Anti-bacterial Effect of Synthesized Silver Nanoparticles using Capsicum Annuum L

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Abstract
Medicinal plants are the sources of medicine .To determine the anti-bacterial effect of synthesized silver nanoparticles using Capsicum on Staphylococcus aureus and Klebsiella pneumoniae. The objective of the study was to determine the effect of different concentration extracts of Capsicum annuum (red bell pepper, green bell pepper and yellow bell pepper). The extract from Capsicum showed a higher antibacterial activity against Klebsiella pneumoniae followed by Staphylococcus aureus. The extract had higher percentages of inhibition with increased concentration of red and yellow bell pepper.

Keywords: Capsicum annuum, bell pepper, anti-bacterial activity

Introduction

Green synthesis of nanoparticles from green plant extract are more stable than silver nanoparticles produced by microorganisms (Roy et al., 2015; Sastryet al., 2003). The antibacterial effect of Ag nanoparticles have a strong inhibitory effect on broad spectrum of organisms (Morones et al., 2005 and Lok et al., 2006), by interacting with the thiol groups of enzymes and proteins that are important for the bacterial respiration and the transport of substance across the cell membrane (Sondi 2004 and Cho et al., 2005). Synthesize of Ag-NPs, is a growing interest in developing green synthesis method to produce nanoparticles using biological systems and plant extracts(Anjugam et al., 2018; Fariq et al., 2017 and Chahardoli et al., 2018). Antimicrobial peptides have possibilities in agricultural and pharmaceutical research (Castro and Fontes, 2005) against bacteria, fungi, viruses and/or protozoa by disrupting membrane integrity (Hancock and Lehrer, 1998; Mygind et al., 2005). Pepper contain valuable antioxidants components other than traditional (Hasler 1998). Phytochemical constituents like alkaloids, tannins, carotenoids, saponins, phenols, and flavonoids have been reported to exhibit high antioxidant activities and may be considered as potential factors for reducing silver to silver nanoparticles. Crude extracts of C. annuum varieties have inhibited growth of species of Bacillus, Clostridium, Pseudomonas, Listeria, Salmonella, Staphylococcus, and Streptococcus (Bacon et al., 2016; Careaga et al., 2003; Cichewicz 1996; Doranteset al., 2000). Chili peppers have a wide range pharmaceutical, natural coloring agents and cosmetics, and as the active ingredient in most defense repellants (Kim et al., 2014).

Methodology

Synthesis of silver nanoparticles

The fresh Capsicum annuum extract wasboiled for 5 min. The extract was filtered through Whatman filter paper no 1 and stored at 4°C. The filtrate was treated with AgNO3 solution and incubated in dark at room temperature. As a result, a brown solution was formed, indicating the formation of silver nanoparticles. It showed that silver ions could be reduced by aqueous extract of plant parts to generate extremely stable silver nanoparticles (Ponarulselvam et al., 2012).

Characterization of silver nanoparticles by UV-visible spectroscopy

Synthesis of silver nanoparticles with pepper extract observed by ultraviolet-visible (UV-Vis) spectroscopy. The reduction of the Ag+ ions in solution was monitored by periodic sampling of aqueous component and measuring the UV-Vis spectra of the solution. UV-Vis spectra of these aliquots were monitored as a function of time of reaction on a spectrophotometer (Shimadzu UV-Vis) in 400-700 nm range.

Preparation of discs

The silver nanoparticles was synthesized, appropriate required concentrations of about 20µl, 40µl, 60µl and80µl was taken for anti-microbial activity. Whatman filter paper (No.1) was used to prepare discs approximately 6 mm in diameter and sterilized in hot air oven. After sterilization, the discs were loaded with different concentrations of synthesized extract and kept under refrigeration for 24 hrs. Above discs were dispensed onto the surface of the inoculated agar plates (Gurupriya 2016).

Anti-microbial Assay

Antimicrobial assay of synthesized silver nano particles was evaluated using disc diffusion method. Petriplates were prepared by pouring 30ml of Muller Hinton Agar (MHA) medium (Forbes et al., 1990).The test cultures of Staphylococcus aureus and Klebsiella pneumonia were cultured on agar plates with the help of spreader. Using sterile forceps, filter paper discs (6mm diameter) containing crude extracts of red bell pepper,green bell pepper and yellow bell pepper (20µl, 40µl, 60µl & 80µl) placed on the prepared agar plates for each bacteria. The plates were incubated at 37°C for 24hr and the resulting zone of inhibition was measured.

Results and discussion

UV-Spectrometric Analysis of AgNPs

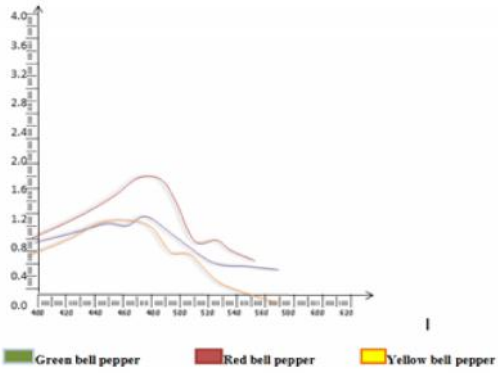

Fig 1:UV-Visible spectrum of biosynthesized bell pepper-AgNPs

Anti-bacterial activity of synthesized AgNPs on Klebsiella pneumoniae

Fig 2: Geen bell pepper

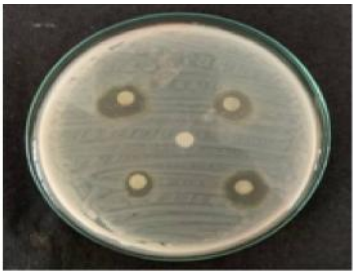

Fig 3:Yellow bell pepper

Fig 4:Red bell pepper

Anti-bacterial activity of synthesized AgNPs on Staphylococcus aureus

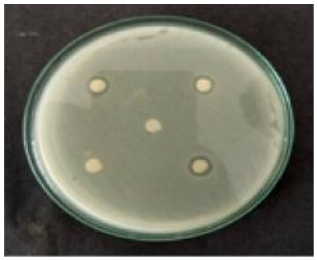

Fig 5:Geen bell pepper

Fig 6:Yellow bell pepper

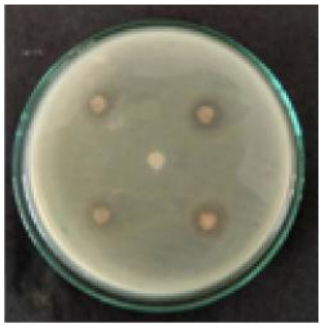

Fig 7: Red bell pepper

Result and Discussion

The emergence of resistant pathogens have threatened the current antibacterial therapy and this necessitated antimicrobial substances from plants for therapeutic properties. Medicinal plants are a rich source of antimicrobial agents due to the secondary metabolites such as alkaloids, flavonoides, tannins and terpenoids that are present in these plants (Mc-Leod 1974; Mole 1987). Plants are important source of potentially useful structures for new chemotherapeutic agents.The silver nanoparticles synthesized by the reductionof silver ions evident from the color change and determined by UV–Vis absorption spectra at 480 nm. Rahman et al. (2010) reported the antimicrobial activity of spices against food spoilage pathogens. The particles showed higher anti-bacterial activity against the pathogenic klebsiella pneumonia and Staphylococcus aureus. Our results are partially compatible with previous antimicrobial activity studies on Capsicum annuum (Berber et al., 2013; Dornates 2000 and Keskin 2011). The higher activity was found in red and yellow bell pepper followed by green bell pepper. The study revealed, nanoparticles using pepper showed good activity against both the gram positive and gram negative organisms, silver has long been recognized for its inhibitory effect on bacterial strains and other microorganisms present in medical and industrial process (Song and Kim, 2009). Location of plants climates, and extraction plays the role in the antimicrobial.

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