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Eco-Friendly Synthesis of some Novel Metal Nanoparticles Mediated by *Ocimum Basilicum-Lamiaceae (Thiru Neetru Pathilai)* Leaves Extract

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Abstract: Nanotechnology is an escalating field, which has an growing impact in each and every sector. There are many ways for synthesizing nanoparticles but biosynthetic route of nanoparticle synthesis is emerging as a new and safer alternative to the conventional methods. Ocimum basilicum Lamiaceae (OBL) is an age old herb native to Southeast Asia and Central African countries. These plants are generally known to be used in different cuisines world-wide. The aroma emitted from the leaves and the twigs of the fresh and dried plants are well known to have insect repellent property. Estragole, citronellal, limonene and nerolidol are the natural volatile compounds present in the basil leaves which acts as repellents. This plant is also widely used as a scent through which it netted its title Queen (basileus) of aromatic herbs. In present study the Green synthesis of some metal oxide nanoparticles have been synthesized by Ocimum Basilicum-Lamiaceae (Thiru Neetru Pathilai).These methods are completely green methods, free from toxic and harmful solvent. Note and measure visual observation of the nanoparticle solutions, preliminary test of electrical conductivity(EC), pH change of the reaction mixture and total dissolved suspend(TDS) in the reaction were measured and recorded.

Keywords: Green synthesis, Metal ions, OBL leaves extract, Nanoparticles, pH, TDS and EC,

I. INTRODUCTION

Over the last decade, novel synthesis approaches/methods for nanomaterials (such as metal nanoparticles, quantum dots (QDs), carbon nanotubes (CNTs), graphene, and their composites) have been an interesting area in nanoscience and technology [1–9]. To obtain nanomaterials of desired sizes, shape, and functionalities, two diferent fundamental principles of synthesis (i.e., top down and bottom up methods) have been investigated in the existing literature (Fig. 1). In the former, nanomaterials/nanoparticles are prepared through diverse range of synthesis approaches like lithographic techniques, ball milling, etching, and sputtering [10]. Te use of a bottom up approach (in which nanoparticles are grown from simpler molecules) also includes many methods like chemical vapor deposition, sol–gel processes, spray pyrolysis, laser pyrolysis, and atomic/molecular condensation. Interestingly, the morphological parameters of nanoparticles (e.g., size and shape) can be modulated by varying the concentrations of chemicals and reaction conditions (e.g., temperature and pH). Nevertheless, if these synthesized nanomaterials are subject to the actual/ specifc applications, then they can sufer from the following limitation or challenges: (i) stability in hostile environment, (ii) lack of understanding in fundamental mechanism and modeling factors, (iii) bioaccumulation/ toxicity features, (iv) expansive analysis requirements, (v) need for skilled operators, (vi) problem in devices assembling and structures, and (vii) recycle/reuse/regeneration. In true world, it is desirable that the properties, behavior, and types of nanomaterials should be improved to meet the aforementioned points. On the other hand, these limitations are opening new and great opportunities in this emerging feld of research. To counter those limitation, an new era of 'green synthesis' approaches/methods is gaining great attention in current research and development on materials science and technology. Basically, green synthesis of materials/nonmaterial, produced through regulation, control, clean up, and remediation process, will directly help uplift their environmental friendliness. Some basic principles of "green synthesis" can thus be explained by several components like prevention/minimization of waste, reduction of derivatives/pollution, and the use of safer (or non-toxic) solvent/auxiliaries as well as renewable feedstock. 'Green synthesis' are required to avoid the production of unwanted or harmful by-products through the build-up of reliable, sustainable, and eco-friendly synthesis procedures. Te use of ideal solvent systems and natural resources (such as organic systems) is essential to achieve this goal. Green synthesis of metallic nanoparticles has been adopted to accommodate various biological materials (e.g., bacteria, fungi, algae, and plant extracts).

Among the available green methods of synthesis for metal/metal oxide nanoparticles, utilization of plant extracts is a rather simple and easy process to produce nanoparticles at large scale relative to bacteria and/or fungi mediated synthesis. Tese products are known collectively as biogenic nanoparticles (Fig. 2). Green synthesis methodologies based on biological precursors depend on various reaction parameters such as solvent, temperature, pressure, and pH conditions (acidic, basic, or neutral). For the synthesis of metal/metal oxide nanoparticles, plant biodiversity has been broadly considered due to the availability of effective phytochemicals in various plant extracts, especially in leaves such as ketones, aldehydes, flavones, amides, terpenoids, carboxylic acids, phenols, and ascorbic acids. These components are capable of reducing metal salts into metal nanoparticles [11]. The basic features of such nanomaterials have been investigated for use in biomedical diagnostics, antimicrobials, catalysis, molecular sensing, optical imaging, and labelling of biological systems [12]. Here, we summarized the current state of research on the green synthesis of metal/metal oxide nanoparticles with their advantages over chemical synthesis methods. In addition, we also discussed the role of solvent systems (synthetic materials), various biological (natural extracts) components (like bacteria, algae, fungi, and plant extracts) with their advantages over other conventional components/solvents. The main aim of this literature study is to provide detailed mechanisms for green synthesis and their real world environmental remediation applications. Overall, our goal is to systematically describe "green" synthesis procedures and their related components that will benefit researchers involved in this emerging field while serving as a useful guide for readers with a general interest in this topic. This not only has environmental benefits but also economic benefits. It plays an important role in the field of waste management. Employing sustainable approaches for production of energy or goods helps in reducing the carbon footprint and in delivering a greener planet and cleaner approaches to the next generation. With the increase in sustainable approaches, our dependency on depleting fossil fuels fades away.

A. Plant Description

Ocimum basilicum also called great basil, is a culinary herb of the family Lamiaceae (mints). Basil is native to tropical regions from central Africa to Southeast Asia. [13] It is a tender plant, and is used in cuisines worldwide. Depending on the species and cultivar, the leaves may taste somewhat like anise, with a strong, pungent, often sweet smell. There are many varieties of basil, as well as several related species or hybrids also called basil. The type used commonly as a flavor is typically called sweet basil (or Genovese basil), as opposed to Thai basil (O. basilicum var. thyrsiflora), lemon basil (O. citriodorum), and holy basil (Ocimum tenuiflorum). While most common varieties of basil are treated as annuals, some are perennial in warm, tropical climates, including holy basil and a cultivar known as "African blue basil". Basil is an annual, or sometimes perennial, herb used for its leaves. Depending on the variety, plants can reach between 30 cm (0.98 ft) and 150 cm (4.9 ft). Its leaves are richly green and ovate, but otherwise come in a wide variety of sizes and shapes depending on cultivar. Leaf sizes range from 3 cm (1.2 in) to 11 cm (4.3 in) long, and between 1 cm (0.39 in) and 6 cm (2.4 in) wide. Basil grows a thick, central taproot. Its flowers are small and white, and grow from a central inflorescence that emerges from the central stem atop the plant. The various basils have such different scents because the herb has a number of different essential oils in different proportions for various cultivars.[13] The essential oil from European basil contains high concentrations of linalool and methyl chavicol (estragole), in a ratio of about 3:1[14] Other constituents include: 1,8-cineole, eugenol, and myrcene, among others.[15] The clove scent of sweet basil is derived from eugenol. [16] The aroma profile of basil includes 1,8- cineole[17-18] and methyl eugenol. [19] The exact taxonomy of basil is uncertain due to the immense number of cultivars, its ready polymorphy, and frequent crosspollination (resulting in new hybrids) with other members of the genus Ocimum and within the species. Ocimum basilicum has at least 60 varieties, which further complicates taxonomy.

Figure:1 Fresh leaves of *Ocimum Basilicum-Lamiaceae* (Thiru Neetru Pathilai).

II. MATERIAL AND METHODS

A. Collection of Sample

Fresh *Ocimum Basilicum-Lamiaceae* (Thiru Neetru Pathilai) leaves were collected from botanical garden, Department of Botany, Government arts college, Chidambaram. Leaves were washed in three times thoroughly by running ordinary tap water (OTW), then washed two times with double distilled water (DDW) to remove any dust particles on the leaves, washed leaves were allowed to dry in air at room temperature.

B. Chemicals, Solvents and Starting Materials

All the metal salts and de-ionized water, whatmann 1≠ and whatmann 41≠ filter papers, Ethyl alcohol, sodium hydroxide pellets, Hydrochloric acids, sulphuric acid and other chemicals were purchased from Merck (India) Ltd. All chemicals were used without further purification.

C. Instruments and Equipment

Electric oven, Magnetic stirrer (REMI 2 MLH), E-1 portable TDS & EC meter, pH-009(I)A pen type pH meter, sterilized 250ml separating funnels, sterilized conical flasks, sterilized 400ml beakers, watch glasses, 7’’ funnels, glass rods, and 10ml measuring cylinders,

D. Preparation of Moringa Oleifera Leaf Extract

50 grams of *Ocimum Basilicum-Lamiaceae* (Thiru Neetru Pathilai) (OBL) leaves were washed thoroughly with double-distilled water (DDW) and both surface of leaves were sterilized using alcohol by gentle rubbing. These leaves were heated for 20 min in 500 ml of distilled water at 80^{O} C. Then the extract was filtered with Whatman 41≠ filter paper. The filtrate was stored under refrigerated conditions. These OBL extract were used to the further green synthesis of process

E. Metal Solution Preparation

All the metal salts are accurately weighed and dissolved in double distilled water (DDW) to prepare the 0.1M solution were prepared

F. The General Procedure for Syntheses of metal Nanoparticles

The 90mL prepared metal solution OBL extract 10mL(ratio 9:1), these reaction mixture under constant stirring with magnetic stirrer for 30 mints, final changes were recorded and shown in Table:1, scheme of green synthesis have shown in figure:1

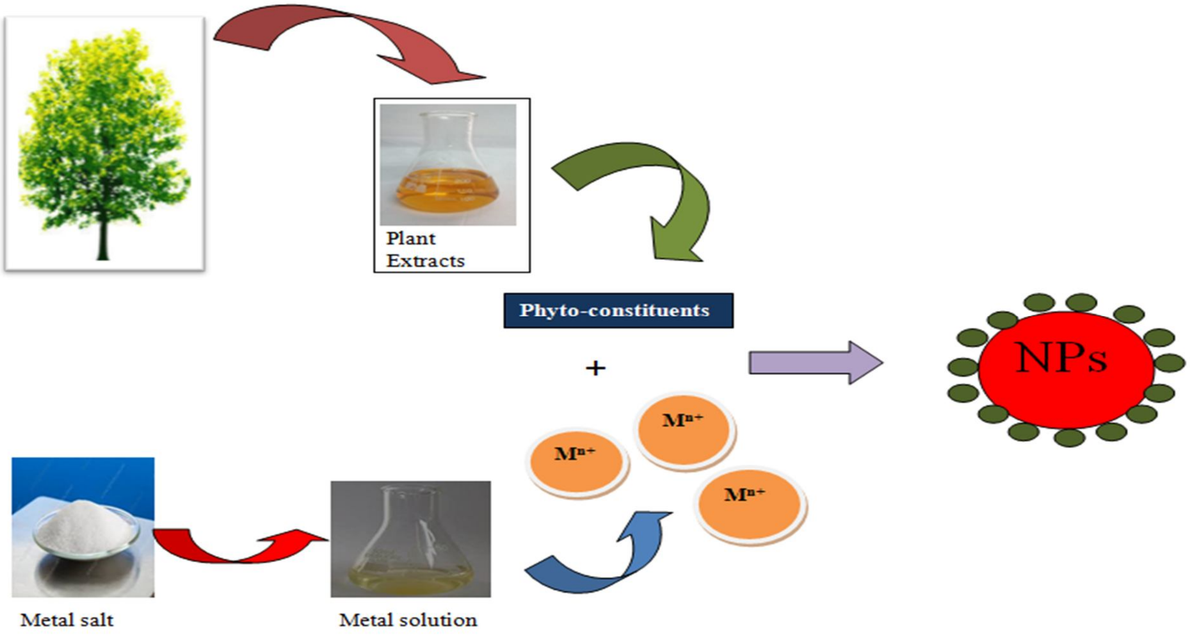


Figure:1 Scheme of green synthesis of metal nanoparticles

III. RESULT AND DISCUSSION

A. *Eco-friendly Synthesis of Nanoparticles*

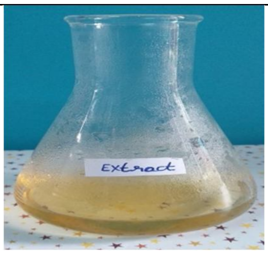
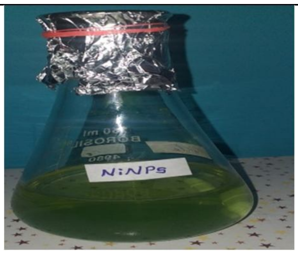
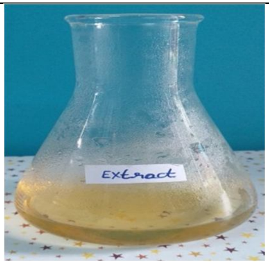
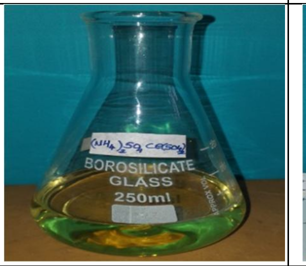
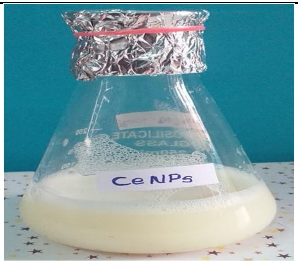
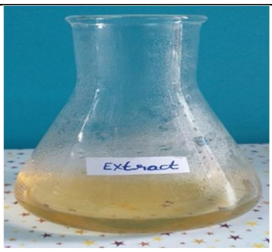
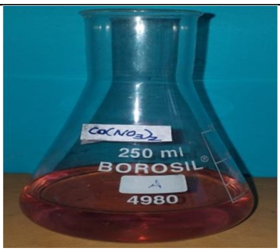
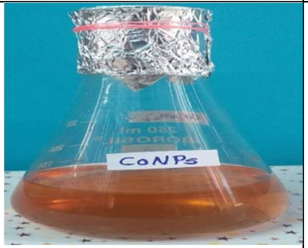
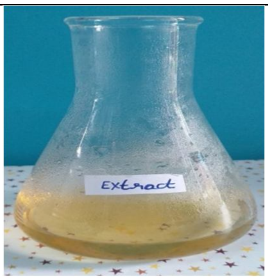
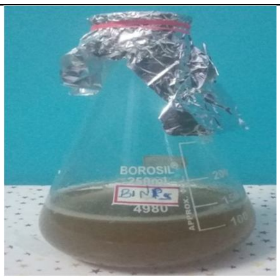
1) *Synthesis of Nickel nanoparticles (NiNPs):* Synthesis of NiNPs was performed by reducing nickel chloride (M.F:$NiCl_2$., MW: 129.60 g/mol) using OBL leaf extract. To achieve this purpose, 100 mL of saturated solution of nickel chloride is steadily mixed with 10mL of OBL leaves extract followed by continuous heating (70 °C) and stirring at 500 rpm for 2 h to achieve homogeneous solution [20], the colour of the solution is turn in pale green to dirty deep green . Further, obtained solution was centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing NiNPs was carefully washed 3 times with distilled water to remove uncoordinated materials. The obtained powder assumed as NiNPs was incubated at ~100 °C until the water evaporated completely, followed by annealing. Further, NiNPs were stored in cool, dry, and dark place. Finally, NiNPs were thoroughly characterized.
2) *Synthesis of Cerium nanoparticles (CeNPs):* Synthesis of CeNPs was carried out by reducing Cerium ammonium sulphate (M.F: $(NH_4)_4$ $(SO_4)_2.Ce(SO_4)_2$, MW: 632.55 g/mol) using OBL leaf extract. To achieve this purpose, 100 mL of saturated solution of Cerium ammonium sulphate is steadily mixed with 10mL of OBL leaves extract, immediately obtained milky colour colloidal suspensions[21]. The colour of the solution is turn in Pale golden-yellowish solution turn to milky white. Further, obtained suspension was transfer to 250mL separating funnel due to collect the suspended enriched part, the suspended enriched part is centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing CeNPs was carefully washed 3 times with distilled water to remove uncoordinated materials. The obtained powder assumed as CeNPs was incubated at ~100 °C until the water evaporated completely. Finally, CeNPs were thoroughly characterized.
3) *Synthesis of Cobalt Nanoparticles (CoNPs):* The CoNPs Synthesis by reducing Cobalt nitrate hexahydrate (M.F: $Co(NO_3)_2$, M.W: 182:94) using OBL leaf extract. To achieve this purpose, 100 mL of lucid solution of cobalt nitrate is steadily mixed with 10mL of OBL leaves extract followed by continuous heating (70 °C) and stirring at 500 rpm for 2 h to achieve homogeneous solution [22], the colour of the solution is turn blood reddish colour to orange. The obtained solution was centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing CoNPs was carefully washed 3 times with double distilled water (DDW) to remove unreacted materials. The obtained wet precipitate is dried, collects and stored the airtight clicklock tube. Finally, CoNPs were thoroughly characterized.
4) *Synthesis of Bismuth nanoparticles (BiNPs):* For the fabrication of BiNPs by reducing sodium bismuthate (M.F:$NaBiO_3$, MW: 279.97 g/mol) using OBL leaf extract. To achieve this intention, 100 mL of homogenous solution of sodium bismuthate is steadily mixed with 10mL of OBL leaves extract followed by continuous heating (70 °C) and stirring at 500 rpm for 2 h at magnetic stirrer with heating instrument, to achieve precipitate containing final solution, The red colour reactant solution is turn to brown in colour. The obtained brown colour solution was centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing BiNPs was carefully washed 3 times[23] with double distilled water(DDW) to remove uninvolved phyto-constituent and other chemicals. The obtained wet precipitate is dried, collects and stored the airtight clicklock tube. Finally, BiNPs were methodically characterized.
5) *Synthesis of Molybdatinum Nanoparticles (MoNPs):* A lucid solution of ammonium heptamolybdate(M.F:$(NH_4)_6Mo_7O_{24}$, M.W: 1235.9 g/mol) was formed by dissolving 0.1M of ammonium hepta molybdate in 100ml of distilled water. 10ml of the OBL leaves extract was added drop by drop to the ammonium heptamolybdate solution under constant stirring. The solution was stirred for 30 mints and then heated in a hot air oven at 60oC. The yellowish green coloured ammonium heptamolybdate solution turns to dark brown in colour. Till the supernant liquid got evaporated [24]. The obtained product was then powdered and calcinated at 700oC for 3hrs in a muffle furnace. The obtained wet precipitate is dried, collects and stored the airtight clicklock tube. Finally, MoNPs were meticulously characterized.
6) *Synthesis of Strontium Nanoparticles (SrNPs):* In a typical experiment, 100mL of 0.1M of strontium nitrate (M.F: $Sr(NO_3)_2$, M.W: 211.630 g/mol) solution is taken in a 250 ml conical flask. Then, 10 ml of OBL leaves extract was added drop wise into strontium nitrate solution under continuous stirring for 30 min at the room temperature, the clear solution of strontium nitrate [25] is turn to pale yellow. The resultant residue was collected by centrifugation at 4500 RPM, by washing with distilled water, followed by ethanol to remove impurities. The dried product was annealed at 500°C for 2 h. The obtained final product was dried, collects and stored the airtight clicklock tube. These SrNPs were scrupulously characterized.

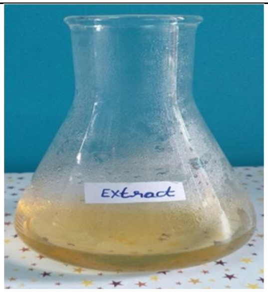
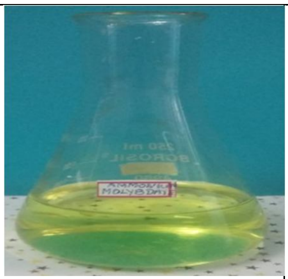
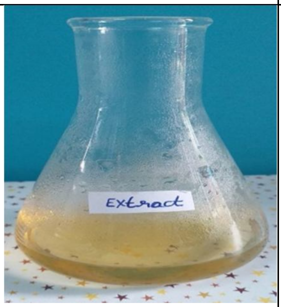
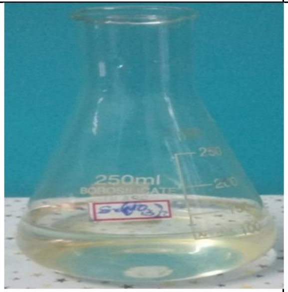
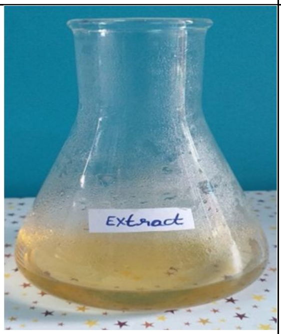
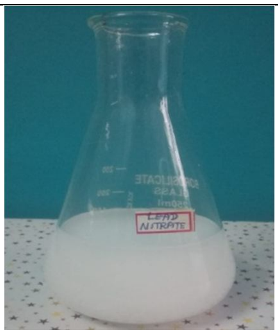
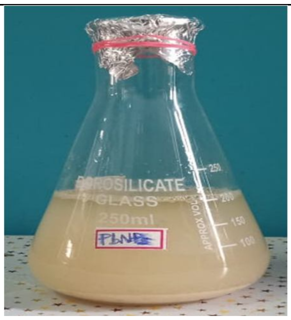
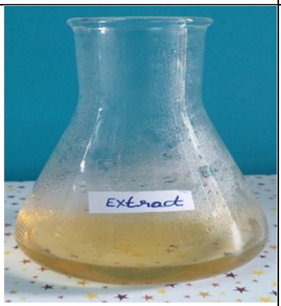
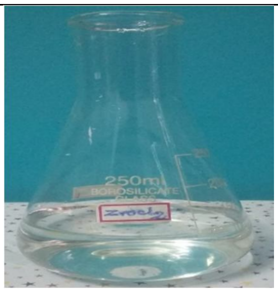
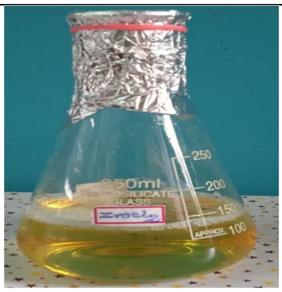
7) *Synthesis of Lead Nanoparticles (PbNPs):* The synthesis of lead nanoparticles carried out by, 100mL of 0.1M of lead nitrate (M.F: $Pb(NO_3)_2$, M.W: 331.2 g/mol) solution is taken in a 250 ml conical flask. Then, 10 ml of OBL leaves extract was added dropwise into lead nitrate solution under continuous stirring for 30 min at the room temperature, the milky white solution of lead nitrate is turn to pale pinkish in colour[26]. The resultant residue was filtered by using whattman 1≠ filter paper, the precipitate is washed several in double distilled water, finally obtained the glittering crystalline product.. The obtained final *product was dried, collects and stored the airtight clicklock tube. These PbNPs were painstakingly characterized.*
8) *Synthesis of Zirconium Nanoparticles (ZrNPs):* The synthesis of zirconium nanoparticles done by, 100mL of 0.1M of zirconium oxy chloride (M.F:$ZrOCl_2.6H_2O$, M.W: 180.14 g/mol) solution is taken in a 250 ml conical flask. Then, 10 ml of OBL leaves extract was added drop by drop into the reaction mixture under continuous stirring for 30 min at the room temperature, the clear solutions of zirconium oxy choride is turn to greenish yellow in colour [27]. Till the supernant liquid got evaporated to got the bifocals precipitate is obtained, this precipitate filtered by using whattman 1≠ filter paper, the precipitate is washed several in double distilled water(DDW), finally obtained the sparkling crystalline pinkish brown precipitate of product is obtained.. The obtained final product was dried, collects and stored the airtight clicklock tube. These ZrNPs were scrupulously characterized.
9) *Synthesis of Chromium Nanoparticles (CrNPs):* For the production of CrNPs by reducing potassium di chromate(M.F: $K_2Cr_2O_7$, MW: 294.19 g/mol) using OBL leaf extract. To achieve this intention, 100 mL of homogenous solution of potassium di chromate is steadily mixed with 10mL of OBL leaves extract followed by continuous heating (70 °C) and stirring at 500 rpm for 2 h at magnetic stirrer with heating instrument, to achieve precipitate containing final solution, The red orange colour reactant solution is turn to brownish red colour. The obtained red colour solution was centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing CrNPs was carefully washed 3 times[28] with double distilled water (DDW) to remove uninvolved phyto-constituent and other chemicals. The obtained wet precipitate is dried, collects and stored the airtight clicklock tube. Finally, CrNPs were steadily characterized.
10) *Synthesis of Zinc Nanoparticles (ZnNPs):* A saturated solution of zinc sulphate (M.F: $ZnSO_4$, M.W: 161.47 g/mol) was prepared by dissolving 0.1mM of zinc sulphate in 100ml of distilled water. 10ml of the OBL leaves extract was added to the zinc sulphate solution under constant stirring. The solution was stirred for 15min and then heated in a hot air oven at 60oC. The colourless zinc sulphate solution turns to reddish yellow in colour. Till the supernant liquid got evaporated [29]. The obtained product was then powdered and calcinated at 700^{o}C for 3hrs in a muffle furnace. The obtained wet precipitate is dried, collects and stored the airtight clicklock tube. Finally, ZnNPs were scrupulously characterized.
11) *Synthesis of Copper Nanoparticles (CuNPs):* 10 ml of OBL leaf extract was added to 100 ml of 0.1M aqueous solution copper sulphate pentahydrate (M.F:$CuSO_4 \cdot 5H_2O$, M.W:249.68) for the reduction of Cu ions. The mixture was boiled for approximately 10-20 minute at 50°C-70°C. Centrifuged the extract for 15 minutes at 4000 rpm.. The pale blue colour copper sulphate solution is turns to brownish green in colour. This colour change is indicated as the CuNPs generation The collected supernatant was then double filtered by Whatman filtered paper [30]. The solution was diluted two times of its volume. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, CuNPs were thoroughly characterized.
12) *Synthesis of tungsten Nanoparticles (WNPs):* Synthesis of WNPs was carried out by reducing tungstic acid (M.F:H□WO□, M.W: 249.85 g/mol) using OBL leaf extract. To achieve this purpose, 100 mL of saturated solution of tungstic acid is steadily mixed with 10mL of OBL leaves extract[31]. The colour of the solution was turn in dark yellow to whitish yellow. Further, obtained suspension was transfer to 250mL separating funnel due to collect the suspended enriched part, the suspended enriched part is centrifuged at 4000 rpm/20 min. Supernatant was discarded and pellet containing WNPs was carefully washed 3 times with distilled water to remove awkward materials. The obtained powder assumed as WNPs was incubated at ~100 °C until the water evaporated completely. Finally, WNPs were systematically characterized.
13) *Synthesis of Iron Nanoparticles (FeNPs):* The synthesis of Iron Nanoparticles was done by adding 100ml of 0.1 M Ferrous sulphate (M.F: $FeSO_4$. $7H_2O$, M.W: 278.01) solution and the 10 ml of OBL leaves extract in a clean sterilized 250 ml conical flask. The solution resulting from the addition of OBL leaves extract and 0.1 M Ferrous sulphate was brownish yellow in color. There was an immediate color change[32] after the addition of OBL leaves extract to the ferrous sulphate solution. The solution was centrifuged and the supernatant was discarded and the pellet was washed with double distilled water and was centrifuged again to remove any impurities. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, FeNPs were methodically characterized.

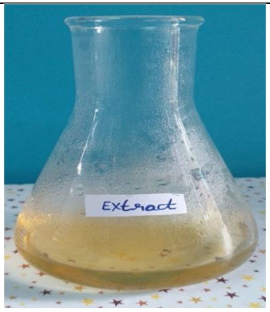
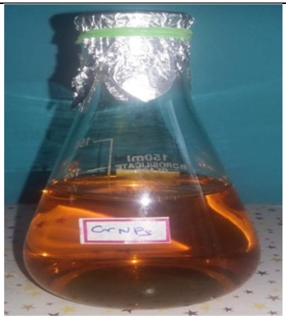
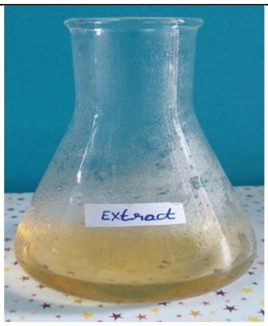
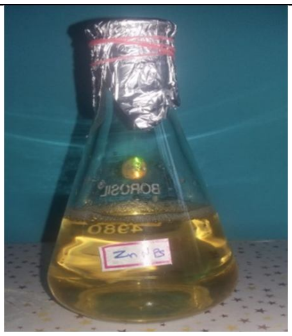
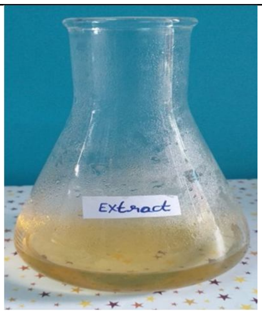
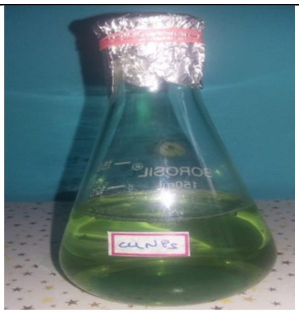
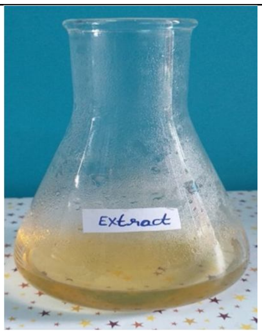
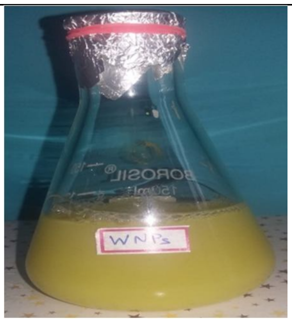
14) *Synthesis of calcium Nanoparticles (CaNPs)*

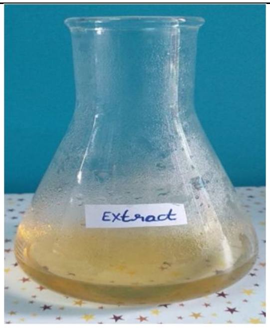
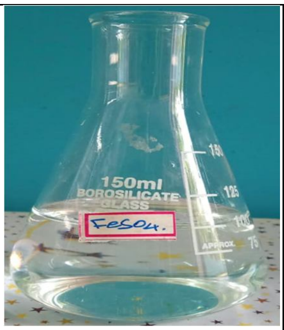
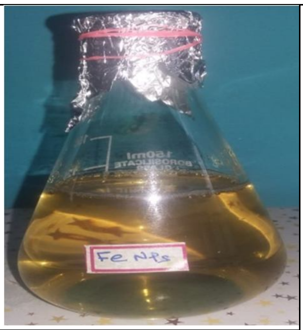
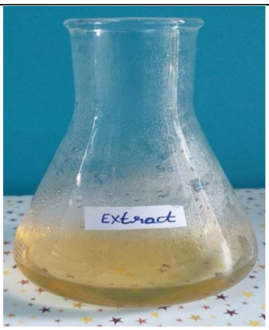
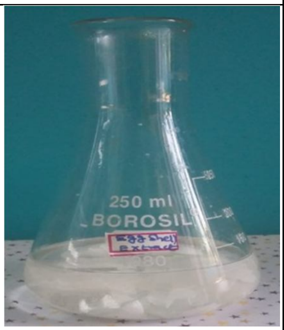
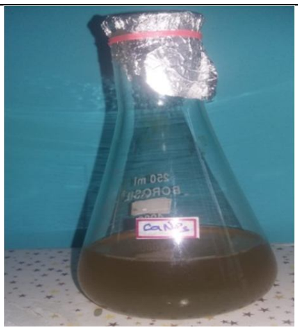
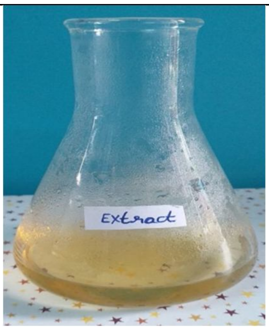
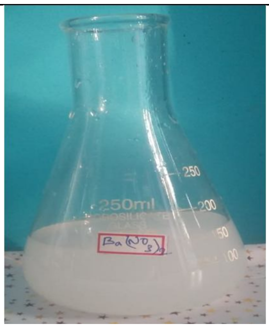
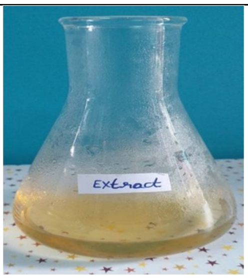
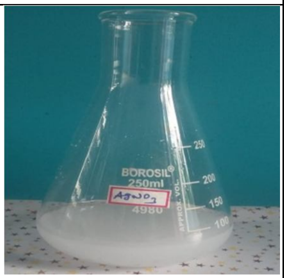
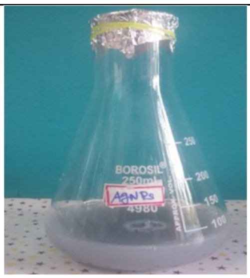
a) *Preparation of Waste Egg Shell Extract:* Chicken eggshell was used as a pioneer for this method. Two waste eggshells were thoroughly washed with warm water and cleaned with double distilled water (DDW). Then the washed sample was dried, the dried egg shell was taken in the 250 ml conical flask and added the 150 ml double distilled water, boiled at 80^{o}C in 30 mints and added 5ml of 0.01N dilute

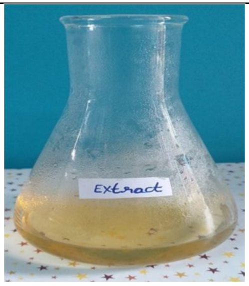
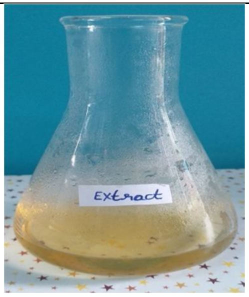
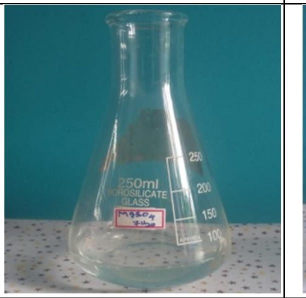
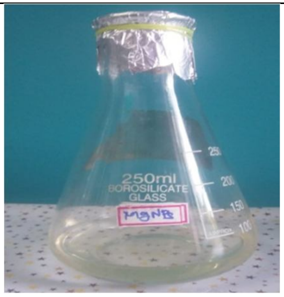
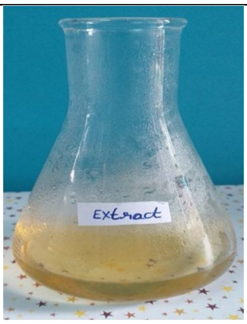
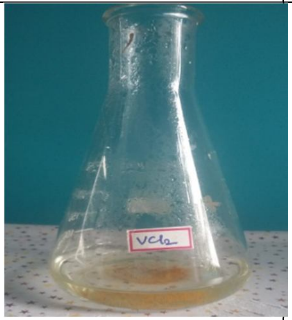
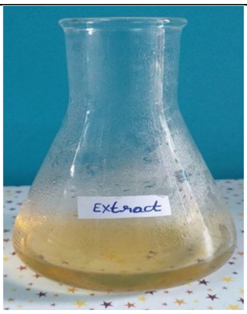
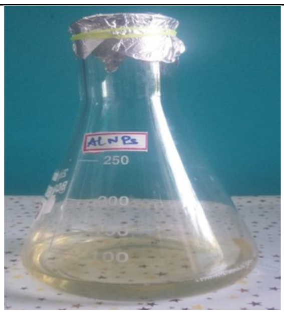
Table:1 Synthesis of some nanoparticles mediated by Ocilius Basium leaves extracts

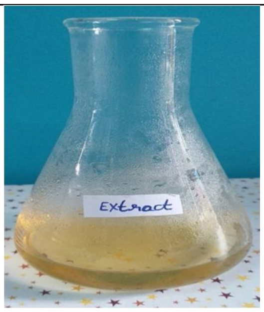
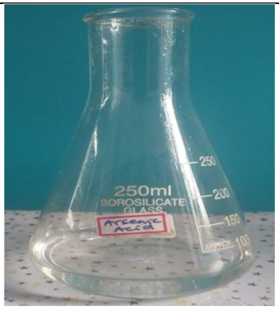
S.No	Extract	Metal solutions	Nanoparticle	Visual observation
1				Pale green solution turn to dirty deep green
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Nickel chloride solution	Nickel nanoparticles(NiNPs)	
2				Pale golden-yellowish solution turn to milky white
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Cerium ammonium sulphate solution	Cerium nanoparticles (CeNPs)	
3				blood reddish colour to orange colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution Cobalt nitrate solution	Cobalt nanoparticles (CoNPs)	
4				red colour reactant solution is turn to brown
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution Sodium bismuthate solution	Bismuth nanoparticles (BiNPs)	

5				Yellowish green to dark brown in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	$1x10^{-1}$ M solution of Ammonium molyptate solution	Molyptinium nanoparticles (MoNPs)	
6				Clear solution to pale yellow colour
	Ocimum Basilicum-Lamiaceae leaves extracts	$1x10^{-1}$ M solution of stroncium nitrate solution	Stroncium nanoparticles (SrNPs)	
7				Milky white colour turn in to pale pinkish colour
	Ocimum Basilicum-Lamiaceae leaves extracts	$1x10^{-1}$ M solution of lead nitrate solution	Lead nanoparticle (PbNPs)	
8				Clear solution turn in to greenish yellow
	Ocimum Basilicum-Lamiaceae leaves extracts	$1x10^{-1}$ M solution of zirconium oxy chloride solution	Zirconium nanoparticles (ZrNPs)	

9				Red orange colour turn in to brownish red colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of potasium di chromate solution	Chromium nanoparticles (CrNPs)	
10				Colourless to reddish yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of zinsulphate solution	Zinc nanoparticles (ZnNPs)	
11				Blue colour turn in to brownish green in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of copper sulphate solution	Copper nanoparticles (CuNPs)	
12				Dark yellow colour turn into whitish yellow
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of tungstic acid solution	Tungsten nanoparticles (WNPs)	

13				Colourless to brownish yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Ferrous sulphate solution	Iron nanoparticles (FeNPs)	
14				Clear solution of egg shell extract turn in to dirty yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	Egg shell extracts	Calcium nanoparticles (CaNPs)	
15				White colour turn into pale reddish yellow
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Barium nitrate solution	Barium nanoparticles (BaNPs)	
16				Milky white turn in to black in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of silver nitrate solution	Silver nanoparticles (AgNPs)	

17				Pale pink colour disappear within 15 mints
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of potassium permanganate solution	Manganese nanoparticles (MnNPs)	
18				Colourless solution turn into pale greenish yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Magnesium sulphate solution	Magnesium nano particles(MgNPs)	
19				Light yellow turn into deep golden yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Vanadium chloride solution	Vandium nanoparticles (VNPs)	
20				Colourless solution turn into pale bluish yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	1x10^{-1} M solution of Aluminium chloride solution	Aluminium nanoparticles (AlNPs)	

21				Colourless solution turn in to dirty yellow in colour
	Ocimum Basilicum-Lamiaceae leaves extracts	$1x10^{-1}$ M solution of Arsanic acid solution	Arsanic nanoparticles (AsNPs)	

Hydrochloric acid until effervescence ceases, then filterd by using whatmann 41 ≠ filter paper. These extract was stored at 4°C for further experiments.

15) *Synthesis process of CaNPs:* 10 ml of OBL leaf extract was added to 100 ml of egg shell extract for the reduction of Ca ions. The solution was centrifuged and the supernatant was discarded and the pellet was washed with double distilled water and was centrifuged again to remove any impurities. Light white or clear solution of the egg shell extract[33] turn to dirty yellowish in colour. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, CaNPs were precisely characterized.
16) *Synthesis of Barium nanoparticles (BaNPs):* The synthesis of Barium Nanoparticles was done by adding 100ml of 0.1 M barium nitrate (M.F: $Ba(NO_3)_2$, M.W:261.35) solution and the 10 ml of OBL leaves extract in a clean sterilized 250 ml conical flask. The solution resulting from the addition of OBL leaves extract and 0.1 M barium nitrate was pale reddish yellow in color. There was an color change[34] after the addition of OBL leaves extract to the barium nitrate solution. The solution was centrifuged and the supernatant was discarded and the pellet was washed with double distilled water and was centrifuged again to remove any impurities. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, BaNPs were meticulously characterized.
17) *Synthesis of Silver nanoparticles (AgNPs):* The synthesis of silver nanoparticles carried out by, 100mL of 0.1M of silver nitrate (M.F: $AgNO_3$, M.W: 169.87g/mol) solution is taken in a 250 ml conical flask. Then, 10 ml of OBL leaves extract was added drop by drop into silver nitrate solution under continuous stirring for 30 min at the room temperature[35], the milky white solution of lead nitrate is turn to pale whitish block in colour. The resultant residue was filtered by using whattman 1≠ filter paper, the precipitate is washed several in double distilled water, finally obtained the glittering crystalline product.. The obtained final product was dried, collects and stored the airtight clicklock tube. These, AgNPs were thoroughly characterized.
18) *Synthesis of Manganese nanoparticles (MnNPs):* Synthesis of manganese nanoparticles (MnNPs) An aqueous solution of 1mM of potassium permanganate (M.F: $KMnO_4$, M.W: 158.03 g/mol) was prepared for the synthesis of MnNPs. Double distilled water was used throughout the reaction[36]. The manganese ions are reduced by the addition of freshly prepared manganese solution (100 ml) with prepared stored OBL leaves extract (10 ml) in a beaker and the mixture was constantly stirred for the proper reduction of metal ions. The reaction mixture was kept in the magnetic hot stirrer at 50-60^{o}C for an hour to occur pale pink color of the potassium permanganate disappear within 15 minits change from pale green to pale yellow which denoted the metal ion reduction. The solution was centrifuged with washing several times to obtain the pure MnNPs. The supernatant was decanted and kept in oven to dryness. Then scrupulously characterized
19) *Synthesis of Mangnesium nanoparticles (MgNPs):* Synthesis of magnesium nanoparticles (MgNPs) An aqueous solution of 0.1mM solution of magnesium sulphate (M.F: $MgSO_4$. $7H_2O$, M.W:120.37g/mol) was prepared for the synthesis of MgNPs. Double distilled water was used throughout the reaction[37]. The magnesium ions are reduced by the addition of freshly prepared magnesium solution (100 ml) with prepared stored OBL leaves extract (10 ml) in a beaker and the mixture was constantly stirred for the proper reduction of metal ions. The reaction mixture was kept in the magnetic hot stirrer at 50-60^{o}C for an hour to Colourless solution turn into pale greenish yellow in colour which denoted the metal ion reduction. The solution was centrifuged with washing several times to obtain the pure MgNPs. The supernatant was decanted and kept in oven to dryness. Then scrupulously characterized

20) *Synthesis of Vanadium nanoparticles (VNPs):* 10 ml of OBL leaf extract was added to 100 ml vanadium chloride (M.F: VCl_2, M.W: 157.30g/mol)for the reduction of Vanadium ions. The solution was centrifuged and the supernatant was discarded and the pellet was washed with double distilled water and was centrifuged again to remove any impurities. Light yellow turn into deep golden yellow in colour [38]. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, VNPs were precisely characterized
21) *Synthesis of Aluminum nanoparticles (AlNPs):* The synthesis of Aluminum nanoparticles carried out by, 100mL of 0.1M of Aluminum chloride (M.F: $AlCl_2.6H_2O$, M.W: 241.43 g/mol) solution is taken in a 250 ml clean conical flask. Then, 10 ml of OBL leaves extract was added drop by drop into Aluminum chloride solution under continuous stirring for 30 min at the room temperature [39]. Colourless solution turn into pale bluish yellow in colour. The resultant residue was filtered by using whattman 1≠ filter paper, the precipitate is washed several in double distilled water, finally obtained the glittering crystalline product.. The obtained final product was dried, collects and stored the airtight clicklock tube. These AlNPs were thoroughly characterized.
22) *Synthesis of Arsanic nanoparticles (AsNPs):* The synthesis of Arsanic Nanoparticles was done by adding 100ml of 0.1 M arsenic acid (M.F: H_3AsO_4, M.W: 141.94 g/mol) solution and the 10 ml of OBL leaves extract in a clean untainted 250 ml conical flask. The solution resulting from the accumulation of OBL leaves extract and 0.1 M arsenic acid was pale dirty yellow in color. There was an color change [40] after the addition of OBL leaves extract to the arsenic acid solution. The solution was centrifuged and the supernatant was discarded and the pellet was washed with double distilled water and was centrifuged again to remove any impurities. The obtained product was dried, collects and stored the airtight clicklock tube. Finally, AsNPs were meticulously characterized.

B. Preliminary Analysis of Synthesized Nanoparticle Solution

The series of synthesized nanoparticles carryout the some preliminary analysis, these analysis are reveals to the nanoparticle production. The nanoparticle formation is mainly denoted as the pH of the extract, Metal solution and synthesized nanoparticle solution, all the results of the pH values gives as some salts solutions decrease the pH values compared to double distilled water(DDW), some of the metal solution decrease the pH values compare to the DDW. TDS analysis also the one of the best tools of the conformation of nanoparticle formation for the green synthesis of nanoparticle, the TDS of the some metal solution increase compare to the synthesized nanoparticle solution, these is evident that nucleation the metal ion in phyto-constituents. An additional preliminary analysis is electrical conductivity measurement (EC). All the results are shown in **Table:2**

Table:2 Preliminary analysis of synthesized nanoparticles solutions

S.No	Compound	pH	TDS	EC(µg/^{o}C)
1	DDW	1.3	0067ppm, at 29.8^{o}C	00012 µs/cm, at 29.8^{o}C
2	OBL extract	2.6	5492 ppm at 33.5^{o}C	- µs/cm, at 33.5^{o}C
3	$NiCl_2$	1.3	7018ppm, at 32.8^{o}C	3422 µs/cm, at 32.8^{o}C
	NiNPs	1.7	7865 ppm at 31^{o}C	-- µs/cm, at 31^{o}C
4	$(NH_4)_2$ SO_4 $Ce(SO_4)_2$	1.1	0036ppm at 29.2^{o}C	--- µs/cm, at 29.2^{o}C
	CeNPs	1.4	7530ppm at 29.2^{o}C	--- µs/cm, at 29.2^{o}C
5	$Co(NO_3)_2$	1.1	6022ppm at 29^{o}C	2321 µs/cm, at 29^{o}C
	CoNPs	1.7	6867 ppm at 28.3^{o}C	--- µs/cm, at 28.3^{o}C
6	$NaBiO_3$	2.3	2611 ppm at 27.7oC	5222 µs/cm, at 27.7oC
	BiNPs	2.0	4622 ppm at 27.6^{o}C	4223 µs/cm, at 27.6^{o}C
7	$(NH_4)_6Mo_7O_{24}$	1.5	3367 ppm at 27^{o}C	----- µs/cm, at 27^{o}C
	MoNPs	1.9	4532 ppm at 28.2^{o}C	6342 µs/cm, at 28.2^{o}C
8	$Sr(NO_3)_2$	1.5	6234 ppm at 29.2^{o}C	-- µs/cm, at 29.2^{o}C
	SrNPs	1.9	6895 ppm at 29.3^{o}C	-- µs/cm, at 29.3^{o}C
9	$Pb(NO_3)_2$	1.3	4320 ppm at 28.9^{o}C	--- µs/cm, at 28.9^{o}C
	PbNPs	1.8	4970ppm, at 29.0^{o}C	9941 µs/cm, at 29.0^{o}C
10	ZrO_2Cl_2 $.6H_2O$	1.3	3146 ppm at 27.8^{o}C	--- µs/cm, at 27.8^{o}C
	ZrNPs	1.8	3868 ppm at 27.8^{o}C	-- µs/cm, at 27.8^{o}C
11	$K_2Cr_2O_7$	2.4	4286 ppm at 29.2oC	--- µs/cm, at 29.2oC
	CrNPs	1.7	4893ppm at 29.3^{o}C	9793 µs/cm, at 29.3^{o}C
12	$ZnSO_4$	1.6	5868 ppm at 29.2^{o}C	-- µs/cm, at 29.2^{o}C
	ZnNPs	1.8	5379ppm, at 29.2^{o}C	-- µs/cm, at 29.2^{o}C
13	$CuSO_4.5H_2O$	1.5	5346 ppm at 28.4^{o}C	-- µs/cm, at 28.4^{o}C
	CuNPs	1.7	5079ppm at 28.6^{o}C	-- µs/cm, at 28.6^{o}C
14	H□WO□	1.3	3672 ppm at 27.9^{o}C	-- µs/cm, at 27.9^{o}C
	WNPs	1.6	4346ppm at 29.0^{o}C	8693 µs/cm, at 29.0^{o}C

15	$FeSO_4$. $7H_2O$	2.0	4224 ppm at 29.2^{o}C	-- µs/cm, at 29.2^{o}C
	FeNPs	1.8	5070ppm at 28.5^{o}C	-- µs/cm, at 28.5^{o}C
16	Egg shell Extract	8.4	9896 ppm, at 28.8^{o}C	5433 µs/cm, at 28.8^{o}C
	CaNPs	6.6	3046ppm, at 28.9^{o}C	6092 µs/cm, at 28.9^{o}C
17	$Ba(NO_3)_2$	1.9	0008ppm, at 27^{o}C	0016 µs/cm, at 27^{o}C
	BaNPs	2.3	5520 ppm, at 27.9^{o}C	0034 µs/cm, at 27.9^{o}C
18	$AgNO_3$	1.4	5701ppm, at 28.2^{o}C	-- µs/cm, at 28.2^{o}C
	AgNPs	1.8	5670ppm, at 27^{o}C	-- µs/cm, at 27^{o}C
19	$KMnO_4$	1.8	3455ppm, at 27.8^{o}C	6911µs/cm, at 27.8^{o}C
	MnNPs	2.2	3383ppm, at 28^{o}C	6767 µs/cm, at 28^{o}C
20	$MgSO_{4\,.}7H_2O$	1.5	0014ppm, at 29.1^{o}C	0028 µs/cm, at 29.1^{o}C
	MgNPs	1.8	5582ppm, at 28^{o}C	- µs/cm, at 28^{o}C
21	VCl_2	1.1	0012ppm, at 28.3^{o}C	0024 µs/cm, at 28.3^{o}C
	VNPs	1.7	5079ppm, at 27.8^{o}C	-- µs/cm, at 27.8^{o}C
22	$AlCl_3.6H_2O$	1.4	6797ppm, at 28.3^{o}C	- -µs/cm, at 28.3^{o}C
	AlNPs	1.5	6419 ppm, at 28.5^{o}C	-- µs/cm, at 28.5^{o}C
23	H_2AsO_4	1.2	6785 ppm, at 32^{o}C	- µs/cm, at 32^{o}C
	AsNPs	1.6	5670ppm, at 28^{o}C	- µs/cm, at 28^{o}C

IV. CONCLUSIONS

Nature has its own schooling etiquette of synthesizing miniaturized functional materials. Increasing attentiveness of green chemistry and the promote of synthesis of metal nanoparticles (MNPs) using plant extracts can be ascribed to the fact that it is eco-friendly, stumpy in cost, and provides maximum fortification to human health. Green synthesized metal nanoparticles have unmatched significance in the field of nanotechnology. Metal nanoparticles(MNPs) cover a wide spectrum of noteworthy pharmacological activities, and the cost-effectiveness provides an alternative to local drugs. Besides plant-mediated green synthesis, special emphasis has also been placed on the diverse bioassays exhibited by metal nanoparticles (MNPs). This review will help researchers to develop narrative metal nanoparticles -based drugs using green technology.

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