WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 10, Issue 7, 16-21. Review Article ISSN 2277– 7105

# REVIEW ON GREEN SYNTHESIS METAL NANOPARTICLE WITH IRRADIATION MICROWAVE AND CHARACTERIZATION

***Sari Kusumahati**

Department of Pharmacy University of Surabaya, Indonesia.

Article Received on
27 April 2021,
Revised on 17 May 2021,
Accepted on 07 June 2021
DOI: 10.20959/wjpr20217-20758

***Corresponding Author**
**Sari Kusumahati**
Department of Pharmacy
University of Surabaya,
Indonesia.

## ABSTRACT

Biological resources have been developed by many scientists to synthesize nanoparticles. Organic compounds contained in plants are known to have the ability to reduce metal ions in the biosynthesis process. The synthesis of nanoparticles using plant extracts has several advantages, namely that plants are easy to obtain, safer to handle, and act as a source of several metabolite compounds, and have various metabolite compounds that can help reduce metals. This review discusses the effect of microwave irradiation with contact time and bioreductor concentration on the synthesis of nanoparticles from previous research on nanoparticle synthesis.

**KEYWORD:** Green synthesis metal nanoparticle, irradiation microwave.

## INTRODUCTION

The formation of nanoparticles can be carried out by various methods, namely physical methods and, chemical methods, but both methods cause various problems, such as the use of toxic solvents, the generation of hazardous waste, and high energy consumption. Therefore, environmentally friendly methods need to be developed.

Concerning eco-safety, it is necessary to expand environmentally friendly approaches without using toxic and hazardous chemicals. The Use of plant-based extractions for the synthesis of metallic nanoparticles is advantageous, which is convenient, cost-effective, and non-hazardous for the environment.[1]

**Plant Mediated Green Metal Nanoparticle**

Plant extracts contain phytochemical compounds which are reducing agents to convert metal precursors into metal nanoparticles. Phytochemicals are antioxidants and free from toxic chemicals, and act as reducing and stabilizing agents.[2]

Phytochemical compounds of plant extracts such as terpenoids, flavonoids, phenolic compounds, aldehyde, and alkaloids contribute to the reduction process. The phytochemical content as a reducing agent has different concentrations in each plant extract. So the composition of each plant extract has a significant effect on the synthesis of nanoparticles. Several factors that affect the synthesis of nanoparticles, stabilization of nanoparticles, and the number of nanoparticles produced are pH, temperature, contact time, metal salt concentration, and plant phytochemical profile.[3]

Activity Phytochemical compounds together with metals such as copper, silver, gold, titanium, zinc, iron, and nickel produce metal oxides so that the metal ions reach the growth and stabilization phases. The formation of oxygen finally results in the linking of metal ions, and a defined shape is formed. The processes involved in the plant-based extraction mechanism of nanoparticle synthesis are preparation of the plant extract, mixing of the metallic solution in the plant extract, and the formation of biocompatible nanoparticles.[4] Figure 1 shows a basic schematic diagram of the mechanism of green synthesis by using plant extracts.

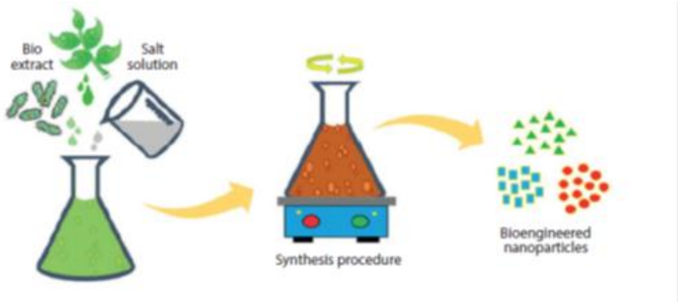



**Figure 1: Green synthesis mechanism by using plant exstract.[5]**

The main mechanism of green biosynthesis through plants is illustrated in Figure 2 as follows.

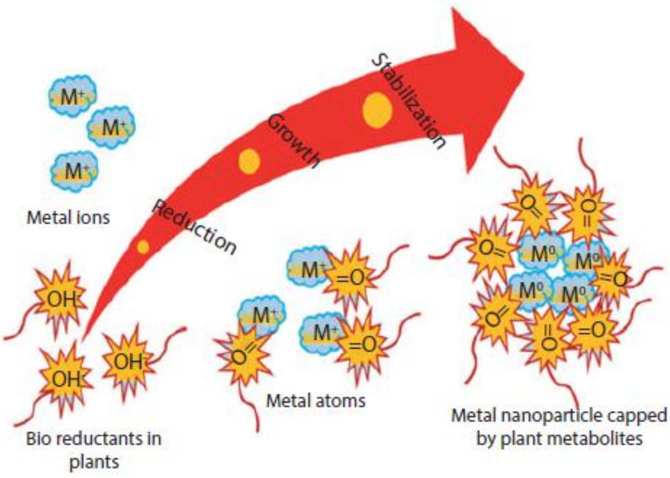



**Figure 2: Green synthesis mechanism[5]**

**Irradiation Microwave**

This review discusses the synthesis of nanoparticles using microwave irradiation with the effect of variations in contact time and bioreductor concentration in the process of synthesizing nanoparticles with plant extracts.

A microwave is a device that uses electromagnetic waves with a wavelength of 0.1 to 100 cm or an equivalent frequency between 0.3 -300 GHz and can convert electromagnetic radiation into heat to control chemical reactions. Microwave heating has advantages, namely a relatively short time, reducing energy consumption, and better results by preventing agglomeration in particle formation.[6]

Microwave irradiation provides a fast and homogeneous heating system that confirms consistent nucleation and growth of nanoparticles in the reaction medium within a short period of time, increases the rate of capping by plant extracts, and speeds up the stabilization process of nanoparticle synthesis.[7]

Sovawi reported that he has succeeded in synthesizing gold nanoparticles with irradiation microwave and, bioreductor extract *Psidium guajava* leaves with variations in the volume of the bioreductor, where the more the volume of bioreductors increases, the more the number of nanoparticles produced on volume addition of the bioreductor 0.25 mL and 0.5 mL no change in λmax. On addition of 0.75 mL bio reductant volume and 1.25 mL there is an increase in max, then at addition volume of 1.5 mL max back stable. With the addition of a bio reductant, then the Au3 + ion reduces to Auo as well more and more. More and more additions bioreduction, indicating an increase in absorbance. Increased absorbance indicates that gold nanoparticles are increasingly reduced a lot, it causes the collision between particles to occur more frequently and results in the occurrence of agglomeration showing in Figure 3.[8]

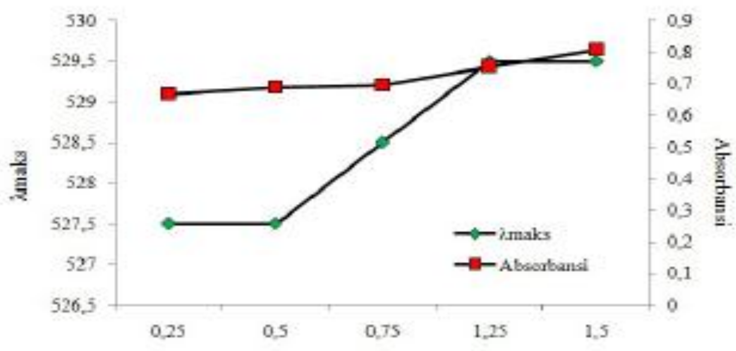
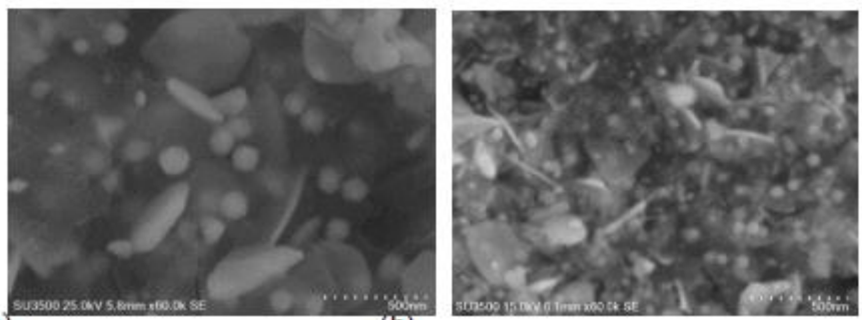



**Figure 3: Bioreductor addition relationship with max and absorbance.[8]**

Suriati reported synthesizing gold nanoparticles with irradiation microwave and bioreductor extract of *White Bol Guava* Leaves with varying contact times. There was a significant color change between the microwave and non-microwave methods, namely in the microwave method a rapid color change occurred from yellow to blackish purple in the next 5 minutes and minutes, whereas in the method without a microwave, the color change from yellow to blackish purple occurred when 60 minutes and then the next day. It can be concluded that the microwave method can cause color changes that are relatively fast with the Au-NPs produced. Analysis of Au-NPs with SEM instruments was carried out to determine the morphology and tendency of nanoparticles to aggregate. The SEM result by using microwave and without microwave method show the morphology of the images reflected from the BSE (Backscattered Electron) as shown in Figure 4. This reflection gives the difference in molecular weight of the atoms that make up the surface, where atoms with high molecular weight will be lighter colors than atoms with low molecular weight.[9]



(a) (b)

**Figure 4: Morphology of AuNP (a) using *microwave* (b) without a microwave.[9]**

**Characterization Nanoparticle**

The synthesized nanoparticles were further confirmed by UV-Vis spectroscopy. gives absorption in the UV-Vis region at around (550–600) nm for copper and 400–450 nm for silver. The UV-Vis spectrum of iron nanoparticles was showed an absorbance peak at ~270 nm.

*Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM) Analysis.*

The morphology, shape, and sizes of the synthesized nanoparticles were confirmed by transmission electron microscope (TEM) and scanning electron microscope (SEM) techniques. SEM images reveal the outside surface morphology of the synthesized nanoparticles and whereas, TEM images were given information about the inner surface morphology of the synthesized nanoparticles.

*X-Ray Diffraction (XRD) Analysis*

From the XRD spectra, we can calculate the average crystallite particle sizes of the synthesized nanoparticles. It is calculated by Scherrer equation $d = K\lambda/\beta\cos\theta$, where d is the average crystalline particle size; K is a dimensionless shape factor, with a value close to unity (0.9); $\lambda$ is the X-ray wavelength; $\beta$ is the line broadening at half the maximum intensity (FWHM); $\theta$is the Bragg angle of the crystal plane. The highly intense and narrow diffraction peaks revealed the highly crystalline nature of the synthesized nanoparticles.

*Fourier Transform Infrared (FTIR) Spectroscopy*

From the FTIR spectra, we can determine the functional groups which were responsible for the reduction process and formation of metals nanoparticle.[5]

**CONCLUSION**

Natural materials used as bioreductors have a requirement that they have active ingredients that can reduce metal ions in the synthesis of nanoparticles. Microwave irradiation has advantages in the synthesis of nanoparticles, and the factors that influence this synthesis are the factors of contact time and the volume of the bioreductor.

## REFERENCES


1. Jha AK, Prasad K, Prasad K, Kulkarni AR. Plant system: Nature's nanofactory. *Colloids Surfaces B Biointerfaces*, 2009; 73(2): 219-223. doi:10.1016/j.colsurfb.2009.05.018.
2. Singh J, Dutta T, Kim KH, Rawat M, Samddar P, Kumar P. "Green" synthesis of metals and their oxide nanoparticles: Applications for environmental remediation. *J Nanobiotechnology*, 2018; 16(1): 1-24. doi:10.1186/s12951-018-0408-4.
3. Mukunthan KS, Balaji S. Cashew apple juice (Anacardium occidentale L.) speeds up the synthesis of silver nanoparticles. *Int J Green Nanotechnol Biomed*, 2012; 4(2): 71-79. doi:10.1080/19430892.2012.676900.
4. Jayachandran A, T.R. A, Nair AS. Green synthesis and characterization of zinc oxide nanoparticles using Cayratia pedata leaf extract. *Biochem Biophys Reports*, 2021; 26: 100995. doi:10.1016/j.bbrep.2021.100995.
5. Kanchi S, Ahmed S. *Green Synthesis, Characterization and Applications of Nanoparticles*. Scrivener Publishing, Wiley, 2019. doi:10.1016/c2017-0-02526-0.
6. Iravani S. Green synthesis of metal nanoparticles using plants. *Green Chem*, 2011; 13(10): 2638-2650. doi:10.1039/c1gc15386b.
7. Joseph S, Mathew B. *Microwave Assisted Facile Green Synthesis of Silver and Gold Nanocatalysts Using the Leaf Extract of Aerva Lanata*. Vol 136. Elsevier B.V., 2015. doi:10.1016/j.saa.2014.10.023.
8. Sovawi AC, Harjono, Kusuma SBW. Sintesis Nanopartikel Emas dengan Bioreduktor Ekstrak Buah Jambu Biji Merah (Psidium guajava L). *Indones J Chem Sci*. 2016; 5(3). http://journal.unnes.ac.id/sju/index.php/ijcs%0ASINTESIS.
9. Putri SE, Pratiwi DE, Side S. The Effect of Microwave Irradiation on Synthesis of Gold Nanoparticles Using Ethanol Extract of White Bol Guava Leaves. *J Phys Conf Ser*, 2021; 1752(1). doi:10.1088/1742-6596/1752/1/012058.