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Screening for synthesis of silver nanoparticles from red ripened Capsicum

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A B S T R A C T

Capsicum is an important part of the human diet with significant medicinal importance. It is it proven in various studies that capsicum is rich in phytochemicals and antioxidants. In this study we have determined the natural concentration of two biological reducing agents *i.e.,* ascorbic acid and total phenolic contents that are responsible for bioreduction of silver ions from red ripened capsicum. Free radical scavenging activity was also measured before synthesis of nanoparticles. The screening of silver nanoparticles biosynthesis was done by scanning of samples at 300-700 nm with UV-VIS Spectrophotometer. The effect of time on Plasmon peaks were also observed for 15 days incubation time. DPPH scavenging activity was about 54.15 % and the phenolic content was 157.47 µg/ml.

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1. Introduction

Due its potential application in biomedical and industrial level silver nanoparticles are very much in consideration nowadays researchers are very much interested in the synthesis of silver nanoparticles from various chemical and biological sources. Silver nanoparticles showed significant antimicrobial activities against various pathogenic microorganisms such as *Salmonella typhi, Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Klebsiella, Pseudomonas, Mycobacterium* (Hazarika et al. 2016). Various studies are being conducted for a cost effective synthesis of nanoparticles from plants , for example, Cycus leaf extract, Alfalfa, Aloe Vera, Tulsi, Neem, Cane Molasses (Jha & Prasad 2010; Shankar et al. 2003; Chandran et al. 2006; Banerjee et al. 2014; Pavani et al. 2016). Capsicum consists of approximately 20–27 species, five of which are domesticated: *C. annuum, C. baccatum, C. chinense, C. frutescens, and C. pubescens.* Phylogenetic relationships between species were investigated using biogeographical, morphological, chemosystematics, hybridization,

and genetic data. Fruits of Capsicum can vary tremendously in color, shape, and size both between and within species, which has led to confusion over the relationships between taxa (Babu 1999).Earlier some studies were undertaken indicating the synthesis of silver nanoparticles from green fruits of chili with the different amount (Chakra & Rao 2015). In this study, natural concentration of total phenolic content and free radical scavenging activities were determined. Various literature searches indicated that some plant phytochemicals like ascorbic acid and total phenolic contents play important role in green synthesis of silver nanoparticles. Earlier some studies were undertaken indicating the synthesis of silver nanoparticles from green fruits of chili utilizing the different amount of chili (Chakra & Rao 2015). In this study, natural concentration of total phenolic content and free radical scavenging activities were determined. Various literature searches indicated that some plant phytochemicals like ascorbic acid and total phenolic contents play important role in green synthesis of silver nanoparticles.

2.Materials and Methods

2.1.Materials

Red ripened fruit of capsicum was collected from the local market of Meerut.The chemicals and reagents used in this study were of analytical and HPLC grade.

2.2.*Synthesis of silver nanoparticles from red ripened capsicum fruit extracts*

Synthesis of silver nanoparticles from red ripened capsicum was done with a slight modification of Jha & Prasad protocol (Jha & Prasad 2011). For the preparation of red ripened capsicum extracts 10 gms red fruits of capsicum were taken and washed thoroughly in running tap water for 10 min in order to remove the dust particles and then it was cut into small pieces and rinsed with sterile distilled water. Capsicum fruits extracts were then mixed with 200 ml of 40% Et-OH and boiled for about 45-45 minutes followed by filtration through a muslin cloth. For the experiment, 40 ml of the filtered capsicum extracts was added in 40 mL of deionized water after which it was treated with 20 mL of 0.25(M) $AgNO_3$ solution and the resulting solution was heated at 80°C for 5 min.Silver nanoparticles formation was confirmed by peaks on UV-VIS spectrophotometer in the range of 360-450 nm. Concurrently, UV-vis spectrophotometric study was pursued in which 40% Et-OH extract of the fruit (containing crude Capsaicin) was taken as blank.

2.3.Determination of total phenolic content

For total phenolic content estimation, about 3 ml diluted extracts of the sample (leaf/flower extracts) were added to the 0.5 ml Folin's reagents. After incubation of 3-5 min, 2 ml of 20 % $NaHCO_3$ was added to each tube and mixed thoroughly.Tubes were incubated in boiling water bath for 1min and after cooling, the formation of colored compounds was observed at 650 nm using gallic acid as standard.

2.4.Determination of Free radical scavenging activity by DPPH method

The DPPH radical scavenging activity was estimated by adding 1.0 ml of extract from each dilution into the test tube containing 2.0 ml of DPPH solution. Control was prepared by adding 1.0 ml of methanol to 2.0 ml of DPPH solution. Ascorbic acid was used as a standard. The mixture was shaken vigorously and was left to stand in dark for 30 min.The absorbance of the resulting solution was measured at 517nm.

2.5.Antimicrobial Activity

Antimicrobial activity was observed using microorganism isolated from soil by the well diffusion method. A comparative study was performed using antibiotics and silver nanoparticles.

3.Results and Discussion

Silver nanoparticles synthesis by green synthesis is one of the easiest and cost effective methods. Good peaks were observed in our study indicating the synthesis of silver nanoparticles. Effect of time is represented sequentially on Plasmon peaks and it was clearly observed in peaks that the after incubation there is a slight increase in peaks (Figure 1). The nanoparticles synthesized from red ripened capsicum is showing clear antimicrobial activity as represented in figure 2A and 2B. It was observed that silver nanoparticles isolated from red ripened capsicum displayed less antimicrobial activity in comparison to antibiotics and cannot be used as an alternative to antibiotics. Total phenolic content and free radical scavenging activity of red ripened capsicum was also determined.

3.1.Synthesis of nanoparticles

Green synthesis of silver nanoparticles was done from extracts of red ripened capsicum. Samples were scanned at 300-700 nm and Plasmon peaks described the synthesis of silver nanoparticles. Samples were observed for 15 days and scanning was performed. Results indicated that time duration plays a significant role in the synthesis of silver nanoparticles which was clearly observed by the difference in Plasmon peaks every day (Figure 1).

3.2.Total phenolic contents

It was earlier found that some phenolic contents may play a significant role in the bioreduction of salt for green synthesis of silver nanoparticles. Natural concentration of total phenolic content was found 157.47 µg/ml in red ripened chili (Table 1).

3.3.Free radical scavenging activity

Free radical scavenging activity was found significant in green synthesis of nanoparticles.During experiments, free radical scavenging activity was found about 54.15 % (Table 1).

3.4.Antimicrobial activity

Antimicrobial activity of silver nanoparticles was analyzed against bacterial species isolated from the soil and significant antimicrobial activity was observed. A comparison between the antimicrobial activity of synthesized nanoparticles and streptomycin was also performed (Figure 2A, 2B).

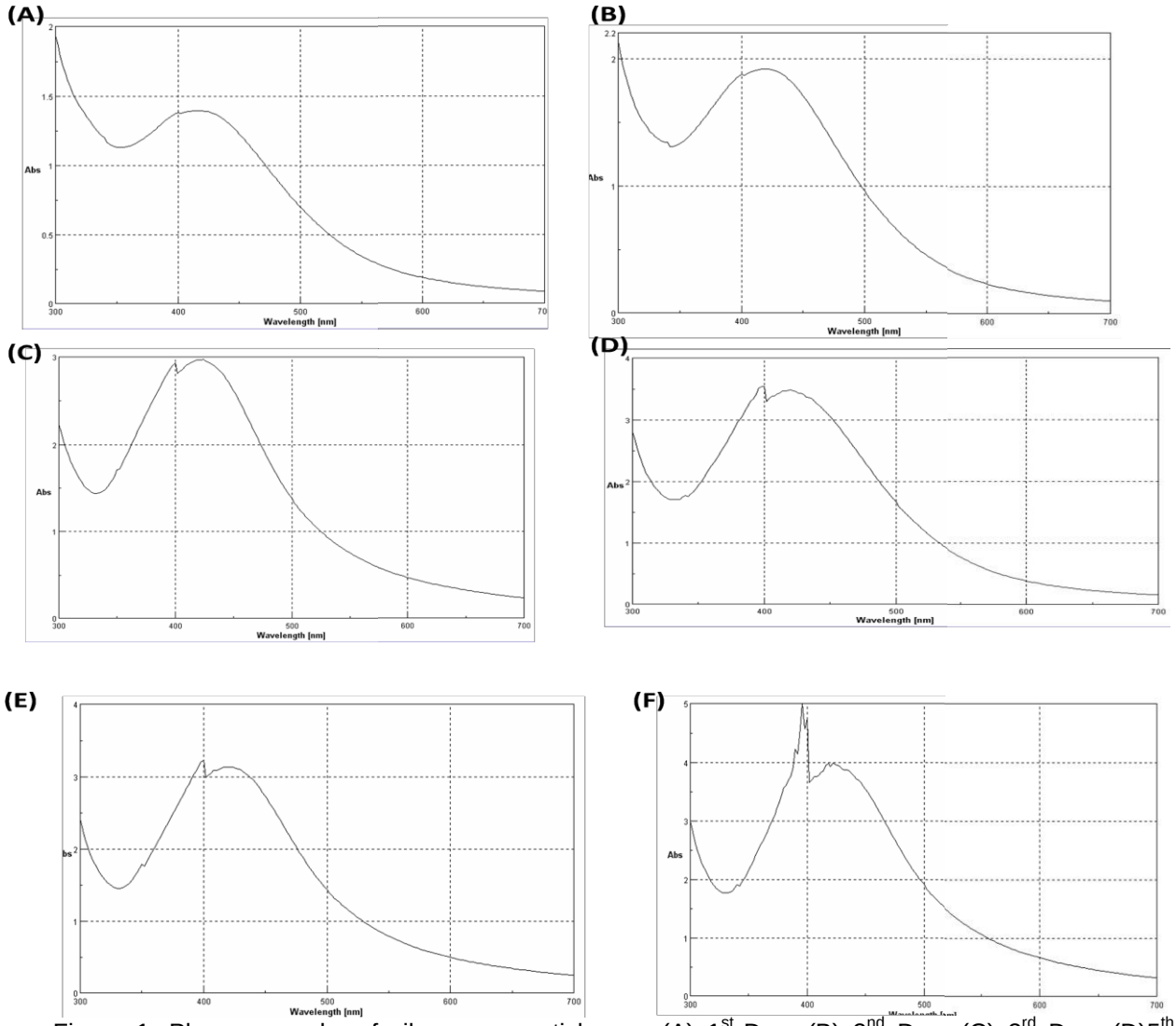

Figure 1: Plasmon peaks of silver nanoparticles on (A) 1st Day, (B) 2nd Day, (C) 3rd Day, (D)5th Day, (E)7thDay, (F)15thDay

Figure 2a: Representing the antimicrobial activity of synthesized silver nanoparticles
Figure 2b: Comparative analysis of antimicrobial activities of antibiotics and synthesized silver nanoparticles.

4.Conclusion

Synthesis of silver nanoparticles was performed under the context of phytochemicals mediated green synthesis from red ripened capsicum.Effect of time on synthesized nanoparticles was analyzed for 15 days. Our synthesized nanoparticles exhibited antimicrobial activities. It was observed that phenolic content present in plants play a crucial role in biologically synthesized nanoparticles, however, further investigation is required for better understanding of their role in nanoparticle synthesis.

5.Acknowledgements

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