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SAFETY EVALUATION OF CERIUM OXIDE NANOPARTICLES

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Abstract

The field of Nanotechnology is the branch of science concerned with particles ranging from one to a hundred nanometers. This Nanomedicine of Nanoparticles is used in a wide variety of biomedical, and environmental sectors. The outcome of this study, however, are on the biomedical applications UV-Protection of biosynthesized nanoceria, chitosan-based hydrogel membranes, Wound- Healing activity significant improvement in wound-healing progression was observed when cerium oxide nanoparticles were incorporated into the chitosan hydrogel membrane as a wound dressing, and also our prime focus was on the influence of different factors. Different bacterial strains were selected as experimental biological models of the antibacterial activity of the manganese-doped cerium oxide nanocomposite. Nanocomposite sensitivity profiling.

Keywords: Cerium oxide nanoparticles; Wound-Healing, UV- Protection and Sensitivity Profiling.

1. Introduction

Nanobiotechnology is one of the most advanced and emerging research field of science and technology, it consists of metals and metal oxides at the very small nano range. Over the Last decade, the research field of nanotechnology has increased distinctly due to rapid innovation of new ideas and commercialization [1]. In addition, nanotechnology as a wide range of many applications and especially, the biomedical research field. As a previous report, engineered nanoparticles (NPs) are used broadly in a wide range of industrial and commercial applications.

Open in several styles of nanoparticles are carbon nanotubes (multi-walled and single-walled), fullerenes, metals (Au, Ag, and so on), metal oxides (ZnO_2), metallic element chemical compound (CeO_2), titania (TiO_2), liposome-bound, dendrimer-bound, egg whites sure, polymer, quantum specks and enticing nanoparticles [2-4]. The metallic element of lanthanides is a very rare earth metal and the atomic number is 58. It is the foremost common grouping metal found in two states of oxidation, i.e., + 3 and + 4 [5].

The Cerium chemical compound lattice includes a cubical fluorspar composition at the nanoscale, and each Ce^{3+} and Ce^{4+} can be on the surface. Charge deficiency was compensated for by oxygen vacancy in the lattice due to the presence of Ce^{3+}; thus, Ce oxide contains intrinsic oxygen defects at the nanoscale. Currently, these oxygen defects are 'hot spots' of catalytic response. With a decrease in particle size, the concentration of oxygen defects increases. A metallic element chemical compound is believed to be a metal oxide of lanthanide and is used as an ultraviolet absorbent, a catalyst, a sharpening agent, gas sensors, etc [6-7]. In addition, cerium compounds are synthesized by using extraction processes, especially nanoceria from plant extract, Seed extract, and also leaf extract. The Compound of Cerium oxide Nanoparticles is synthesized by many methods like Traditional Methods, Chemical Methods, and green Synthesis methods. Free radicals are formed in very minute quantities during normal metabolism and carry an electron in the outermost shell. They are formed within a cell and include superoxide (O^{2+}), hydrogen radicals, lipid hydroperoxides, etc. [8]. As a by-product, normal oxygen metabolism produces reactive oxygen species (ROS) and plays a major role in inflammation that affects normal cell function and further contributes to pathogenicity through the degradation of cell membranes, proteins, and DNA, inducing apoptosis [9,10].

However, in this review of studies, we have a tendency to focus on the synthesis of cerium oxide nanoparticles from totally different medicative plants by utilizing various strategies and procedures (i.e) Methods and furthermore, they are useful for many applications and biological regions. They include UV- Protection of biosynthesized nanoceria, chitosan-based hydrogel membranes, Wound- Healing activity with the animal trail, and also Nanocomposite sensitivity profiling.

2.Properties of Cerium Oxide Nanoparticles:

2.1 UV- Protection of Cerium Oxide Nanoparticles

Synthesized CeO_2 NPs (1 g) was poured in 100 mL ethanol, sonicator for 15 minutes. Then, 5 mL of the solution was volumed to 50 mL volumetric flask with ethanol. Finally, absorption values were measured using spectrophotometer ranged from 290 to 320 nm. All

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experiments were repeated three times. UV protection factor (UPF) of treated polyester samples was determined by measuring changes in the color of the dyed wool fabrics with highly UV-sensitive dye (Methylene Blue (0.05 %W/V)). Thus, the dyed wool fabrics were covered with the treated or untreated polyester fabrics and were then subjected to UV radiation. An Osram ultraviolet lamp HTC 400 was employed for UV irradiation and the samples were located 1 m beneath for 4 h. The color changes between the control and covered wool fabrics with the untreated or treated polyester fabrics were evaluated After UV irradiation according to Eq. (1) (ΔEC and ΔET). Finally, the UV protection enhancement was calculated based on Eq. (6).

$$\text{UV protect enh } (\%) = ((\Delta EC - \Delta ET)/\Delta EC) \times 100 \quad (6)$$

The control and treated fabrics were tested by Instron (USA) with gauge length of 10 cm and extension rate of 100 mm min^{-1} in warp direction and straight position to measure mechanical properties of the samples for tree replicates and the average was reported. Also, the bending length of the treated polyester fabric was measured in the warp direction using a Shirley fabric stiffness tester.

UV- Protection effect of treated polyester samples was evaluated by measuring the variations in the color of the methylene blue dyed wool fabric based on ΔE for untreated and treated covered wool after and before UV irradiation. The treated sample (sample 1) indicates a very good UV blocking property (64.24 %) compared with the untreated sample.The electronic structure of metal oxide semiconductors plays main role in the mechanism of UV protection of treated sample. The metal oxide nanoparticles with band gap energy (Eg) located at UV range of the solar spectra have very good potential for absorption of UV ray through the high surface area to volume ratio. They can absorb equal or higher energy (hv) than Eg under UV irradiation. Hence the substrates coated with UV absorber semiconductor can be exhibited an enhancement in the absorption of UV [11-13].

2.2 Chitosan Hydrogel–CeO_2 Composite Membranes Preparation

The chitosan-based hydrogel membranes were prepared by the freeze–gelation process. For this, a 2% solution of chitosan (CS) was prepared into the 1% acetic acid (25 mL). The green synthesized CeO_2 nanoparticles (1% w.r.t chitosan) were suspended in deionized water via sonication for 5 min; then, the prepared suspension of CeO_2 NPs was added to the CS solution, and the mixture solution was kept under continuous stirring for 2 h. Then, the glycerol (3 mL) was added up as a crosslinking material for CS, and the solution was kept in an oven at 80 °C for 4 h [14-16]. The same process was followed for the preparation of chitosan and 5% CeO_2 NPs hydrogel membrane as dressings for wound treatment.

2.3 Wound-Healing Activity

2.3.1 Swelling Percent of Chitosan Hydrogel–CeO_2 Membranes

The healing procedure was assessed by observing regular changes in the color of the wound. The photographs of the representative rat wounds from each group were acquired to evaluate the healing potential of the cerium oxide nanoparticles at different concentrations. After 4 days of healing, Demonstration of the swelling percent of the chitosan-based hydrogel membranes. 3.8.2. The fine changes in wound extent during the wound-healing development for different samples of green synthesized CeO_2. The healing procedure was assessed by observing regular changes in the color of the wound [17-19]. The photographs of the representative rat wounds from each group were acquired to evaluate the healing potential of the cerium oxide nanoparticles at different concentrations. After 4 days of healing, fresh skin was grown (after it was treated with 1% and 5% cerium oxide nanoparticles); it had fewer scabs and was smoother than the control group; these observations represent the initiation of the wound-healing process. On day 7, a brown dark color was observed for the cerium oxide nanoparticles-treated groups. These observations confirm the initiation of wound-healing progress by producing collagen. On day 11, the 1% and 5% cerium oxide nanoparticles-treated group showed that the wounds were significantly reduced in size

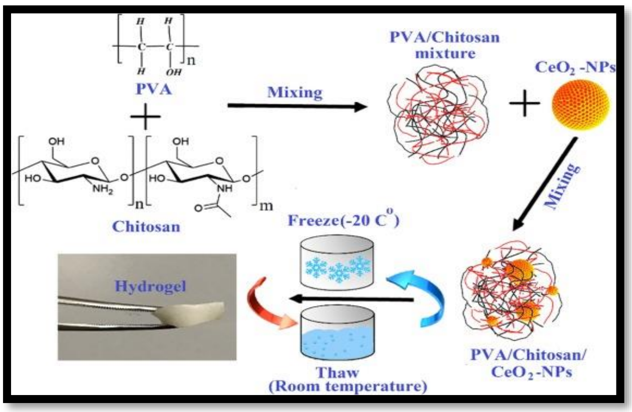

Fig 1: Chitosan Hydrogel–CeO_2 Composite Membranes Preparation

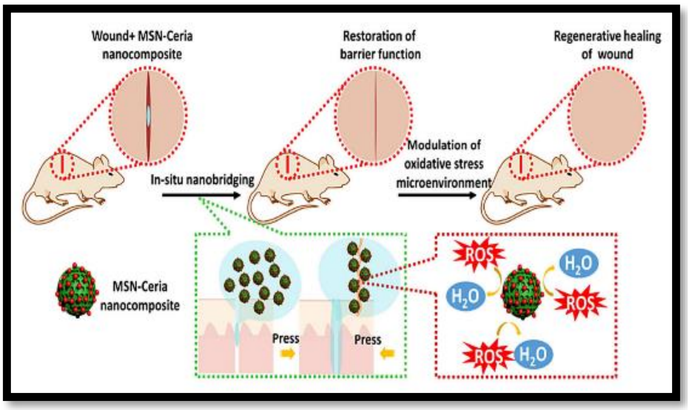

Fig 2: Wound-Healing Activity

compared to the control group. Regarding the scab formation of the control group, an increase in the concentration of cerium oxide nanoparticles significantly affected the wound size [20-21]. The wound closure comparison of the incision. which represents the effect of the concentration of cerium oxide nanoparticles on the diameter of the wound compared with the control sample [Fig 2]. On day 15, the wound site differed from the treated group in which the maximum contraction of the wounds was achieved by increasing the concentration of the cerium nanoparticles as compared to the control group, which showed a visibly larger wound size.

2.4 Nanocomposite Sensitivity Profiling

The nanocomposite susceptibility patterns of the bacterium were determined by disc diffusion on Mueller–Hinton agar (MHA) plates. Discs diffusion plates containing different concentrations of nanocomposites were placed on the surface of the bacterium-inoculated plates. It can also be inferred were measured in millimeters after the plates were incubated for one day at room temperature. Colonies of pathogens were cultured in Luria–Bertani (LB) agar is a widely used rich medium is popular because it permits the fast growth of many species (Fig 3).

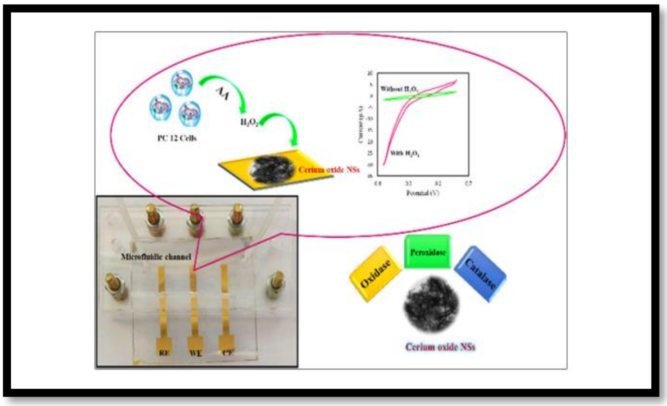

Fig 3: Nanocomposite Sensitivity Profiling

3 Conclusions

In summary, Despite the experimental review paperwork focused on simple, green synthesis of CeO_2 NPs from different plant medicine. The synthesis of Cerium oxide nanoparticles has enormous activity and is therefore widely used both in the biomedical sector and in the agriculture and environmental sectors. The impact of nanoceria is a significant worry among scientists on human well-being. We have talked about the general cycles and an ongoing blend of nanoceria through compound and green techniques. In this review article on UV Protection, Chitosan Hydrogel–CeO_2 Composite Membranes Preparation, Wound Healing Activity, and also sensitivity profiling proficient blend of ceria nanoparticles in activity and green parts of maintaining a strategic distance from poisonous impetus.

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Conflict of Interest: Nil

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