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Research Article

STRUCTURAL AND SPECTRAL STUDY OF BIOSYNTHESIZED MANGANESE OXIDE NANO PARTICLES USING *OCIMUM SANCTUM* (TULSI) LEAF EXTRACT

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ABSTRACT

Various applications of nano particles stimulate the need for synthesizing them. Since chemical and Physical approaches for the production of NPs are often costly and harmful to the environment, biosynthesis method is chosen due to its simplicity, fastness, chemical free nature, nontoxicity and economical approach. Mn oxide NPs potentially hold great promise for sustainable nano particle. In this study, a simple efficient and ecofriendly procedure for the green synthesis of manganese oxide nano particle by *Ocimum Sanctum* (Tulsi) leaf extract is described. The biosynthesized nano particles were characterized by X-ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) which revealed the formation of Manganese oxide nano particles. The size is about 40-45 nm. From EDAX analysis the presence of Mn and O is confirmed. The polymorphic morphology of manganese oxide nano particles were suggested by SEM technique.

Keywords: Ocimum Sanctum, Mn oxide nano particles, XRD, FTIR, SEM, EDAX

1. INTRODUCTION

Nanoscience is the study of phenomena and manipulation of material at the nanoscale, in essence an extension of existing sciences into the nanoscale. Nanoparticle synthesis is one of the most prominent and highlighted spheres in current research worldwide. The menace of growing contamination cause a great request for green chemistry and biological process for preparation, recycling and degradation of chemical materials. Diverse arrays of protocols have been developed for nanoparticle synthesis that include precipitation, room temperature solid reactions [1], solvent evaporation and solvent diffusion and hydrothermal methods [2].

Green synthesis of metal nanoparticle is an expanding research area due to the potential applications for the eco friendly development of novel technique. Green synthesis mainly concerns with the elimination of hazardous wastes and the utilization of sustainable process, implementation of environmental friendly chemicals, solvents and renewable materials [3]. Biosynthesis techniques involving plant extract have been gained increased consideration as a simple, efficient cost effective and feasible method as well as an excellent alternative means to conventional preparation methods for nanoparticle reduction.

Metal nanoparticles due to their excellent surface area to volume ratio, surface energy, spatial confinement and reduced imperfections have characteristics of physicochemical electrical, mechanical, thermal, optical and biological properties compared with other methods. Plant extracts used reduction methods can be considered as a more effective green approach for synthesizing metal nanoparticle, because the presence of broad viability of bio-molecules in plants can act as capping and reducing agents [4].

Manganese oxide nanoparticles of size less than 100 nm have received increasing interest due to their extensive application in several field such as catalysis, rechargeable batteries, chemical sensing devices, anti bacterial activity, magnetic materials, micro electronics and opto electronics. Many structural forms have been obtained for manganese oxide nano particles. The green synthesis of manganese oxide nanoparticles has been reported from *Syzgium aromaticum* (clove extract) CE to be applied as a stabilizing as well as reducing agent and the resulting nanoparticle was applied towards p-nitrophenol sensing [5].

In another synthesis manganese dioxide nanoparticles have been produced from *Kalopanax pictus* leaf (Casto

aralia) extract and applied towards the methodology of degradation of dyes [6].

A methodology has been reported for biosynthesis of manganese oxide nanoparticles by using lemon extracts and turmeric curcumin extract as reducing and capping agent respectively and analyzed for their antibacterial and antifungal activities [7].

Nanoparticles consisting of a large range of transition metals and metal oxides have found to exhibit advantageous size dependent catalytic properties and are being investigated intensively. There are many reports of green synthesis of manganese oxide nanoparticles using plant extract as reduction and stabilization of metal oxide. The methods are eco friendly, simple and cheapest method in green chemistry. In this present study, an approach towards manganese oxide nano particles synthesis has been formulated by using Tulsi extract. *Ocimum sanctum* (Tulsi) is a member of family Lamiaceae. Tulsi means "Matchless one". Also known as "Queen of Herbs" [8]. The leave contain a high content of essential oils which contain Toluene, Camphene, Octane Benzene, Citronellel, Dimethyl benzene, Iso-eugenol etc. [9]. The resulting manganese oxide NPs were characterized by X-ray diffraction study (XRD), FT-IR analysis technique, Energy Dispersive X-Ray (EDAX) and Scanning electron Microscope (SEM) study.

2. MATERIAL AND METHODS

2.1. Collection of extract

Ocimum Sanctum (Tulsi) leaves were collected from the local market. The leaves were cleaned in double distilled water to remove dust and other contaminants .Then they were dried at room temperature (35°C) and the leaves were chopped and grinded to make pure extract. Then the extract was filtered using Whatman's No. 1 filter paper. The filtrate was collected in a clean dried container and it was stored for further uses.

2.2. Synthesis of manganese oxide nano particles

The aqueous solution of 0.2 mM of Potassium permanganate (15 ml) was mixed with 15 ml of leaf extract in a beaker and the mixture was stirred for the reduction of metal ions. The reaction mixture was kept in the magnetic hot stirrer for four hours to occur colour change from purple to brown which indicate the reduction of manganese oxide nano particles. The present precipitate is placed in hot air oven at 80°C for 8 hours and they were calcined at 400°C for 30 mins for removing impurities. The bulk particles were crushed by using mortar to get nano powder.

3. RESULTS AND DISCUSSION

The bio synthesized Manganese oxide Nps were characterized by XRD study to calculate crystalline size of the nano particle. The functional groups present in the sample were analyzed by FT-IR Studies. The morphology was studied by SEM studies. The presence of Mn and O in the sample was confirmed by EDAX study.

3.1. XRD Studies

The crystalline phase and particle size of manganese nano particles were analyzed by X-Ray diffraction (XRD) measurement which was carried out at room temperature (25°C) by using the X'PERT-PRO diffract meter system (scan step of 0.001 (2 Θ), counting time of (3.1750 s per data point) equipped with a cu take for generating cu ka radiation (k=1.5406 Å); as an incident beam in the 2Θ mode over the range of 10°-80°, generator settings 30mA, 40Kv. The XRD patterns recorded for the manganese specimen. The peak at 2Θ =24.2006 with corresponding to the hkl values (011) respectively, it resembles the presence of tetragonal structure of MnO_2 nano-particles with the lattice parameter a=b≠c. The obtained values were well coincidence with the (JCPDS File No: 24-0735) All the diffraction lines observed have been found to be in good agreement with standard lines as given in the above file. Thus, the comparison confirms the presence of MnO_2 phases in the present specimens with tetragonal crystal structures.

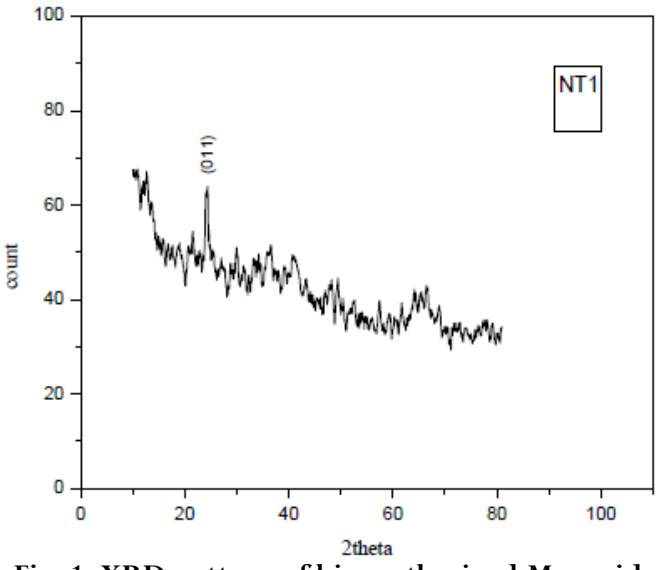

Fig. 1: XRD pattern of biosynthesized Mn oxide nanoparticles

3.2. FT-IR spectra studies

FTIR studies are important in the investigation of molecular structure of nano particles. This study involves the stretching, bending, twisting and vibrational modes of atoms in a molecule and hence to identify the functional groups of the samples. The broad band appeared around 3649.07cm^{-1} indicates the stretching vibrations of hydrogen-bonded surface water molecules and hydroxyl groups. Additionally, the band at 1654 and 1461cm^{-1} correspond to the existence of large numbers of residual hydroxyl groups, which imply the O-H vibrating mode of traces of absorbed water. The band located at 518.24cm^{-1} can be ascribed to the Mn-O vibrations of MnO_2 nano particles.

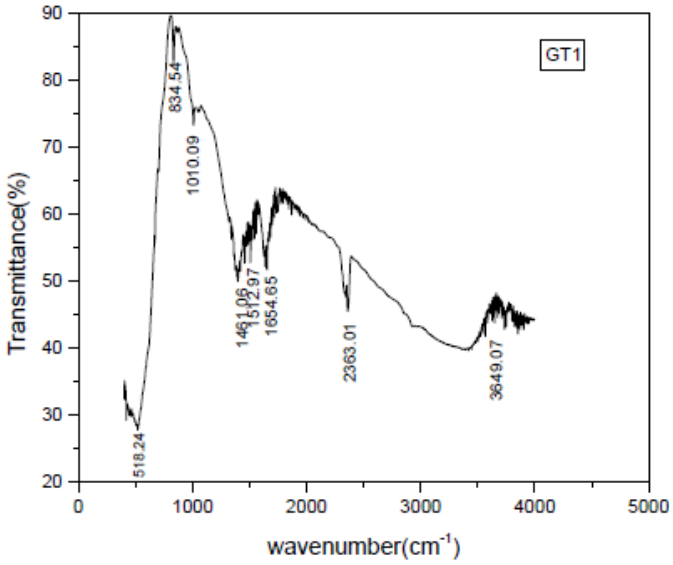

Fig.2: FT-IR Spectrum of Mn Oxide nanoparticles

3.3. SEM Studies

The SEM study is used to analyse the morphology of synthesized manganese nano particles. The SEM image of Mn NPs is shown in the figure which shows the agglomeration occurred during the synthesis process. It is clear that most of the particles are polymorphic morphology of material.

The EDAX analysis showed the presence of Mn and O in the sample. The chemical composition analysis using EDAX confirmed the presence of Mn and O in the nanoparticle sample (Table 1). The results are similar to the earlier studies of other researchers [10].

Table 1: EDAX of sample containing Mn oxide NPs

Element	Weight %	Atomic %
C, K	29.45	46.36
O, K	33.30	39.35
Mn, K	26.66	9.17

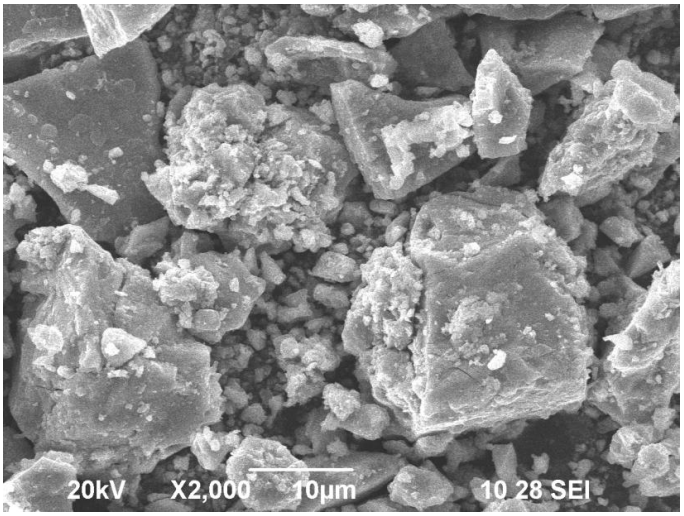

Fig. 3: SEM image of Mn oxide nanoparticles

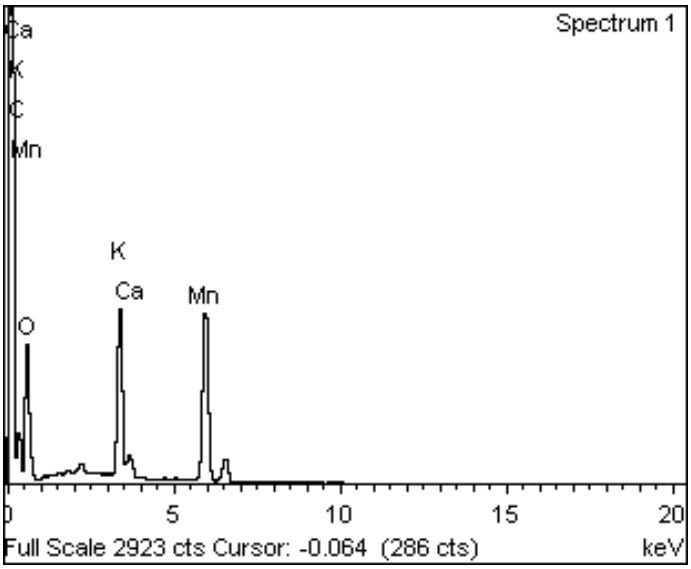

Fig 4: EDAX of Sample containing Mn Oxide nano particles

4. CONCLUSION

Manganese oxide nanoparticles were synthesized successfully using *Ocimum Scantum* (Tulsi) leaf extract as reducing agent. Potassium Permanganate ($KMNO_4$) was used as the precursor. The synthesized Mn oxide NPs were characterized by Scanning Electron Microscopy (SEM) which revealed the poly morphic morphology of the particles. EDAX Study confirms the presence of Mn and O in the sample. The crystalline size of the particle is calculated as 40-45 nm using X-Ray Diffraction study. The FT-IR study confirms the presence of functional groups and the peak at 518.24 cm^{-1} clears the presence of metal oxide (Mn Oxide) in the sample. The Bio

synthesized manganese oxide NPs is an apt replacement for chemically synthesized Mn Oxide NPs.The synthesis process is eco friendly and low cost. Mn oxide nano particles can be employed in magnetic storage device, water treatment, and dye degradation.

5. REFERENCES

1. Yan D, Yan P, Cheng S, Chen JT, Zhuo RF, Freng JJ, Zhang GA. *Cryst Growth Des*, 2009; **9:**218-222.
2. Yuan A, Wang X, Wang Y, Hu. *Electrochim Acta*, 2009; **54:**1021-1026.
3. Anastas PT, Warner JC. *Green chemistry; Oxford University Press*, New York, 1998; 30.
4. Duran N, Marcato PD, Alves Ol, De Souza Gl. *Journal of Nanobiotechnology*, 2005; **3:**1-17.
5. Vineet K, Kulvinder S, Shaily P, Surinder KM. *Int Nano Lett.*, 2007; **7:**123-131.
6. Sun AM, Bipinchandra KS, Bassam A, Ezhaveni S, Beom SK. *IET Nanobiotechnol*, 2015; **9:**220-225.
7. Muhamed Haneefa M, Jayandran M, Anand B, Balasubramanian V, Muthumariappan S. *International Journal of Natural Products Research*, 2015; **4:**882-887.
8. Maharajan R, Khinda PK, Gill As, Karur J. *Eur J Med Plants,* 2016; 13:1.
9. Singh N, Verma P, Pandey BR, Bhalla M. *Int J Pharamaceut Sci Drug Res,* 2012; **4:**97-104.
10. Shayantani Chatterjee, Anita J, Adrija Subramanian, Sangeetha Subramanian. *International Journal of Pollution Control*, 2017; **33(2):**1627-1632.