Chitosan Nanoparticles: An Approach to Sustainable Living

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Abstract– **Chitosan is a linear polymer extracted from sea waste; and shrimp shells. Chitosan fungicidal effects and can act as a defense mechanism in plant tissue; it has become a valuable and highly appreciated polymer as a naturally biodegradable high molecular polymer compound, and bioactive agent. Chitosan-based for various applications their biodegradability, high permeability, to humans, and cost-effectiveness. Green synthesis is a newly emerging field of nanobiotechnology that offers economic and environmental advantages. Chitosan were synthesized a plant-based method. Plant extracts of Neem leaves were used with chitosan for the synthesis of Neem based .The biosynthesized Neem based Chitosan Nanoparticles were scanned to detect the absorbance peak between the wavelengths of 200 and 400 nm. FTIR and SEM nanoparticles performed. These Neem based can efficiently release nutrients in the soil and can probably inhibit fungal and bacterial contamination of soil. in increased yield, and lower cost crops.**

Keywords– **Neem based chitosan nanoparticles, UV - -Vis spectra, FTIR, SEM analysis, antibacterial and antifungal activity.**

I. INTRODUCTION

The study of molecules and particles with sizes between one and one hundred nanometers is the focus of nanoscience. The origins of nanoscience may be traced in the fifth century B.C., to Greek scientists who contemplated, whether substance is continuous or composed of indivisible units, particularly are now called atoms. the principles of nanoscience, nanotechnology useful applications by carefully applying scientific at the nanoscale (Chau et al., 2022; Narayanan et al., 2022a). the foundation material from which they originate, nanosized materials may exhibit enhanced or unexpected features. Numerous manufacturing methods (evaporation–condensation, top-down, laser ablation, microbial, fungal, etc.,) and potential applications (treatments electronics textile, medicinal, pharmaceutical,) (Sheng et al., 2022; Narayanan et al., 2022b; Prema et al., 2022; Ahmad et al., 2019) have been uncovered via extensive both inorganic and organic nanoparticles. Nevertheless, important to note that have been raised about their impact on the environment and the human body. However, polysaccharide-based NPs proven to be safe for the environment and have minimal concerns about toxicity, biodegradability, or physiological stability. A dependable, environmentally , and sustainable method of producing nanoparticles is through green synthesis (Tatarchuk et al., 2021; Youssef et al, 2017; El-Naggar et al 2022).

Chitosan is an amino derivative of the polysaccharide chitin, which is naturally bound to proteins in cellular structures such as fungal cell walls and the shells of invertebrates (Lodhi et al., 2011; Zhang et al 2021). Chitin is purified through acidification and alkalization before being N-deacetylated to chitosan in a well-established controlled environment. Chitosan facilitates the opening of cellular epithelial tight junctions, which increases penetration and helps with both passive and active drug transport (Olecg et al., 2012).

indicates that the characteristics of chitosan nanoparticles (NPs) might significantly on the surface modification and preparation processes employed, thus opening new application areas (Roy et al 2010; Soni et al., 2013). The medical sector has undergone a great deal of scrutiny. Aside from the tremendous progress in over the last few decades, scientists have focused on a variety of uses, including wastewater treatment, agriculture, and cosmetics. Furthermore, chitosan nanoparticles (NPs) can be utilized as for biodegradable matrixes mechanical and barrier qualities. Possessing a positively charged surface, chitosan and chitosan-derived nanoparticles can attach to mucosal tissues, facilitating the continuous release of the therapeutic carrier (Duraisamy et al., 2022). Research conducted both in vitro and in vivo has confirmed that chitosan-based nanoparticles are biocompatible. These characteristics make them useful for treating disorders linked to digestion, treating cancer, treating pneumonic diseases, treating eye infections, and administering medications to the brain -.

In light of the aforementioned assertions, in this study to create plant-based chitosan nanoparticles using fresh neem leaves. Our findings were subsequently validated UV-VIS spectrophotometry and further identified SEM analysis. FTIR analysis was also used to validate the functional groups.

II. MATERIALS AND METHODS

2.1 Preparation of neem extract:

of fresh *Azadirachta indica*, or neem, leaves were , and each leaf was carefully cleaned with tap water. , these leaves were once again washed with distilled water, and a mortar and pestle were used to make a thin paste. After the paste formed, 100 of D/W combined with it and heated to for twenty minutes. Muslin cloth was used to filter this mixture, was centrifuged for 20 minutes at 1000 rpm. The supernatant was collected and for further use.

2.2 Preparation of chitosan nanoparticles

The plant extract and 1% chitosan solution were combined in test tubes a 1:1 ratio total volume of . For twenty-four hours, the tubes were stored in a dark environment. centrifuged for 15 minutes at 5000 rpm. The nanoparticle pellet was collected and five times with deionized water. Later, UV-VIS spectroscopy was employed . Here plant extract was as a control.

2.3 UV-VIS spectroscopic analysis of plant-based chitosan nanoparticles

The purified nanoparticles were UV-VIS spectroscopy in the range wavelength UV-VIS spectrophotometer spectra .

2.4 FTIR analysis of plant-based chitosan nanoparticles

For this analysis the nanoparticles were in the range of -800 cm^{-1}. Here chitosan was used as control with plant based chitosan nanoparticles.

2.5 SEM analysis of plant-based chitosan nanoparticles

The powdered sample of chitosan nanoparticles was sent for SEM analysis to analysis section, SPPU, Pune.

III. RESULTS AND DISCUSSION

3.1 Preparation of based chitosan nanoparticles

plant extract was added 1% of chitosan solution 1:1 and kept dark for 24 hours. Later the color of the solution changed from light green to dark brown indicating the formation of chitosan nanoparticles. Nigam et al (2022), also performed similar experiment chitosan nanoparticles leaves, and roots of *Clitoria ternatea* leaves. They obtained pale yellow, greenish and brownish nanoparticles. that the color of the chitosan nanoparticles prepared with the use of extract.

3.2 UV-VIS spectroscopic analysis of plant-based chitosan nanoparticles

Using UV-VIS spectroscopy, the pure chitosan nanoparticles were examined, and the sample was scanned between 200 and 800 nm in length. The absorbance peak at 235 nm in Figure 1 is indicative of chitosan nanoparticle production. The chitosan absorption peak was found at 295 nm, suggesting a shift in the position of peak. of present in accordance with the peak at 250 nm found by Thamilarasan et al. (2018). According to Rai et al. (2017), 320 nm is the absorption peak of chitosan nanoparticles. According to reports, the presence of CO has caused the UV–visible spectrum to vary between 200 and 322 nm (Duraisamy et al., 2022).

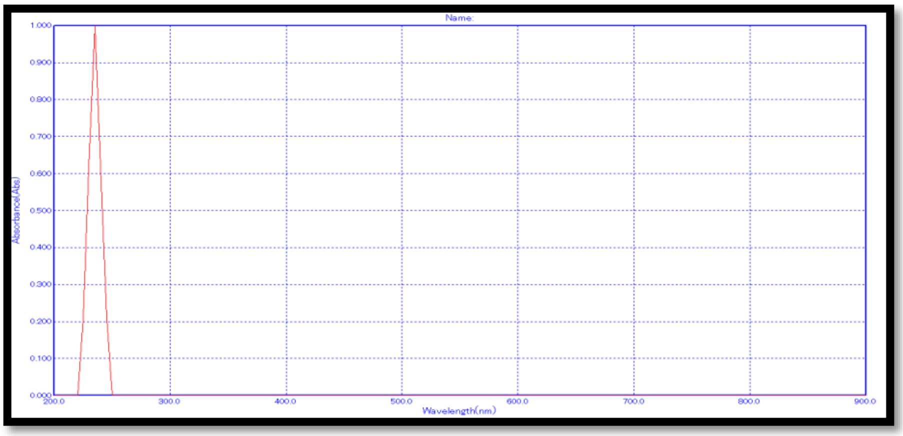

Figure 1: analysis of based chitosan nanoparticles

3.3 FTIR analysis of based chitosan nanoparticles:

FTIR analysis the spectra of chitosan nanoparticles with standard chitosan. characteristic vibrational at 3333.43 cm which is associated O-H stretching which is a primary functional group of chitosan, 1636 cm peak corresponds to C=O stretching of (Varun et al., 2017), 1419.38 cm is associated C-H bending and 1278.48 cm corresponds to C-OH vibrations (Hong et.al., 2021; Fernanades et al., 2014). when the FTIR spectra of neem based chitosan nanoparticles studied (Figure 4), multiple peaks other chitosan were observed. The peaks at 3412.72, 3204.98 and 3047.01 the stretching vibrations of amino and -OH groups. The peak at 2377 is related to symmetric stretching of C-H, 1628.77 is due to stretching of amide I group, 1328.23 is -NH2 bending. peaks between 1200 850 stretching of III. The results of parallel the FTIR results obtained by Dursaisamy et al., (2022) and Abdallah et al., (2020), plant materials for synthesis of chitosan nanoparticles. These findings imply that the most effective chemicals in ethanol extract are those that can convert chitosan from its natural form into chitosan nanoparticles. The reduction, capping, and stability of chitosan nanoparticles are facilitated by the presence of terpenoids, polyphenols, and flavonoids as important functional groups (Singh et al., 2018).

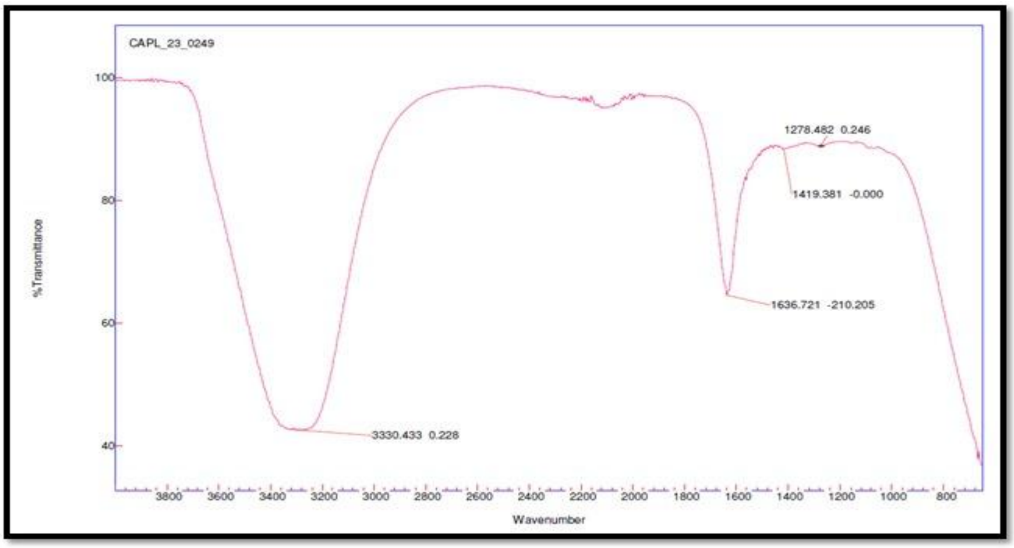

Figure 2: FTIR spectra of

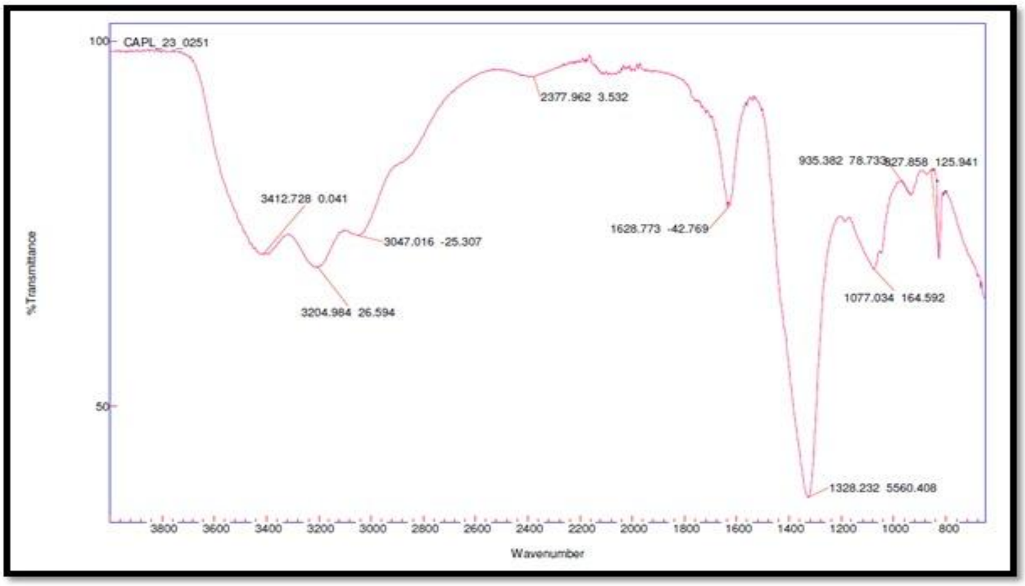

Figure 3: FTIR spectra of Neem based chitosan nanoparticles

3.4 SEM analysis of plant-based chitosan nanoparticles

SEM analysis of the chitosan nanoparticles was analysis section in SPPU, Pune. Figure 4, the structure of nanoparticles, which are spherical shape and size . Manne et al. (2020) that *Pterocarpus marsupium* heartwood extract was used to create spherical CNPs, which ranged in size from 90 - 110 nm. According to Shetta et al. (2019), the pure and original chitosan typically up to 350 nm. Similarly, plant extracts were used to create 200–350 nm-sized spherical-shaped CNPs, according to Ilk et al. (2017). The concentration utilized and the parameters (such as reaction time) for the manufacture of MA-CNPs determine the size and form of the resulting particles (Garavand et al., 2022).

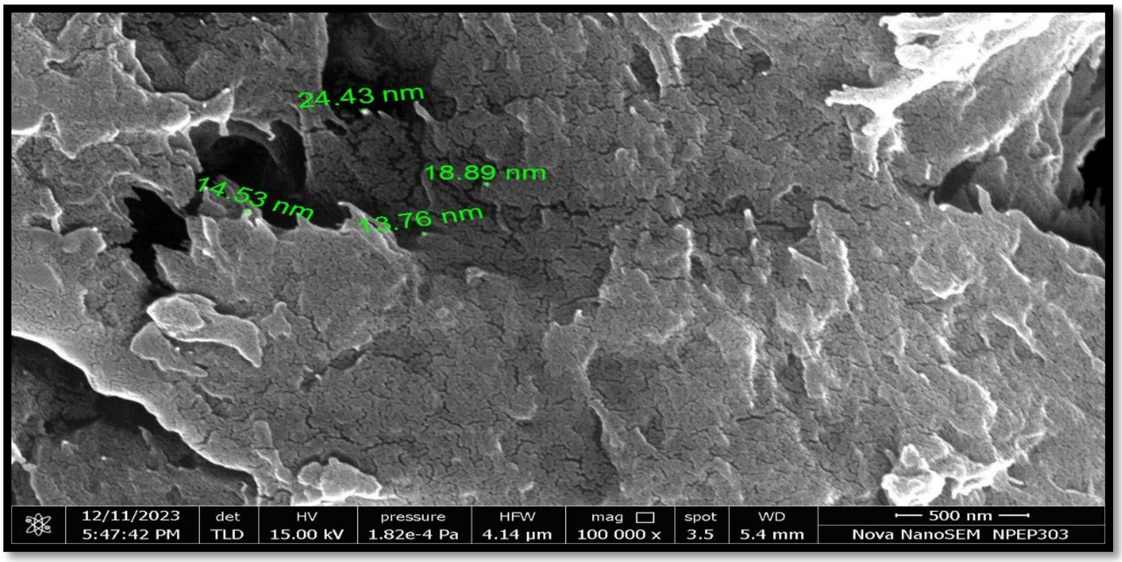

Figure 4: SEM analysis of plant-based chitosan nanoparticles

IV. CONCLUSIONS

Owing to multiple advantages of chitosan, in current study an attempt was made for plant-based synthesis of chitosan nanoparticles for which fresh neem leaves were selected. Later, the formed chitosan nanoparticles were confirmed and SEM analysis revealed that the nanoparticles were spherical in shape and size. FTIR analysis was used to confirm the different functional groups attached to this study that, plant based nanoparticles if made fresh leaves, small nanoparticles are very stable in nature.

Conflict of Authors:

The authors have no the work in this research paper.

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