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Invited Review

Biomedical applications of green synthesized Nobel metal nanoparticles

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ABSTRACT

Synthesis of Nobel metal nanoparticles, play a key role in the field of medicine. Plants contain a substantial number of organic constituents, like phenolic compounds and various types of glycosides that help in synthesis of metal nanoparticles. Synthesis of metal nanoparticles by green method is one of the best and environment friendly methods. The major significance of the green synthesis is lack of toxic by-products produced during metal nanoparticle synthesis. The nanoparticles, synthesized by green method show various significant biological activities. Most of the research articles report the synthesized nanoparticles to be active against gram positive and gram negative bacteria. Some of these bacteria include *Escherichia coli*, *Bacillus subtilis*, *Klebsiella pneumonia* and *Pseudomonas fluorescens*. The synthesized nanoparticles also show significant antifungal activity against *Trichophyton simii*, *Trichophyton mentagrophytes* and *Trichophyton rubrum* as well as different types of cancer cells such as breast cancer cell line. They also exhibit significant antioxidant activity. The activities of these Nobel metal nano-particles mainly depend on the size and shape. The particles of small size with large surface area show good activity in the field of medicine. The synthesized nanoparticles are also active against leishmanial diseases. This research article explores in detail the green synthesis of the nanoparticles and their uses thereof.

1. Introduction

Different definitions for Nanotechnology are expressed in literature, but for the purposes of our current work, Nanotechnology is observed to be the capability to work with materials ranging between 1 and 100 nm in size [1–3]. At nano scale, the materials synthesized have novel properties with respect to other isolated and bulky materials. The applications mainly depend upon the size and morphology of synthesized nano-materials.

Nano-technology is not specific and limited to a discipline, but it is interdisciplinary including natural science and engineering science [2] and most recently toxicology. The synthesis of nano-material at the dimensional scale are not new, but the entire natural, for example the life depending nano scale materials including proteins, enzymes, DNA and small size particles are occurring in nature. For the purposes of color, ceramic glazes and stained glass silver nano-particles (AgNPs) and gold-nano-particles (AuNPs) have been in use since 10th AD and 4th century [4–5].

There are many natural sources for nano-particles, included fires and volcanic bursts. Few biological examples include magnetite (usually occur in animals and cell), viruses and protein like ferritin. The interest of researchers in nano-technology has increased melodramatically to synthesized nanoparticles by straightforward way of combustion and simple industrialization methods. All the engines, power plants and others like welding gases release nano-particles into the environment [6]. The environment has been affected by the rapid step of industrialization. The rapid developments of nano-technology play a vital role in the environmental applications. The existence of organic pollutant in air and water present a great problem to humanity. In this field, nano-materials are excellent catalyst and good sensors

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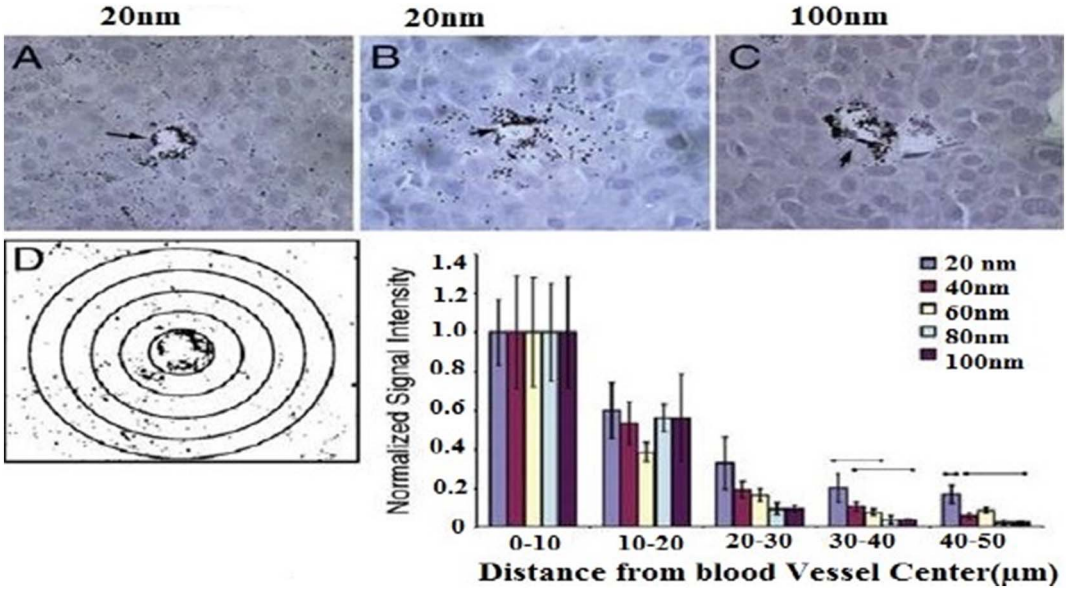

Fig. 1. The size nanoparticles dependent pervasion of the tumor interstitial space. (A–C) Historical sample were found for 20, 60, and 100 nm at eight post injection (HPI). (D) ImageJ software was used to create contrast-enhanced images for densitometry analysis. (E) Densitometry signal was enumerated at 10 μm detachment gone from blood vessel center 8HPI and was legalized to the single 0–10 μm.

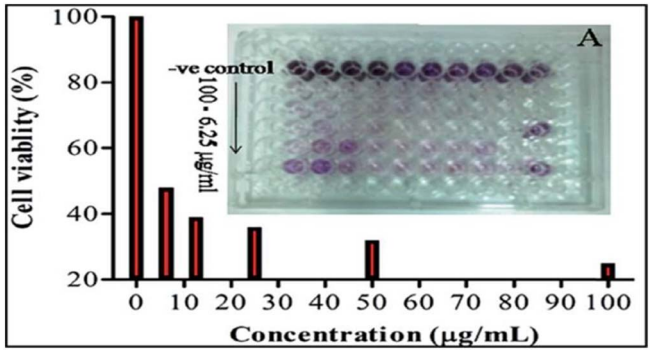

Fig. 2. Cytotoxicity of gold nanoparticles in contradiction of human breast cancer cell line MCF-7 screening % of feasible at diverse conc: after 24 h of action, where inst (A) expressions the progressive alteration in color due to the number of viable cells. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

because NPs show high reactivity and have specific surface area. The ratio of high surface area (HAS) and mass of NPs increases the adsorption capability of sorbent materials. Due to small and spherical size of nano-particles (NPs), develop exponentially for the similar density as the diameter shrinks. Furthermore, NPs agility in solution is approximately higher and the as whole liquid scanned quickly, because of small size and high surface area. Having these unique properties, NPs can be applied for degradations and scavenge of pollutant in water [7]. The organic pollutants absorbed on the surface of NPs and may remove by gravitational or magnetic force. The size, shape and morphology of NPs have significant role in natural environment [8,12]. The distributions of NPs are mainly based on size, shape and reactive sites as well as the messy surface area. Furthermore, it is confirmed from natural science and engineering that NPs like chitosan, AgNPs, photo catalytic TiO_3 and other carbon nanotube (CNT) have strong anti-microbial applications [9–17]. The NPs can be achieved by (1) crushing, and mechanically alloying techniques (2) deposition of vapors either by physical or chemical (3) sol-gel chemical synthesis procedure (GP) gas-phase synthesis techniques like, flame paralysis, electro explosion, (4) by combustion methods or determination of layered materials [16–18].

To improve the morphology and surface area of nanoparticles usually fictionalization process is applied. The functionalization method is also applied in order to avoid aggregation and eliminate interaction between nano materials and in microbial activities. Nowadays the great challenges faced by researchers are chemotherapy developing drugs delivery [18–19]. The passive and active targeting methods have been used with nano carriers such dendrimers [20–21], liposomes [22], metal nano-particles (MNPs) [23], polymer micelles and vesicles [24,25]. The Drug Delivery system (DDS) has better distributions of the therapeutics for cancer treatment. The gold nanoparticles play vital role to improve rapidly DDs efficiency [24–27]. The characteristic properties of gold nanoparticles make them a very auspicious vehicle for delivery of drugs.

To control the size of various particles up to 1–150 nm limited disparity has been established [28–31], exhausting ligand place exchange reactions [29] multi-functional mono-layers can be fabricated. Variety of structures enables nano-particles size that comprises multiple pointing agents. The diverse application of AuNPs permits them for a different DDS projects. All the hydrophobic drugs can be encumbered onto gold nano-particles (AuNPs) by non-covalent interactions, demanding no structural modification to the drug statement [32]. Covalent conjugations to the gold nanoparticles by breaking link also be used to transfer pro-drugs to the cell and released outside [33] or inside [34–35] stimulation. Regardless of the approach used, the tunability of the AuNPs mono-layer is crucial for internal or external release mechanisms.

1.1. Applications of nano-technology impacting on human health

In many fields, the toxicology of Nobel metals (NMs) is unknown, but its applications and importance is well realized. The quantity of production in nano-particles is increasing day by day from multi-tone black productions and furious silica up to microgram quantities, especially for biological properties [36]. This range comes under the dominions of nano-medicine as the applications of nano-technology for the treatment of fictional diseases, analysis, nursing and control of biological system [37]. The synthesized mono-structured nano-particles can be intended to self-assembly and produce structure for tissue engineering, efficiently imitating mineralization methods [38]. Self-assembly peptide can direct mineralization of −OH apatite (hydroxyapatite) with development of collagen fibrils which is curiosity in mineralization tissue restoration [39]. Light irradiation of Au-coated