Chapter 11
Biogenic Synthesis of Gold Nanoparticles and Their Antimicrobial Activities

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ABSTRACT

Gold nanoparticles (AuNPs) are widely used in biomedical applications, especially diagnostic and drug delivery. The antibacterial activity of nanoparticles depends on the dimensions of the particles. AuNPs may associate with the surface of the cell membrane and cause disorder such as respiration and permeability. The method of binding of particles for bacteria depends on their surface available for interaction. Smaller particles which have the larger surface area available for interaction will show better bactericidal effect than the larger particles. Useful antibacterial agents should also be toxic to various pathogenic bacteria with the ability to coat different surfaces like biomaterials, devices, textiles, food packaging, and so on. The biological and physiochemical properties of synthesized AuNPs have impact on the use of gold nanoparticles like antimicrobial agents, especially for water purification, as well as other biomedical applications.

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INTRODUCTION

Nanotechnology is the most investigated field in the last decades. A very spread usage (almost in every kind of technology and science) of nanotechnology makes this field the most interestig due to usage like cosmetics or drug delivery to electronics, sensing and catalysis (Grana *et al.,*2017). In the last decade, the big interest and demand among researches and chemist for metal nanoparticles is due to applications in photography, catalysis, optics as well as in other areas (Zhou *et al.,*2004). In the last few years, nanotechnology undergo enormous development in the field of methodologies for synthesis of nanoparticles with certain shape and size to meet the goal (Fang *et al.,*2010; Dhayalan *et al.,*2018). In markets it is possible to find more than 800 products connect with nanotechnology, and this number increase every day (Shedbalkar *et al.,*2014; Husen & Siddiqi, 2014).

Beside silver, the properties (electrical, photothermal and optical) of gold, make this element the most investigated. Until today, scienties found several ways to prepare AuNPs from different starting materials and various methods (Selvakannan *et al.,*2002; Sun & Xia, 2002). The previously described methods are limited due to disadvantages such as utilization of toxic substances, various pH values, temperatures, costly instruments or the process will give smaller yield. These disadvantages have impact on the researchers to make efforts to develop new profitable methods and eco-friendly acceptability (Hulkiere *et al.,*2017). Thus, currently it is necessary to synthesize new nanoparticles, where preparation does not include harmful substances. The most promising source of non-toxic chemicals can be plants or microorganisms, due to this fact plants or microorganisms will be used for biosynthesis in order to solve potential problem of destroying the environment (Kar *et al.,* 2014; Fatima *et al.,*2015). The green technology is the word used for synthesis of nanoparticles from natural sources (plants) without using toxic chemicals (Arunachalam & Annamalai, 2013). For the green synthesis the best choice is to use microbes such as bacteria or fungi in order to get novel nanomolecules (Shedbalkar *et al.,*2014; Sanna *et al.,*2014). The presence of elemental metal can be a good evidence for formation of nanoparticles. Therefore, the plant extract must contain certain type of chemicals which can reduce metal ion. The best choice is smelling plants or leaves, because they are made from chemicals which are capable for reduction (Husen & Siddiqi, 2014).

Plants have possibility to accumulate different metals (Jabeen *et al.,*2009). In some cases this promises to protect the plants from insects or herbivores. Nanoparticles can be used to prevent plant diseases and exibit growth of plants (Park *et al.,* 2007) as well as to diagnose various diseases. This can be helpful for plants which humans use every day (such as radish, rice, spinach and others) (Rico *et al.,* 2011). The high potential for the controlled release of drug, usage of trace elements without destroying