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Characterization of Medicinal Nanoparticles incorporated in Nanomedicine by FE-SEM

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Abstract-Nanoparticles are used in various fields, including medical, consumer, and industrial purposes, due to their unique physical and chemical properties. Nowadays, they have been used for several applications, including as antibacterial agents, in industrial, household, and healthcare-related products, in consumer products, medical device coatings, optical sensors, and cosmetics, in the pharmaceutical industry. Nano size biomaterials including plant extracts are unique and can considerably change physical, chemical, and biological properties due to their surface-to-volume ratio. After synthesis, precise particle characterization is necessary, because the physicochemical properties of a particle could have a significant impact on their biological properties. In order to address the safety issue to use the full potential of any nano material in the purpose of human welfare, in nanomedicines, or in the health care industry, etc., it is necessary to characterize the prepared nanoparticles before uses. To evaluate the formulated nanomedicine from the sea weed *Padina gymnospora* , many analytical techniques have been used, including Ultraviolet visible spectroscopy (UV-vis spectroscopy), Field emission scanning electron microscopy (FE-SEM) and the medicinal particles size and morphology were characterized.

Keywords: Sea weed; Nanomedicine; Nanoparticles; Ballmilling; DMSO; P,gymnospora.

1. INTRODUCTION

Nanotechnology is found in a wide range of applications in the medical and pharmaceutical fields. Nanoparticles are defined as particulate dispersions or solid particles with a size in the range of 10-1000 nm and nanoparticles based drug delivery system have the advantage of in modern medicine formulation and treatment. It is important to determine powdered medicinal material and its particle size. Nano sized medicinal particle distribution exerts a significant effect on the physical properties of the bulk material (Gurunathan et al 2015; Sondi et al, 2004; Lin et al, 2013).

The therapeutic nanoparticles are prepared from biocompatible polymers in size between 10-1000 nm. One recent application determined the particle size of nano drugs or nanomedicine is by field emission scanning electron microscopy (FE-SEM). It is governed by the size, shape, and surface morphology of the sample (Pleus, 2012). The prospective application of FE-SEM was suggested for determining particle size and morphology of powder form of nanomedicine. A FE-SEM is microscope that works with electrons (particles with a negative charge) instead of light. These electrons are liberated by a field emission source. The object is scanned by electrons according to a zigzag pattern. Researchers in biology, chemistry and physics employ the Field Emission Scanning Electron Microscope (FE-SEM) to observe small structures (as small as 1 nanometer=one billion of a millimeter) on the surface of cells and material (Sapsford, 2011). A few examples of object that are studied with a FE-SEM in practice are organelles and nuclei of cells, synthetic polymers and coatings of microchips. A FE-SEM is used to visualize very small topographic details on the surface or entire or fractioned objects. Electrons are liberated from a field emission source and accelerated in a high electrical field gradient. Within the high vacuum column these so-called primary electrons are focused and deflected by electronic lenses to produce a narrow scan beam that bombards the object (Duan et al, 2013; Zodrow et al 2009).

As a result secondary electrons are emitted from each spot on the object. The angle and velocity of these secondary electrons relates to the surface structure of the object. A detector catches the secondary electrons and produces an electronic signal. This signal is amplified and transformed to a video scan-image that can be seen on a monitor or to a digital image that can be saved and processed further (Brunet et al, 2009; Gurav et al, 2017). The present study evaluated the characterization of nanomedicine formulated by using marine macro algae *Padina gymnospora*. The morphology and size distributions of synthesized nanomedicine with medicinal nanoparticles were clearly observed in the FE-SEM analysis.

2. MATERIALS AND METHODS

2.1 Nanomedicine Sample Preparation

The sea weed Padina gymnosphora was used here to produce powder form of nanomedicine. The medicine yielding biomaterials (Padina gymnosphora), first of all simply powderd and grinded by using a ordinary Blender. Then the coarse micro sized irregular powder form is converted into nanomedicine form using high energy ball milling technique. The bulk material of Padina gymnospora powder form of 100gm was milled. The resulting biomaterials in the form of nano medicine contain nanonized medicinal particles.

2.2 Spectral analysis

UV-Visible spectroscopy measures the extinction (scatter + absorption) of light passing through a sample. Nanoparticles have unique optical properties that are sensitive to the size, shape, concentration, agglomeration state, and refractive index near the nanoparticle surface, which makes UV-Vis a valuable tool for identifying, characterizing, and studying nanomaterials. At nano composix, spectral analysis is performed with an Agilent 8453 single beam diode array spectrometer which collects spectra from 200–1100nm using a slit width of 1nm. Deuterium and tungsten lamps are used to provide illumination across the ultraviolet, visible, and near-infrared electromagnetic spectrum. Spectra can be collected from samples as small as 60 µL using a microcell with a path length of 1cm.

2.3 Fe-sem Characterizarization

The formulated powder form nanomedicine was characterized and the morphology of the medicinal nano particles present in the nanomedicines was analyzed by (FESEM), JSM-7500 F (JEOL-Japan) operated at 10 KV. This work was full and full carried out in the Centre for Nanoscience and Technology, Bharathiar University, Coimbatore, Tamilnadu, India.

3. RESULTS AND DISCUSSION

The UV-Vis spectrum of medicinal nanoparticles present in nanomedicine (Figure 1) was analyzed using 10% medicine dispersion in DMSO. The medicinal sample shows similar behavior with maximum absorption peak ranging between 390–410nm. The maximum absorption peaks for *P.Gymnospora* were 400-410nm, respectively.

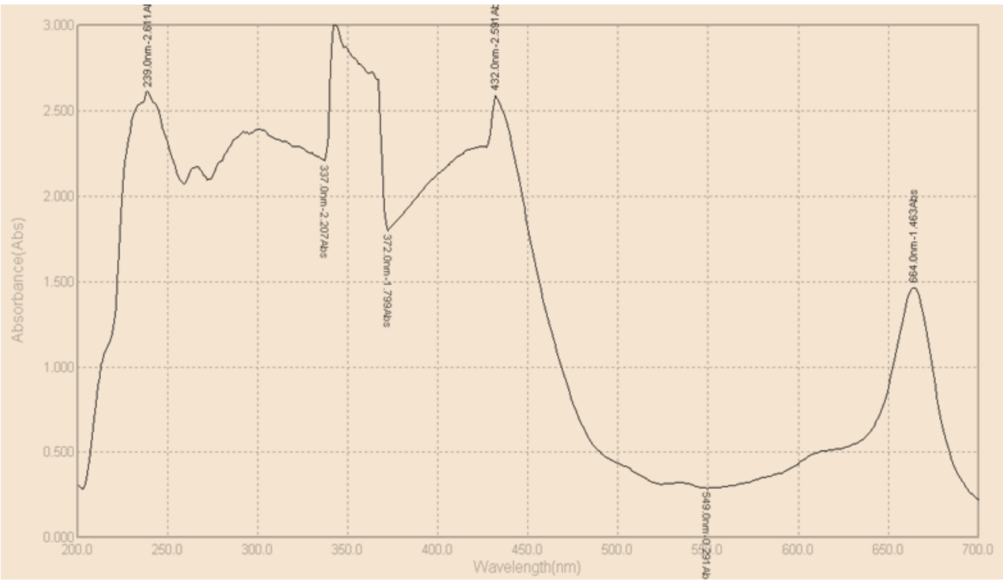

Fig.1 UV-Vis spectroscopy shows absorbance frequency of nano particles present in the nanomedicine formulated from Pdina gmnospora

UV-vis spectroscopy is a very powerful and acurate technique for the immediate primary characterization of formulated nanomedicine and nano materials.UV-VIS also useful to monitor the synthesis and stability of various types of nanoparticles(Tsuji et al.2005; Amulyavichuset al. 1998).

The nanoparticles in the nanomedicine have unique optical properties which make them strongly interact with specific wavelengths of light (Malik et al 2002).further, UV-Vis spectroscopy is fast, easy, simple, sensitive, selective for different types of NPs, needs only a short period of time for measurement, and finally a calibration is not required for particle characterization of liquid and colloidal suspensions (Sergeev et al, 1999). The results obtained by UV-Vis spectroscopic analysis shows the polydispersive nature of medicinal nanoparticles present in the nanomedicine. Similar findings were reported by many author using sea weeds for nano particle synthesis (Ganaie et al, 2015).

The morphological character and size of the nanoparticles observed by FE-SEM (Fig2),shows the powder form of nanomedicine sample consists of medicinal nano particles covering the size range between 90-140 nm and all particles have the semi spherical shape.

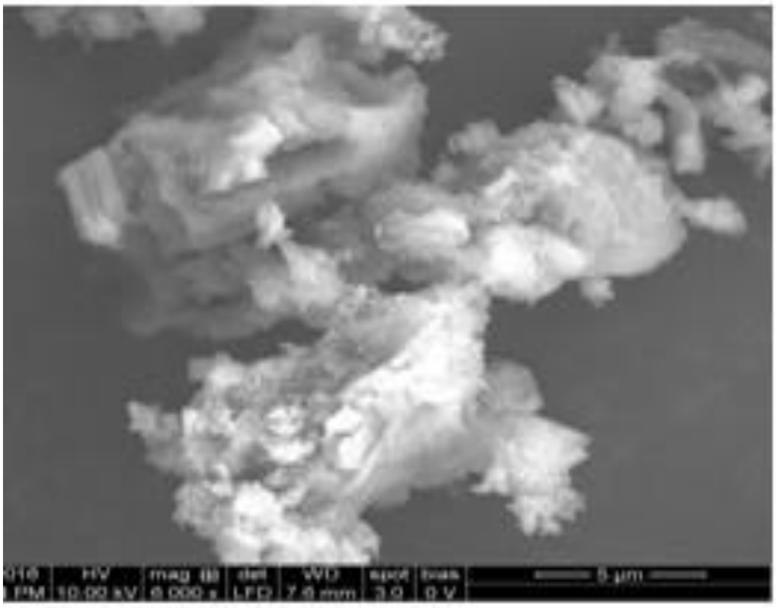

Fig 2. Formulated nanomedicine in powder form shows medicinal nanoparticles by FE-SEM characterization.

The field of nanoscience and nanotechnology has provided the development of various high-resolution microscopy techniques in order to learn more about nanomaterials using a beam of highly energetic electrons to probe objects on a very fine scale (Sergeev et al,1999). Among various electron microscopy techniques, FE-SEM is a morphological method, fully capable of resolving different particle sizes, size distributions, nanomaterial shapes, and the surface morphology of the synthesized particles at the micro and nanoscales (Kumar et al, 2014). The modern high-resolution FE-SEM is able to identify the morphology of nanoparticles below the size level of 10 nm. Based on this valuable, frequently used FE-SEM we have clearly characterized the nanomedicine and its associated medicinal nanoparticle morphology and/or grain size clearly.

4. CONCLUSION

The optical and structural properties of medicinal nano particles present in the nanomedicine prepared from sea weed *Padina gymnospora* was studied by UV-Vis spectroscopy and FE-SEM techniques .The medicinal nanoparticles were gradually aggregated to a mean-diameter of 80-140 nm. The stability of nanomedicine prepared from *Padina gymnospora* by ball milling method was observed for more than 6 months, and an peak at the same wavelength using UV-Vis spectroscopy was observed. Nano particle aggregation, and its grain size, also observed in FE-SEM micrograph.

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