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Green Synthesis and Characterization of Zinc Nanoparticle using *Aegle marmelos* leaf Extract

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Abstract : *Aegle marmelos* is noted for its meritable medicinal as well as commercial usages. From the past until now, it has been used as a promising remedy for several ailments. Recently, the concept of nanotechnology has astonishingly changed its outlook for biomedical applications. Nanotechnology has revolutionized several fields with its admirable capabilities and ground-breaking innovations. In the field of medicine, nanostructured materials have introduced a great range of flexibility by refashioning traditional practices and also by exploring new effective approaches. Accordingly, the usage of *Aegle marmelos* in the form of nanoparticles, nanocomposites, nanofibers, hydrogels, and bio-inspired sponges has unlimited its well recognized application spectrum in the fields of wound healing, tissue engineering and drug delivery. In addition, the growing interest in consuming and synthesizing materials based on green or eco-friendly methods also highly encourages the use of numerous plant-based natural products including *Aegle marmelos*. Hence, an effort has been made to discuss the works related to recent advancements made in the use of *Aegle marmelos*, especially in the form of biomaterial-based nanostructures In this research paper, we discussed on the Synthesis and characterization of zinc Nanoparticles by green synthesis method. It attempt was made to zinc Nanoparticles is prepared by using a medicinally plant *Aegle marmelos*. Zinc acetate as used to synthesis the zinc Nanoparticles by using leaf extract of *Aegle marmelos*. The optical characterization was carried out using UV – Vis and FT – IR analysis.
Keywords : Green synthesis, nanoparticles, zinc oxide nanoparticles, FTIR,UV.

Introduction

The Maha *Vilva* tree is associated with Lord Shiva. Its trifoliate leaf or tripatra, is believed to symbolize the three functions of the Lord – creation, preservation and destruction - as well as His three eyes. The offering of the leaves is a compulsory ritual while worshipping Lord Shiva all over India. It is commonly called as *Vilva* tree. *Aeglemarmelos*Linn.is commonly called as Bael in Hindi, Vilvam in Tamil and Bilva in Sanskrit. It belongs to the family Rutaceae. It is aboriginal to India and is used in folk medicines. The Ayurvedic practitioners use almost all of their parts but the greatest medicinal value ascribed to its fruits [1-5]. Vilvamis a perennial tree, wild in the subHimalaya tract, central and South India. *Aegle marmelos*is a medium sized armed deciduous tree grows up to aheight of 9-10 meters with straight, sharp, axillary thorns and yellowish brown shallowly furrowed corky bark. Theleaves are trifoliate alternate, leaflets are ovate to lanceolate with pellucid – punctuate aromatic oil glands. Thelateral leaves are subside and the terminal one is long petioled. There is little scientific evidence of the effectiveness or safety of *Aegle marmelos* extracts for either cosmetic or medicinal purposes. A research study finding positive evidence is frequently contradicted by other studies. Despite this, the cosmetic and alternative medicine industries regularly make claims regarding the soothing, moisturizing, and healing properties of *Aegle marmelos*. The leaves are useful in opthalamia, inflammations, catarrh, diabetic and asthmatic complaints. The leaves are used for the heart and brain disorders. Vilva leaves are helpful in jaundice and in the treatment of wounds. The extract of leaves is valuable in the treatment of conjunctivitis, leucorrhoea and deafness. Fruits give feeling of freshness and energy. It is used as carminative and astringent [6-8]. It finds good utility in thyroid related disorder. The other fine therapeutic uses reported are cardiac stimulant, swollen joints, pregnancy trouble, typhoid and coma. The dried out powder of leaf is used in the treatment of irritable bowel syndrome. Aegle marmelos leaf is widely reported to possess antioxidant activity against a variety of free radicals. Antioxidant activity of the fruit of A. marmelos was reported. Antioxidant activity and free radical scavenging activity of the ripe and unripe fruit of Aegle marmelos was compared. Results indicate that the enzymatic antioxidants increased in ripe fruit when compared to unripe fruit extract [9-12].The *Aegle marmelos* contains extra of natural Antioxidant in the leaves and the fruit pulp. Since of this explicit property the Vilva is used in the treatment and defensive of all common ailment of mankind.

These plant extracts also allow a proscribed synthesis. Organic chemical solvents are toxic and require excessive conditions during nanoparticle synthesis. Plant extractsfunction as stabilizing, capping or hydrolytic agents.In nanotechnology, a nanoparticle is defined as a small object that behaves as a whole unit in terms of its transport and properties. The science and engineering technology of nanosystems is one of the most exigent and fastest growing sectors of nanotechnology . Zinc oxide (ZnO) is a class of inorganic metal oxides available and exhibits a wide range of nanostructures. Photocatalytic and photo oxidizing ability against chemical and biological species are used to characterize these metal oxides[13-19]. Recently, the concept of nanotechnology has surprisingly changed its outlook for biomedical applications. Nanotechnology has revolutionized several fields with its admirable capabilities and ground-breaking innovations. In the field of medicine, nanostructured materials have introduced a great range of flexibility by refashioning traditional practices and also by exploring new effective approaches. Accordingly, the usage of *Aegle marmelos* in the form of hydrogels, nanoparticles, nanocomposites, nanofibers and bio-inspired sponges has extended its well established application spectrum in the fields of wound healing, tissue engineering and drug delivery. In addition, the growing interest in unbearable and synthesizing materials based on green or eco-friendly methods also highly encourages the use of numerous plant-based natural products including *Aegle marmelos*. The synthesis of nanoparticles with specific morphologies and properties is one of the most important aspects of nanoscience which studies materials whose size lies within the nanometer range (1 nm=10-9 m). Applications ofthese nanostructures are seen in catalysis, sensors, water purification, antibacterials and nanoelectronics [20-27]. Whilechemical synthetic procedures can lead to the generation of toxic chemical by-products or require high temperaturesand/or pressure, biosynthesis of nanoparticles using plant extracts provides a facile and ‘green’ method of nanoparticle synthesis.ZnO nanoparticles have gathered the increasing interest of the scientific and industrial community due to diverseapplication in solar energy conversion, sensors, catalysis, cosmetics, paints, fibers, drug-delivery antibacterial andluminescence properties.In this work we have used environmentally benign plant leaf extracts of *Aegle marmelos* which have exceptional therapeutic properties. Thestructural, optical, properties of the ZnO NPs have been evaluated.

Materials and Methods

Zinc acetate dihydrate (Merck), sodium hydroxide pellets (Merck.), distilled water were usedin the nanoparticle synthesis with the extracts. Maha *Vilva* leaves were collected from the Botanical garden.

Preparation of leaf extracts

Aegle marmelos leaf (50 g) were thoroughly washed, dried and then boiled in 50 ml of deionised water for half anhour. The resulting extract was cooled and used as the extract solutions.

Synthesis of ZnO nanoparticles

In this method, 0.25 g of zinc acetate was dissolved in 50 ml water. 4 ml of the extract of *Aegle marmelos* was added dropwise and the resulting mixture was stirred for 10 minutes using a magnetic stirrer. In order to adjust the pH of thesolution to pH 12, NaOH (2 M) was added drop-wise while stirring. A white crystalline precipitate of zinc oxidewas obtained, which is washed repeatedly with water, filtered and dried in an oven at 60°C to obtain the ZnO nanoparticles.

Result and Discussion

Synthesis of Zinc Nanoparticles by reducing the zinc ion solutions with *Aegle marmelos* leaves extract to optical characterized by using UV – Visible spectrometer. UV-Vis spectral analysis was used to confirm the formation of ZnO-NPs in the solutions. UV-visible absorption spectra of the ZnO-NPs synthesized from the mixture with *Aegle marmelos* is presented in Figure 1. It is generally recognized that UV-Vis spectra could be used to examine the size and shape controlled nanoparticles in aqueous suspension. ZnO-NPs exhibit strong UV absorption spectra with the absorption peak ranging from 360 to 375 nm due to their excitonic transition. The UV analysis of the methanol extract synthesized zinc oxide nanoparticles of *Aloe vera* gel extract have the maximum absorption peak it was obtained at 364 nm wavelength (**Fig. 1**).

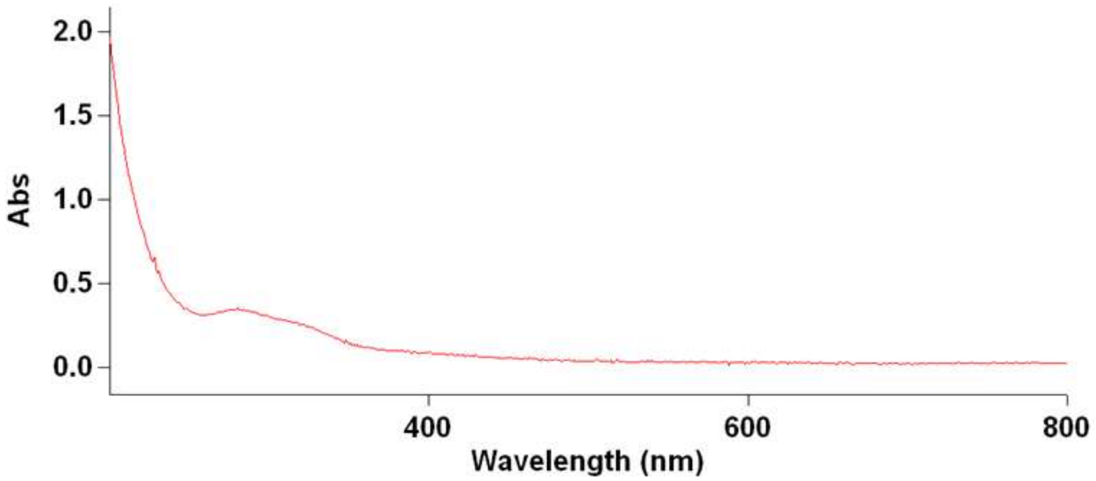

Fig. 1: UV Spectrum of ZnO Nanoparticles

In order to determine the functional groups on zinc nano *Aegle marmelos* particles leaf extract and identify their role in the synthesis of zinc nanoparticles, FT – IR analysis was performed. FT – IR spectrum of zinc nanoparticles of *Aegle marmelos* leaf extract and synthesized are shown in Fig 2 Peak at 699 cm-1 corresponds to C – H bending, 851cm-1and 877cm-1 corresponds to N–H bending and C–H bending. The peak located at 1080cm-1, 1109cm-1 could be assigned to the C – O stretching vibration. Peak at1588 cm^{-1},3421cm^{-1}corresponds to C=O stretching and O–H stretching Oraganic compound. The FTIR analysis of Zinc nanoparticles suggested that they might surround by the any of these organic molecules.

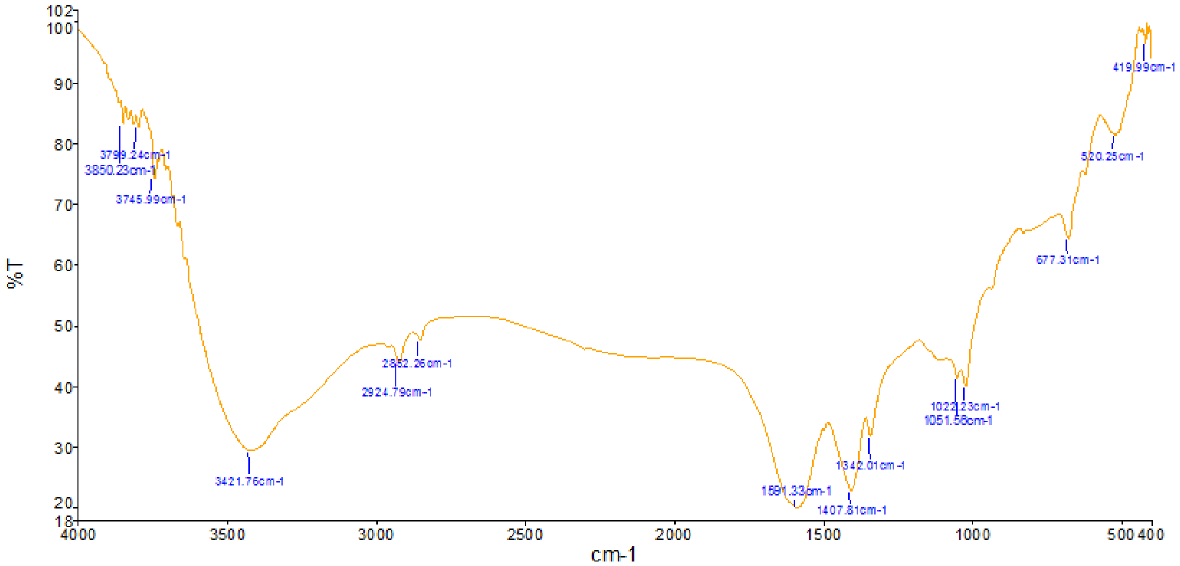

Fig. 2: FTIR- Spectra of ZnO Nanoparticles

Conclusion

The field of nanoscience and nanotechnology is the development of eco-friendlyprocesses for synthesis of zinc Nanoparticles. Here we have reported the zinc Nanoparticles were effectively synthesized by using *Aegle marmelos* leaf extract. The optical characteristics of zinc Nanoparticles were studied using the UV – Vis analysis and FTIR. The peak in the absorption spectrum is confirmed the formation of zinc Nanoparticles. The functional grouppresent in the leaf extract was confirmed by FT – IRanalysis.The leaves are useful in opthalamia, inflammations, catarrh, diabetic and asthmatic complaints. The leaves are used for the heart and brain disorders.

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