

Green Synthesis of Palladium nanoparticles from Eucalyptus globulou s Leaves Extract

Characterization and Biological Activity studies

Tilottama M. Thakur¹, Rama S. Lokhande¹, Milind M. Thigle² and V. R. Patil³

School of Basic Sciences, Department of Chemistry, Jaipur National University, Jaipur¹

Polyheal Systems, Dombivali MIDC²

Department of Chemistry, University of Mumbai, Mumbai³

Abstract: *Effective biological methodologies have been broadly designed for the preparation of metal nanoparticles. Hence, the use of biogenic materials such as plants, bacteria biomass, algae, enzymes and fungi has been utilized to synthesize various metal nanoparticles as an efficient, economical and sustainable process. Aqueous extract of dried leaves of Eucalyptus globulou s is used as a biogenic reducing agent for ecologically sound synthesis of palladium nanoparticles. Dynamic Light scattering (DLS), UV-visible spectroscopy, Fourier-Transform infrared spectroscopy (FTIR), Energy Dispersive X-Ray analysis (EDAX) and Scanning electron microscope (SEM) analyses were used to characterize the formed Palladium nanoparticles. The synthesized palladium nanoparticles exhibited antimicrobial activities.*

Keywords: PdNps, Bioreductant, Stabilizing Agents.

REFERENCES

- [1]. W. Niu, L. Zhang, and G. Xu., Shape-Controlled Synthesis of Single- Crystalline Palladium Nanocrystals, ACS Nano 4(4),1987-1996(2010). DOI: 10.1021/nn100093y.
- [2]. 2. H. B. Ahmed, M.K. Zahran, H. E. Emam, Heatless synthesis of well dispersible Au nanoparticles using pectin biopolymer, International Journal of Biological. Macromolecules 91 ,208–219,(2016) <https://doi.org/10.1016/j.ijbiomac.2016.05.060>
- [3]. Y. Tan, X. Dai, Y. Li and D. Zhu., Preparation of gold, platinum, palladium and silver nanoparticles by the reduction of their salts with a weak reductant-potassium bitartrate, Journal of Material Chemistry, 13, 1069-1075,(2003).<https://doi.org/10.1039/B211386D>.
- [4]. A. Nemamcha, J.L.Rehspringer, D. Khatmi .Synthesis of palladium nanoparticles by sonochemical reduction of palladium(ii) nitrate in aqueous solution. The Journal of Physical Chemistry B, 110(1), 383-387,(2006). DOI: 10.1021/jp0535801.
- [5]. N.Pugazhenthiran , S.Anandan ,G.Kathiravan , N.Kannaian ,U. Prakash, S.Crawford ,M. Ashokkumar ; MicrobialSynthesis of Silver Nanoparticles by Bacillus sp. Journal of Nanoparticle Research, 11(7), 1811-1815(2009). DOI 10.1007/s11051-009-9621-2
- [6]. Y. Konishi, K. Ohno, N.Saitoh, T. Nomura, S.Nagamine, H.Hishida, Y.Takahashi, T.Uruga. Bioreductive Deposition of Platinum Nanoparticles on the Bacterium ShewanellaAlgae. Journal of Biotechnology, 128(3), 648-653 (2007). DOI: 10.1016/j.jbiotec.2006.11.014.
- [7]. Y.Xiong, J. Chen, B. Wiley, Y.Xia.Understanding the role of oxidative etching in the polyol synthesis of Pd nanoparticles with uniform shape and size. Journal of the American Chemical Society, 127 :(20), 7332-7333(2005). DOI: 10.1021/ja0513741.
- [8]. S.Bharathiraja; N.Q.Bui; P.Manivasagan; M.S.Moorthy; S.Mondal; H.Seo; N.T.Phuoc; T.T.VyPhan; H.Kim; K.D.Lee; et al. Multimodal tumor-homing chitosan oligosaccharide-coated biocompatible palladium nanoparticles for photo-based imaging and therapy. Scientific. Reports. 8, 500(2018) DOI.10.1038/s41598-017- 18966-8

- [9]. Y.Liu; D.-D.Wang; L. Zhao; M. Lin; H.-Z. Sun; H.-C. Sun; B.Yang. Polypyrrole-coated flower-like Pd nanoparticles (PdNPs@PPy) with enhanced stability and heat conversion efficiency for cancer photothermal therapy. *Royal Society Chemistry Advances*. 6,15854–15860,(2016).DOI: 10.1039/C5RA25613E.
- [10]. N.Rabiee;M. Bagherzadeh; M. Kiani; A.M. Ghadiri. Rosmarinus_cinalis directed palladium nanoparticle synthesis: Investigation of potential antibacterial, antifungal and Mizoroki-Heck catalytic activities. *Advances Powder Technology*. 15, 3983–3999(2020).DOI:10.1016/j.appt.2020.01.024.
- [11]. R.K.Petla; S.Vivekanandhan; M.Misra; A.K. Mohanty; N Satyanarayana. Soybean (Glycine max) leaf extract based green synthesis of palladium nanoparticles. *Journals of Biomaterials and Nanobiotechnology*. Vol.3No.1,(2012)DOI: 10.4236/jbnb.2012.31003
- [12]. Sathishkumar, M.; Sneha, K.; Yun, Y.S. Palladium nanocrystals synthesis using Curcuma longa tuber extract. *International of Journal of Materials Sciences* vol.4, 11–17. 2009.
- [13]. M.N.Nadagouda; R.S.Varma. Green synthesis of silver and palladium nanoparticles at room temperature using coffee and tea extract. *Green Chemistry*. 10, 859–862, (2008). DOI:10.1039/B804703K
- [14]. S.Lebaschi; M.Hekmati; H.Veisi.Green synthesis of palladium nanoparticles mediated by black tea leaves (Camellia sinensis) extract: Catalytic activity in the reduction of 4-nitrophenol and Suzuki-Miyaura coupling reaction under ligand-free conditions. *Journal of Colloid and Interface Science*.485, 223–231 (2017).DOI:10.1016/j.jcis.2016.09.027.
- [15]. X.Yang; Q. Li; H. Wang; J.Huang; L.Lin.; W.Wang; D.Sun; Y. Su.; J.B.Opiyo.; L.Hong; et al. Green synthesis of palladium nanoparticles using broth of Cinnamomum camphora leaf. *Journal of Nanoparticle Research*. 12,1589– 1598. (2010), DOI 10.1007/s11051-009-9675-1
- [16]. E.C.Njagi , H.Huang , L.Stafford , H. Genuino, H.M.Galindo, J.B.Collins , G.E.Hoag , S.L.Suib , Biosynthesis of iron and silver nanoparticles at room temperature using aqueous sorghum bran extracts. *Langmuir*, 27, 264–271(2010). DOI: 10.1021/la103190n.
- [17]. A.D.Dwivedi, K.Gopal , Biosynthesis of silver and gold nanoparticles using Chenopodium album leaf extract. *Colloids and Surfaces. A*, 369, 27–33(2010) DOI:10.1016/j.colsurfa.2010.07.020
- [18]. P.P.Gan , S.F.Y. Li , Potential of plant as a biological factory to synthesize gold and silver nanoparticles and their applications. *Reviews in Environmental Science and Biotechnology*.11, 169–206(2012)DOI:10.1007/s11157-012-9278-7
- [19]. R.K.Das, N.Gogoi, U.Bora , Green synthesis of gold nanoparticles using Nyctanthes arbortristis flower extract. *Bioprocess and Biosystems Engineering*, 34, 615–619(2011). DOI: 10.1007/s00449-010-0510-y
- [20]. P. M. Griffin and R. V. Tauxe, The epidemiology of infections caused by Escherichia coli O157:H7, other enterohemorrhagic E. coli, and the associated hemolytic uremic syndrome, *Epidemiologic Reviews*, 1360-98. (1991) DOI: 10.1093/oxfordjournals.epirev.a036079
- [21]. D.R.Batish, H.P.Singh, R.K.Kohli, S.Kaur . Eucalyptus essential oil as a natural pesticide. *Forest Ecology and Management*; 256:2166-2174(2008). DOI:10.1016/j.foreco.2008.08.008
- [22]. Y.C.Yang, H.C.Choi, W.S.Choi, J.M.Clark, Y.J Ahn. Ovicidal and adulticidal activity of Eucalyptus globulus leaf oil terpenoids against Pediculus humanus capitis (Anoplura: Pediculidae). *Journal of Agricultural and Food Chemistry*. 52, 2507–2511(2004). DOI:10.1021/jf0354803.
- [23]. OE Olorundare, ON Irobi, SA Kuteyi. Antifungal activities of crude extracts of Sennaalata(L).*Bioscience research communication*.;10:181-184(1998).
- [24]. P.Sartorelli, A.D. Marquiere, A.Amaral-Baroli, MEL.Lima, PRH Moreno. Chemical composition and antimicrobial activity of the essential oils from two species of eucalyptus. *Phytotherapy Research*.21:231-233. (2007).DOI: 10.1002/ptr.2051.
- [25]. M.I.H Brooker, D.A. Kleinig, South-eastern Australia, Third edition. *Bloomings*, Melbourne. *Field Guide to Eucalyptus*. vol.1(2006).
- [26]. F.He, J.Liu, C.B.Roberts, D.Zhao, One-Step “Green” Synthesis of Pd Nanoparticles of Controlled Size and Their Catalytic Activity for Trichloroethene Hydrodechlorination. *Industrial Engineering Chemistry Research*. 48(14), 6550-6557(2009). DOI:10.1021/ie801962f

- [30]. V.Manikandan; P.Velmurugan; J.H.Park; N.Lovanh; S.K. Seo; P.Jayanthi; Park, Y.J.; M.Cho; B.T Oh., Synthesis and antimicrobial activity of palladium nanoparticles from Prunus x yedoensis leaf extract. Materials Letters. 185, 335–338(2016), DOI:10.1016/j.matlet.2016.08.120.
- [31]. FarhanaAnjum, SaimaGul, Mohammad Iqbal Khan and Murad Ali KhanEfficient synthesis of palladium nanoparticles using guar gum as stabilizer and their applications as catalyst in reduction reactions and degradation of azodyes,DeGruyter,Green Processing Synthesis.9: 63–76(2020). DOI:10.1515/gps-2020-0008.
- [32]. Hilal Ahmad, Krishnan Venugopal, KalyanaramanRajagopal, Savitha De Britto, BoregowdaNandini, HosurGnanaprakashPushpalatha, NarasimhamurthyKonappa, Arakere C. Udayashankar , NagarajaGeetha and SudishaJogaiahGreen Synthesis and Characterization of Zinc Oxide Nanoparticles Using Eucalyptus globules and Their Fungicidal Ability Against Pathogenic Fungi of Apple Orchards. Biomolecules 10, 425,(2020). DOI:10.3390/biom10030425.
- [33]. Y.-G.Gil; S.Kang; A. Chae; Y.-K.Kim; D.-H.Min; H.Jang. Synthesis of porous Pd nanoparticles by therapeutic chaga extract for highly efficient tri-modalcancer treatment. Nanoscale 10,19810–19817(2018), DOI:10.1039/C8NR07172A.