Silver Nanoparticles from Wheatgrass Extract and its biological applications

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Abstract:

Nanoparticles are microscopic particles smaller than 100µm. Nanoparticles was synthesized usingvarious metals. The nanoparticles synthesized with silver nitrate were preferred for numerous applications.In the present study wheatgrass was used as herbal medium. Wheatgrass has pharmacological andmedicinal properties. The nanoparticles were synthesized by using incubation process. After addition of1mM $AgNO_3$ in wheatgrass extract, the extract becomes brown indicated the synthesis of nanoparticles.The synthesized silver nanoparticles showed maximum absorption at 420nm indicated the formation ofnanoparticles. The synthesized nanoparticles were showed considerable effect on seed germination rateand nodule formation. As well as the synthesized nanoparticles was showed countable antimicrobialactivity against gram positive, gram negative and fungus.

Keyword- nanoparticles, medicinal properties

Introduction:

The growth of nanotechnology and the creationof new nanomaterials and nanodevices presentopportunities for novel uses in biotechnology andagriculture. Materials with at least one dimensionsmaller than a few hundred nanometers areconsidered nanoparticles because they aresmall enough to fall inside the nanometric range.It has been widely reported that nanotechnologyhas the potential to change the fields of healthcare, textiles, materials, information andcommunication technology, and energy [1,2].The use of nanotechnology in the food andagricultural industries is currently receivingattention. The potential benefits of investing inagriculture and food nanotechnologies rangefrom increased food quality and safety to loweragricultural inputs, enhanced processing, andgreater nutrition. Even though the majority offunding is concentrated in rich nations, recentresearch developments hint at possibleagricultural, food, and water safety applicationsthat might have a big impact on ruralcommunities in poor nations. The focus of this is on contemporary methods ofnanotechnology that are utilized to managewater, pesticides, restrictions on the use ofchemical pesticides, and the potential ofnanomaterials in sustainable agriculturemanagement [3,4]. A nanomaterial is a substance that includesparticles having at least one dimension thatranges in size from 1 to 100 nm. Its capacity tomanipulate and/or create matter at this scaleleads to the creation of fresh and inventiveproperties that can be used to tackle a widerange of technical and societal problems.Developing nations like China have hurriedlycompleted their research on the delivery ofagricultural pesticides using nanotechnology, andin the following five to ten years, fieldapplications are anticipated. However, severalelements, including market demand, profitmargin, environmental advantages, riskassessment, and managerial practices in thecontext of other competing technologies, arecrucial to their success. The importance ofagriculture to all human communities is nowmore apparent than ever thanks to the growingglobal population [5,6]. Every human has a basicand essential need for food, and agriculture bothdirectly and indirectly contributes to this need. Indeveloping nations, expanding the agriculturalsector is viewed as crucial to achievingdevelopment goals. It is clearer than ever beforethat new technology must be used in theagriculture sector following years of the greenrevolution and a drop in the agricultural productratio to the global population increase. India isone of many developing nations whoseeconomies are based largely on agriculture, andwhere the bulk of the population depends on itfor survival. Indian food production has reacheda level of self-satisfaction as a result of the greenrevolution of the 1960s. Globally, food security isa top priority, and both the public and thegovernment have been working to solve thisdifficult issue. Modern science and technologyhave made it possible to transform the situationfor the better [7,8]. The use of technology hasbrought advantages in resolving the farmsituationthe agricultural industry has been ableto respond to the rising demand for agriculturalproducts because of a wide array of agriculturalresearch systems, robust extension apparatus,and government policies (Ali et al. 2014).However, recent decades have seen severalchallenges for agriculture, including farm losses,low soil quality, the emergence of new diseasestrains, global warming, and climate change. Theincreased demand for food caused by populationgrowth makes it necessary to place an increasingemphasis on the study and creation of newtechnologies. It is important to generate newtechnology and spread it through the growth ofhuman resources. To address the issues ofincreasing global food security and climatechange, continuous innovation is very necessary [9,10]. To do this, new science and developingintermediate technologies must be added to thetraditional research methodologies. Agriculturehas profited from numerous technical advancesover the years, including the manufacture ofhybrid crops, synthetic chemicals, andbiotechnology. At the moment, scientists arelooking into nanotechnology as a potential newsource of agricultural improvements. The primarygoal of research on agricultural nanotechnologyapplications has been to find answers to a varietyof agricultural problems, such as sustainability,better seed quality, and increased productivity. Inagriculture, nanomaterials might be more usefulfor managing nutrients and water, deliveringactive ingredients, and other tasks where moreconventional approaches have fallen short. Byfusing DNA with nanoparticles, geneticengineering, a process that has proven verypopular in synthetic biology, has also found aplace in nanotechnology.

Material and Methods

Sample collection

The present study included with synthesis of nanoparticles and its uses in different aspect. Forsynthesis, we used 5-8 days grown wheatgrass. Wheat was sown in plastic tray for synthesis inG.B. pant nagar university Nanital.and collected after full growth.Nanoparticles synthesis

In the present work, the synthesis of silver nanoparticles has been carried out using theaqueous extract of wheatgrass. 1mM Silver nitrate solution was prepared and stored in ambercoloured bottle. (Azam, et al. 2009) [1].

Preparation of leaf extract:

The wheatgrass leaves were washed several times withdeionized water. 100gm of finely cut wheatgrass leaves wastaken and boiled in 300ml of double distilled water for 3minsand filtered. After centrifugation at 10,000rpm for 15mins, thesupernatant was collected and stored at 4 °C. (Krithiga et al.2015) [8].

Synthesis of silver nanoparticles:

Typical synthesis process of silver nanoparticles, 10 ml of leafextract was added into 90 ml of 1 mM silver nitrate. When weadd 90 ml of 1 mM silver nitrate solution into the 10 ml ofwheatgrass leaf extract then immediately colour change tobrown. Aqueous solution and incubated at room temperature. Formation of brown colour was indicates synthesis of silvernanoparticles. After the 24 hrs. incubation period bottom ofthe flask observe silver nanoparticles (Banerjee et al. 2014)[10].Analysis of nanoparticles synthesis. Spectroscopic analysis of synthesized nanoparticles wascarried. The solution of AgNPs were checked at differentnanometer from 300 to 700 nm at visible range. The AgNPsshowed maximum absorbance at 420 nm.Effect of AgNPs treatment on germination rate andnodule formationsSynthesised wheatgrass silver anoparticles were used to checkthe germination rate and formation nodule to groundnut crop.of local varity. Seeds of groundnut were treated and incubatedovernight. Treatment of synthesized Ag nanoparticles solutionwas in 10:20 (No. of seeds: AgNps solution) ratio (Shakeeland Saiqa 2015) [14].AgNPs antimicrobial activitythe antibacterial assay was done on two bacteria *Escherichia coli*, *Staphylococcus aureus* and one fungus species*Candida albicans* by using standard disc diffusion method.Fresh overnight cultures were taken and spread on the nutrientagar and potato dextrose plates to cultivate bacteria andfungus. Sterile paper discs of 5 mm diameter were saturatedwith plant extract, silver nanoparticles and double distilledwater (as control) were placed in each plate and incubated at37 oC for 24 h and the antibacterial activity was measuredbased on the inhibition zone around the disc impregnated withplant extract synthesized silver nanoparticle. (Shakeel et al.2016, Ratika and Vedpriya 2013) [15, 11].

Results:

UV-VIS spectral analysisWheatgrass were collected and extract were prepared withhomogenisation method. Plant materials were collected andplant leaf extracts were prepared both by conventional andhomogenization methods. Biosynthesis of silver nanoparticlesby the filtrate of wheatgrass was confirmed by change in thecolour of the filtrate to brown after addition of silver nitrate. The obtained nanoparticles were recovered and stored. Thisresulted due to excitation of surface plasmon vibrations in thesilver nanoparticles. The bioreduction of silver in the filtrate reaction solution wasmonitored by using UV-Vis spectroscopy. Control flasksmaintained with silver nitrate solution (without plant filtrates)did not show any change of colour and its absorbancemaximum was found to be at 420nm, which was specific forsilver nitrate solution.

Effect of AgNPs treatment on germination rate and nodule formations:

The biosynthesized nanoparticles showed considerable effecton germination rate and nodule formation. Compared betweencontrol and treated seeds of groundnut we found germinationrate increased by 20% due to treatment of nanoparticles. Outof 100 seeds groundnut 50 % seeds were showed germinationin control and 70% seeds were showed germination in treatedseeds.

Table 1: Effect of synthesized nanoparticles on germination rate.

s.no.	Groundnut crop (100 seeds)	No. of seeds Germinated
1.	Without treated (Control) 50	50
3.	Treated with wheatgrass NPs	70

While compared between control and treated nanoparticles toseeds of groundnut for nodule formation, treated seedsshowed increased number of nodule count than control.Nodules play important role in nitrogen fixation. Controlplant of groundnut showed maximum 9 number of noduleswhile treated plant of groundnut showed maximum 13number of nodules.

Table 2: Effect of synthesized nanoparticles on nodule formation

s.no.	Groundnut crop	Number of nodules
1.	Without treated (Control)	7-9
3.	Treated with wheatgrass NPs	10-13

Antimicrobial activity of AgNPs

The antibacterial activity of synthesized nanoparticles againstE. coli (-ve), S. aureus (+ve) bacteria and fungus showedmoderate antimicrobial activity. Compared in between gramnegative and gram-positive organism gram negative (-ve)bacteria showed significant zone of inhibition. Whileantifungal activity against *C.albicans* showed varied zone ofinhibition from 5 to 9mm.

Table 3: Antimicrobial activity of synthesized nanoparticles

s.no	Nanoparticles	Microorganism	Zone of inhibition (mm
2.	Biosynthesized from Wheatgrass	Escherichia coli	10
		Styphlococus aureus	5-7
		Candida albicans	5-9

Discussion:

The absorbance of spectra of synthesized nanoparticles were analysed on spectrophotometer exhibit orahbe-yellow colourdue to excitation of the locakised surface Plasmon vibrationsof metal nanoparticles (Kelly et al. 2003, Stepanov 1997) [6,16]. Previous studies showed that spherical AgNP contribute tothe absorption bands at around 400nm in the UV-visiblespectra (Maiti et al. 2013; Barman et al. 2014) [7, 2].Chemical antibiotics are day by days becoming resistant. Thesubstitute for antimicrobials is required the mechanism ofthe inhibitory effects of Ag ions on microorganisms ispartially known. It is reported that the positive charge on thesilver ion is the reason for antimicrobial activity as it canattract the negatively charged cell membrane ofmicroorganisms through the electrostatic interaction (Dibrovet al. 2002; Hamouda et al. 2000) [4, 5]. Due to their uniquesize and greater surface.This study indicates that Ag-NPs can be used as effectiveantibacterial materials against various microorganisms whichcan endanger human beings. In conclusion, this study showedthat Ag-NPs have potent antibacterial activities against *E. coli*and *C. albicans* cells. The growth and reproduction of Ag-NPstreated bacterial cells were inhibited.

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