International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

A Review on Antimicrobial Effect of Silver Nanoparticle against Biofilm Producing Bacteria

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Abstract: ***In recent era multi drug resistant biofilm forming bacteria band Nanotechnology is a burning field for the researchers. Microbial infection caused by Biofilm forming bacteria due to ability of these bacteria to form Biofilm. Formation of biofilm is characteristic for various gram negative and gram positive bacteria hence Staphylococusaureus are most common biofilm producing bacteria. Biofilm composed by several layers of bacterial encased with in an exopolysachharidematrix. In this review it has been observed that Nanotechnology play a key role in control and prevention of the infection occur due to multidrug resistant biofilm forming bacteria. In most of the observation antimicrobial effect of silver nanoparticle it has been determine by disc diffusion and microdilution technique. For the determination of biofilm production Congo redagar technique and Tube technique has been used. Due to the significance of biofilm in medical science and increase of drug resistance, silvernanoparticle can play a vital role for the prevention and control of biofilm.***

Keywords: *Staphylococcus aureus,* Nanotechnology, Silvernanoparticles, Biofilm

1. Introduction

Biofilm are complex microbial community which are bind together and enclosed in a exopolysaccharide matrix.[1]Growth of bacterial biofilm is a significant virulence factor which play a vital role in severe infection.[2] The patient who are immunocompromised and using artificial implant medical devices such as contact eye lenses, intrauterine devices, urinary catheter, central venous catheters and artificial heart valves have severe risk factor for skin, wound and teeth infection due to biofilm formation. Approx 65% of infection occur in human population, are related to the microbial biofilm.[3]Chronic inflammation with persistent infection and tissue distraction due to the Bio film production in spite of antibiotic treatment.[4]

The biofilm producing *Staphylococcus* are the commonest causative agent of infection related to artificial implant device.[5]Multidrug resistant *Staphylococcus such as* MRSA and MRSE have appeared as a major nosocomial infections[5]. In most of the cases it is observe that wounds, respiratory and feeding tubes, urinary catheters, or indwelling devices are responsible for spreading of bacterial infection.

The ability of biofilm formation on Indwelling medical device or damaged host tissue is an important virulence factor of S.*aureus* and S.*epidermidis* for this bacteria especially in hospital where uses of antibiotic is very high. Afterward, biofilm production appears as endurance mechanism for the bacteria[7].

Growing drug resistance and significant role of Biofilm in bacterial infection, Researcher are penetrating for suitable method to prevent and control Biofilm production. Generally, for the prevention of Biofilm production, Nanopraticles are used with the combination of antibiotic, chelating agent, halogens, phage therapy and Quorum Sensing[8].

Recently nanotechnoplogy has been diagnosed to treat infectious diseases originate by antibiotic resistant bacteria. Bacterial cells are inconceivable to increase resistance to nanoparticles due to mechanism of action for silver Nanoparticle is different than that of traditional antibiotics.[9]

The size of nanoparticles is approx 1 to 100nm and showing exclusive optical, biological and physicochemical properties[10]. Nanoparticles have vast scope in the medical science, together with specific target drug delivery, artificial implants devices, Imaging and antimicrobial activity to annihilate the broad range of pathogens and multidrug resistant micro organisms[11].

2. Identification and Isolation of Bacteria

In various study different types of the sample are used for the identification and biofilm detection. One of the studies on biofilm formation by MRS was performed in Faculty of Medicine, Department of Medical Microbiology and Immunology, Tata University. In this research taken 122 different samples where108 sample collected from patient and 14 samples from medical devices. In this study aspirates of Endotracheal, Blood, Urine specimen from wounds, implant devices were inoculated followed by recognition of the growing colonies as per standard microbiological technique. Cultures were preserving on trypticase soy broth composed 20 % glycerol at –80°C[12]. One other experiment on microbial biofilm conducted in Tabriz University, Iran in which bacteria were isolated from ulcer, throat, mucus and urine sample which were determined by standard test[13].

Detection of Biofilm

In both the above mention study was done by Congo red agar technique, tissue culture and tube technique[14, 15, 16].

Antimicrobial Susceptibility Testing

In the first research experiment, according to the norms of Clinical and laboratory Standards Institute the disk diffusion technique was carrying out for the finding of antimicrobial

susceptibility[17]. E-test strips (LIOFILCHEM® - ITALY) were used to establish the minimum inhibitory concentration (MIC) for oxacillin. MIC of ≥4µg/mL and ≥0.5µg/mL was measured as resistant and MIC of ≤ 2µg/mL and ≤ 0.25µg/mL was reported as liable for S.aureus[18, 19].

In the second research experiment, the microtitre assay was performed for identify the biofilm inhibition activity of silver nanoparticles and Biofilm inhibitory concentration (BIC) were achieve by dilution of silver nanoparticles. After preparation of silver NPs and their inoculation with 5cfu/ml bacteria, the micro-plates were keep at 37°C for incubation. The wells in micro-plate have been washed with 200µl saline phosphate buffer two times after two days. Then, the wells keep in incubator with 0.1% crystal violet for 15 minutes; at last the wells were washed with water and keep to dry at room temperature. Excess color present on the surface was detached by 95%; ethanol then optical density (OD) of colored microbial biofilms was examine by ELISA auto-reader with wave length of 570nm.The biofilm inhibition percentage was determined by the standard formula[20].

Similar results are also found in other studies. Biofilm production by *staphylococcus aureus* is notorious by Congo red agar technique and tube technique. The anti-inhibitory deed of silver nanoparticles is done by agar well diffusion technique and then MIC and MBC value has been calculate.

3. Discussion

The function of Microbial Biofilms which are well controlled structure depends on intricate arrangement of microbiological communications[21]. Microbial growth rate related with biofilms character in a different way. In above mention research, for the finding of Biofilm tri-methods were performed, and the most sensitive method has been found MA assay as compared to Congo red agar and tube technique. According to earlier research, for detection of biofilm, MA is a gold standard technique[22]. The large number of biofilm forming bacteria which are isolate from different was *S. aureus*. Other bacteria also having ability for biofilm formation include *E.coli* and *P.aeruginosa*.

Treatment of biofilm associated infection is difficult to treat as penetration of antimicrobials to the polysaccharides capsule to destroy or eliminate biofilm. Nanotechnology can facilitate to reduce biofilm formation and penetrate biofilm. One of the study reported that the biofilm creation in *E. coli*, *S. aureus*, *S. typhi* and *V. cholera* was introverted by silver nanoparticles[23].

In both above mentioned studies it is reported that bactericidal effect of nanoparticles is subjective by the particle size which may control by different synthesis method. As compare to large particle small particles had more antibiofilm activity, as well as antimicrobial activity of triangular – fashioned nanoparticles had more antibiofilm activity than large particles. According to earlier studies it was also reported that antimicrobial activity of nanoparticles depends on their size.

Similarly, both above mentioned research on silvernanoparticles in different concentration used to restrain microbial biofilm and recommended that silver nanoparticles be able to prevent microbial biofilm, and may possibly be helpful for treatment of transmissible diseases.

4. Conclusion

Infectious diseases caused by biofilm forming bacteria can be treated by Silver nanoparticles and make the treatment more easily. Similar study also suggested green synthesis of silvernanoparticles. Similarly by using different stabilizing agent we can prepare nanoparticles in various sizes. It is conclude that silvernanoparticles synthesized by different method may produce small size nanoparticles which are more effective against biofilm producing bacterialinfection.

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