Green and instant synthesis of gold nanoparticles by *Trichoderma* sp. and its heterogeneous catalysis in degradation of 4-nitrophenol

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ABSTRACT

Nanotechnology has revolutionized the concept of catalysis by making a highly desirable gold nanoparticles with their highly active solid surface and recyclability for efficient and rapid organic transformations. The present study aims to biosynthesize the nanoparticles within minutes with well-known biocontrol agents, *Trichoderma viride* and *Hypocrea lixii*. The biosynthesis of the nanoparticles was very rapid and took a minute at 30°C and 100°C respectively. It yielded mixed population of spheres, rods, triangles, hexagons of size 10-80 nm at 30˚C while spherical particles of size 2-40 nm were obtained at 100°C by *T. viride* and *H. lixii*, respectively. UV-Vis spectrum was observed at 528 nm after one min of addition of $HAuCl_4$ to the cell free extract of *T. viride*. In the presence of biogenic gold nanoparticles, yellow color of 4-nitrophenol disappeared within 30 min into colorless indicating its degradation to 4-aminophenol. The small quantity of gold nanoparticles required and its reuse for bioremediation purposes not only makes it a substitute for catalyst matrix but also provides a new hope to green and low cost bioremediation.

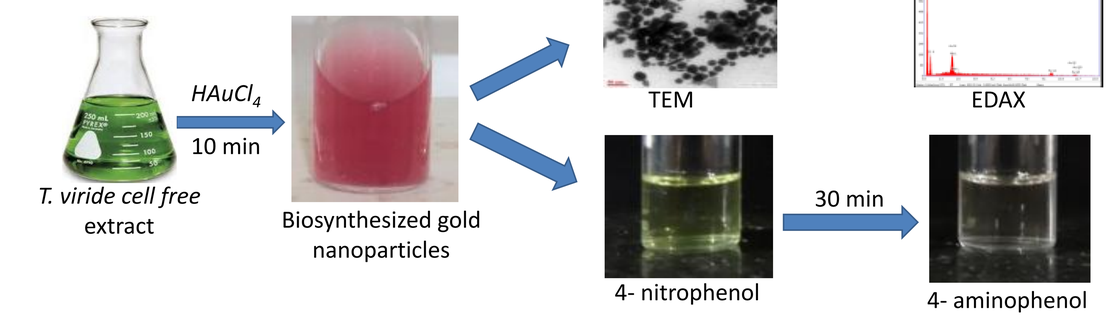
INTRODUCTION

- **Biological synthesis of nanoparticles is an eco-friendly and economical approach**
- **The major drawback of biological synthesis is the long time duration involved to complete the reaction**
- **The different shape and size of nanoparticles biosynthesized can find its application in medicine, agriculture, bioremediation**
- **Gold nanoparticles is an efficient biocatalyst to degrade organic pollutants such as 4-nitrophenol**

OBJECTIVES

- **Rapid and instant biosynthesis of gold nanoparticles by *Trichoderma viride* and *Hypocrea lixii***
- **Characterization of gold nanoparticles**
- **Catalytic degradation of *4*-nitrophenol into 4- aminophenol**

METHDOLOGY



- **Rapid extracellular biosynthesis of gold nanoparticles by biocontrol agents *T. viride* and *H. lixii* at different temperatures**
- **Characterization of gold nanoparticles by visual observations, UV-vis spectroscopy, zeta sizer, TEM, SAED and EDAX**
- **Biosynthesized gold nanoparticles used as efficient biocatalyst**
- **Biodegradation of 4-nitrophenol into 4-aminophenol within 30 min**
- **Recovery of gold nanoparticles applied as catalyst by centrifugation for its sustainable reuse**

CONCLUSION

- ***T. viride* and *H. lixii* were efficient to overcome the limitations of conventional methods by synthesizing nanoparticles within 10 min**
- **Biosynthesized nanoparticles were monodispersed and capped with cell free extract of *Trichoderma* spp**
- **Mixed population of spheres, rods, triangles, hexagons of size 10-80 nm at 30˚C by *T. viride* while spherical particles of size 2-40 nm were obtained at 100°C by *T. viride* and *H. lixii*, respectively**
- **Biosynthesized gold nanoparticles proved themselves as an efficient biocatalysts for degradation of organic pollutants**

ACKNOWLEDGMENT

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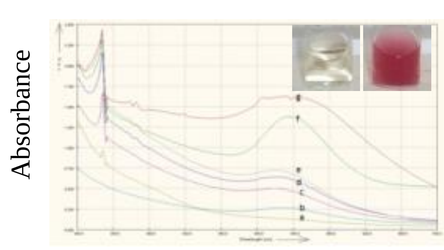
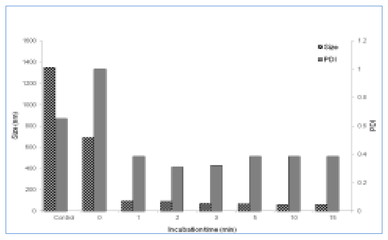
RESULTS

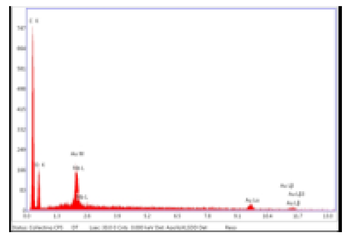
Biosynthesis of gold nanoparticles within 10 min at 30˚C by *T. viride*



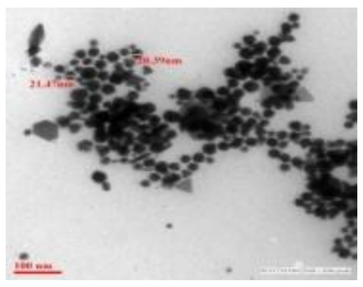
UV- visible spectroscopy for surface plasmon resonance



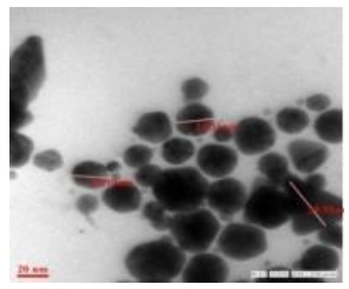
ZETA size (nm) of synthesized nanoparticles



EDAX – peak showing the presence of capping element on gold nanoparticles



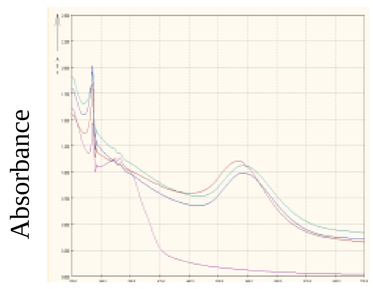
TEM image of gold nanoparticles at 15,000 X



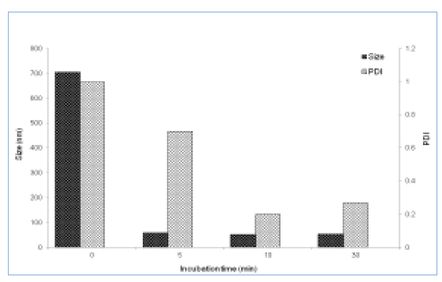
TEM image of gold Nanoparticels at 30,000 X

Crystalline nature by SAED pattern

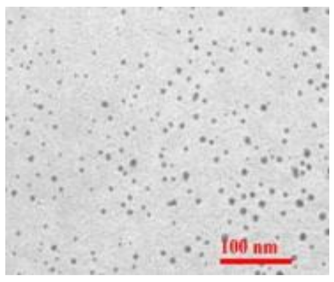
Biosynthesis of gold nanoparticles with in 10 min at 100º C by *T. viride*



Wavelength in nm

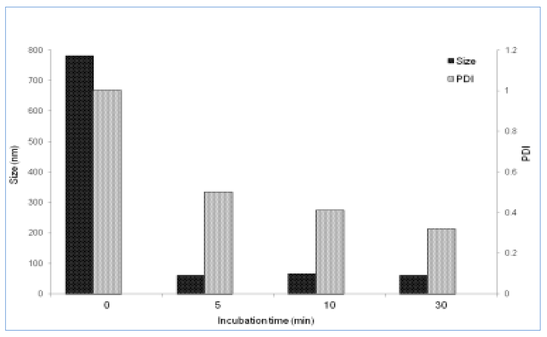


ZETA size

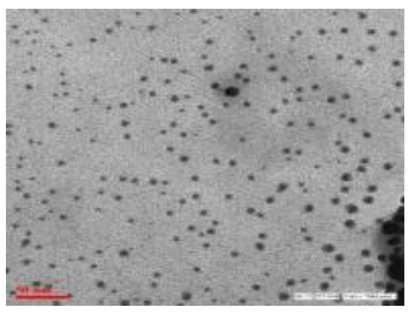


TEM at 30,000 X

Biosynthesis of gold nanoparticles at 100˚C by *H. lixii*



ZETA size



TEM at 30,000 X

Degradation of 4-nitrophenol into 4-aminophenol