Ecological synthesis and properties of manganese nanoparticles using UV-Vis and FTIR

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Summary

Green synthesis of metal nanoparticles is an interesting and growing field of research because of its applicability to the development of new technological ecology. Nanoparticles are usually obtained by various chemical and physical methods that cause most environmentally friendly waste. This study describes a simple, easy, and inexpensive process for the synthesis of manganese nanoparticles by reducing manganese acetate using available natural extracts, namely lemon extract as a reducing agent and curcumin curcumin as a stabilizer. Curcumin was isolated from turmeric using a solvent extraction process and used to stabilize manganese nanoparticles. The characterization of curcumin and manganese nanoparticles was carried out using UV-visible and Fourier-IR spectroscopy.

Introduction

Coordination bonds are found in plants and animals. Chlorophyll is an important part of plant life and the coordination compounds of Mg (II). Blood color is due to the coordination compound Fe (II), hemoglobin. Most other trace elements in the human body act in the form of coordination bonds. [1] Due to the various redox states, the unique properties of metal ions, such as electron reduction / transport and multivalent coordination structures, can make metal ions and their complexes potentially applicable to drugs. Organic compounds (the latter are widely used for drug discovery) [2].The use of metal complexes as therapeutic agents dates back to 3500 BC. Tracking bc [3]. Most modern strategies are usually based on the physical or chemical principles of the synthesis of metal nanoparticles. However, both production processes are not environmentally friendly due to many disadvantages, such as the presence of toxic organic solvents, the production of hazardous by-products and intermediates, and high energy consumption [4].

Synthesis of Manganese Nanoxide Materials

Synthesis of nanomaterials MnO2. It is known that MnO2 can exist in different structural forms: α, β, γ, δ, ε, etc. When the basic structural unit (the [MnO6] octahedron) is differently associated with different bonds [MnO6], MnO2 can be divided into three categories: type, tunnel β and type of tunnel chain structure, type of sheet structure or layer. There is. 3D structure of λ-MnO2 and [[5] types. The properties of MnO2 are greatly influenced by the stage and morphology. In addition, the performance of lithium-ion batteries depends on the stage of MnO2. In this case, many attempts were made to obtain MnO2 having a different phase and shape [6].In general, MnO2 nanostructures can be synthesized by oxidation of Mn2, reduction of MnO4, a redox reaction between Mn2 and MnO4, or other direct phase conversion of manganese oxide. Other special forms, such as nanowall [7] and nanoplate [8], produced nanoblocks such as hedgehog [9], multipod [10] and nanoplate [11].

Materials and Methods

All chemicals and solvents used are analytical reagents and are supplied by Merck (India) Ltd. All samples were prepared using fresh double distilled water. Curcumin was isolated from turmeric (BSR-01), purchased locally.

Collection of extracts

A collection of lemon extract has been collected from local markets. They are washed twice with distilled water, cut into pieces and squeezed well until a pure extract is obtained. The lemon extract is filtered using Whatman ~ 1 filter paper, and the filtrate is collected in a clean, dry container and stored for future use.Curcumin (CR) was extracted from turmeric by using soxhlet solvent extraction method in 95% ethanol medium. BSR01 turmeric variety was used in this method for better curcumin yield which was investigated in our previous research work [12] The final curcumin extract absorbance was measured at 425 nm against alcohol blank and the curcumin content was estimated as per[13]. The above ethanol residual extract was evaporated and dried then stored for further uses.

Synthesis of Manganese Nanoparticles (MnNP). For the synthesis of MnNP, a dilute solution of manganese acetate (1 mM) is prepared. During the reaction, twice distilled water is used. PH and temperature are maintained to some extent for best results. A freshly prepared solution of manganese (10 ml) with pure lemon extract (10 ml) stored in a beaker is added to reduce manganese ions, and the mixture is constantly mixed to properly restore metal ions. The reaction mixture is stored at a temperature of 50 to 600 ° C. for 1 hour in a thermomagnetic stirrer for 1 hour to change color from light green to light yellow, which means a decrease in metal ions.Then, freshly prepared curcumin extract (1 mM) with the above mixture from a solution of a nanoparticle stabilizer is added and stirred continuously for about 1 hour. The color of the solution gradually changes from yellow to tan, and finally, a constant reddish-brown color is obtained. This indicates complete stabilization of MnNP. The main factor is that during the experiment, the pH is maintained at 3-4, and the temperature is 50-600 ° C. The solution is centrifuged by washing several times to obtain pure MnNP. The supernatant is decanted and dried in a dryer. [14]

Characterization

A typical UV-visible absorption spectrum of a sample was measured using a Shimadzu UV-Vis V-530A spectrophotometer in the range of 425 nm. FT-IR spectrum analysis and a Jasco FT-IR / 4100 spectrophotometer investigated nanoparticles with a resolution of 4 cm? 1 1 from 4000 to 400 cm was recorded. Microscopic scanning electronic images (SEM) were obtained using a scanning electron microscope model JEOL JSM-6390LV. Morphological changes are detected by high resolution electron microscopy (HRTEM) using a 300 kV JEOL-3011 ultra-high resolution polar instrument.

The synthesized MnNP is known for color solutions that change color from light green to light yellow due to a decrease in ionic metals and from yellow to reddish brown due to the blocking of stabilizers. Color changes can be easily seen with the naked eye. This clearly shows the formation of well reduced and stabilized MnNP.

UV-Vis spectra studies

One of the simplest methods for characterizing nanoparticles is UV-Vis spectroscopy. Synthesized curcumin curcumin (CR) was confirmed by a strong broad absorption peak at about 425 nm. This may be due to a combination of n → π * transitions or π → π * and n → π * transitions (see Figure 1). UV-visible MnNP spectroscopy (Fig. 2) shows the maximum absorption at critical wavelengths. The maximum absorption of Mn nanoparticles, which is 360 nm. The appearance of absorption edges at 360 nm is a clear indicator of the formation of Mn nanoparticles.

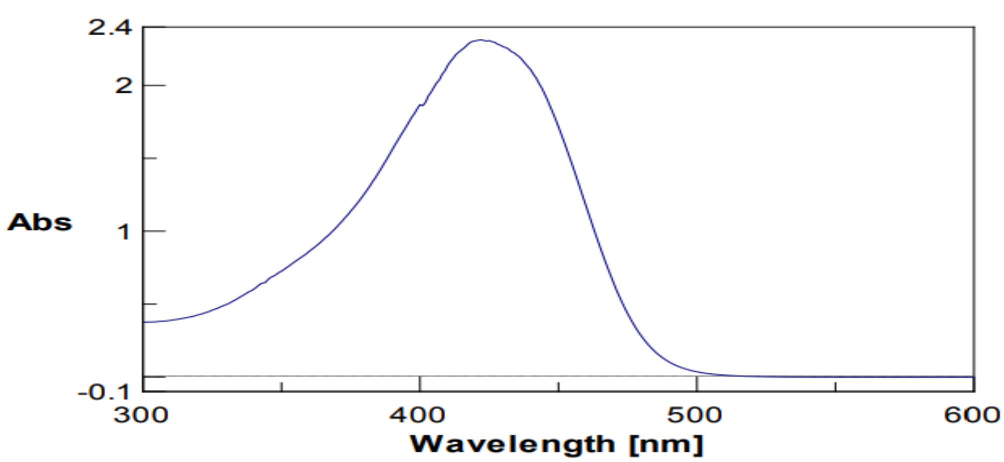

Fig. 1: UV-Vis spectra of curcumin.

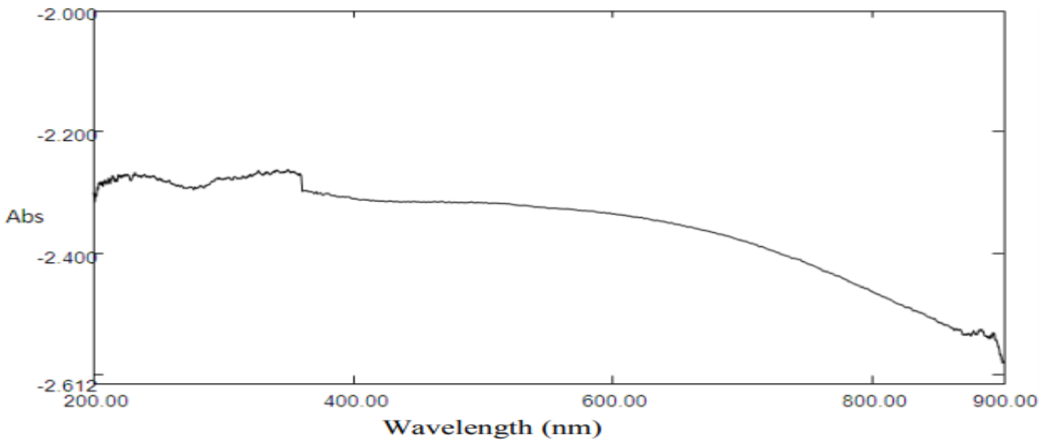

Fig. 2: UV-Vis spectra of Mn nanoparticles.

FT-IR spectra studies

Fourier infrared (FT-IR) spectroscopy is becoming increasingly sensitive, especially from the point of view of detecting inorganic and low organic species. The IR Fourier spectrum of curcumin and manganese stabilized nanoparticles is shown in Figure 3. Spectra were recorded in the range from 4000 to 500 cm1. The FT-IR spectrum shows a characteristic peak. Data obtained at 3650 cm? 1 peaks due to lengthening of —OH of water or ethanol present in the system. Broadband is weak in the 2935 cm range. 1 was assigned to the Ph-OH group in the curcumin section. C = 1625 cm? curcumin deformation; ¹ reaches a higher wave number at 1704 cm due to interaction with manganese nanoparticles; ¹ 3 characteristic peaks and a supervisor were detained in the range from 1574 to 1515 cm; ¹ Check the aromatic unsaturation (C = C) of the stabilized curcumin system.

The absorption peak at 1393 cm-1 symbolized the bending band of adsorbed water of Mn nanoparticles. The (C-O) band presence which belongs to curcumin was assigned by the peaks found at 1026 cm-1 and 1160 cm-1 . The two significant absorption peaks observed at 901 cm-1 and 730 cm-1 are corresponded to characteristic stretching bonds O-Mn-O which demonstrated the presence of the MnO_2 nanoparticles in the sample.

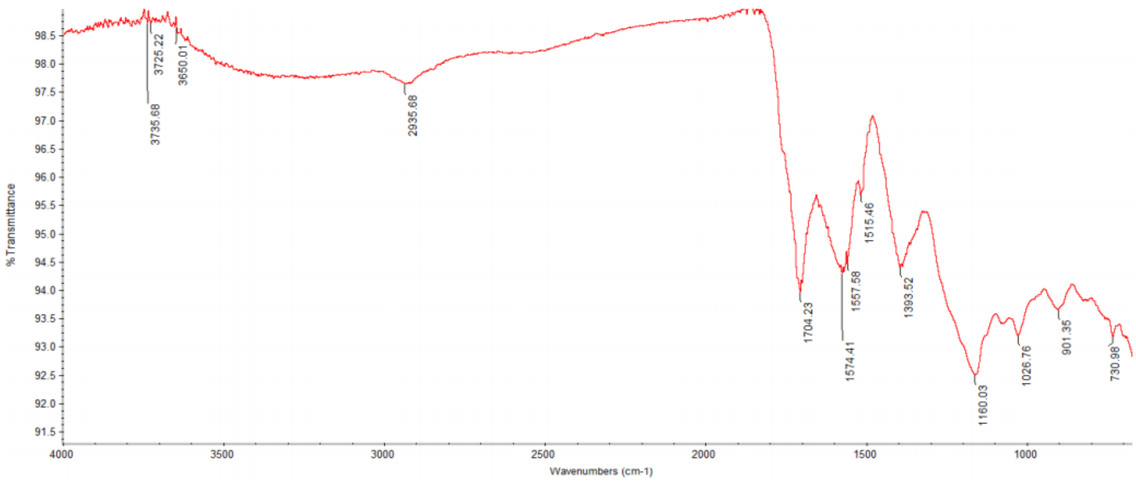

Fig. 3: FT-IR spectrum of Mn nanoparticles.

Results And Discussion

The synthesized results and discussions of MnNP are known for color solutions that change color from light green to light yellow due to a decrease in metal ions and from yellow to reddish brown due to the limitation of the stabilizer. Color changes can be easily seen with the naked eye. This clearly shows the formation of well reduced and stabilized MnNP. Manganese oxide nanoparticles have been successfully obtained from manganese salts from two different anions. The resulting manganese oxide nanoparticles have high crystalline properties with a tetragonal structure. The average size of manganese oxide nanoparticles varies from 25 to 60 nm. The inventors have found that the size of the nanoparticles can be controlled by changing the metal precursor. The IR Fourier spectrum confirms the presence of manganese oxide.

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