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Synthesis of Gold Nanoparticles Production by Fungi

Hannah Howard*

Department of Biomolecular Engineering, University of Tennessee Knoxville, Knoxville, USA

Perspective

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***For Correspondence:**
Hannah Howard, Department of Bimolecular Engineering, University of Tennessee Knoxville, Knoxville, USA
E-mail: Hannah@ward.edu.com

DESCRIPTION

Fungi have been used as a food source and to ferment and persevering of foods and beverages throughout history. In the twentieth century, humans discovered how to use fungi to safeguard human health, while business used fungi to produce enzymes, acids, and bio surfactants on a wide scale. Fungi have remained relevant since the introduction of contemporary nanotechnology in the 1980s by providing a greener substitute to chemically manufactured nanoparticles.

A nanoparticle is defined as having a single dimension of 100 nm or less. Because environmentally damaging or biologically dangerous reducing agents are frequently used in the chemical synthesis of nanoparticles, greener production methods have been sought. Microorganisms, plant extracts, and fungi have been proven in recent study to create nanoparticles *via* biological mechanisms. Fungi are most commonly used to generate silver and gold nanoparticles, but they have also been used to synthesise zinc oxide, platinum, magnetite, zirconia, silica, titanium, and cadmium sulphide and cadmium selenide quantum dots.

Synthesis of gold nanoparticles has been investigated utilizing *Fusarium Neurospora*, *Verticillium*, yeasts and *Aspergillus*. Extracellular gold nanoparticle synthesis was demonstrated by *Fusarium oxysporum*, *Aspergillus niger*, and cytosolic extracts from *Candida albican*. Intracellular gold nanoparticle synthesis has been demonstrated by a *Verticillum* species. In addition to gold and silver, *Fusarium oxysporum* has been used to synthesize zirconia, titanium, cadmium sulfide and cadmium selenide nanosize particles. Cadmium sulfide nanoparticles have also been synthesized by *Trametes versicolor, Schizosaccharomyces pombe*, and *Candida glabrata*. The white-rot fungus Phanerochaete chrysosporium has also been demonstrated to be able to synthesize elemental selenium nanoparticles.

At different doses chloroauric acid is commonly utilised as a source of gold ions. Cadmium sulphide nanoparticles were synthesised for *Fusarium oxysporum* using a 1:1 ratio of Cd^{2+} and $SO4^{2}$ at a concentration of 1 mm. The structure and size of gold nanoparticles could vary depending on the pH of the ion solution. Gericke and Pinches (2006) found that for *Verticillium luteo-album* small spherical gold nanoparticles form at pH 3, larger gold nanoparticles form at pH 5 and huge nanoparticles lack a definite structure from pH 7 to pH 9. Temperature interactions were similar for silver and gold nanoparticles; lower temperatures produced larger nanoparticles whereas higher temperatures produced smaller nanoparticles.

Many fungi, including *Penicillium* species, have been implicated in the formation of nanoparticles by nitrate reductase, while *Fusarium oxysporum* has been implicated in the formation of silver nanoparticles by -NADPH-dependent reductases, nitrate-dependent reductases, and an extracellular shuttle quinone. *Aspergillus flavus* silver nanoparticle manufacturing begins with a "33kDa" protein followed by a protein electrostatic attraction that stabilises the nanoparticle by producing a capping agent. Although the creation of intracellular silver and gold nanoparticles is not completely understood analogous fungal cell wall surface electrostatic attraction, reduction, and accumulation has been hypothesised. Laccase was found to be responsible for external gold nanoparticle production in *Phanerochaete chrysosporium* while ligninase was found to be responsible for intracellular gold nanoparticle synthesis.