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Bacterial combating potential of biogenic nano silver particles

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ABSTRACT

The nanotechnology had been gaining importance in all the fields like technology, medicine even in robotics. The scientists are focusing on that type of synthesis wherein the advantages overcomes the disadvantages of the production and the plants have been probed as better alternatives in this field. The emerging technology of using plants as precursors or aiding in the production of nanotechnology is viewed as ecofriendly, low toxicity and better in approaching the preparation of nanoparticles. That is why nanoparticles of silver had been in usage considering its antibacterial potency to kill any kind of bacteria. Silver particles had been the best choices for physicians to treat wounds. Hibiscus Rosa sinensis plant leaves are found to have abundant polyphenols and so they can be used to reduce the silver ions into nanoparticles. The formed nanoparticles were less toxic as they were synthesized in a natural process. These when tested for antibacterial activity against three species of bacteria, the results were as expected. The produced silver particles showed a significant ZOI compared to the standard drug.

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INTRODUCTION

The nanotechnology had been gaining importance in all the fields like technology, medicine even in robotics. Because of their advantages, these have been widely used in medicine in diagnosis, treatment and aiding purpose. But the production of nanoparticles has its disadvantages besides having its benefits. So the scientists are focusing on that type of synthesis wherein the advantages overcome the disadvantages of the production and the plants have been probed as better alternatives in this field. The emerging technology of using plants as precursors or aiding in the production of nanotechnology is viewed as ecofriendly, low toxicity and better in approaching the preparation of nanoparticles [1].

Silver is a known antibacterial agent to human beings during the history from the early period. The utensils made up of silver are used to preserve food, milk, wine and water, which helps them store for more extended periods as evident from their experience though there was no enough scientific evidence. Though the silver is being used extensively, the toxicity of it is always a matter of concern. But the antibacterial activity of silver is being considered valuable and any method to surpass the toxicity makes it useful. That is why nanoparticles of silver had been in usage considering its antibacterial potency to kill any kind of bacteria. Silver particles had been the best choices for physicians to treat wounds. Silver particles are not just only use in the pharmacy or medicine but it is also used in various electrical and related technology [2].

There had been numerous amounts of research that had been done and published on the production of nanoparticles of silver by using herbal extracts as reducing agents. Few of them are Soap nuts, Neem,

Citrus species, Cinnamon, Lannea Coffee, tea, Catechins etc.. so this present research focusses on the production of the silver particles using herbal extract and the focus was made on the polyphenol-rich hibiscus leaves. Hibiscus Rosa sinensis plant leaves are found to have abundant polyphenols and so they can be used to reduce the silver ions into nanoparticles [3].

METHODOLOGY

Herbs collection & processing

The Leaves of Hibiscus rosa sinensis are procured from locally cultivated plants and were authetified by Prof. C. Madhava Chetty, S.V.University, Chittoor, Andhra Pradesh. The leaves were shade dried at room temperature and are powered. The powder is a weight for 50gm and was extracted with distilled water in 250ml beaker. This was stirred continuously for every 6hrs and continued for 24hr. After the period the macerate was filtered and the filtrate is passed through a whattman paper thrice to achieve a clear solution. This solution was directly used for synthesis.

Bacterium Cultures

Bacterium cultures that were used to study were bought from pure cultures from the nearby lab and are developed in the college laboratory. All the cultures were incubated and multiplied on agar medium.

Synthesis of Nano-Particles

Silver nitrate of concentration 1milli moles was taken in a measured quantity of 150ml and is distributed in 3 flasks with 50ml in each flask. 5ml, 10ml and 15ml of plant extract solution were poured into these flasks and the volume is made up to 200ml with distilled water. This solution was subjected to centrifugation under 1500 rpm to separate any precipitates of silver nitrate. The supernatant liquid is collected and then heated at a temperature of 50ºC - 60ºC on a water bath. The process was carried out until the change of colour is noted. The heating is stopped when there was a colour change in the solution and the final solutions were named as HNS-5, HNS-10 and HNS-15 where the extracts added are 5ml, 10ml and 15ml respectively.

Confirmational analysis

As the silver particles are formed due to the reducing capacity of the extracts, the effect is measured by analyzing in the UV spectroscopy. The solution was diluted with distilled water to a volume that exhibits spectrum at a range of UV and the volume is maintained constant for all the three media. They were subjected to UV for a frequency at the range of wavelengths to find the wavelength maximum. The absorbance was measured after the reaction timings of 1min, 1hr, 2hr and 3hr.

Potency against selected bacteria

The potency of the prepared particles was evaluated on three microorganisms, Staphylococcus aureus, Pseudomonas aeruginosa, and Bacillus subtillis. The used to test the antibacterial strength is estimated using a dip well method using a standard practice by Theivasanthia. Agar medium as prepared and poured in petri plates and these are inoculated and incubated using the three bacterial cultures. Cavities were dug out in the medium and filled with 20 microlitres of three formulations of nanoparticles and clindamycin is taken as standard drug. The plates were incubated for about 24hr in an oven and the zones of inhibition were calculated.

Comparisons

The data were subjected to ANOVA and compared to each other using one-way Dunnett's tests. The level of significance was tabulated along with the results.

DATA & ANALYSIS

The biogenesis of silver particles was confirmed by noting of colour change in the solution after heating. The filtrate was pale orange-yellow before subjected to heat and it turned into dark reddish-brown colour in after heating. This colour change denotes the formation of silver particles [4] (Table 1).

The biogenesis is also confirmed when they are tested for surface plasmon resonance phenomenon in UV. The UV graphs were seen in time durations of 1min, 1hr, 2hr and 3hr. The peaks are observed at 415nm and the height of the peak was proportional to time duration. With the increase in time duration, the peaks tend to become sharper that suggests the formation of nanoparticles are of even size. The height of the peaks denotes the extent of establishment of nanoparticles with the help of reducing chemical constituents like polyphenols [5]. (Figure 1)

The formed nanoparticles were less toxic as they were synthesized in a natural process. These when tested for antibacterial activity against three species of bacteria, the results were as expected.The produced silver particles showed a significant ZOI compared to the standard drug the results were given in table 1. But interestingly the silver particles showed a better activity for HNS-15 when compared to clindamycin in petri plate with the bacillus.The formed silver HNS-5, HNS-10 and HNS15 showed ZOI [6].

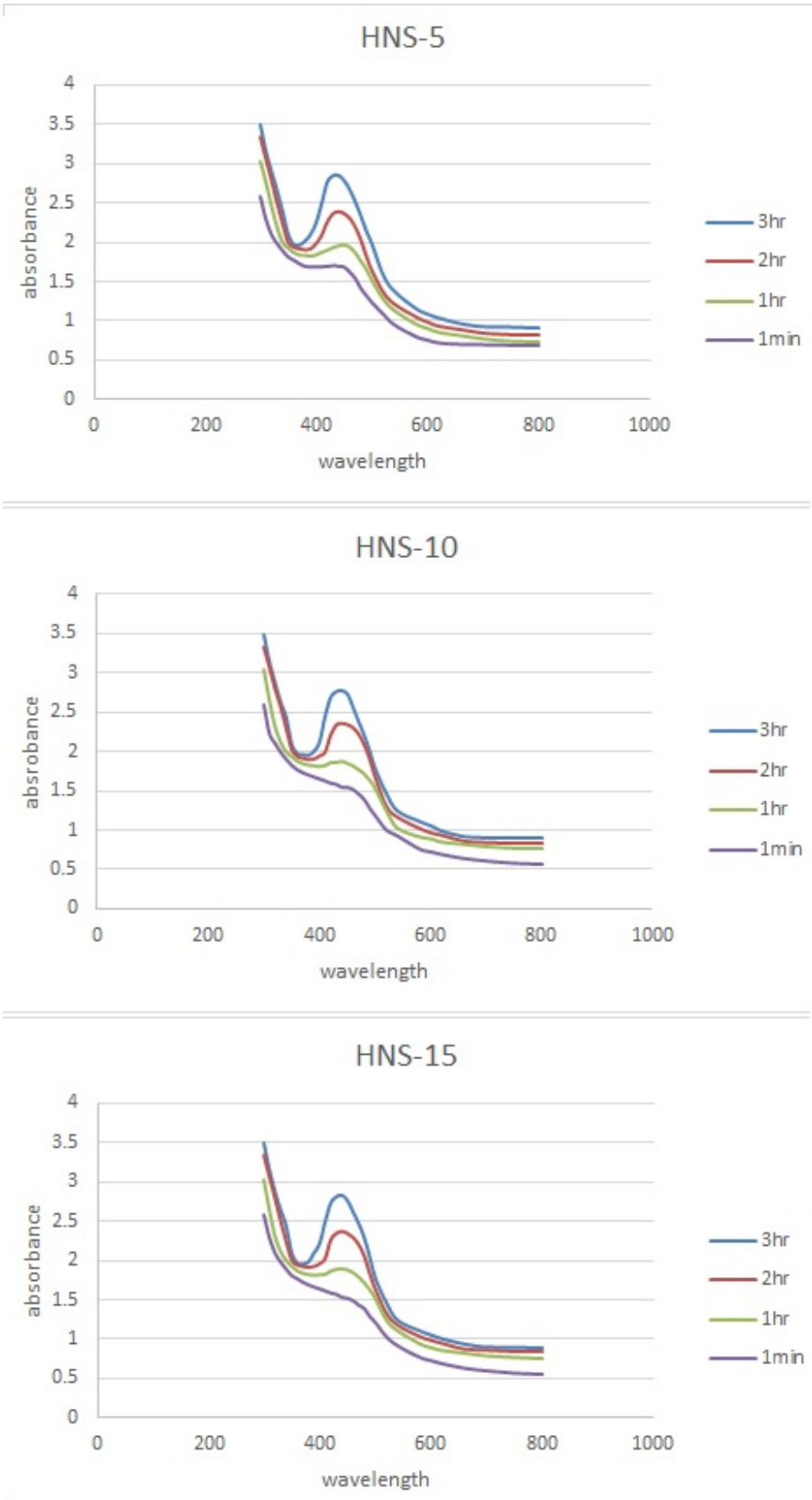

Figure 1: UV confirmation of formed silver particles

Table 1: Antibacterialpotential of HNS

Pseudomonas aeruginosa		Bacillus subtilis	Staphococcus aureus
Group	**ZOI(mm)**	**ZOI(mm)**	**ZOI(mm)**
HNS-5	2.52±0.47	2.19±0.52	1.69±0.47
HNS-10	3.92±0.69*	4.51±0.13*	2.84±0.28*
HNS-15	5.18±0.51**	6.09±0.93**	3.95±0.53**
Standard	4.93±0.82	6.24±0.27	4.08±0.69

*P<0.01 insignificant compared to standard; **P>0.01 insignificant compared to standard

CONCLUSION

As discussed, silver nanoparticles had been in medicinal and pharmaceutical applications. Consideration the antibacterial activity of the nanoparticles and the toxicity of the production of those particles, a biogenetic method had been adopted to produce them naturally. This method was believed to bypass the toxic effects of the chemical synthesis of nanoparticles. So the attempt had been made to provide the silver nanoparticles using hibiscus leaf extract and the produced particles were analyzed using UV. The antibacterial activity was also screened using three bacteria species and found to be effective in comparison to the standard drug clindamycin. Further studies can focus on the evaluation of particles size distribution of the particles, surface morphology evaluation.

CONFLICT OF INTEREST

Authors declared no conflict of interest.

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