ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Production of Gold Nanoparticles (AuNPs) from Chloroaurate Ions Using Aqueous Extract Of Air-Dried *Premna obtusifulia* Leaves.

Salprima Yudha S.,[1]* Eka Angasa,[1] Totok Eka Suharto,[1] Yuta Nishina[2], and Zulfikri Achid Mardlia[1]

[1]Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Bengkulu, Jalan Raya W.R Supratman, Kandang Limun 38371A, Bengkulu, Indonesia.
[2]Research Core for Interdisiplinary Sciences, Okayama University, Tsushima-naka, Kita-Ku Okayama, 700-8530, Japan.

ABSTRACT

Gold nanoparticles (AuNPs) were synthesized easily using bottom-up method in aqueous extract of air-dried *P. obtusifulia* R. Br. leaves without elevated temperature. The appearance of surface plasmon resonance (SPR) peak at 549.5 nm in UV-Vis spectrometry analysis give the early evidence of the AuNPs in the solution. The particles shape was in spherical form and the average size of obtaining amps is 90, 25 nm. The AuNPs was stable for several days and also sensitive toward $Pb(OAc)_2$ solution.

Keywords Chloroaurate Ions, Gold nanoparticles, *Premna obtusifulia* R. Br.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

There are many studies that focused on the investigation of reduction of gold and other metal ions using plants extract, enzymes, proteins, or amino acids [1-2]. The important reasons of the research developments have been caused by the need of the simple in handling, practically easy using cheaper reagents and environmentally benign processes [3-4]. It is not worthy that for environment development and their sustainability, everybody should take care on the design of safer chemicals as well as to generate substances that possess little or no toxicity to human health and the environment [1-4]. On the other hand, in nanoscience and nanotechnology field, the use of different reagents, solvents and variation reaction conditions would give different effects on the obtained nanomaterial's properties including interesting mechanistic aspects of the reaction, subsequently will bring to different appplication of the materials [5-10]. In this case, research on synthesis of gold nanoparticles (AuNPs) beeing investigated substantially because AuNPs already known have distinct electronic, optical, molecular-recognition characteristics [11] and they are also can be used for some applications such as synthesizing of unique materials with unique properties and to support biomedical and electronics technology [10-13]. In line with the development of green synthesis of metal nanoparticles, we have reported the synthesis of gold nanoparticles using the extract of air-dried *Callophyllum inophyllum* L. leaves and the obtained nanoparticles was in sperical form with the average size was 27,5 nm[14]. Here, we would like to report other promising natural reducing agent as well as medium for the AuNPs synthesis; an aqueous extract of air-dried *P. obtusifulia* R. Br. leaves. It should be noted that the aqueous extract of fresh leaves of *Premna serratifolia* L. was succesfuly reduce of silver ions to form silver nanoparticles (AgNPs) [15]. Beside that, in pharmaceutical field, the *P. obtusifulia* R. Br. was used in obesity thereupetic or other purposes [16]. To the best of our knowledges, there is no report on synthesis of AuNPs based on aqueous extract of air-dried *P. obtusifulia* R. Br. leaves.

EXPERIMENTAL

Premna obtusifulia R. Br leaves were obtained from Enggano island, Indonesia. The leaves were cut to small pieces and air-dried for 15 days. To anticipate the fungal growth during the drying process, the sample was treated by metanol spray for every day. The air-dried leaves (0,5 gram) were boiled in 25 ml demineralized-water (DM-water) under stirring for 15 minutes. Some impurities were removed using paper filter. The fresh extract was used immediatly for current reaction. The solution of 0,01 M of $HAuCl_4$ was prepared using demineralized-water. A representative procedure for synthesis of green AuNPs is as follow: solution of $HAuCl_4$ 0,01 M (1 ml) was added dropwise to the aqueous *Premna obtusifulia* R. Br leaves extract (5 ml) at room temperature in a reaction tube under shaking. The reduction process of gold ions (Au^{3+}) to gold metal (Au^0) has monitored by taking photograph of the solution after 30 minutes. The UV-Vis spectra were recorded using Carry 300 UV-Vis spectrophotometer by scanning the each solution containing the $HAuCl_4$, leaves extracts and also the mixture of $HAuCl_4$- leaves extracts at wavelength from 380-800 nm, while the shape and morphology of the obtained AuNPs were determined using Trasmission Electron Microscopy (TEM) analysis and the particles size were determined using Particle Size Analyzer (PSA).

RESULTS AND DISCUSSION

The addition of $HAuCl_4$ solution to the aqueous extract of *P. obtusifulia* R. Br leaves has ben monitored visually to see the colour changes of the extract solution from clear brown to darkbrown (Figure 1). The colour changes of both precursor solutions as first signal for predicting whether a reaction will occur in the solution.

(a) (b) (c)

Figure 1: The colour of solution of (a) $HAuCl_4$ (b) *P. obtusifulia* R. Br. leaves extract (c) reaction mixture of $HAuCl_4$- *P.obtusfulia* R. Br. after 30 minutes.

ISSN: 0975-8585

The UV-vis spectrophotometry measuerement have been carried out to the three solutions; $HAuCl_4$ solution, solution of *P. obtusifulia* R. Br leaves extract and the reaction mixture of $HAuCl_4$-leaves extract. The solution of $HAuCl_4$ and the leaves extract were not give any peaks around 380 – 800 nm, while the reaction mixture of of the $HAuCl_4$-leaves extract shows new peaks at 549,5 nm after 30 minutes (Figure 2a)

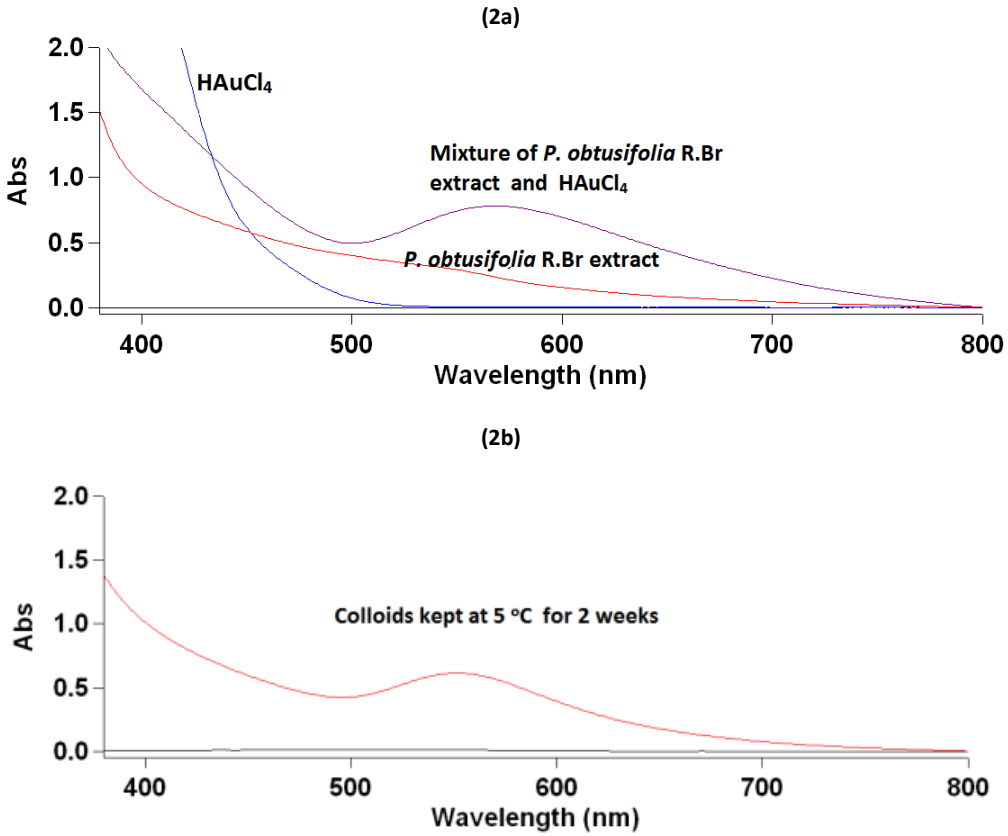

Figure 2: UV-Visible Spectroscopy pattern of synthesized AuNPs using *P. obtusifolia* R.Br leaves extract, (a) after 30 minutes at room temperature (b) after 2 weeks stored at ca. 5 ^{o}C

The new peak at 549,5 was devoted to special surface plasmon resonance (SPR) of the AuNPs. This phenomenon suggested that the extracts can reduce the gold ions to gold metals effectively without any elevated temperature and it is one advantage of this new method for preparation of gold nanoparticles. These results also suggested that the reaction proceeded very fast even at room temperature by simple mixing of the precursor and aqueous leaves extract. Although there is no clear evidence why the extract could reduce the gold ions to gold metals, it was predicted that the presence of some active compounds in the extract could act as reducing agents to reduce the chlorourate ions to form gold nanoparticles even at room temperature. Although the reaction mechanism remain uncertain, one possiblity is the reaction proceed by the oxidation of some main compounds in the extract by chlorouarate ions and vice versa. The presence of some other inactive compounds and also the oxidized compounds might stabilized the nanoparticle and also affects the size and shape of the obtained nanoparticles.

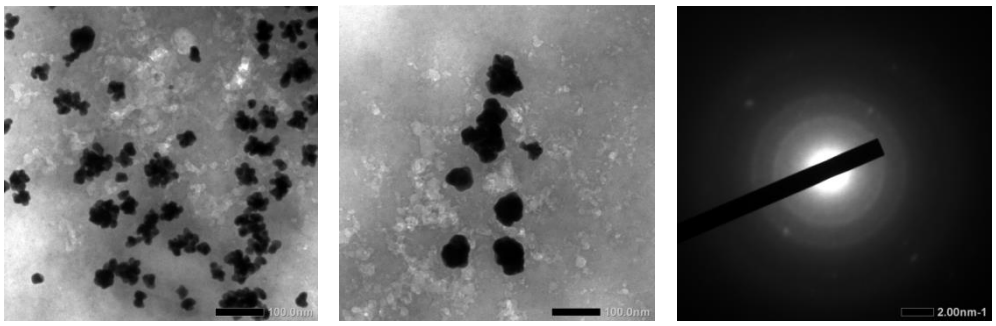

Figure 3: TEM patern of AuNPs using aqueous extract of *P. obtusifolia* R.Br leaves

ISSN: 0975-8585

To know the stability of the colloids, the reaction mixture stored at room temperature for 48 h and still give same peaks. More over, when the colloids stored at 5 ^{o}C, it was stable for up to 2 weeks. It is clearly shows that some organic compounds in the extract not only can reduce the gold ions but also could stabilize the nanocolloids, due to the presence of some important capping agents in the extract (Figure 2b). Furthermore, the shape and morphology of the AuNPs produced by the current reducing system was investigated using TEM analysis and revealed that the obtained gold nanoparticles was almost in spherical form as shown in Figure 3. The formation of spherical form AuNPs could not predicted based on the presence of current active compounds in the extract.

Further investigation of their sizes ditribution have been carried out using Particle Size Analyzer and revealed that the current reduction system give AuNPs with average diameter is 90,25 nm (Figure 4). The results suggested, even at room temperature the the extract could give small particles that lies under nanoparticles ranges.

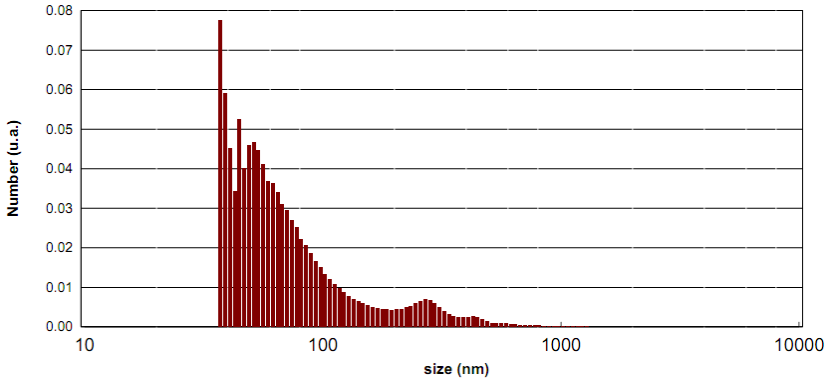

Figure 4: Distribution patern of AuNPs sizes obtained in aqueous extract of air-dried *Premna obtusifolia* R.Br leaves.

A study to investigate the interaction of current green AuNps with heavy metals ions was carry out using a series of concentration of $Pb(OAc)_2$ solution and the appearance of the solutions are shown in Figure 5.

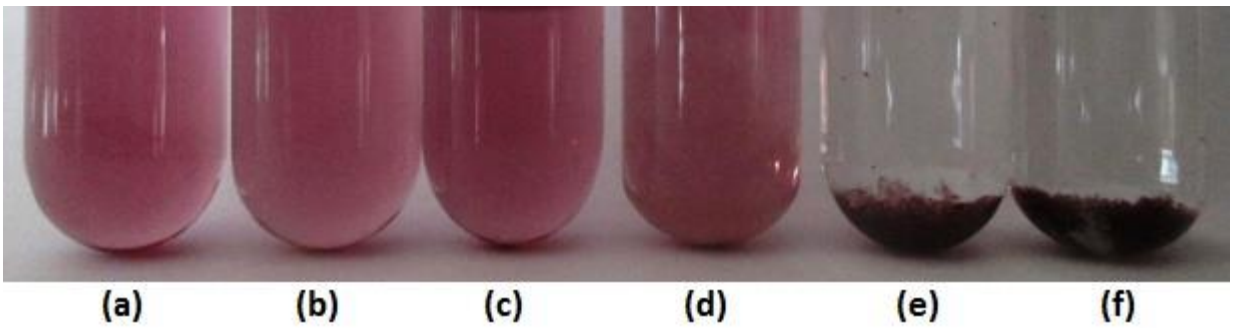

Figure 5: Visual appearance of Pb^{2+} addition to AuNPs solution: (a) AuNps solution (b) AuNPs + 10^{-5} M $Pb(OAc)_2$ (c) AuNPs + 10^{-4} M $Pb(OAc)_2$ (d) AuNPs + 10^{-3} M $Pb(OAc)_2$ (e) AuNPs + 10^{-2} M $Pb(OAc)_2$ (f) AuNPs + 10^{-1} M $Pb(OAc)_2$.

When the low concentration of Pb^{2+} ions solution (10^{-5} M, 10^{-4} M and 10^{-3} M) were added to the diluted AuNPs (diluted 10 times) the solutions were stable for several hours, while when the higher concentration of Pb^{2+} ions were used (10^{-2} M and 10^{-1} M) the aggregation on both solutions were occured immediately. These results shows that the current AuNPs colloids were not stable in the presence heavy metal solution especially $Pb(OAc)_2$ in high concentration.

In summary, practically easy handling on synthesis of AuNPs at room temperature condition have been developed using aqueous extract of air-dried *P. obtusifolia* R.Br. The present reduction system provide new information on the use of natural reducing agent for synthesis of gold nanoparticles. Further investigations on the use of the gold nanoparticles and other coinage metal nanoparticles for some applications are in progress in our laboratory.

ISSN: 0975-8585

ACKNOWLEDGEMENTS

We would like to thank Directorate for Higher Education (DIKTI) of Indonesia for funding this research.

REFERENCES

[1] SF Adila; ME Assala; M Khana; A Al-Warthana; MRH Siddiquia; LM Liz-Marzana, Dalton Trans, 2015. (In Press).
[2] S Iravani. Green Chem 2011;13:2638.
[3] V Kumar, K Yadav. J Chem Technol Biotechnol 2008;84:151
[4] P Mohanpuria, KN Rana, SK Yadav. J Nano Res 2008;10:507.
[5] KB Narayanan, N Sakthivel. Adv Colloid Interface Sci 2011;169:59.
[6] N Duran, PD Marcato, M Duran, A Yadav, A Gade, M Rai. Appl Microbiol Biotechnol 2011;90:1609.
[7] J Huang, et al. Nanotechnol 2007;18:105104.
[8] NC Sharma, SV Sahi, S Nath, JG Parsons, JL Gardea-Torresdey, T Pal. Environ Sci Technol 2007;41: 5137.
[9] TVM Sreekanth, PC Nagajyothi, N Supraja, TNVKV Prasad. Appl Nanosci 2015;5:595-602.
[10] S Gurunathan, JW Han, JH Park, J-H Kim. Nanoscale Res Lett 2014;9:248.
[11] J Zhao, X Zhang, XR Yonzon,AJ Haes, RP van Duyne. Nanomed 2006;1:219.
[12] RC Johnson, JT Hupp. Nano Lett 2001;4:165.
[13] RR Arvizo. S Bhattacharyya, RA Kudgus, K Giri, R Bhattacharyaa, P Mukherjee. Chem Soc Rev 2012;41:2943.
[14] S Yudha S. ZA Mardlia, E Angasa, TE Suharto, Y Nishina. Proceeding of The 9th Joint Conference on Chemistry, Semarang, Indonesia, 2014.
[15] S Soman, J Ray. J Nano Biomed Eng 2013;5:148.
[16] D Thirumalai, M Paridhavi, M Gowtham. Int J Res Phytochem Pharmacol 2011;4:196.