GREEN SYNTHESIS OF MAGNESIUM NANOPARTICLES FROM *Magnolia champaca* AND *Chrysanthemum grandiflorum* – A COMPARITIVE STUDY

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Abstract

Nanobiotechnology are used in various fields of science and has potential applications which is classified based on its morphology and size. Green synthesis of Magnesium Nanoparticle is odorless, non-toxic, high hardness, high purity and high melting point. The magnesium nanoparticle is used in many fields such as electronics, catalysis, ceramics, phytochemical products and many other fields of coating industries. *Magnolia champaca* and *Chrysanthemum grandiflorum* is used for the synthesis of Magnesium Nanoparticles. The phytochemical preliminary screening was performed to identify the presence of metabolites in the floral part. The synthesized particles were subjected to UV Visible Spectroscopy , Scanning Electron Microscope (SEM), Energy Dispersive X-ray Analyzer (EDAX), Particle Size Analyzer (PSA), Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Diffraction (XRD) techniques were used to understand its morphology, size and characters of the synthesized nanoparticles. The comparison was made between the two synthesized Magnesium nanoparticles.

Keywords: Nanoparticle; magnesium nanoparticle; phytochemical; characterization.

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1. Introduction

The Synthesis using bio-organisms is compatible with the green chemistry principles. "Green synthesis" of nanoparticles makes use of environmental friendly, non-toxic and safe reagents. *Magnolia champaca* L. is an evergreen or semi-deciduous, graceful, small to medium sized tree up to 50 m tall; bole straight, cylindrical, up to 200 cm in diameter, margins slightly undulate, glabrous, chartaceous, midrib nearly flat above, secondary nerves 12-16 pairs; stipules adnate to or free from the petiole; flowers on short, solitary or rarely in pairs, large, tepals 6-21, in 3-6 usually subequal whorls, pale-yellow with strong ordor; stamens many, anthers with a short to prominently elongated connective; seed hanging from its funicle, brown and 1-4 in fruit. Flowering is during summer season, chiefly in April and fruiting in winter season (Rajshree Sinha *et al.,* 2016).

The *chrysanthemum* (*Chrysanthemum grandiflorum*) is one of the most famous traditional flowers in China that possesses high aesthetic value and abundant cultural associations. At present, the number of chrysanthemum cultivars worldwide is approximately 20,000–30,000. The traditional *Chrysanthemum* are the most popular potted, cut, and garden ornamentals with a market share of 21% in China, and they command a comparable market share in other Asian countries. The phytochemicals cure diseases without causing any harm to human beings these can also be considered as “man- friendly medicines” (Yuan zhang *et al.*, 2014).

2. Sample preparation

The plants were collected and identified the specimen at Botanical Survey of India, TNAU campus, Coimbatore as ***Magnolia champaca*** (Voucher number: BSI/SRC/5/23/2018/Tech./2267) and ***Chrysanthemum grandiflorum*** (voucher number: BSI/SRC/5/23/2019/Tech./2685). The flower part of the sample were shade dried and powdered. The extraction was made by using water as a solvent in Soxhlet apparatus. 15 g of each flower dried sample were weighed and mixed with 300 ml of solvent (distilled water) and kept in magnetic stirrer at 80 ° C for an hour. After incubation the mixture was filtered by using whatman No. 1 filter paper. The filtrate of both sample were stored at 4 ° C for future use.

3. Phytochemical screening

Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek *phyto*, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators. Phytochemicals under research can be classified into major categories, such as phenolics, alkaloids, saponins, flavonoids and tannins (Arvind Kumar Shakya *et al.*, 2016).

Test For Phenolics: A) Ferric Chloride Test- To 2 ml of plant extract add 1 ml of 5% ferric chloride solution. Formation of blue color indicates the presence of phenols; B) Lead Acetate Test- To 3 ml of plant extract, 3 ml of 10 % lead acetate solution was added. The occurrence of yellow precipitate indicates the presence of phenols. **Test For Flavonoids**: Lead Acetate Test- To 3 ml of plant extract, 3 ml of 10 % lead acetate solution was added. The occurrence of yellow precipitate indicates the presence of flavonoids. **Test For Alkaloids**: A) Wagner’s Test- To 3 ml of plant extract add few drops of Wagner’s reagent. Formation of reddish brown or yellow precipitate indicates the presence of alkaloids. B) Hager’s Test- To 3 ml of plant extract add few drops of Hanger’ s solution (saturated picric acid solution). Formation of prominent yellow color showed the presence of alkaloids. C) Meyer’s Test- To 3 ml of plant extract, few drops of Meyer’s reagent were added. Formation of white precipitate showed that presence of alkaloids. **Test For Tannins**: Ferric Chloride Test- To 2 ml of plant extract add 1 ml of 5% ferric chloride solution. Formation of blue color indicates the presence of tannins. **Test For Saponins**: Foam Test- To 2 ml of the plant extract, 4 ml of distilled water were mixed well and shaken vigorously. Foam formation shows that the presence of saponins.

4. Green synthesis

Magnesium chloride is used as a precursor molecule to synthesis magnesium nanoparticle. 1M concentration of magnesium chloride were prepared and mixed by using two flower extract. The mixture were mixed well by using magnetic stirrer at 80° C for 2 hours. The mixture were observed until it forms precipitation. The precipitated mixture were dried to evaporate the water molecule present in the mixture using hot plate drying method for 24 hours at 100° C. The impure powder were collected and it kept in the crucible and heated under the furnace at 500° C for 24 hours. After the period of incubation the powder were collected from the crucible and grind it. The white powder were appeared and stored it at room temperature for future use.

5. Characterization

Magnesium nanoparticle were characterized through several techniques such as UV vis spectroscopy, Scanning Electron Microscope (SEM), Particle Size Analyser (PSA), Fourier Transform Infrared Spectroscopy (FTIR), Energy Dispersive X- ray (EDX) and X-ray diffraction. The UV Vis Spectrophotometer is a technique which determines the absorbance range of a synthesized nanoparticles in the UV to near IR (200–800 nm) spectral region. A SEM is a type of electron microscope that produce the image of the sample by scanning its surface with a focused beam of electrons. The electron were interact with atoms of the sample and produce the various signal that contains the information about the structural topography and composition present in the sample. The EDX is an analytical technique used for elemental analysis or chemical characterization of the samples. It was used to identify the morphology, microstructure and elemental composition of the prepared magnesium nanoparticles.

An FTIR spectrometer simultaneously collects high – spectral resolution data over a wide spectral range and absorbance is used to identify the presence of functional group of nanoparticle present in it. The FTIR spectra of synthesized magnesium nanoparticles were obtained using an FTIR spectrometer in the frequency range from 400 to 4000 cm^{-1} using a KBr pellet. Particle Size Analyzer (PSA) is a technique which determines the size range and average or mean size of the particles in a powder or liquid sample. X-ray Crystallography is a technique used for determining atomic and molecular structure of a crystal, in which the crystalline structure causes a beam of incident X-rays to diffract into many specific directions.

6. Results and discussion

The phytochemical analysis of floral aqueous extract from *Magnolia champaca* and *Chrysanthemum grandiflorum* were performed and showed in the Table 1. The results revealed the presence of phenolics, alkaloids and flavonoids. In the recent study the flower methanolic extract of champaca were undertaken for the preliminary study of phytochemicals showed the positive response for phenolics, flavonoids, alkaloids and carbohydrate (Ananthi T *et al.*, 2013). The methanolic extracts from *Chrysanthemum* species showed the presence of various quantities of alkaloids, tannins and flavonoids (Ahlem Ben Sassi *et al.*, 2008).

Table 1 : Phytochemical analysis for floral extracts of MC (*M.champaca)* and CG (*C.grandiflorum)*

Plant sample	Phytochemical tests							
	Phenolics		Flavonoids	Alkaloids			Tannins	Saponins
	Ferric chloride test	Lead acetate test	Lead acetate test	Wagner's test	Hager's test	Meyer's test	Ferric chloride test	Foam test
MC	-	+	+	+	+	+	-	-
CG	-	+	+	+	+	+	-	-

The white powder indicates the presence of magnesium nanoparticles and it obtained by using the green synthesis method and it shown in the Figure 1 (A,B). Both the sample of *Magnolia champaca* and *Chrysanthemum grandiflorum* were obtained in the same colored powder and it stored for further use of characterization. During the green synthesis, the formation of nanoparticles was observed by change in the color of the solution. The results are shown in $Mg(NO3)^2$ solution was colorless. When it was mixed with flower extract, it turned light brown and finally to muddy brown, indicating MgNP formation, as shown by a recent research on *Emblica officinalis* extract-mediated synthesis of Magnesium nanoparticles (Gopalu Karunakaran *et al.,* 2016)

Figure 1. A) It shows the calcinated powder of magnesium nanoparticle from *Magnolia champaca*

Figure 1. B) It shows the calcinated powder of magnesium nanoparticle from *Chrysanthemum grandiflorum*

A B

The synthesized magnesium nanoparticle of both samples were analyzed in UV vis spectrophotometer after the interval of 10 minutes. The absorption spectrum of magnesium nanoparticles of

M. champaca and *C. grandiflorum* formed in the reaction had a peak for champaca (272 nm) and chrysanthemum (315 nm) respectively and shown in the Figure 2. UV-Vis spectroscopy shows a specific absorption peak at 273.5 nm which is in range of 260 to 280 nm which is specific for MgO nanoparticles. The band gap of the magnesium oxide nanoparticles was estimated from the UV-VIS absorption. It was observed that the band gap of the sample constant i.e. (7.5eV) for constant calcinations temperature at 500 and 700° C (Varsha Srivastava *et al.*,2015). It confirms the present of magnesium nanoparticle in both the sample. the UV–VIS spectrum of colloidal MgO NPs synthesized using leaf extracts and its Cutoff peak around 221 nm for both of precursors (L. Umaralikhan *et al.*, 2016).

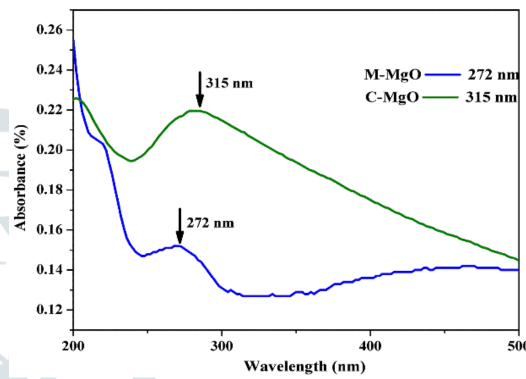
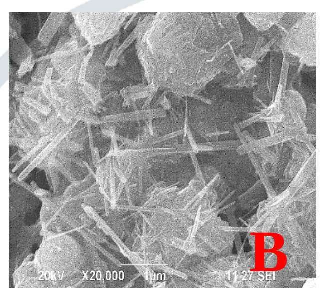
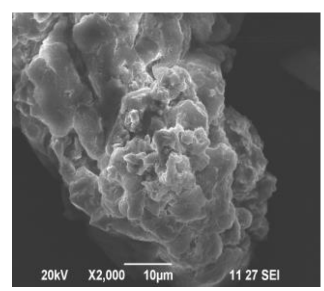


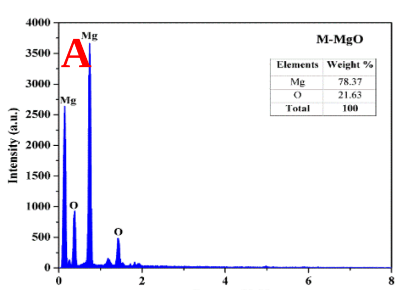
Figure 2. It showed the magnesium nanoparticle absorbance range. Where M-MgO denotes *Magnolia champaca* and C- MgO denotes *Chrysanthemum grandiflorum*

The SEM were performed and identified nanoclusters were from *Chrysanthemum grandiflorum* and nanofibers were identified from *Magnolia champaca* and showed in the Figure 3 (A,B). SEM images of (Acacia gum) AGM-10 and AGM-20 of nanoflowers was also recorded to investigate surface nature (Varsha Srivastava *et al.*,2015). . EDAX were analyzed from both the samples of magnesium nanoparticles, the high composition of magnesium were present in the sample of *C.grandiflorum* (average presence of magnesium 83.12% and oxygen 26.88%) than that of *M.champaca* (average presence of magnesium 78.37% and oxygen 21.63%) were showed in the Figure 4 (A,B). The elemental percentages were obtained from EDX pattern. The average presence of Mg is 46.20 and the presence of O is 53.80 (S Krishna Moorthya *et al.*,2015).

A







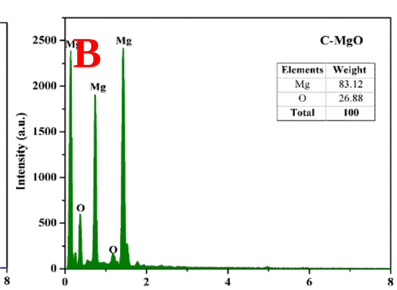


Figure 3. A) Nanofibers from *Magnolia champaca*

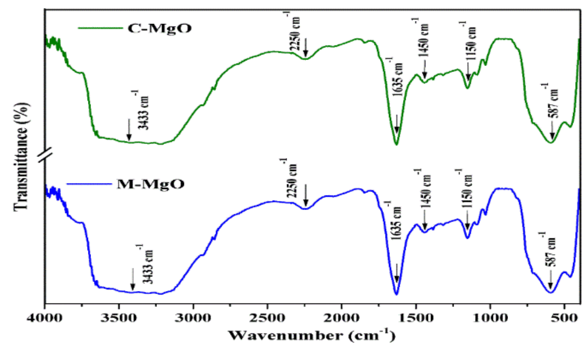
Figure 3. B) Nanoclusters from *Chrysanthemum grandiflorum*

Figure 4. A) EDAX pattern of *Magnolia champaca*

Figure 4. B) EDAX pattern of *Chrysanthemum grandiflorum*

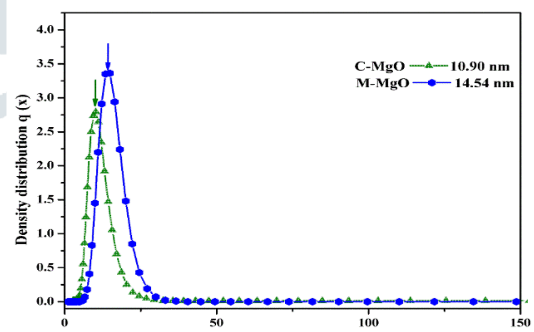
The magnesium nanoparticle were analyzed in and both the magnesium nanoparticle shows the similar peak is shown in the Figure 5. The absorbance peaks at 3433 cm^{-1} showed the presence of strong O–H stretching vibration bonds (L. Umaralikhan *et al.,* 2016). The range 2250 cm^{-1} absorbance peak is due to presence of alkenes and carboxylic acids (L. Umaralikhan *et al.,* 2016). The range 1635cm^{-1} peak range showed the presence of symmetrical and asymmetrical stretch of nitro compound (L. Umaralikhan *et al.,* 2016). The peak rage of 1450 cm^{-1} showed the presence of assigned to the asymmetric stretching of the carbonate ion, CO32− species (Saeid Taghavi Fardood *et al.,* 2018) . The peak ranges at 1150 cm^{-1} is due to the presence of absorption peaks of Aldehyde, ketone can be observed (Kobra Atrak *et al.,* 2019). The peak at 587 cm^{-1} were consider as a major peak due to the presence of the stretching vibration mode for the Mg–O–Mg moiety at the range of 587– 681 cm−1 as a broad band (Saeid Taghavi Fardood *et al.,* 2018).

Figure 5. FTIR pattern of C-MgO (*Chrysanthemum grandiflorum)* and M-MgO (*Magnolia champaca*)



The particle size analyzer is used to find the average particle size of magnesium nanoparticles from both the samples. The PSA resulted that the *C.grandiflorum* (10.90 nm) showed the higher efficiency than that of *M.champaca* (14.54 nm) and the results were shown in the Figure 6. The histograms of the particle sizes verse undersize percentages are shown in the figure and the average particle size of the MgO Nanoparticles is 43nm (S Krishna Moorthya *et al.,*2015).

Figure 6. PSA result of C-MgO (*Chrysanthemum grandiflorum*) and M- MgO (*Magnolia champaca*)



The magnesium nanoparticle were observed in the form of crystalline structure and it was proved by the high absorbance peak at (111), (200), (220), (311) and (222). Both the sample of magnesium nanoparticle showed the similar peaks of well crystalline broad band at 2Ɵ angle. The high crystalline broad bands were shown in the Figure 7. The pattern exhibited reflection from (111), (200), (220), and (311) (Gopalu Karunakaran *et al.,* 2016). The diffraction peaks (111), (200), (220), (311) and (222) respectively matched with the face centered cubic structure of MgO (Varsha Srivastava *et al.,*2015).

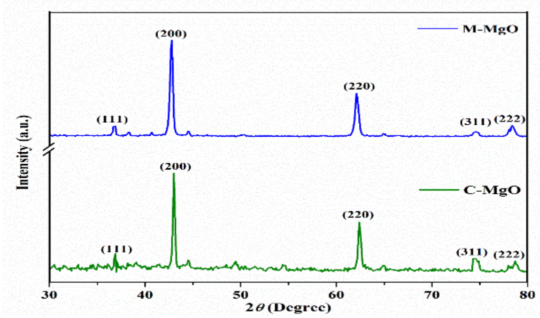


Figure 7. XRD pattern of M-MgO (*Magnolia champaca)* and C-MgO (*Chrysanthemum grandiflorum)*

7. Conclusion

In summary of this study showed that the magnesium nanoparticle were successfully prepared by means of using plant based method called green synthesis from the different floral samples such as *Magnolia champaca* and *Chrysanthemum grandiflorum*. The obtained nanoparticle were purified by the process of calcination. The preliminary test of phytochemical were performed for different floral aqueous extracts and it showed similar results of both samples with the presence of flavonoids, phenolics and alkaloids with the absence of tannins and saponins. The characterization of the magnesium nanoparticle showed higher efficiency in *Chrysanthemum grandiflorum* than that of *Magnolia champaca*.

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