, USA)

P. aeruginosa, E. coli, and S. aureus utilizing field discharge filtering electron microscopy (FESEM) and nuclear power microscopy (AFM).

Amalgamation of Gold Core Silver Shell Nanoparticles (Au Ag h NPs) DBTE was set up according to our prior report [7]. In a word, new tubers of D. bulbifera were washed altogether and hacked into cuts and shade dried followed by crushing into fine powder. 5 g of the powder was bubbled in 100 mL of refined water for 5 min and tapped followed by filtration. Union was started by expansion of 5 mL of DBTE to 95 mL of watery arrangement with 1 mM HAuCl4 and 0.7 mM of AgNO3 followed by hatching at 50 C for 5 h. The advancement of decrease was checked by estimating the UV-obvious spectra of the arrangement at ordinary stretches on a spectrophotometer (SpectraMax M5, Molecular Devices Corp, USA) worked at goal of 1 nm. Bioreduced AucoreAgshellNPs blended by DBTE were centrifuged at 10,000 rpm for 15 min at room temperature, trailed by redispersal of the pellet in sterile refined water to eliminate any awkward organic particles. Redundancy of substitute centrifugation and redispersion in sterile refined water for multiple times guaranteed better partition of free substances from the nanoparticles which were utilized for all further organic exercises. Transmission Electron Microscopy (TEM), High Resolution Transmission Electron Microscopy (HRTEM), Dynamic Light Scattering (DLS) Measurements. Shape and size of the bioreduced AucoreAgshellNPs were resolved utilizing TEM (Tecnai 12 cryo TEM, FEI, Netherland) and was affirmed by JEOL-JEM-2100 higher goal transmission electron magnifying instrument (HRTEM) combined with basic organization planning under filtering transmission electron minute mode (STEM). Energy dispersive spectra of AucoreAgshellNPs, recorded in the energy dispersive spectrometer (EDS) prepared in JEOL JSM 6360A insightful checking electron magnifying instrument at an energy range 0–20 keV affirmed the combination of AucoreAgshellNPs. Molecule size was broke down utilizing the dynamic light dissipating gear (Zetasizer Nano2590, Malvern Instruments Ltd, Worcestershire, UK) in polystyrene cuvette.