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Biosynthesis of Silver Nano Particles by Using Bacteria, Fungi and Plant Extract

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Abstract: Silver nanoparticles are nanoparticles which are in the range of 1 and 100 nm in size. Silver nanoparticles have unique properties which help in molecular diagnostics in therapies and in devices which are used in several medical procedures. The major methods used for silver nanoparticles synthesis are the physical and chemical methods. The problems with the chemical and physical methods are that the synthesis is expensive and also have toxic substances absorbed onto them. To overcome this, biological methods provides a feasible alternative. The major biological system involved in this is bacteria, fungi and plant extracts. The major application of silver nanoparticles in the medical fields includes diagnostics application and therapeutics application. The major and in most of the therapeutic application, it is the antimicrobial property that is being majorly explored though the anti-inflammatory properties has its fair share of applications. Though silver nanoparticles are used in many medical procedures and devices as well as in various biological fields, they have their drawbacks due to nontoxicity. This review provides a comprehensive view on the mechanism of action, synthesis and its application.
Keywords: Silver nanoparticles, Antimicrobial action, nanoparticle synthesis.

I. INTRODUCTION

Nanoparticles have been known to be used for number of physical, biological and pharmaceutical applications. Silver nanoparticles are being used as antimicrobial agents in many public places such as railway stations and lifts in china, and they are said to show good antimicrobial action.

Silver is generally used in the nitrate form to induce antimicrobial effect, but when silver nanoparticles are used. There is a huge increase in surface area available for the microbe to be exposed to. Though silver nanoparticles finds use in much antibacterial application, the action of silver metal on microorganisms is not fully known. It has been hypothesized that silver nanoparticles can cause cell lysis or inhibit cell transduction.

There are many ways designed in various literatures to synthesized silver nanoparticles. These are physical, chemical and biological methods. The physical and chemical methods are numerous in number and many of these methods are bit expensive or use of toxic substances which are major factors that make them “not so favored” methods of synthesis. An alternate, feasible method to synthesize silver nanoparticles is to employ biological methods of using microorganisms and plants

Silver nanoparticles find use in many fields and the major applications sensors of zeptomole (10^{-21}) concentration, in textile engineering, in electronics, in optics and most importantly in medical fields as a therapeutic agents. Silver ions are used in the formulation of dental resin composites in coating of medical devices, as bacterial coating in water filter , as an antimicrobial agent in air sanitizer sprays ,pillows, respirators ,socks, wet pipes, detergents, soups, shampoos, toothpaste, washing machines and many other consumers products; as bone cement.

This review provides an idea of the antimicrobial properties silver possesses as a nanoparticle, the various methods used for to synthesize silver nanoparticles, and an overview of their applications in various fields.

II. MATERIAL AND METHODS

A. *Biological synthesis of sliver nanoparticles*

The problem with most of the chemical and physics methods of nanosilver production is that they are extremely expensive and also involved the use of toxic chemicals, which may create potential environmental and biological risks. It is an ineluctable fact that the silver nanoparticles synthesized have to be handled by humans and must be available by cheaper rates for their effective utilization;

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thus, there is for an environmentally and economically feasible way to synthesize these nanoparticles. The quest for such method has led to the need for the biometric production of silver nanoparticle whereby biological methods is used to synthesize the silver nanoparticle. The growing need to developed environment friendly and economically feasible technologies for material synthesis led to the search for biological methods of synthesis, there are three major sources of synthesizing silver nanoparticles by using bacteria, fungi and plant extracts. Biosynthesis of silver nanoparticles is a bottom-up approach that mostly involved reduction/oxidation reactions. It is majorly the microbial enzymes or the plant photochemical with antioxidants or reducing properties that act on the respective compounds and give the desired nanoparticles.

B. Silver nanoparticles synthesizing bacteria

There are some microorganisms that can survive metal ion concentration and also grow under those conditions and this phenomenon is due to their resistance to that metal.

The most widely accepted mechanisms of silver biosynthesis are the presences of the nitrate reductase enzyme. The enzyme convert nitrate into nitrite.

C. Silver nanoparticle synthesis by E.coli

1) Collection of sample For the isolation of *E.coli*bacteria soil sample were collected randomly from area of the department of Microbiology of New Arts, Commerce and Science College, Ahmednagar.
2) Isolation of bacteria For the isolation of bacteria, serial dilution method was used. For that add 1gm of soil sample in 10ml of sterile distilled water, mixed it properly and furthers dilution(10^{-1} to 10^{-5}) were carried out as per the standard protocol. Streak these five dilutions on the sterile nutrient agar plates. Incubate it for 37ºC for 24 hours.
3) Identification of Bacteria For the identification and characterization of the culture, morphological character such as colony color, shape and size. The strain was characterized as facultative anaerobic, motile, gram negative, nonspore forming bacteria. They showed positive results of Indole Production, Methyl Red and negative results of VogesProskauer test and citrate utilization [3].
4) Production of biomas Active (24 hours old) culture of bacterial strain *Escherichia coli* was cultured in nutrient agar medium to produce the biomass for biosynthesis. The culture flask was incubated on an orbital shaker at 37^0C and agitated at 200 rpm. The biomass was harvested after 24 hours of growth and centrifuged at 10000rpm for 10 minutes. The supernatant was collected for further reaction [3].

D. Synthesis of silver nanoparticles

For the biosynthesis of silver nanoparticle, 10 ml supernatant was mixed with 5ml silver nitrate ($AgNO_3$) solution (10mM) and another reaction mixture does not contain silver nitrate was used as control. The prepared solutions were incubated at 37^0C for 24hours. All solution was kept in dark to avoid any photochemical reactions during the experiment. After 24 hours as the solution turned into brown from yellow solution.

The silver nanoparticle (AgNPs) were purified by centrifugation at 10,000rpm for 5 minutes twice and collected for characterization.

The appearance of brown color evident that the formation silver nanoparticle in the reaction mixture and the efficient reduction of silver nanoparticles were still not clear, but believe that protein molecule and enzymes, includes nitrate reductase enzymes acts as good regulating agent in silver nanoparticles synthesis. The formed color solution allowed measuring the absorbance against wavelength to conform the formation of silver nanoparticles detected by spectroscopy becausethe colored nanoparticle solution shows a peak ̰400nm [5].

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Fig. Synthesis of Silver Nanoparticle

E. Silver nanoparticles synthesizing fungi

When in comparison with bacteria, fungi can produce larger amount of nanoparticles because they can secrete larger amount of proteins which directly translate to higher productivity of nanoparticles. The mechanisms of silver nanoparticles production by fungi is said to follow following steps: trapping of Ag+ ions at the surface of the fungal cells and the subsequent reduction of the silver ions by the enzyme which is present in the fungal system [5].

F. Biosynthesis of silver nanoparticle by Trichodermareasei.

In a typical biosynthesis production scheme of silver nanoparticles, 10gm of *Trichodermareasei*fungus wet biomass was mixed with a 100ml aqueous solution of 1mM silver nitrate ($AgNO_3$). Then the mixture was placed in a 100 rpm rotating shaker at 28^0C for 120 hours duration. In this process silver nanoparticle were produced through reduction of silver ions metallic silver. The reduction of silver ion was routinely monitored by visual inseption of the solution as well as by measuring the UV-visible spectra of the solution by periodic sampling of aliquots (2ml) of aqueous components [5].

G. Silver nanoparticle synthesizing plants

The major advantages by using a plant extract for silver nanoparticle synthesis is that they are easily available, safe and non-toxic in most caseshas a broad variety of metabolites that can aid in the reduction of silver ions and are quicker than microorganisms in the synthesis.

The main mechanisms considered for the process is plant assisted reduction due to phytochemicals. The main phytochemicals involves are terpenoids, flavones, ketones, aldehydes, amindes and carboxylic acids and quinones are water soluble phytochemicals that are responsible for immediate reduction of the ions.

Table No: 1 Silver nanoparticle synthesizing bacteria [4]

Sr. No.	Name of Organisms	Synthesis location	Method
1	*Escherichia coli*	Extracellular	Reduction
2	*Thermomonospora* spp.	Extracellular	Reduction
3	*Rhodococcus*spp.	Intracellular	Reduction
4	*Bacillus* spp.	Intracellular	Reduction
5	*Lactobacillus* spp.	Extracellular	Biosorption

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Table No: 2 Silver nanoparticle synthesizing fungi [5]

Sr. No.	Name of Organisms	Synthesis location	Method
1	*Pediococcus* spp.	Extracellular	Biosorption
2	*Fusarium* spp.	Intracellular	Reduction
3	*Verticillium*spp	Intracellular	Reduction

Table No: 3 Silver nanoparticle synthesizing plants [4]

Sr. No.	Name of Organisms	Synthesis location	Method
1	Coriolusversicolor	Intracellular Extracellular	Reduction
2	Acalyphacurcas	Extracellular	Reduction
3	Medicago sativa	Extracellular	Reduction
4	Alfalfa plant	Intracellular	-------
5	Jatrophacurcas	Extracellular	Reduction

H. Action of Silver nanoparticles on microbes

The extract mechanism which silver nanoparticles employ to cause antimicrobial effect is not clearly known. There are various theories based on the action of silver nanoparticles on microorganisms to cause the microbicidal effect.

The bacterial cells in contact with silver take a silver ion, which inhibit several functions in the cell and damage the cell. There by causing structural changes in the cell membrane and death of the cell.

Silver in a soft acid and there is a natural tendency of an acid to react with a soft base. The cells are majorly made up of sulfur as well as phosphorus are the soft bases. The action of these nanoparticles on the cell can cause the reaction to take place subsequently lead to the cell death.

It is found that the antibacterial effect of silver nanoparticles on both gram-positive as well as gram-negative microbes.

I. Application of silver nanoparticle

Silver nanoparticles find use in many day-to-day applications in human life because of their unique properties. A few examples includes their addition in house cleaning chemicals, in fabrics cleaners, as antireflection coating to improve the transfer of heat from collector of solar energy to their fuel tanks. Though all these are important application of silver nanoparticles, perhaps their need is most desired in medical field. The antimicrobial nature of silver nanoparticle is the most exploited nature of silver nanoparticles in the medical field, though the anti-inflammatory nature is also considered immensely useful in the medical field.

Silver nanoparticles are used in bone cement that is used as artificial joint replacements.

The antimicrobial property of silver nanoparticles is documented and it has immense potential to be used in disinfectant.

It is also believed that most medical treatment such as intravenous catheters, endotracheal tubes, wound dressing, bone cement and dental filling can all make use of nanosilver to prevent microbial infection.

III. CONCLUSION

For the conformation of production of silver nanoparticles by observing the color change in the medium, reaction mixture from light yellow to brown after incubation of 24 hours.

Silver has always been an excellent antimicrobial and has been for ages biosynthesis of metal nanoparticles is a reliable and with ecofriendly protocol. Though there are many mechanisms attributed to the antimicrobial activity shown by silver nanoparticles the actual and most reliable mechanisms is not fully understood or cannot be generalized as the nanoparticles are found to act on different ways. Though bacterial, fungal and plant extract sources can be used for nanosilver synthesis, the easy availabilities and the advantage of quicker synthesis make plant extract the best and the excellent choice for nanosilver synthesis. The use of silver nanoparticle are varied and many, but the most exploited and desired aspect is their antimicrobial capacity and anti-inflammatory capacity.

It can be believed that if utilized properly silver nanoparticles can be a good friend, but if used hazardously, they can become a mighty foe. Hence this current review conclude with a hope that there would be mechanisms devised to clear any toxicity caused by nonsilver to humans and the environment so that the unique properties of this substance can be put to great use for human betterment without any controversies.

In the biosynthesis of metal nanoparticle by a fungus, enzymes are produced which reduce a salt to its metallic solid nanoparticles through the catalytic effect.

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REFERENCES

[1] Honary, Barabadi, Gharaei-Fathabab and Nagihibi: Green synthesis of nanoparticles induced by the fungus Penicilliumcitrinum . Tropical journal of pharmaceutical 12(1) 7-11(2013)
[2] Konish Y., Deshmukh N., Tsukiyama T., Saitoh N., Trans mater Res soc Jpn,29, 2341(2004)
[3] Kushwaha, Singh, Bharatariya,Singh and Yasmeen : Isolation and identification of E.coli bacteria for the synthesis of silver nanoparticles, characterization of the particles and study of antibacterial activity. European journal of experimental biology 5(1) 65-70 (2015)
[4] Parthiban S. , Raja S., Mukhopadhyay H.K., everyman's science 106(2014)
[5] Vahabi, Monsoori, Karimi**:** Biosynthesis of silver nanoparticles by fungus TrichodermareeseiInsciences J 1(1)65-79(2011)