

Green Synthesis of Manganese Oxide Nanoparticles and Characterization USING UV- Vis and FTIR Spectroscopy

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Abstract

Green methods of synthesis of nanoparticles have various advantages over chemical methods. Manganese oxide nanomaterials are biosynthesized from manganese (II) chloride using medicinal plant extracts *Acalypha indica*, *Cassia occidentalis*, *Cleome viscosa*, *Euphorbia hirta* and *Ecbolium ligustrinum* as reducing agents. The resulting nanoparticles are characterized using UV- Vis and FTIR. The UV- Vis absorbance peak from 265 – 269 nm indicates the formation of Manganese oxide nanoparticles. The FTIR results of all the samples confirm the formation of manganese oxide nanoparticles.

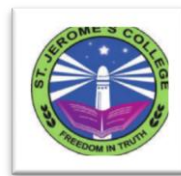
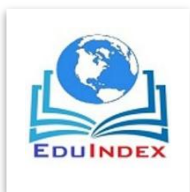
Key Words: Manganese oxide, green methods, reducing agents, *Ecbolium ligustrinum*, *Cassia occidentalis*.

INTRODUCTION

Medicinal plant extracts play very important role in our daily life [1] The increase in environmental pollution motivates us to think of an alternative way of synthesizing nanoparticles that can be carried out in an environmentally friendly manner. Plant extracts can play a vital role in synthesizing nanoparticles. Hundreds of plant extracts are found to have the capacity of reducing metal salts to their corresponding metal oxides. Plant mediated synthesis reduces the expense of synthesizing nanoparticles and follows green methods [2,3,4]. Medicinal plant extracts using alcohol as solvent possess a large number of organic compounds which helps in reducing metal salts to the corresponding nano metal oxides. Leaves of five medicinal plants *Acalypha indica*, *Cassia occidentalis*, *Cleome viscosa*, *Euphorbia hirta* and *Ecbolium ligustrinum* were selected for the study.

Materials and methods

The leaves of medicinal plants like *Acalypha indica*, *Cassia occidentalis*, *Cleome viscosa*, *Euphorbia hirta* and *Ecbolium ligustrinum* were collected from Kurusady village, Kanyakumari District, Tamilnadu and shade dried. The dried leaves were powdered in a mixer grinder and extracted using ethyl alcohol in a soxhlet extractor. Manganese (II) chloride was purchased from Merck Life Science Private Limited, India. 25 grams of



Manganese (II) chloride was mixed with 40ml of *Acalypha indica* alcoholic extract and heated at 80°C for 1 hour and thirty minutes. The resulting manganese oxide nanoparticles obtained was dried and characterized using UV-VIS and FTIR spectroscopy. In the same manner Manganese oxide nanoparticles were also synthesized using *Cassia occidentalis*, *Cleome viscosa*, *Euphorbia hirta* and *Ecbolium ligustrinum* alcoholic extracts. The ability of the extracts in reducing Manganese (II) chloride to manganese oxide was compared.

RESULTS AND DISCUSSION

Analysis of UV – VIS spectrum

The UV – VIS spectrum of Manganese oxide nanoparticles synthesized from Manganese (II) chloride and plants extracts *Euphorbia hirta*, *Cassia occidentalis*, *Ecbolium ligustrinum*, *Acalypha indica*, and *Cleome viscosa* were recorded FT – IR Bruker, Alpha T, Germany are shown in figures 1,2,3,4 and 5 respectively. Oxides and hydroxides of metal nanoparticles gives absorption peak in the finger print region below $\lambda = 1000\text{nm}$. UV – VIS spectrum of Manganese oxide nanoparticles synthesized using all the five plant extracts shows absorption bands at 265- 269 nm [5]. This may be due to the presence of CO₂. Pure Manganese oxide nanoparticles shows absorption maximum at 376 nm. The UV – VIS absorption spectra of Manganese oxide nanoparticles synthesized using *Cassia occidentalis* and *Ecbolium ligustrinum* shows additional peaks at 345nm and 344nm respectively showing the formation of pure manganese oxide nanoparticles. These results confirm the formation of Manganese oxide nanoparticles. It also reveals that out of the five plant extracts *Cassia occidentalis* and *Ecbolium ligustrinum* act as better reducing agents for the conversion of Manganese (II) chloride to Manganese oxide nanoparticles.

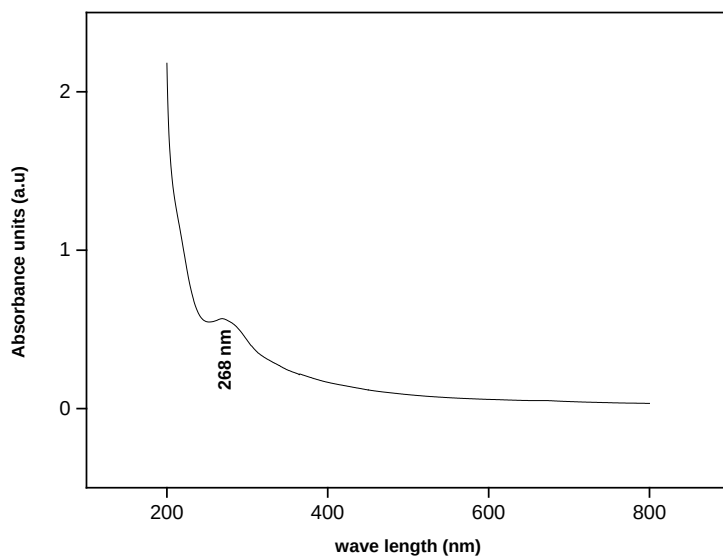
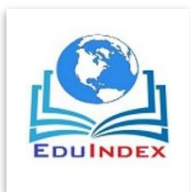


Fig.1.UV- Visible absorption spectrum of Manganese Oxide nanoparticles using Euphorbia hirta

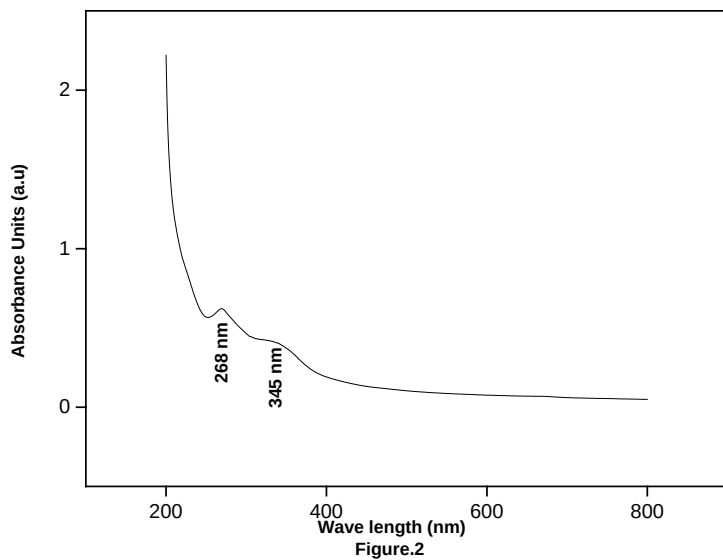


Figure.2
UV - VIS absorption spectrum of Manganese Oxide nanoparticles using Cassia Occidentalis

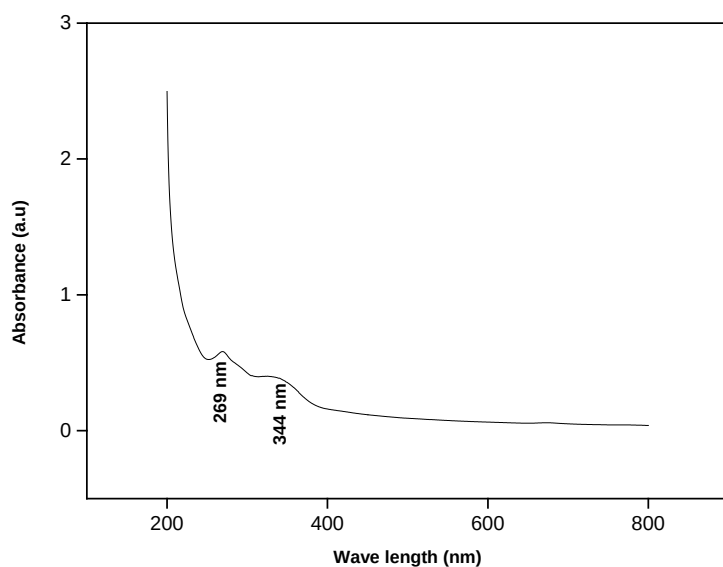
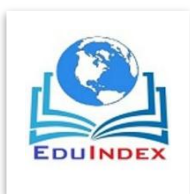


Fig.3 UV - Visible absorption spectrum of Manganese Oxide nanoparticles using Ecbolium ligustrinum

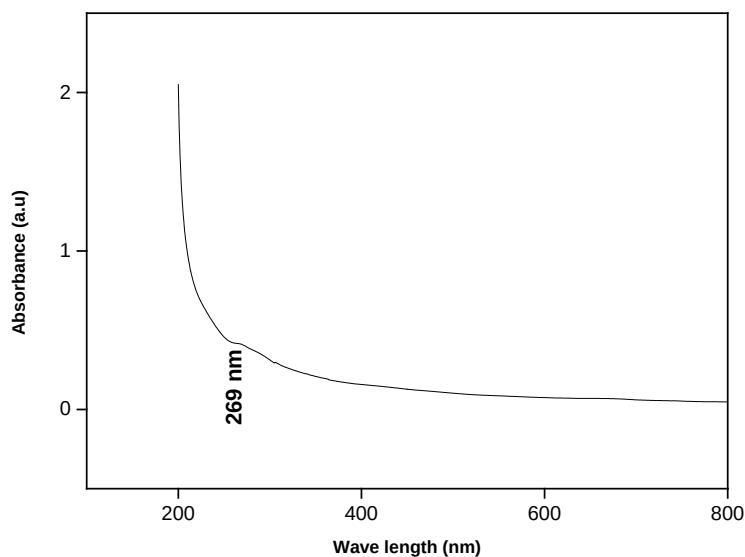


Figure.4 UV- Visible absorption spectrum of Manganese Oxide nanoparticles using Acalypha indica

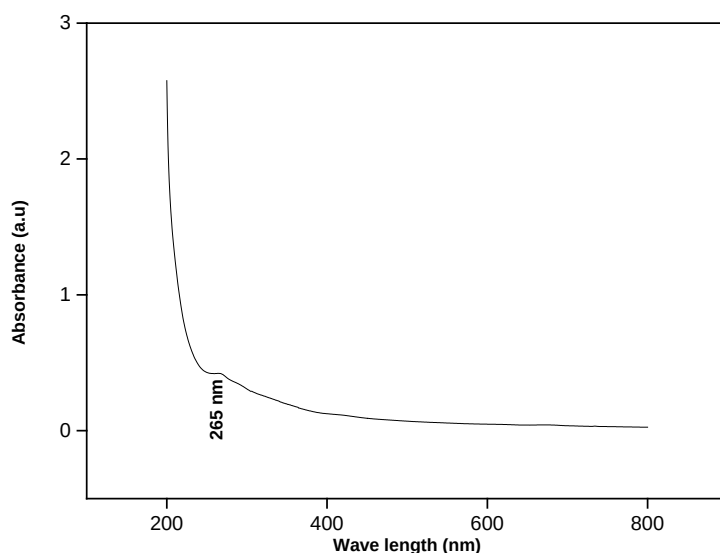
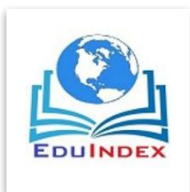


Fig.5 UV - Vis absorption spectrum of Manganese oxide using Cleome viscosa

Aalysis of FTIR spectroscopy

The FTIR spectrum of Manganese oxide nanoparticles synthesized using the plant extracts *Euphorbia hirta*, *Cassia occidentalis*, *Ecbolium ligustrinum*, *Acalypha indica*, and *Cleome viscosa* were recorded using shown in figures.6,7,8,9 and 10 respectively. Except nano Manganese oxide synthesized from *Ecbolium ligustrinum* extract all the four samples shows a peak at $3738 - 3758 \text{ cm}^{-1}$ this may be due to stretching collision of H - O - H and free hydroxyl group[6,7,8] The broad peak at $3358 - 3348$ can be ascribed to stretching of hydrogen bonded O - H group. The sharp peak at $2907 - 2920 \text{ cm}^{-1}$ may be due to C - H stretching frequency of alkane. The peak at 2842 cm^{-1} may be allocated to = C- H stretching frequency of aldehyde group. The peak at 2365 cm^{-1} to 2372 cm^{-1} indicates the presence of CO_2 molecules. The peak at $1624 - 1650 \text{ cm}^{-1}$ is due to C = C stretching of alkene. The absorption peak at wavelength near $1019 - 1031 \text{ cm}^{-1}$ may be due to - OH groups of Mn-OH manganese oxide nanoparticles.

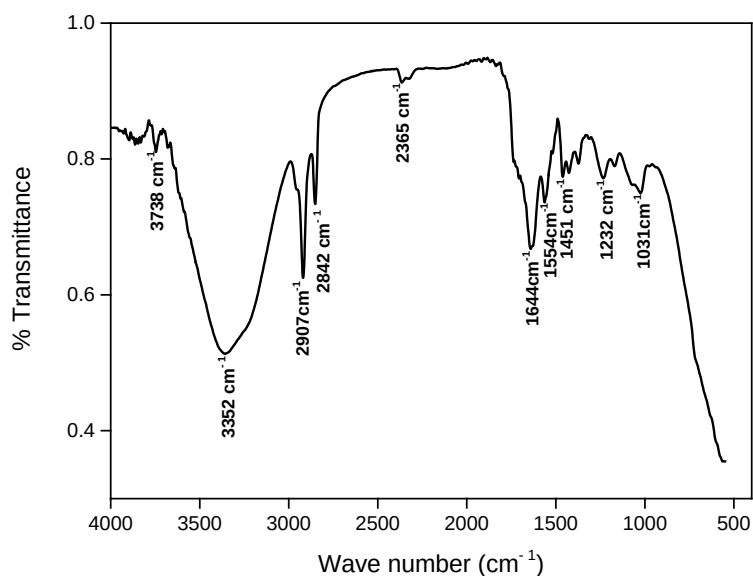
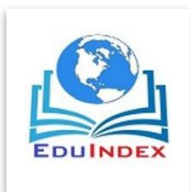


Figure .6. FTIR spectrum of Manganese oxide using Euphorbia Hirta

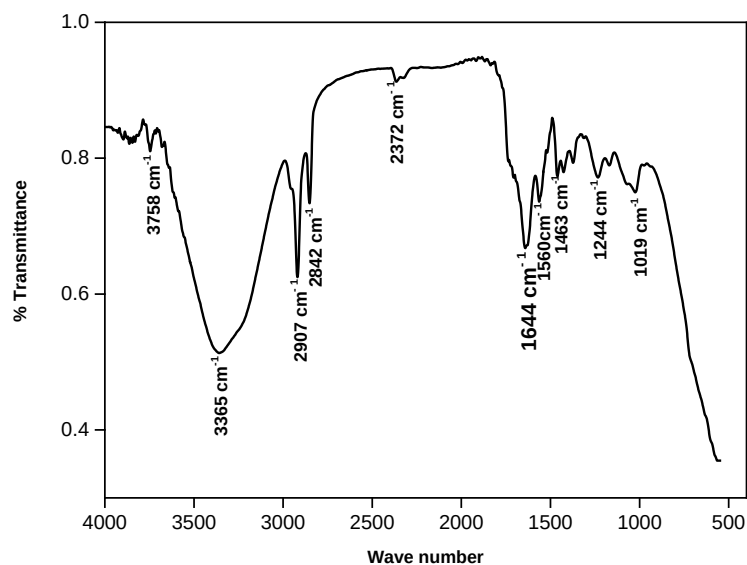


Figure.7.FTIR spectrum of Manganese oxide using Cassia Occidentalis

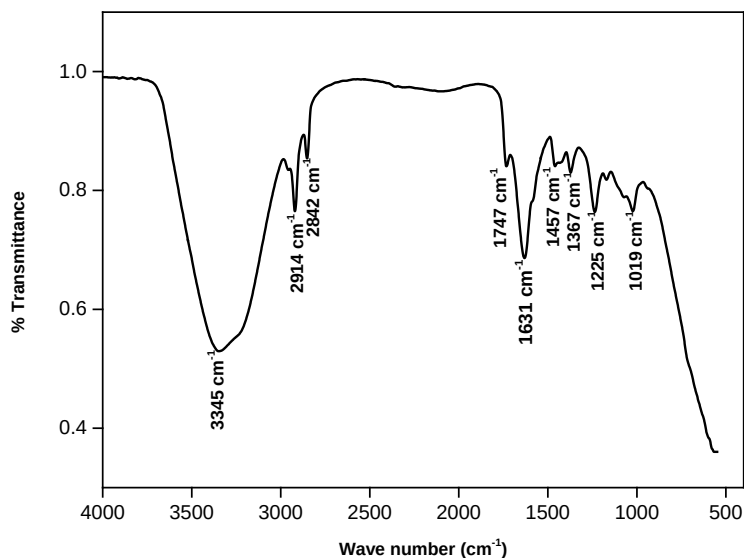
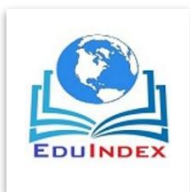


Figure.8. FTIR spectrum of Manganese Oxide using Ecbolium ligustrinum

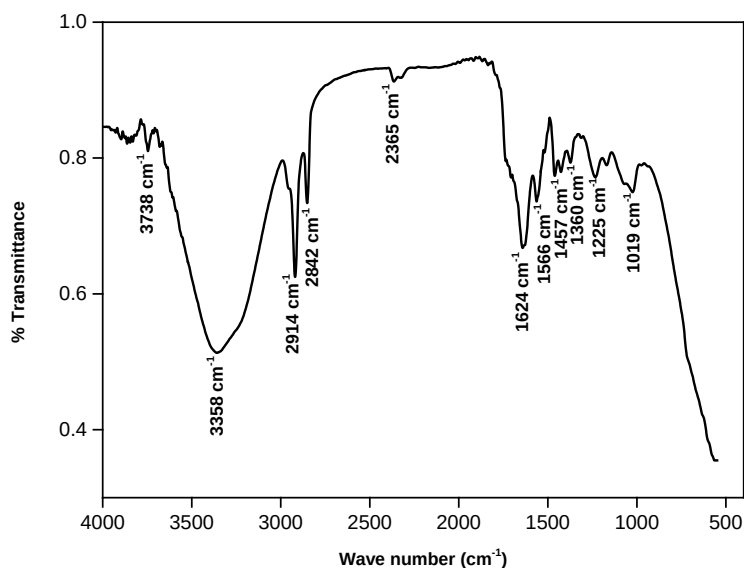


Figure.9. Manganese Oxide using Acalypha indica

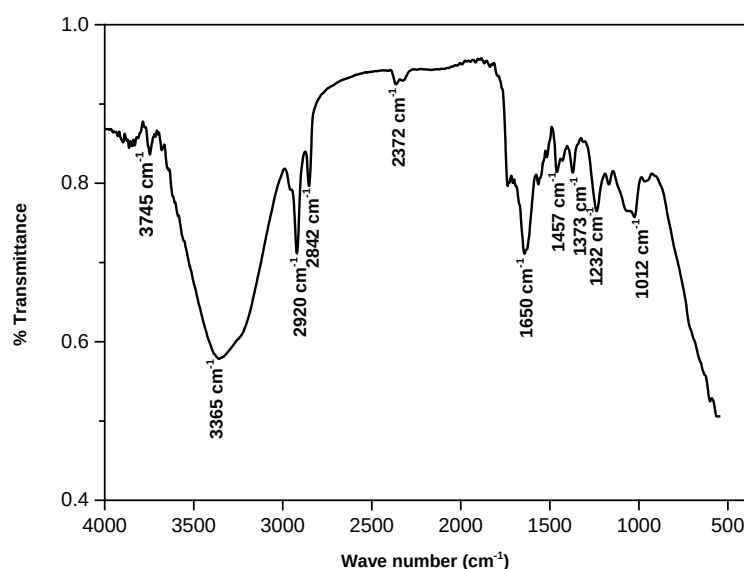
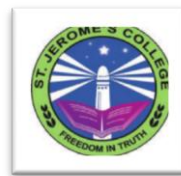
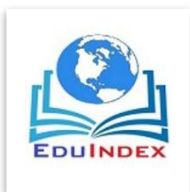


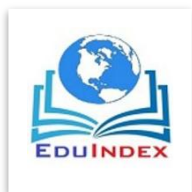
Figure.10. FTIR Spectrum of Manganese Oxide using Cleome viscosa

CONCLUSION

Manganese oxide nanoparticles were synthesized using Manganese (II) Chloride and medicinal plant extracts of Kanyakumari District as reducing agents. UV – VIS spectroscopy reveals the formation of nano manganese oxide particles. Out of the five medicinal plant extracts *Cassia occidentalis* and *Ecbolium ligustrinum* gives good results. The FTIR spectrum also confirms the formation of manganese oxide nanoparticles.

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