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Study of Anti Microbial Activity of Silver Nano Dots by Varying The Lattice Constants.

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ABSTRACT

From ancient times, medical practitioners have used the noble metal Silver for its anti bacterial, anti fungal activities. In this report we study about anti bacterial activities of silver nano dots on E. Coli bacteria only because it contains thin cell wall of few layers of peptidoglycan and is found everywhere in infections and wounds. We critically analyze the changes of inner unit cell lattice constant of silver dots and its enhanced anti bacterial effects¹²². Silver is a safe and effective noble metal because of its non-toxic property to human cells and highly toxic to bacteria such as Escherichia coli (E. coli). The antibacterial activity studies of silver nano dots were carried out by the well diffusion method against the bacterial strains of E.coli on Mueller Hinton agar, according to the Clinical and Laboratory Standards Institute (CLSI). The lattice constants were varied to study the efficacy of the anti microbial activity of silver nano dots and their positive controls on microbial colonies. The results showed that lattice constant variations have significant control on the antimicrobial activity of silver nano dots.

KEYWORDS: Silver nano dots, Antimicrobial activity, chemical reduction, lattice constants.

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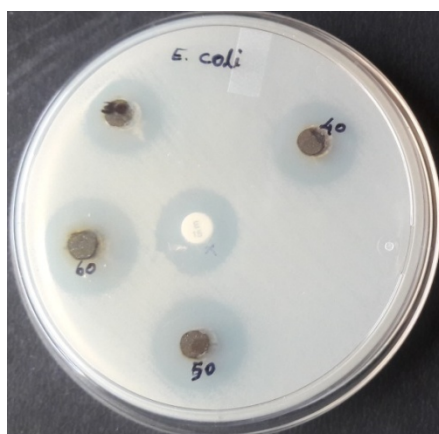
INTRODUCTION

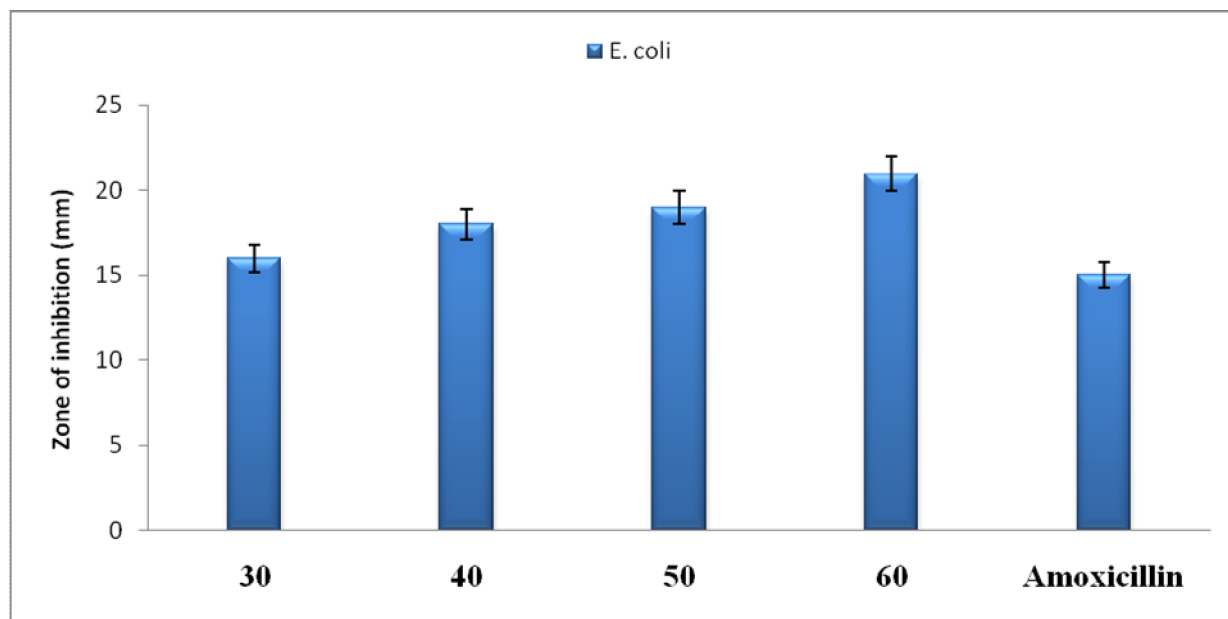
Silver is used by medical practitioners in ayurveda, siddha, allopathy in micro amounts for the effective anti microbial properties it possesses. We understand from studies that nano dots of silver has enhanced antibacterial properties than their bulk material¹. In nano medicine, silver nano dots play a vital role for both therapeutic and diagnostic purposes. Either in drug delivery, diseased cell detection etc silver nano dots are used as effective nano biosensors. Owing to their non toxicity towards human tissues at very low concentration levels they can be used to inhibit bacterial growth in artificial implants, wound dressings and other applications in medicine.

MATERIALS AND METHODS

In this report , we have synthesized Silver Nano dots by dissolving Silver Nitrate salt in de-ionized distilled water and used monosaccharide fructose as reducing agent. The Silver Nano dots harvested by this chemical reduction method was collected, dried and washed . XRD analysis of these nano dots has been done and lattice constant calculated². Cubic structure of Silver Nano dots prepared by this unique method using a mono saccharide simple sugar like fructose is recognized from XRD measurement. Particle size is calculated by using Debye-Scherrer formula, $D = 0.9 \lambda / \beta \cos \theta$

Where ' λ ' is wave length of X-Ray (0.1541 nm), ' β ' is FWHM (full width at half maximum), ' θ ' is the diffraction angle and 'D' is particle diameter size. The calculated particle size diameter is <12 nm. The value of lattice constant 'a' was calculated for (1 1 1) diffraction peak and its calculated value is 4.070 Å. By varying the lattice constant slightly to 4.093 we found the zone of inhibition becoming very stronger and stronger.





Many studies have been done to analyse specific surface area, particle size and lattice constant by various researchers²². Theivasanthi et al have studied the anti bacterial activities of silver nano particles as well as Yamamoto et al. have studied the effect of lattice constant on antibacterial activity of ZnO, resulting in the enhancement in antibacterial activity with the slight increase of the lattice constant. The studies of this experiment showed results in such a way that by varying the lattice constant such as 'a', the antibacterial activities of silver nano dots can be enhanced to a considerable extent¹.

RESULTS AND DISCUSSION

Silver is non-toxic, hypoallergenic, and finds wide application in medicinal field such as heart valves coatings, artificial organ implants, medical face masks, wound dressings and bandages. In addition, no research has discovered any bacteria able to develop immunity to silver as they often do with antibiotics³. Recently, due to the emergence of antibiotic-resistant bacteria and limitations of the use of antibiotics the medical field is nowadays using silver nano particles for inhibiting the formation of infections in wounds and medical devices³. The mechanism of action of silver is linked with its interaction with thiol group compounds found in the respiratory enzymes of bacterial cells. The silver nano dots show efficient antimicrobial property compared to other salts due to their extremely large surface area, which provides better contact with microorganisms. The nano dots get attached to the cell membrane and also penetrate inside of the bacteria. When silver nano dots enter the bacterial cell it forms a low molecular weight region in the center of the bacteria to which the bacteria conglomerates protecting the DNA from the silver ions⁵. The nano dots preferably attack the respiratory chain and cell division finally leading to cell death. E.Coli a gram-negative bacteria have a relatively thin cell wall consisting of a few layers of peptidoglycan.

CONCLUSION

People have used silver for its antibacterial qualities for many centuries. However, Silver Nano dots have showed antibacterial activities more than their bulk metallic counterpart. The biocidal effect was more pronounced and fast when compared to the actions of Silver nanoparticles alone. It was very fast and quick to react and very strong. A slight change in lattice constant 'a' is enhancing its antibacterial activities and Silver nano dots synthesized by this method are showing more antibacterial activities for E.Coli bacteria than Silver nano particles synthesized by other methods¹. The future stands with silver nanodots in fields of allopathic medicine.

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