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Silver Nanoparticle Synthesis from Plant Extracts and its Application – A Review

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Abstract: *In the recent years, increased development of green synthesis of nano particles is predictable, because of its incredible applications in all fields of science. The soluble organics present in the plant materials were mainly responsible for the reduction of silver ions to nanosized Ag particles. A systemic characterization of silver nanoparticles was performed using UV, FTIR, SEM, TEM, XRD and EDX.*

1. INTRODUCTION

Nanotechnology is a dynamically developing field of innovative research with potential effect ranges from electronics to medical in the modern material world. Among all available methods, silver nanoparticle synthesis can be broadly classified into 1) Physics 2) Chemistry 3) Biology 4) Hybrid. Nowadays natural compound from plants & microorganism has extensively used to the synthesis nanoparticles. Moreover synthesis of the nanoparticle using plant extract is more advantageous over microorganism due to simplicity, attractive, user friendly, economical & speedy synthesis [1]. Metal nanoparticles have received great attention due to their catalytic role in the reduction & degradation of dyes. Metal nanoparticles are mostly prepared from noble metals such as Gold, Silver, Platinum, etc & its biosynthesis also has been achieved using enzymes, proteins, & amino acids [2]. In addition, the reason for the development of biosynthesis of nanoparticles is due to environmentally friendly. Silver nanoparticles place a noble role in metal nanoparticles due to the potential application in the field of medical, chemistry, physics, biotechnology, photography, electronics, food industry, clothing & optoelectronics [3]. Among these interesting properties Antibacterial, Antiviral, & Antifungal activities are very important in several applications known from ancient times. Plenty of physical, chemical methods, polar solvents, and reducing compounds have been employed for the synthesis of silver nanoparticles. In turn to develop biocompatible, nontoxic, eco friendly silver nanoparticles, plant extracts have been extensively used [4].

2. REVIEW OF THE LITERATURE

Deshpande Raghunandhan et al., (2011) [5] synthesized gold & silver nanoparticles using an aqueous extract of guava leaves and clove buds. The experimental procedure was to found out the invitro anticancer activity against 4 human cell lines. The reported human cell lines are colorectal adenocarcinoma, a human kidney, human chronic myelogenous, leukemia, bone marrow & human cervix. From this report, it was found that gold nanoparticle synthesized in aqueous clove bud extract have more potential activity against the cancer cell when compared to silver nanoparticles of the same extract. The observed activity of gold nanoparticle was due to the scavenging activity of the generated free radicals. Nitric oxide assay method was used to confirm the free radical scavenging activity of silver nanoparticles conclude, that the gold nanoparticles act as an anticancer agent from the microscopic assay methods. It was concluded that gold nanoparticles act as a potential anticancer agent.

Sangiliyandi Gurunathan *et al.*, (2013) [6] focused on antitumor potential of AgNpS to the study was determine the cytotoxic effects of AgNpS against the breast cancer particularly *MDA-MB-231* breast cancer cell. In this experiment culture, supernatant of *bacillus funiculus* were developed and the silver nanoparticles was characterized by various analytical techniques such as UV, particle size analyzer &

TEM. The toxicity test was also evaluated. The present results showed that AgNps showed a dose-dependent cytotoxicity against *MDA-MB-23*cells, thus AgNps as a potential agent for human breast cancer therapy.

Shivakumar sing *et al.,* (2014) [7]synthesized the silver nanoparticles using *Annona reticulata* leaf aqueous extract against antidermatophytic activity was confirmed by a change in color from transparent to dark brown. The synthesized AgNps was found to be spherical, rod; triangular in shape with size ranging from 23.84-50.54nm.This size was evident by UV, X-ray diffraction studies, and TEM. TEM analysis revealed that the AgNps are crystalline in nature. Further, from the FTIR method it has appeared that some chemical compounds such as hydroxyl carbonyl groups aqueous extract be associated with nanoparticles. Finally, this procedure proved that the extract of *annona roticulata* leaves act as an antidermatophytic agent.

Seema carg *et al.,* (2014) [8] reported wound healing potential activity of (AgNps) hydrogel using *arnebia nobilis* aqueous root extract. From the study, it was investigated that the AgNps hydrogel of *A.nobilis* root extract had antibacterial potential & wound healing potential. The wound healing activity was carried out by an excision animal model.

Nazeema *et al.,* (2014) [9] biosynthesized AgNps from stem extract of *jatropha aucas and jatropha gossypifolia.* The aqueous extract was evaluated against lung cancer A549 cell line. Both *jatropha curcas and jatropha gossypifolia* showed a Ic50 value of 19.5µg/ml & 13.5µ g/ml in a dose dependent manner.

Nehal MEI-Deeb *et al.,* (2015) [10] synthesized silver nanoparticles using honey bee extracts, a novel trend in colon cancer therapy. The synthesized silver nanoparticles are sphericalin shape & 12-18nm in size. The biogenic AgNps characterized by using X-RD, X-ray, (EDX), SEM & TEM. IC50 value of silver nanoparticles was found to be safe up to 30µg/ml concentration. From the result, both AgNps & their capping biomolecules showed anticolon cancer activity.

Combination of drugs cyclophosphamide, mercaptopurine & busulfan with AgNps on *invitro* studies was carried out by Royyuru Sree Soumya *et al.,* (2013) [11]. The result concluded that chemo drug cyclophosmpamide & busulfan in the presence of silver nanoparticle enhanced cytotoxic activity whereas mercaptopurine for concentration was found to be effectively against *THP-1* cell line.

Swarnalatha *et al.,* (2012) [12] synthesized the silvernanoparticles using an ethanolic extract of the whole plant of *amaranthoides*. The experimental procedure was to found out the *invitro* antidiabetic activity of the extract of *sphaeranthus amaranthoides* silver nanoparticle. From this study, the AgNps inhibit the activity of alpha-amylase ina dose -dependent manner. Acarbose is a standard drug act as a synthetic inhibitor for enzyme alpha amylase. The Ic50 value of plant extract was found to be 0.28µg/ml & the standard drug acarbose the Ic50 value of 0.725 µg/ml.

Synthesis of silver nanoparticles of two seaweeds *Gracedulisilaria edulis and syringodium isoetifolium* against the antidiabetic & antibacterial activity was studied by Abideense *et al.,* (2015)[13]. The activities were against seven different clinical pathogens such as E.coli, streptococcus, staphylococcus, shigella, salmonella, vibrio & enterobacteria. The synthesized nanoparticles were characterized UV, FTIR, XRD, SEM and EDX. Finally, the report showed that biosynthesized AgNps using the aqueous extract of *Gracillaria edulis & syringodium isoetifolium* had a significant antibacterial & antidiabetic activity.

Bhuvaneswari *et al.,* (2014) [14] investigated the hepatoprotective and antioxidant property of aqueous extract of *embilica officinalis* & synthesized AgNps using *embilica officinalis.* The experiment was divided into 8 groups each with of male albino rats. The synthesized AgNps with a fruit extract act as an effective antioxidant & hepatoprotective activity. The biochemical observations like AST, ALT, ALP, LDH & Bilirubin level. When treated with aqueous fruit extract of *embilica officinalis* synthesized silver nanoparticles & *embilica officinalis* nanoparticles was examined & also showed a similar report. The fruit extract of *embilica officinalis* synthesized silver nanoparticles have an effective antioxidant & hepatoprotective activity.

Kalamegam Kalaiarasi *et al.,* (2015) [15] synthesized AgNps using *invitro* grown leaf extract of *Bambusa arundinacea and bambusa nutans*. The experiment was based on the human prostatic cancer cell line(pc3). The characterization studies are UV, FTIR, TEM, SEM and EDX. The cytotoxic activity of the biosynthesized AgNo3 of both plant extract is used as the anti therapeutic agent.

Cytotoxic effect of two different plant extracts of *Syandenium grantii and Kalanchoe pinnata* fresh leaves was compared Pratik Durgavel *et al.,* (2014) [16] against the human cervical cancer cell line *HeLa*. Cell viability assay, MTT cytotoxicity assay was performed. The data concluded that both nanoparticles has antiproliferative activity on a concentration- dependent manner. Furthermore both nanoparticles sample are identified to have anticancer activity.

Invitro anti-inflammatory activity of synthesized silver nanoparticles using an aqueous extract of the unripe fruit of *piper nigrum* was studied by Aparna Mani *et al.,* (2015) [17]. The synthesized silver nanoparticles of unripe fruit extract were characterized by UV, SEM, FTIR, Atomic absorption spectroscopy & HPTLC. From the characterization result, flavonoid and proteins present in the *piper nigram*. From this extract act as a reducing agent & also a capping agent in silver nanoparticle synthesis IL-1BETA, IL-6 assay were assed and compared with commercially available silver nanoparticle dispersion (CNP). In the present study, the result revealed that the green synthesis of silver nanoparticles using piper nigrum extract at the concentration range of 10-20 µg/ml showed greater inhibition to all the three cytokines. Thus, these findings suggest the synthesized silver nanoparticle using *Piper nigrum* acts as a novel treatment for inflammatory disorders.

Anthelmintic activity of the biosynthesized silver nanoparticles using an aqueous extract of *Saraca indica* leaves has been reported by Seema Garg *et al.,*(2102) [18]. The result of synthesized silver nanoparticles is spherical in shape with 50nm in size. The anthelmintic activity was studied against the *Pheretima posthuma*(Earthworm) the activity of colloidal solution (synthesized silver nanoparticle) was more when compared to aqueous leaves extract. Finally, it was clearly that the synthesized silver nanoparticles of *Saraca indica* leave extract showed a potent & took less time to cause paralysis & death of earthworms.

Kayamurthi Satyavani *et al.,* (2012) [19] reported antitumor activity. The synthesized silver nanopaticle was evaluated by MTT assay on human epidermoid larynx carcinoma cell line. The result showed that the effect of silver nanopartcles reduces the toxicity of Hep-2 cancer cells in a dose-dependent manner & act as a antitumor agent.

Usha *et al.,* (2014) [20] studied the larvicidal activity of synthesized silver nanoparticles from *achyranthesbidentata* leaves extract & & observed the maximum efficacy of crude aqueous & synthesized silver nanoparticles against fourth instar larvae of *aedesaegypti*. From the result of larvicidal bioassay clearly indicate that the biosynthesized silver nanoparticles provide an excellent larval control activity.

Durgadevi *et al.,* (2014) [21] tested the leaf mediated silver nanoparticles with *Euphorbia hirta* for Larvicidal activity. The silver nanoparticles was against the 1st to 4th larvae crop pest of cotton boll worm, *Helicoverpa armigna*.The green synthesized nanoparticle using *Euphorbia hirta* methanol leaf extract produce a significant effect on pupicidal & larvicidal activity.

Namithasoni *et al.,* (2014) [22] evaluated the effect of synthesized silver & gold & nanoparticles through the aqueous bark extract of *cinnamomum zeylanicum* (Indian spice dalchini).The larvicidal activity of the phyto synthesized nanoparticles was tested against the mosquito control. The malaria vector *Anopheles stephensi* & flariaris vector *Culexquefasciatus*. Concentration & different time of treatment was performed the experimental periods. The result suggests that the *Culexquefasciatus* synthesized silver & gold nanoparticle was found to be highly susceptible towards leaves *Anopheles stephensi* than the *Culexquefasciatus.*

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