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Isolation of zinc nanoparticles and analysis of antibacterial activity from *Cinnamomum tamala* against *Staphylococcus aureus*

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Abstract
This work is to investigate the phytoconstituents and the presence of zinc nano particles in *Cinnamomum tamala*. The plant sample was collected and the zinc nano particles were isolated and characterized by spectrum analysis such as UV-Visible Spectroscopy and Fourier Transform Infra Red Spectroscopy. This study shows that the environmentally benign and renewable leaf extract of *Cinnamomum tamala* can be used as an effective stabilizing as well as reducing agent for the synthesis of zinc oxide nanoparticles. The presence of alkaloids and terpenoids, flavonoids, tannins, phenolic compounds are present in the *Cinnamomum tamala*. Our findings could be targeted for the promising potential applications such as bio sensing devices and nano electronic devices because of its pollution free and eco-friendly approach. We concluded that *Cinnamomum tamala* has effective antibacterial activity and it is effectively docked with receptor. This study could be very helpful in the pharmaceutical applications in future.

Keywords: zinc nanoparticles, *Cinnamomum tamala*, phytoconstituents, antibacterial activity

Introduction

Nanotechnology is a developing interdisciplinary field which includes martial science, bionanoscience and technology. Nanotechnology provides a potential alternative for antimicrobial agents against traditional antibiotics. Metal oxides have been exploited for a long times for their antimicrobial properties. Zinc oxide nanoparticles are preferred because of their biocompatible nature and excellent antibacterial potentials [1]. Nanoparticles are studied extensively for their specific catalytic, magnetic, electronic, optical, antimicrobial, and anti-inflammatory properties. This study focus on the synthesis of Zn nanoparticles from *Cinnamomum tamala* using aqueous extract and acetone extract and to evaluate their antimicrobial efficacy [2].

Cinnamomum tamala is a wonderful medicinal agent mainly used for antidiabetic and antioxidant potential with immune suppressive property [3]. The leaves of *Cinnamomum tamala* have been traditionally used for curing a number of ailments in biological systems such as immune system, gastrointestinal tract, liver and its antioxidant, antidiabetic, anti-inflammatory, anticancer, and antimicrobial activity [4]. The methanolic extract of Cinnamomum tamala showed efficacy against *Staphylococcus aureus* [5].

Nano sized Zno particles of specific morphology were synthesized using the plant leaf of *Cinnamomum tamala*. The structures, morphology, optical properties, surface area and thermal behavior of these fabricated Zno nanoparticles were characterized by X-ray diffraction, Scanning Electron Microscopy, Ultraviolet visible spectroscopy (UV-Vis) and Photo degradation for the antibacterial activity of the nanoparticles. [6] Zinc oxide (ZnO) is a attractive semiconductor material with many properties in material science, physics, chemistry and biomedical science [7].

Nanoparticles can be classified into two categories such as organic and inorganic nanoparticles. Organic nanoparticles may include carbon nanoparticles and inorganic nanoparticles may include magnetic nanoparticles, noble metal nanoparticles like gold and silver and semiconductor nanoparticles like titanium dioxide and zinc oxide [8]. Nanoparticles exhibit improved characteristics due to their size, distribution and morphology and are widely used in several scientific fields and they are important especially due to their physiochemical and antimicrobial properties help in therapies, molecular diagnostics and in devices used for medical procedures [9]. The samples were characterized by x-ray diffraction and Scanning Electron Microscopy and the biological synthesis of ZnO nano particles are very fast, easy, cost effective and eco-friendly it is used for the preparation of various antibacterial formulations [10].

Materials and Methods

Collection and preparation of plant extract

The leaf of Cinnamomum tamala was collected from Perambalur region and washed with water to remove the dust particles and dried under shadow to remove the residual moisture. The extract was used for the reduction of zinc ions (Zn2+) to zinc nanoparticles (ZnO) was prepared by placing 200g of dried fine cut leaves in 500ml glass beaker along with 200ml of sterile distilled water. The mixture was added with aqueous solution changed from cooled temperature and the extraction was filtered. using filter paper. These extracts were used for phytochemical analysis qualitatively. Phytochemical analysis was performed to identify the presence of major phytoconstituents using standard qualitative methods.

Preparation of zinc nanoparticles

For the synthesis of nanoparticles 200 ml of *Cinnamomum tamala* extract was taken and boiled to 60-80ºC using a stirrer heater. 10g of zinc Nitrate was added to the solution as the temperature reached to 60ºC. The mixture is then boiled until it reduced to a deep yellow coloured paste. The paste was then collected in a ceramic crucible and heated in an airheaded furnace at 400ºC for 2 hours. A light yellow coloured powder was obtained and this was carefully collected and packed for characterization purposes. The material was washed with pestle so as to get finer nature for characterization.

Characterization of Zinc nanoparticles

Several techniques are used for characterizing different nanoparticles. Here we have used Absorption spectrophotometer (UV-VIS), Particle size analyzer and Fourier transforms infrared spectroscopy (FTIR) for characterization of zinc nanoparticles.

Results

Phytochemical analysis

The phytochemical constituents like alkaloids, flavonoids, terpenoids, fixed oils and fats, phytosterols, saponins, phenolic compounds, fats, carbohydrates, proteins, glycosides, lipids and tannins of ethanolic, aqueous and acetone extract of *Cinnamomum tamala* were analyzed qualitatively represented in Table 1.

Table 1: Phytochemical constituents analyzed qualitatively with various extracts

S.No	Metabolites	Ethanolic extract	Aqueous extract	Acetone extract
1	Alkaloids	++	++	+++
2	Flavonoids	+++	+++	+++
3	Terpenoids	++	+	+
4	Fixed oils	-	-	-
5	Phytosterols	+	++	+
6	Saponins	-	-	-
7	Phenolic compounds	+	++	+++
8	Fats	-	-	-
9	Carbohydrates	++	-	_
10	Proteins	++	++	+
11	Glycosides	++	+	+
12	Lipids	-	-	-
13	Tannins	+	+	+

+++ indicates high concentration ++ indicates medium concentration + indicates low concentration
- Not present in the sample

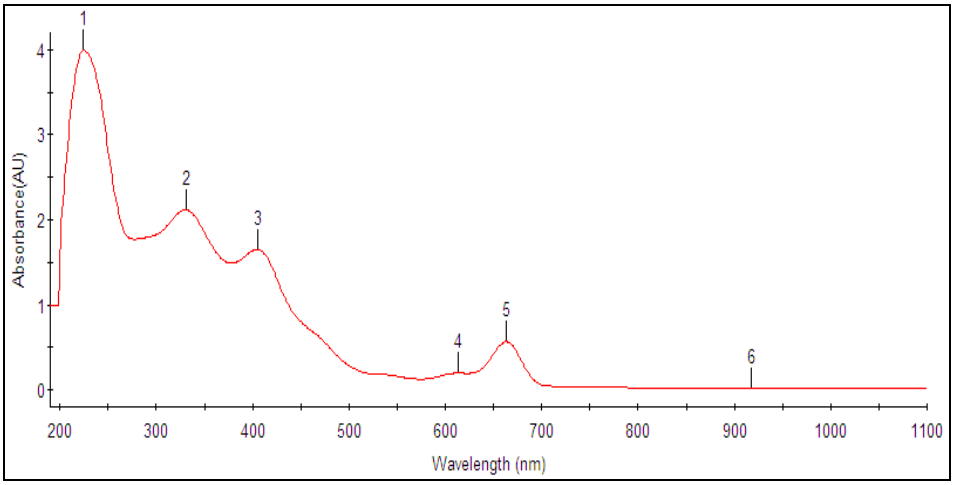

Fig 1: UV-Vis of *Cinnamomum tamala* Plant Extract

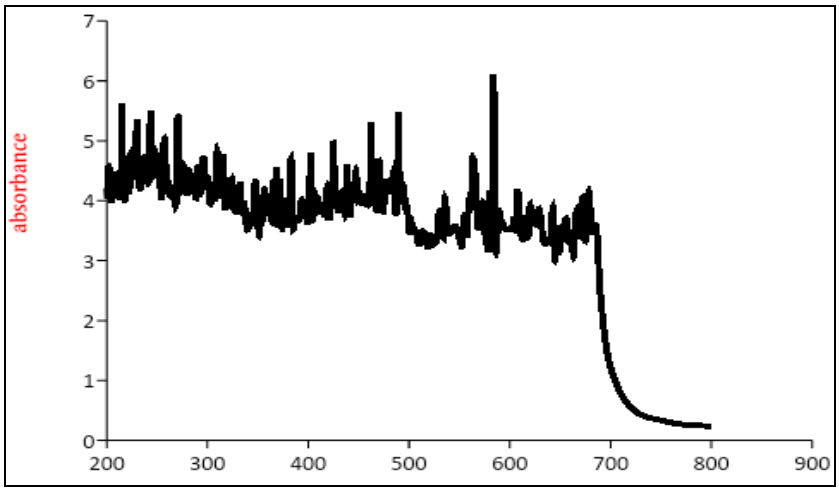

Fig 2: UV-Vis of Zinc Nano particles

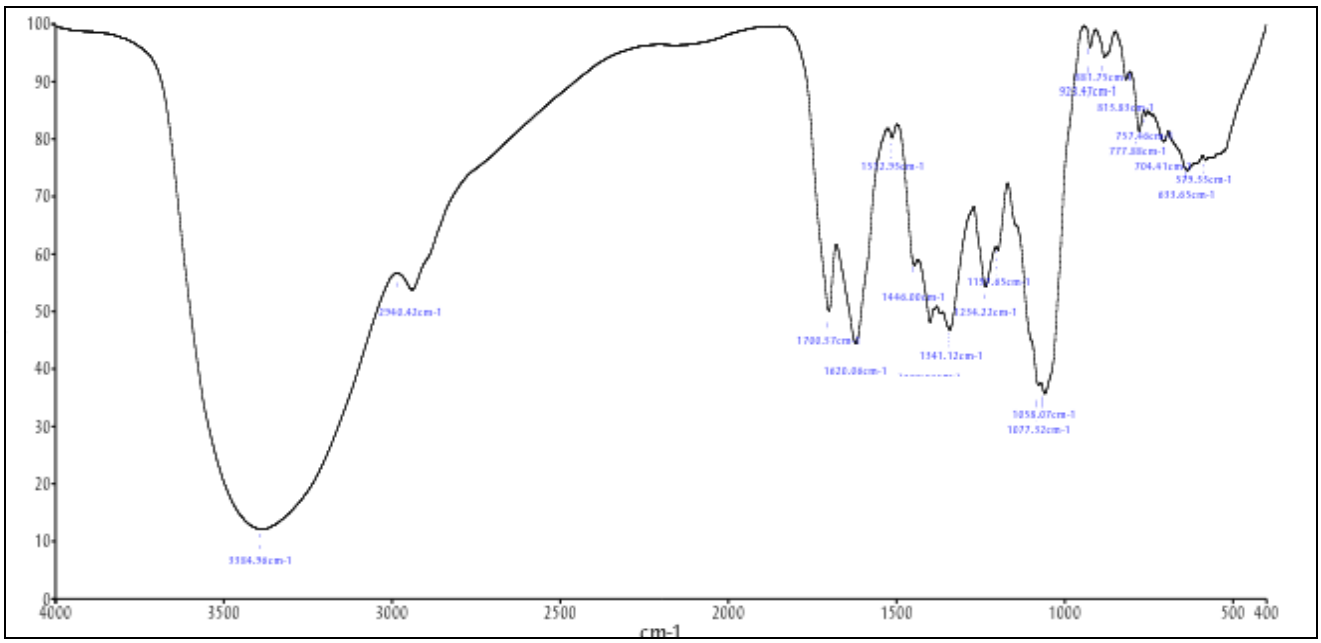

Fig 3: FTIR of Zinc Nano particles

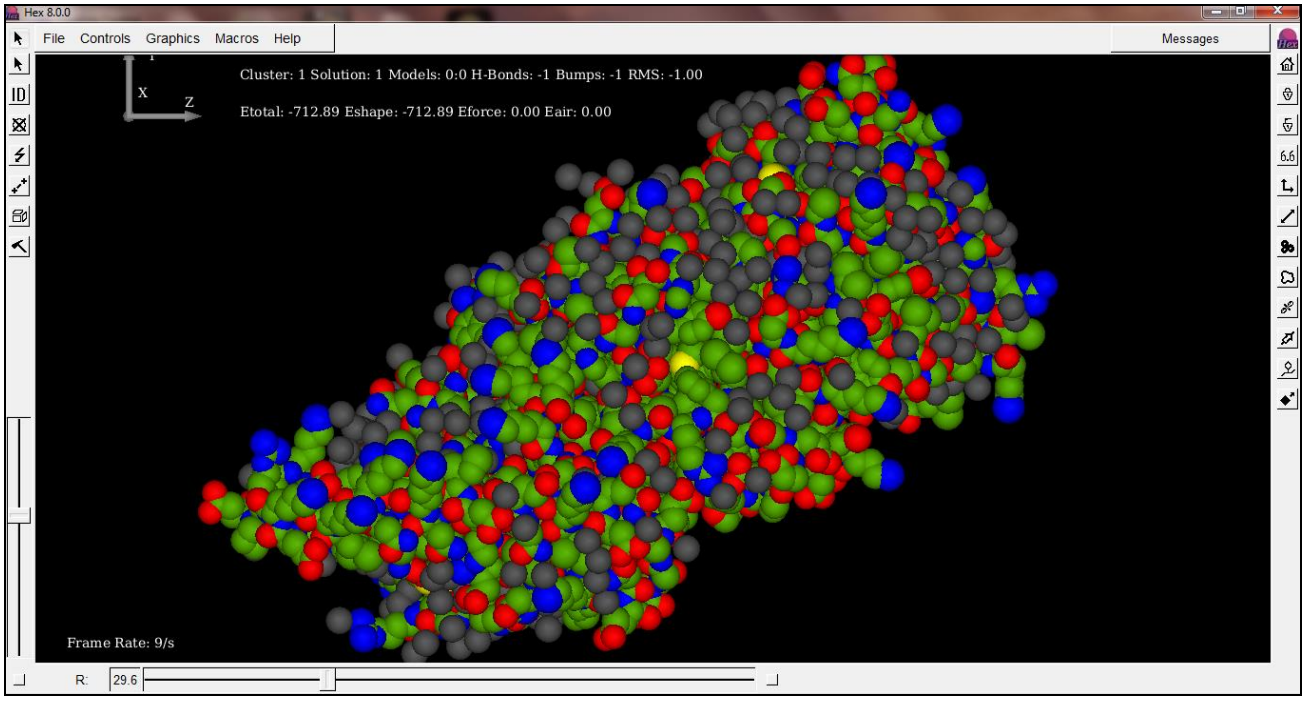

Fig 4: Receptor docked with the ligand cinnamaldehyde

Table 2

Models	Residues	Atoms	Charged Residues		Net charge	Etotal	Eshape
			+ve	-ve			
Receptor	719	4367	54	56	-2	-712.89	-712.89
Ligand	366	1556	17	9	8	-712.89	-712.89

Discussion

The results of preliminary phytochemical analysis are represented in the Table 1. The phytochemical study revealed the presence of various phytoconstituents in ethanol, aqueous, and acetone extracts. The alkaloids and flavanoids are present in highest concentration whereas terpenoids, phenolic compounds, proteins and glycosides are present in medium concentration in these extracts.

On the basis of UV-Vis and FT-IR spectral analysis on *Cinnamomum tamala*, we have found that UV-Vis showed the elevations for alkaloids and flavanoids in the graph and the values were interpreted. FTIR is shown in graph 3 yielded maximum and minimum peak levels for the compounds and it confirms the presence of functional groups in the compound. The structure of the ligand effectively docked with *Staphylococcus aureus* and it inhibits the activity.

Conclusion

These results suggest that *Cinnamomum tamala* has large amount of metabolites such as alkaloids, flavanoids, phenolics, terpenoids and glycosides. From these results, we observed that UV-Vis and FT-IR spectral analysis on *Cinnamomum tamala*, showed the elevations for metabolites and it confirms the presence of functional groups. The ligand effectively binds with *Staphylococcus aureus* and it confirms the antibacterial activity. Therefore, these extracts are having compound with antibacterial and antioxidant properties which could be possible to predict new ailments in future.

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