Studying the free radical scavenging activity using low concentration of nanogold particles

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Abstract: Radiation is the emission energy or transition through space or through material medium in the form of a particle or wave. The radiation affects human body in highly complied processes. Various degrees of biological effects, from degrees to death of living tissues, involve a number of pathological change in human cells due to produce free radicals which are chemical species such as an atom, a molecule or an ion which contains unpaired electrons. In this study, gold nanoparticles (AuNPs) were synthesized by reducing agent gel and inhibition to reduce Au⁺³ ions of chlorooric acid (H₄AuCl₄·3H₂O) to nano gold. Requires reactive heating about 70°C. NPs were monitored by UV spectroscopy. The UV spectra showed 524 nm wavelength. The AuNPs, such as size, shape and stability, AFM and TEM techniques indicating a volume of 20-50 nm. Evaluation of antioxidant properties of AuNPs residues was done using DPPH assay. These nanoparticles have been found to be highly capable of antioxidants and can therefore be used as potential radical contaminants against harmful damage caused by free radicals.

1 Introduction
Radiation is the emission energy or transition through space or through material medium in the form of a particle or wave. It can be produced in one of two ways: by radioactive decay of an unstable atom, or by the interaction of a particle with matter. Light and heat from the sun are natural forms of it that are essential to man presence[1]. The radiation has different kinds one of them external radiation uses high energy rays that are delivered to the tumor by a machine. Brachytherapy or internal uses a radioactive seed or radioactive pellet which is place inside the body, in or near the tumor; the radioactive source releases energized particles that target and kill the tumor cells. Systemic radiation involves introducing radioactive chemicals into the body, usually through the mouth or blood vessels (IV injection)[2]. The radiation affects human body in highly complied processes. Various degrees of biological effects, from degrees to death of living tissues, involve a number of pathological change in human cells[3].
Free radicals are chemical species such as an atom, a molecule or an ion which contains unpaired electrons. There are many sources for free radicals in biological systems. Also there are a number of ways to generate free radicals, but their most prevalent source is the mitochondria that uses 90% of the O$_2$ in human body. Antioxidants are molecules that can donate an electron to a free radical. This causes the free radical to stabilize and become less reactive. Oxidation is a normal and necessary process that takes place in human body. Oxidative stress occurs when there’s an imbalance between free radical activity and antioxidant activity. When functioning properly free radicals can help fight off pathogens. When there are more free radicals than can be kept in balance by antioxidants, the free radicals cause damage to fatty tissue, DNA, and proteins in human body. Proteins, lipids and DNA make up a large part of the human body, so that damage can lead to a vast number of diseases over time [4]. Nanotechnology is the study of extremely small structures, having size of 0.1 to 100 nm [5]. Nanotechnology is one of the fastest developing sciences over. Nanotechnology is interdisciplinary science that connects knowledge of biology, physics, chemistry, engineering, material science, medicine and pharmacology. The products of nanoparticles, nanotechnology have a size in nm scale and have very high bioactivity thanks to their small size [6]. Nanotechnology used nanoparticles such as metals, semiconductors and metal Oxides are of great interest for a wide of variety of applications in the field of information, energy, environmental and medical technologies [7]. Recent advances in nanotechnology are as a result of the development of engineered nanoparticles. Efficiently, metallic nanoparticles have been widely exploited for biomedical application and among them, gold nanoparticles (AuNPs) are highly remarkable. Consequently upon their significant nature, spherical and gold nanorods (Au NRs) nanoparticles attract extreme attention. Their intrinsic features such as optical, electronic, physicochemical and, surface plasmon resonance (SPR); which can be altered by changing the characteristics of particles such as shape, size, aspect ratio, or environment; ease of synthesis and functionalization properties have resulted to various applications in different fields of biomedicine such as sensing, targeted drug delivery, imaging, photothermal and photodynamic therapy [8]. There are many researches that have been studied the scavenging of free radicals and antioxidant activity of metals such as silver nanoparticles [9] cerium oxide nanoparticles [10] gold nanoparticles are the most important metal that may utilize as free radical scavengers due to its inert properties and more compatible.

The aim of the present work is decontamination of absorbed radiation in the biological tissue and protect and minimize the radiation hazard due to the formation of free radicals which is responsible of tissue cancer and its adverse effects in the human body using the gold nanoparticles.

2 Experimental Method
Research chemicals were provided by HIMEDIA-India and MERCK Company Germany. DPPH was purchased from Sigma Aldrich by United Tetra Group for medical and scientific equipment / Jordan. The water samples were irradiated by gamma ray emitted from $^{137}$Cs radionuclide with 5mCi activity. The colloidal gold particles with (26.85, 53.5, 67.15, 79.65, 107.4 and 121.33 μg/ml) concentrations are determined by the atomic absorption method. (Philips CM 100, Netherlands), and the potential Zeta analyst (Brock Haven), the United States of America (SPM AA 3000), USA) used to characterize AuNPs.

2.1 Preparation of nanogold particles
Two g of reduced factor gel was dissolved in 200 ml of distilled water and the solution was heated to 70°C. This mixture was added to 2.9 ml of 10 mM, HAuCl4.3H2O with continuous decrease with continuous stirring. After 20 minutes, the color of the solution was changed from pale yellow to dark red, indicating the formation of AuNPs [11]. The ability to remove free radicals of gold nanoparticles was assessed using DPPH method as described above. DPPH (2, 2-diethyl-1-Bicyl hydrazyl) is a free stable root and has been used as a free radical compound model to evaluate the effectiveness of
antioxidants. Ethanol solution was prepared from DPPH (0.1 mm) and incubated at room temperature. To prevent the formation of free radicals, AuNPs are added to the water samples after the irradiation process. Different concentrations (0.04, 0.08, 0.12, 0.16, 0.20 g/L) were added from AuNPs in a same volume, to ethylene DPPH solution and water sample. The mixture was vigorously shaken and allowed to stand for a half hour in dark place and the absorption of all samples was monitored at about 520 nm. DPPH solution without nanoparticles acts as a control. The percentage of DPPH inhibition is calculated according to the formula: \[ \text{Inhibition} \% = \frac{A-C}{A} \times 100 \] where A is the absorption of irradiated water with the DPPH samples as a control, and the C is absorption of samples at a different concentration of nanoparticles.

3 Results and Discussion

Table 1 represents the DPPH absorption before and after irradiated with gamma ray. DPPH absorption around 225 nm of all water samples with different concentration of gold nanoparticles add after irradiation are shown in Figure 1.

Table 1: Values of DPPH radical absorption and free radical inhibition% of different gold nanoparticles concentration.

| Gold nanoparticles concentration (g/L) | DPPH Absorption | Inhibition% |
|----------------------------------------|-----------------|------------|
| Irradiate water with different gold nanoparticles concentration | 1.312 | 60.21 |
| 0.04                                   | 0.522           | 61.35      |
| 0.08                                   | 0.507           | 63.49      |
| 0.12                                   | 0.479           | 63.10      |
| 0.16                                   | 0.484           | 62.27      |
| 0.20                                   | 0.495           |            |

Figure 1 shows the DPPH absorption around 225 nm for all samples with different gold nanoparticles concentration. The results reveal the existence of effective radical scavenging activity of gold nanoparticles (Fig 2). The highest radical scavenging activity is 11.13% was observed in 0.12g/L gold nanoparticles concentration.

From this figure we can observe that the peak position appearing in the figure is creeping towards high wavelengths as well as increasing its width when increasing the concentration of nanoparticles. This means an increase in the effectiveness of free radical lysis when the concentration of nanoparticles increases.
4 Conclusions
The finding obtained from this study showed that the free radicals scan function (percentage of inhibition) as measured by the DPPH method increases with increase of concentration of nanoparticles made of gold. Thus the manufactured AuNPs can play the role of new antioxidants. Protection of free radicals in a wide range of conditions. So the antioxidant behavior in AuNPs makes them useful in treating many diseases caused by oxidative stress.

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