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Green synthesis, characterization and application of Gold Silver and Palladium Nano particles and their potential applications assays.

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Abstract.
Green blend strategy is a basic, modest, environmental, and quick method for the synthesis of nanoparticles when contrasted with the ordinary physical and synthetic techniques which are very costly and possibly risky to the climate, gold(Au^0), silver (Ag^0) and palladium (Pd^0) nanoparticles (NPs) have been incorporated effectively by green synthetic technique utilizing the lessening specialist, combined from Kalanchoepinnata (Ranapalam plant). The presence of cell reinforcement compounds in Kalanchoepinnata remove is liable for lessening and covering of metal nanoparticles.The synthesized Au-Ag-Pd-NPs further characterized by UV-Visible spectroscopy to conform the Nanoparticles synthesis, and the functional group identification characterized by FT-IR spectroscopy, the crystallite nature of synthesized Au-Ag-Pd-NPs identified by X-ay diffraction spectroscopy,the morphological structure were determined by SEMand TEM.Thesynthesized nanoparticles exhibit excellent microbial activity against gram-negativebacterial strains.

Keywords. *Green synthesis, Kalanchoepinnata (Ranapalam plant), Microbial activity.*

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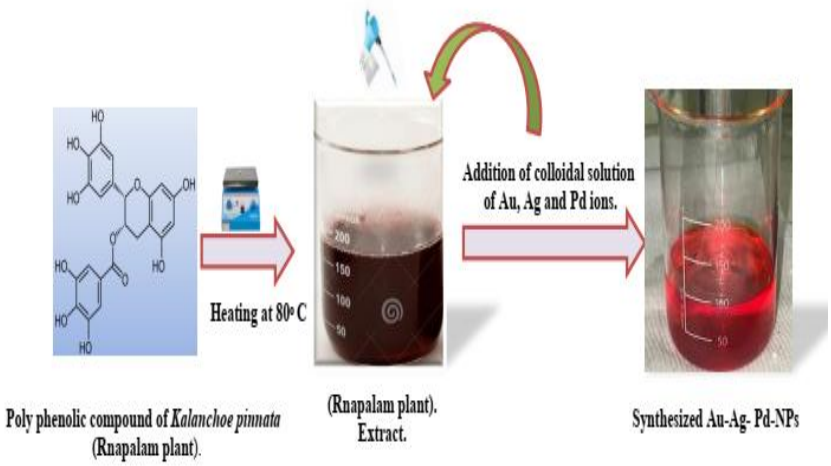
I. Introduction.

The synthesis of metallic nanoparticles utilizing plant separates as diminishing specialists have drawn in concentrated research consideration in the area of nanotechnology in the momentum decade. Green blend procedure is a basic, modest, biological and rapid course forthe creation of nanoparticles when contrasted with the traditional physical and compound techniques which are very costly and possibly unsafe to the climate. The green diminishing specialist, Kalanchoepinnata (Rnapalam plant).Stem is a famous restorative plant in India, having a place with the family Bryophyllum, normally known as kidney stones evacuation because of its cell reinforcement property. Kalanchoepinnata (Rnapalam plant)contains ascorbic corrosive, carotene, phenols, tannins, anabolic, phytochemical quercetin, steroidal substances, calcium and phosphorus. Kalanchoepinnata (Ranapalam plant)is perceived as a characteristic cell reinforcement which stops or postpones the course of oxidation and furthermore has free extremist searching action. The worldwide development of bacterial protection from traditional clinical practices is a serious danger to human wellbeing.One of the promising ways to deal with beat bacterial obstruction is the utilization of metallic nanoparticles in medications. Among the different metal nanoparticles, Au, Ag, and Pd are generally utilized in biomedical applications because of their biocompatible nature.Noble metal nanoparticles arewidely used in electrochemical sensor applications. Green combination procedure is a basic, modest, biological, and rapid course for the development of nanoparticles when contrasted with the regular physical and synthetic strategies which are very costly and possibly unsafe to the climate gold (Au0),silver (Ag^0) and palladium (Pd^0) nanoparticles (NPs) have been synthesized successfully by Green synthesis method using the reducingagent, synthesized from ***Kalanchoepinnata*** (Ranapalam plant). The presence of antioxidantcompounds in ***Kalanchoepinnata*** *extract*is responsible for reducing and capping of metal nanoparticles. The synthesized Au-Ag-Pd-NPs further characterized by UV-Visible spectroscopy to conform the Nanoparticles synthesis, and the functional group identification characterized by FT-IR spectroscopy, the crystality nature of synthesized Au-Ag-Pd-NPs identified by X-ay diffraction spectroscopy, the morphological structure were determined by SEM and TEM. Thesynthesized nanoparticles exhibit excellent antibacterial activity against gram-negativebacterial strains.

Graphical abstract.



Preparation of metal nanoparticles

For the Green synthesis of Tri metal nanoparticles Au-Ag-Pd-NPs, 5ml of ***Kalanchoepinnata*** (***Ranapalam plant***) extract was blended to a watery arrangement of 0.5mM chloroauric acid, silver nitrate, and palladium chloride individually, and warming persistently for 10min at 450W temperature (by MWI).The response finished gradually, and it showed stable purple shade of Au-Ag-Pd-NPs colloids separately. The arrangements of Au-Ag-Pd-NPs were described by UV-Vis, XRD, FTIR, TEM, and EDX. The resultant items contain respective metal nanoparticlewas used to evaluate the antibacterial action (50µg/ml)against microbial activity.

General characterization of Tri metal nanoparticles Au-Ag- Pd-NPs.

The integrated Tri metal nanoparticles (Au-Ag-Pd-NPs), were portrayed by powder X-beam diffraction framework (X-beam diffractometer (Philip's X'pert Genius) furnished with Cu Kα radiation (λ= 0.15406 nm). The UV-Vis spectra of the examples were concentrated on utilizing a Twofold Pillar UV-Vis Spectrophotometer (Schimadzu 3600) with tests in a quartz cuvette. The FTIR spectra of the examples were recorded over an otherworldly scope of 400 - 4000cm-1. The surface morphology and microstructure of the examples were examined by a filtering electron microscopy (EOL JSM-5600 LV Checking Electron Magnifying instrument) and Change Electron Microscopy (FEI, TECNAI S twin magnifying instrument with a speeding up voltage of 100 KV). Essential structure and stoichiometry of the combined nanoparticles were concentrated on utilizing Energy Dispersive X-ray Spectroscope (EDS).

II. Results and Discussions

UV-Visible spectroscopy

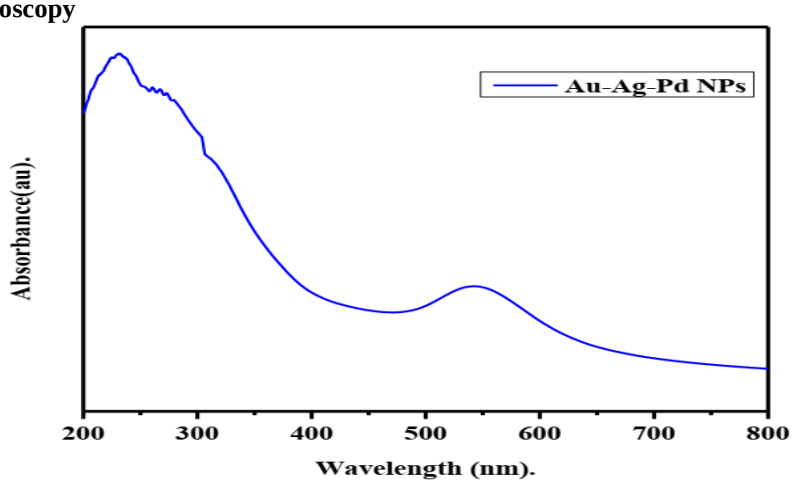


Fig.1. UV-Visible spectroscopy of synthesized Au-Ag-Pd NPs.

Fig.1shows the UV-Vis assimilation spectra recorded for combined Au-Ag-Pd NPs tests. Surface Plasmon Reverberation (SPR) is a little molecule impact, which is missing in mass metals. SPR is impacted by size, shape, arrangement, dispersity, general climate, and surface

science of particles. The spectra of Au-Ag-Pd NPs show solid absorbance at 556 nm, ascribed to SPR beginning from Au-Ag-Pd-NPs. The expansion in the power of retention of Au-Ag-Pd NPs is assigned to an increase in the number of nanoparticlesformed. In this synthetic method the wavelength of Au-NPs can be found as major compare to Ag and Pd NPs, because gold nanoparticles act as core shell and remain metal act as inner metal.

FT-IR

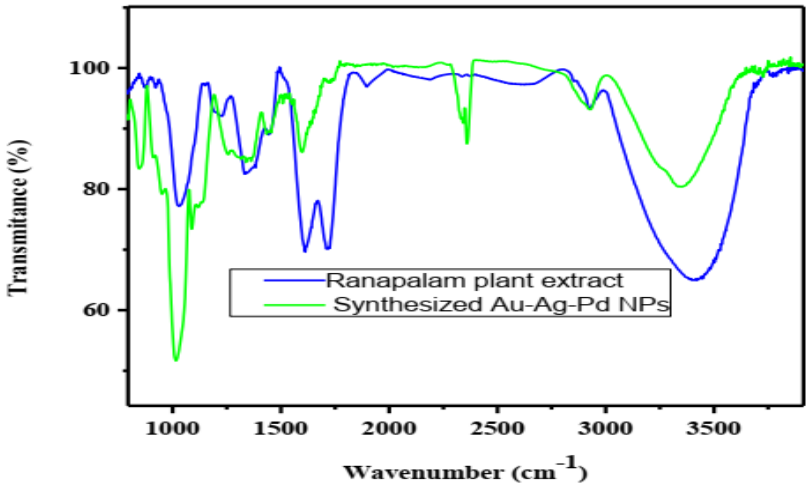


Fig.2. FT-IR studies of synthesized Au-Ag-Pd NPs.

For the synthesized Au-Ag-PdNPs ***Kalanchoepinnata*** (***Ranapalam plant***) extract FTIR spectra were taken. The practical gatherings liable for the covering of Au-Ag-Pd-NPs and the decrease of Au+3, Ag+ and Pd+2 particles were tracked down utilizing FTIR examination. The =C-H and N-H extending are applicable to the tops in the 1000-650 cm-1 territory.The presence of the utilitarian gatherings C-O-C, C-Goodness, and C=O is demonstrated by the pinnacle range 1300-1000cm-1. Extending of NO2 or CH3 and CH2 is shown by the FTIR range 1550-1300 cm-1, though extending of C=C, C=N, and N-H is addressed by the reach 1650-1550 cm-1. Peaks in the scopes of 2250-2100 and 2800-2200 cm-1 relate to C extending of the alkynes and C-N extending of the nitriles, separately, though peaks in the scopes of 1780-1650 cm-1 reflect C=O stretching of esters, ketones, and aldehydes. The O-H stretch of alcohols is addressed by the FTIR peak in the range of 3650-3200 cm-1, while the O-H stretch of carboxylic acids is addressed by the peak in the range of 3300-2500 cm-1. While some peaks have moved from stem extract to Au-Ag-Pd-NPs, a portion of the peaks are available in both the recorded and unrecorded spectra. The presence of optional metabolites in the plant stem concentrate can be ascribed to the peaks found in the spectra.

XRD Studies.

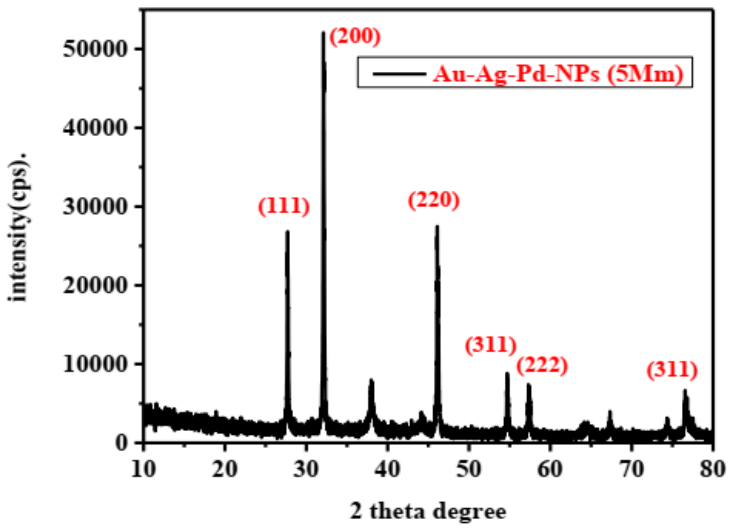


Fig.3 XRD studies of synthesized Au-Ag-Pd NPs.

The crystalline nature of the Au-Ag-Pd-NPs is established using XRD analysis. Fig 3. shows X-ray diffraction peaks at 29.33^0, 37.99°, 45.91°, 64.33° and 76.58°, which correspond to the (111), (200), (220) and (331) crystallographic planes of face centered cubic (FCC) Au-Ag-Pd-NPs crystals, respectively. The crystallinity of the synthesized Au-Ag-Pd-NPs was also confirmed by the SAED pattern. Presence of the additional peaks was because of organic chemicals present in the plant extract that reduce Au-Ag-Pd-NPsions and stabilize the resulting nanoparticles. Similar results were reported by Jemal et al. 2017, that the Au-Ag-Pd-NPs synthesized from plant extracts are Face-centered Cubic, and crystalline in nature.

SEM analysis.

The morphology of the biosynthesized Au-Ag-Pd-NPs was studied from the SEM images. Figure 4 shows the SEM image of synthesized Au-Ag-Pd-NPs. synthesized from ***Kalanchoepinnata*** (***Ranapalam plant***) extract. It can be observed from the Figure 4 that the Au-Ag-Pd-NPs are mostly in spherical shape. To verify the formation of Au-Ag-Pd-NPs, an Energy Dispersive X-Ray spectroscopy (EDAX) study was performed. EDAX peaks show the presence of gold, silver, palladium, carbon and oxygen. Due to Surface Plasmon Resonance, a sharp peak in the gold, silver, palladium region was observed at 3keV indicating the presence of gold, silver, palladium nanoparticles. The peaks also show the presence of carbon and oxygen which may be due to the presence of organic components in the ***Kalanchoepinnata*** (***Ranapalam plant***) extractextract.

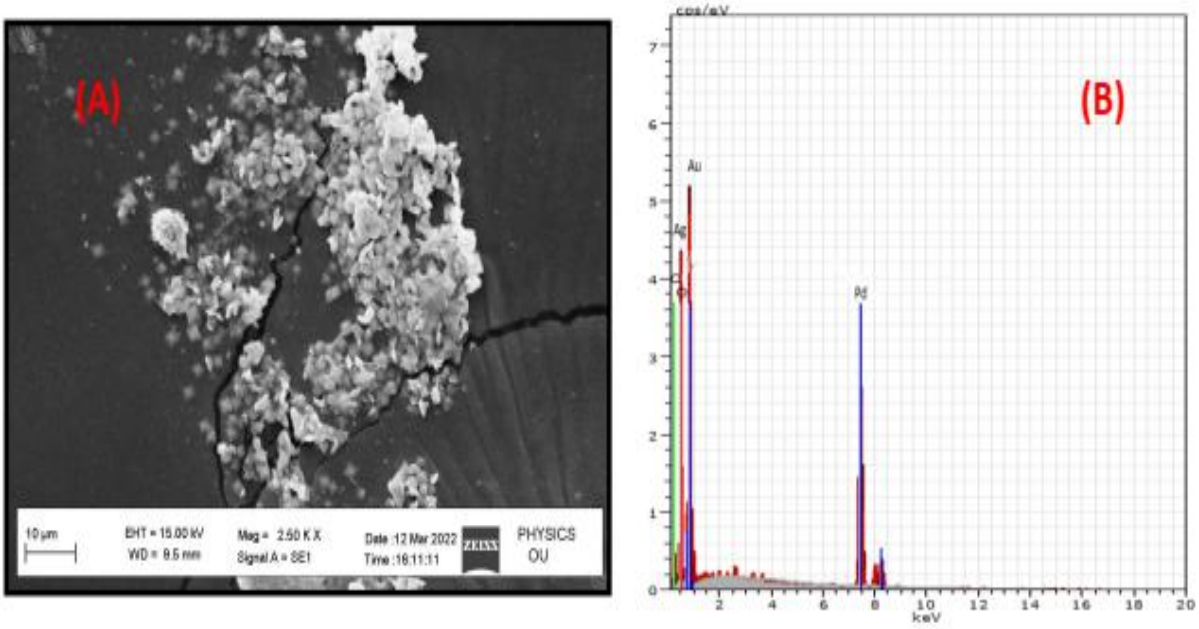


Fig.4. SEM images of synthesized Au-Ag-Pd-NPs.

Table.1. elemental dispersive studies of synthesized Au-Ag-Pd-NPs.

Element	Weight %	Atomic %
O	10.13	16.75
C	19.43	20.01
Au	**32.20**	**27.96**
Ag	23.13	17.02
Pd	15.12	18.24
TOTAL	100	100

TEM.

The shape, size and morphology of the nanoparticles were determined by Transmission Electron Microscopy. The TEM micrographs of the synthesized Au-Ag-Pd-NPs shows that most of the nanoparticles arespherical,

ranging from 2.14 nm to 10.76 nm with an average diameter of 6.45±2.46 nm. The TEM images(Figure 5 a) show that the nanoparticles are well separated from each other. Fig. 6.Histogram showing theparticle size distribution of the Au-Ag-Pd-NPs. The selected area electron diffraction (SAED) performed using aTEM showed ring pattern confirming the nanoparticles are crystalline in nature. Each ring in theSAED pattern corresponds to different lattice planes identified from the XRD analysis.

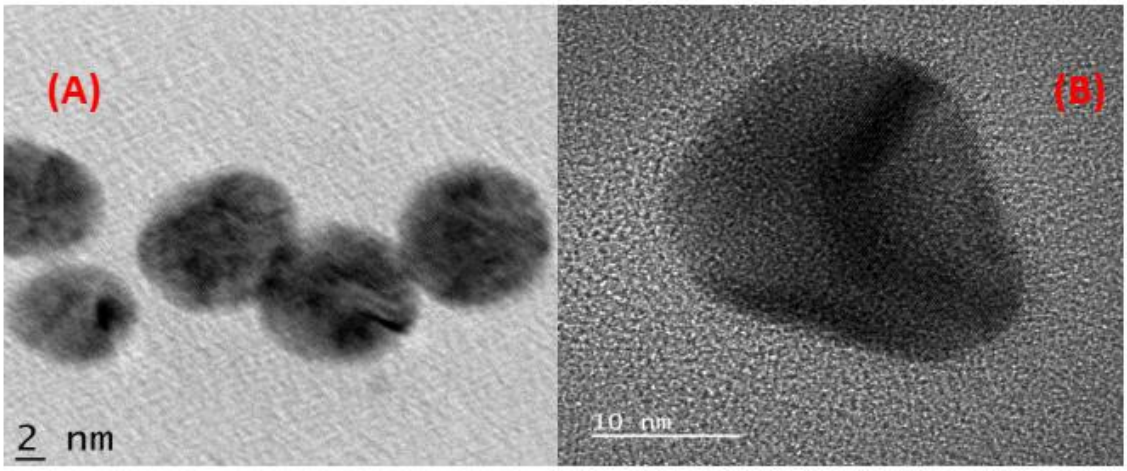


Fig.5. TEM images of synthesized Au-Ag-Pd-NPs.(a) 2nm and (b)10 nm.

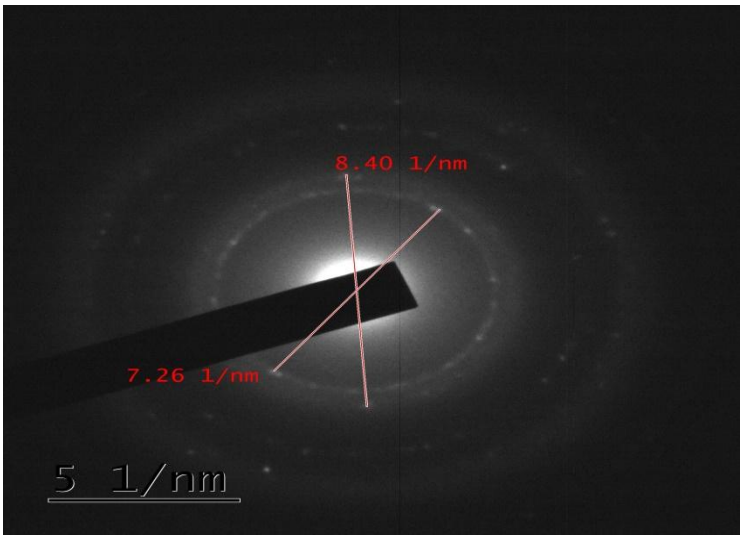


Fig.6. SAED pattern of synthesized Au-Ag-Pd-NPs.

III. Application.

Antibacterial Study

The antibacterial movement of the Kalanchoepinnata (Ranapalam plant) extricate covered Au-Ag-Pd-NPs has done against six microbes microorganisms viz. Klebsiellapneumoniae, Bacillus subtilis, Proteus vulgaris, Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia ***coli. The Kalanchoepinnata (Ranapalam plant) remove covered Au-Ag-Pd-NPs has shown positive antibacterial action against Klebsiellapneumoniae, Proteus vulgaris, Staphylococcus aureus and E. coli (Table-2) and showed negative antibacterial action***against ***Bacillus subtilis*** and ***Pseudomonas aeruginosa***.

Table.2. Antibacterial Study of synthesized Au-Ag-Pd-NPs.

S.NO	Name of the bacteria	1mM	2mM	3mM	4mM	5mM
		Zone of inhibition (mm)	Zone of inhibition (mm)	Zone of inhibition (mm)	Zone of inhibition (mm)	Zone of inhibition (mm)
1	***Klebsiellapneumoniae***	1.6	1.8	1.8	2.0	2.2
2	***Bacillus subtilis***	0	0	0	0	0
3	***Proteus vulgaris***	1.8	2.0	1.8	2.1	2.4
4	***Staphylococcus aureus***	1.6	1.8	1.8	2.2	2.2

5	***Pseudomonasaeruginosa***	0	0	0	0	0
6	***Escherichia coli***	1.8	1.8	1.6	1.0	1.8
7	***Treptomycin*(Standard).**	1.8	1.8	1.8	1.8	1.8

IV. Conclusion.

Kalanchoepinnata (Rnapalam plant) Stem is a famous restorative plant in India, having a place with the family Bryophyllum, regularly known as kidney stones evacuation because of its cell reinforcement property. Kalanchoepinnata (Rnapalam plant) contains ascorbic corrosive, carotene, phenols,tannins, anabolic, phytochemical quercetin, steroidal substances, calcium and phosphorus Kalanchoepinnata (Rnapalam plant) is perceived as a characteristic cell reinforcement which stops or defers the course of oxidation and furthermore has free extremist rummaging action. A straightforward,efficient and eco-friendly synthesis of Au-Ag-Pd-NPs from the extract of ***Kalanchoepinnata*** (***Ranapalam plant***) is reported. The synthesized Au-Ag-Pd-NPswavelength found to be 556 nm, the size and morphology of synthesized Au-Ag-Pd-NPsstill up in the air as 2.14 nm to 10.76 nm, with a typical width of 6.45±2.46 nm. The blended nanoparticles have shown positive antibacterial action against K. pneumonia, P. vulgaris, S. aureus and E. coli.

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References.

[1]. Turunc, E., Binzet, R., Gumus, I., Binzet, G., &Arslan, H. (2017). Green synthesis of silver and palladium nanoparticles using Lithodorahispidula (Sm.) Griseb. (Boraginaceae) and application to the electrocatalytic reduction of hydrogen peroxide. Materials Chemistry and Physics, 202, 310–319. https://doi.org/10.1016/j.matchemphys.2017.09.032

[2]. Vijilvani, C., Bindhu, M. R., Frincy, F. C., AlSalhi, M. S., Sabitha, S., Saravanakumar, K., Devanesan, S., Umadevi, M., Aljaafreh, M. J., &Atif, M. (2020). Antimicrobial and catalytic activities of biosynthesized gold, silver and palladium nanoparticles from Solanumnigurum leaves. Journal of Photochemistry and Photobiology B: Biology, 202(November 2019), 111713. https://doi.org/10.1016/j.jphotobiol.2019.111713

[3]. Yaqoob, S. B., Adnan, R., Rameez Khan, R. M., & Rashid, M. (2020). Gold, Silver, and Palladium Nanoparticles: A Chemical Tool for Biomedical Applications. Frontiers in Chemistry, 8(June), 1–15. https://doi.org/10.3389/fchem.2020.00376

[4]. Meva, F. E. A., Ntoumba, A. A., Kedi, P. B. E., Tchoumbi, E., Schmitz, A., Schmolke, L., Klopotowski, M., Moll, B., Kökcam-Demir, Ü., MpondoMpondo, E. A., Lehman, L. G., &Janiak, C. (2019). Silver and palladium nanoparticles produced using a plant extract as reducing agent, stabilized with an ionic liquid: Sizing by X-ray powder diffraction and dynamic light scattering. Journal of Materials Research and Technology, 8(2), 1991–2000. https://doi.org/10.1016/j.jmrt.2018.12.017

[5]. Karimi, F., Rezaei-savadkouhi, N., Uçar, M., Aygun, A., ElhoudaTiri, R. N., Meydan, I., Aghapour, E., Seckin, H., Berikten, D., Gur, T., &Sen, F. (2022). Efficient green photocatalyst of silver-based palladium nanoparticles for methyle orange photodegradation, investigation of lipid peroxidation inhibition, antimicrobial, and antioxidant activity. Food and Chemical Toxicology, 169(September), 113406. https://doi.org/10.1016/j.fct.2022.113406

[6]. Berhault, G., Kochkar, H., &Ghorbel, A. (2012). Shape-controlled synthesis of silver and palladium nanocrystals using β-cyclodextrin. Materials Research Society Symposium Proceedings, 1446, 89–94. https://doi.org/10.1557/opl.2012.917

[7]. Nishanthi, R., Malathi, S., S., J. P., &Palani, P. (2019). Green synthesis and characterization of bioinspired silver, gold and platinum nanoparticles and evaluation of their synergistic antibacterial activity after combining with different classes of antibiotics. Materials Science and Engineering C, 96(November 2018), 693–707. https://doi.org/10.1016/j.msec.2018.11.050

[8]. Peskova, M., Ilkovics, L., Hynek, D., Dostalova, S., Sanchez-Carnerero, E. M., Remes, M., Heger, Z., &Pekarik, V. (2019). Detergent-modified catalytic and enzymomimetic activity of silver and palladium nanoparticles biotemplated by Pyrococcusfuriosus ferritin. Journal of Colloid and Interface Science, 537, 20–27. https://doi.org/10.1016/j.jcis.2018.11.005

[9]. Wicaksono, W. P., Kadja, G. T. M., Amalia, D., Uyun, L., Rini, W. P., Hidayat, A., Fahmi, R. L., Nasriyanti, D., Leun, S. G. V., Ariyanta, H. A., &Ivandini, T. A. (2020). A green synthesis of gold–palladium core–shell nanoparticles using orange peel extract through two-step reduction method and its formaldehyde colorimetric sensing performance. Nano-Structures and Nano-Objects, 24, 100535. https://doi.org/10.1016/j.nanoso.2020.100535

[10]. Bhattarai, B., Zaker, Y., &Bigioni, T. P. (2018). Green synthesis of gold and silver nanoparticles: Challenges and opportunities. Current Opinion in Green and Sustainable Chemistry, 12, 91–100. https://doi.org/10.1016/j.cogsc.2018.06.007

[11]. COMPARISON OF GOLD , SILVER , AND PALLADIUM NANOPARTICLES PREPARED FROM PLANT EXTRACTS FOR ENHANCING LUMINOL ' S ABILITY TO DETECT BLOOD SAMPLES. (2017). 0002(August).

[12]. Lin, X., Wang, J., Wu, M., Kuga, S., & Huang, Y. (2017). Use of Lignin and Hemicelluloses for Facial Synthesis of Gold, Platinum, and Palladium Nanoparticles. Journal of Bioresources and Bioproducts, 2(4), 149–152. https://doi.org/10.21967/jbb.v2i4.151

[13]. Storm, E., Maggott, E. D., Mashazi, P., Nyokong, T., Malgas-Enus, R., &Mapolie, S. F. (2022). Application of gold and palladium nanoparticles supported on polymelaminemicrospheres in the oxidation of 1-phenylethanol and some other phenyl substituted alcohols. Molecular Catalysis, 528(January), 1–11. https://doi.org/10.1016/j.mcat.2022.112456

[14]. Tajiki, A., Abdouss, M., Sadjadi, S., Mazinani, S., & Ramakrishna, S. (2021). Photo-induced green synthesis of bimetallic Ag/Pd nanoparticles decorated reduced graphene oxide/nitrogen-doped graphene quantum dots nanocomposite as an amperometric sensor for nitrite detection. Analytical and Bioanalytical Chemistry, 413(25), 6289–6301. https://doi.org/10.1007/s00216-021-03584-1

[15]. Dissertation, A. (2012). Ag, Au, Pd Nanoparticles—Ligand Design, Synthesis and Polymer Composites.

[16]. Nizamuddin, S., Hymavathi, A., Yaku, G., &Umesh Kumar, U. (2022). Green synthesis and characterization of ZnO nanoparticles-A novel approach using Carica papaya leaf extract. Materials Today: Proceedings. https://doi.org/10.1016/j.matpr.2022.05.053

[17]. Mohammed, A., Gugulothu, Y., Bandi, R., Dadigala, R., &Utkoor, U. K. (2021). Ultraspeed synthesis of highly fluorescent N-doped carbon dots for the label-free detection of manganese (VII). Journal of the Chinese Chemical Society, December 2020, 1–8. https://doi.org/10.1002/jccs.202000545
[18]. Rekha, K. C., Yaku, G., & Kumar, U. U. (2021). Characterisation, antibacterial and anticancer investigation of green synthesized silver nanoparticles utilizing gymnemasylverstre leaf broth (Podapathri) by microwave light strategy. Rasayan Journal of Chemistry, 14(3), 2031–2039. https://doi.org/10.31788/RJC.2021.1436258
[19]. De, S., Kundu, R., Ghorai, A., Prasad, R., &Ghosh, U. (2014). Journal of Photochemistry and Photobiology B : Biology Green synthesis of gold nanoparticles for staining human cervical cancer cells and DNA binding assay. JOURNAL OF PHOTOCHEMISTRY & PHOTOBIOLOGY, B: BIOLOGY, 140, 130–139. https://doi.org/10.1016/j.jphotobiol.2014.07.014
[20]. Hosny, M., Eltaweil, A. S., Mostafa, M., El-badry, Y. A., Hussein, E. E., Omer, A. M., &Fawzy, M. (2022). Facile Synthesis of Gold Nanoparticles for Anticancer , Antioxidant Applications , and Photocatalytic Degradation of Toxic Organic Pollutants. https://doi.org/10.1021/acsomega.1c06714.

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