ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

Degradation of Dyes by Metallic Nano particles

MaheshChandra

Department of Chemistry Deshbandhu College University of Delhi

Abstract

Disposal of dye-based contaminants has become increasingly problematic in recent decades, posing a serious threat to our ecosystem. Synthetic organic chemicals such as dyes are widely used in industries, from food to tanning to pharmaceutical and cosmetics. Moreover, current procedures are unable to breakdown these colours, posing a harm to people and the environment. These dyes are carcinogenic and highly stable in water. The breakdown of the dyes is accomplished through the employment of hazardous substances in both physical and chemical approaches. The plant extracts of Centella asiatica were used to produce AgNPs and CuNPs using the metallic salts for the corresponding Metallic nanoparticles in this study. UV-Vis spectrophotometer and scanning electron microscope (SEM) analyses were used to examine the produced nanoparticles. Silver had a distinctive "SPR peak" at '420 nm' in"UV-visible" spectrum, while copper had a peak at 323 nm. Silver nanoparticles measured 30-50 nm in size, whereas copper nanoparticles measured 10-30 nm. Since they operate as redox catalysts in dye degradation,metal (NPs) have gotten a lot of interest. To this end, in the present study, we used photocatalysis and chemical catalysis using NaBH4 to degrade dyes MO, MR, PR, and EY.

Keywords: Methyl Orange and Methyl Red as well as Phenol Red, Eosin Y andNaBH4

1. Origin of the Proposal:

The unforeseen activities of the human beings, industrializations and rapidly increasing urbanization have deteriorated the environment to extreme conditions. The pollution has raised to its life-threatening bars especially the water and air pollution. The approaches and methods that have been practiced in the past employing physical and chemical remediation processes; those have their part of the shortcomings.

These dyes are carcinogenic and highly stable in the water moreover conventional methods are unable to degrade these dyes posing a threat to the mankind and nature.The dyes are degraded by physical and chemical techniques, which require hazardous and poisonous compounds once more.

Using the metallic salts for the respective metallic nanoparticles, AgNPs and CuNPs were produced with Centella asiatica plant extracts in this study. A UV-Vis spectrophotometer and SEM examination were used to characterise the nanoparticles created. In the current study, we used photocatalysis and chemical catalysis using NaBH4 to utilise this characteristic for dye degradation of MO, MR, PR, and EY dyes.

2. Review of Research and Development in the Subject International and National status

The catalytic characteristics of metallic nanoparticles in organic dye degradation have long been known. There have been numerous papers describing the catalytic role of nanoparticles in "dye degradation", including studies on AgNPs & CuO NPs as well as metal oxides like TiO2 NPs and their composites. TiO2 coated with silica gel beads was used as a catalyst for the degradation of methyl orange (MO), and for other dyes like methylene blue (MB) and 4-NP reduction, TiO2 NPs were employed.Chemical production of nanoparticles requires additional processes such as temperature maintenance and calcinations in addition to the lengthy operation Aside from using toxic compounds that contaminate the nanoparticles, conventional procedures take a long time and are expensive to develop since they yield promising nanoparticles with good catalytic characteristics and degradation rates. Researchers choose green manufacturing of nanoparticles for organic pollutant degradation to avoid and overcome these hurdles. There are two ways to apply a green approach: using bacteria and fungus, or using plant extracts. Plant extracts are chosen over microbes for the creation of nanoparticles because cell culture maintenance, contamination risk, and complicated downstream procedures make microorganisms less desirable. The phytocompounds included in the extract assist reduce salt & also act as capping & stabilising agents during production of nanoparticles, according to various reports on their use in NP manufacturing. Plant extracts are used in the manufacturing process, which is simple, uncomplicated, and quick. It also takes place at room temperature. Silver and copper nanoparticles have emerged as the most sought-after metallic NPs due to their unique optical and catalytic capabilities. It is believed

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

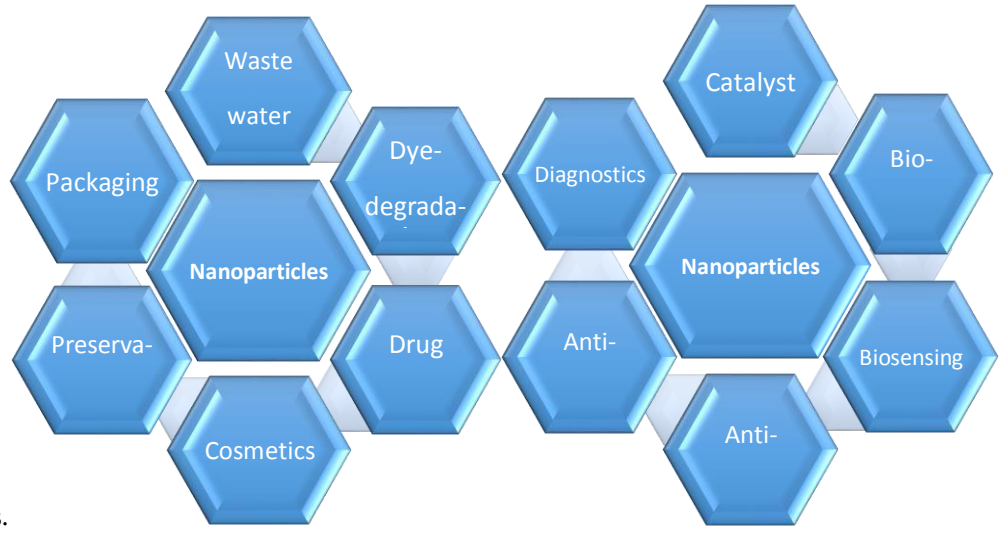
that the nanoparticles operate as an electron relay between donor and acceptor molecules because they generate superoxide when exposed to an acidic environment.Methyl Orange, Methylene blue and Methyl Red are only a few examples of organic dyes used in the industry. Others include 4-nitrophenol, Phenol Red Indigo, Bromophenol Blue and Acridine Orange. Because of this, a safe and nontoxic, energy-saving procedure for dye degradation in aqueous solutions under mild circumstances must be devised in order to fabricate these nanoparticles on an industrial scale that is also favourable to the environment.

Researchers have discovered many active components in Centella asiatica, including triterpenoids and phenols, which are responsible for stabilising the nanoparticles that act as capping agents in their studies.

Centella asiatica (CA), belongs to family Umbellifere (Apiceae). Popularly known as gotu kola is a clonal. The medicinal benefits of the plant owe to the phytocompounds present in the plant.

Centella asiatica is an Ayurvedic plant which is rich in phytocompounds such as Saponins also acknowledged as triterpenoids, Saponins are the principal active constituents of "gotu kola". Asianosides are among the triterpenoids that contribute to wound healing and have vascular actions that prevent collagen from being produced in the wound area.There are also other Centella asiatica components that may be responsible for the CNS effects and uterine relaxing qualities, including Brahminoside, but have no present conformations by lieu of clinical studies. One component in the crude extract is centelloside which is found effective in the venous hypertension treatments. Apart from the components that have pharmacological activities there are some constituents of Centella asiatica like sterols, flavonoids (Srivastava, et al., 1997).In addition to, all its medicinal benefits Centella asiatica has proven an appreciable source of nanoparticles due the presence of the active constituents that serve as stabilizing and synthesizing agents for production of nanoparticles.

Nanotechnology is the field which deals with the fabrication of minute particles (< 100nm in size), and these particles because of their extreme small size serve as the principal block of various physical and biological systems.This arena of nano sized particle has achieved new heights because various research fellows from vivid fields have been attracted to their unique properties and applications (Nadhman et al., 2014). Some attractions in world of nanobiotechnology has been silver nanoparticles (AgNPs) and copper nanoparticles (CuNPs) (Kharissova et al., 2013) due to the fact that these tiny metallic used in industries,including catalysis, textile manufacturing, microelectronics, and a whole lot more.The utilization of these nanoparticles is also in the biological applications which comprises of the biomolecular detection and biosensing, anti-bacterial (Niraimathi et al., 2013) food production, bio-labelling, therapeutics, anti- microbial treatment , drug delivery systems and waste water treatment, as well as biomedical equipment and gene-based diagnostics/therapies.Whereas CuNPs have their potential in the catalytic, optical, electrical properties and activities, for a very long time the Cu and CuO have been used as algaecides and fungicides. Cu has been used in the water purifying systems as it owes to the antibacterial properties and antifouling agents which make them potent to be employed in the water treatment plants and effluent



systems.

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

Figure 1: Applications of Nanoparticles

Green synthesis or green chemistry is the emerging technology for the nanoparticle syntheses. These extracts have been an exclusive choice for numerous researchers as they are natural producers of reducing and capping agents that play a vital role in the nanoparticles synthesis. Also, green synthesis is safe for therapeutic use and unlike the microbial synthesis it is less complex and has almost no scope of contaminations. They offer advantages such as "environment friendly,""single step process", 'cost-effective' & possess almost no toxicity. Apart from this extracellular and intracellular biosynthesis of metallic nanoparticles employed with bacteria, fungi and yeast etc., are eco-friendly method but cultivation of these biomass and downstream processing of nanoparticles seems to be a problematic task and pose a risk of contamination.

Silver nanoparticles and copper nanoparticles are two of the noble metal nanoparticles that have received the greatest attention and have been around for a long time. Silver nanoparticles have outstanding optoelectronic capabilities that are influenced by their size, shape, composition, and surroundings. This feature has led to the widespread usage of compounds based on silver in numerous bacteriacidal applications.Ag is a well-known "antimicrobial agent" because of its great "toxicity" against bacterial species, fungi, protozoa, and certain viruse

Using three different extracts of Centella asiatica (ethanolic, methanolic, and aqueous), Roy and Bhardavaja (2017) synthesised silver nanoparticles (AgNPs) with spherical shapes. Nanoparticle production was carried out using terpenoinds, long chain fatty acids, and secondary amide derivatives, as well as proteins as capping agents, according to FTIR results.

3. Objectives:

1. To Design sunlight based Photo catalytic wastewater treatment plant (PCWTP) especially for sub-urban and rural areas.
2. To save electrical energy through new innovative application of technologies PCPC by Photo catalytic Wastewater treatment plants based on sunlight
3. We will recover more than 95% water from industrial effluents for reuse.
4. This unique innovative technology will able to degrade and separate water soluble organic, Inorganic pollutants and kill all germs in eco-friendly manner as technology is based on AOP
5. Silver and Copper Nanoparticle Biosynthesis from Centella Asiatica Leaf Extracts with Varying Concentrations of Metallic Salts.
6. Characterization of the Metallic nanoparticles.
7. Catalytic Dye degradation by the Nanoparticles photo catalytically and by using reducing agent NaBH4
8. Comparison between the dye degradation percentage using the different methods of dye degradation (photo catalysis and by NaBH4)

4. MATERIALS & METHODS

All of the chemicals used in this experiment were purchased from Sigma Aldrich or Fisher Scientific except for the silver nitrate (99.99 percent) from which it was made. Using distilled water, all glassware was thoroughly cleaned and rinsed.

1. Preparation of extract

The Centella asiatica extract was obtained from NBPGR in New Delhi. A four- to eight-week interval was used to subculture the Centella asiatica tubules. In order to remove excess water from the freshly sub-cultured tubes.The dried leaves were weighed and then boiled for 20 minutes at 60°C in a sterilised conical flask with a volume of 250 ml with 1gm/ 10ml distilled water. This extract was purified using Whatman Filter Paper No. 1 and centrifuged at 10,000 rpm for 5 minutes to remove impurities before being stored for further testing.

2. Nanoparticle Synthesis

1 Silver nanoparticle synthesis

2 Synthesis of Copper nanoparticles

3 Preparation of Dyes and Sodium borohydride

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

4 Characterization of Nanoparticles

1. UV-Vis Spectrophotometer

UV-Vis spectroscopic studies for determining optical properties of nanoparticles were carried out on Cary-300 UV-Vis by Agilent Technologies at Delhi Technological University, Chemistry Department. After adding Centella asiatica plant extract to silver nitrate and cupric sulpate solutions, Ag "nanoparticles" with wavelengths from 300 to 700 nm & copper nanoparticles with wavelengths ranging from 200 to 700 nm were studied.

2. Search Engine Marketing

A Carl Zeiss EVO 18 SEM with a 20 kV accelerating voltage was used to "examine" the surface morphology of "nanoparticles". Glass coverslips were coated with a suspension of nanoparticles, which was then baked in an oven and put on special SEM holders with conductive carbon tape. The photos were captured with a 200 nm bar and a 50 KX magnification.

5 Nanoparticle Catalysis

1.Silver nanoparticle photocatalysis

2.Silver nanoparticle chemical catalysis of dyes

6. Degraded dye UV-Visible Spectroscopy

Using a quartz cuvette containing double-distilled water as a blank, the UV-Vis analysis was carried out on the deteriorated dye by extracting 1ml and analysing the optical characteristics in the quartz cuvette where double-distilled water is predicted to display absorbance in the nanoparticle. The wavelength range for Silver nanoparticles is 300-700 nm, whereas the wavelength range for Copper nanoparticles is 200-700 nm. The UV-Visible spectroscopy (Cary Series 300 UV-SPECTROMETER) was used to calculate the dye degradation percentage and determine the outcome.

7. Percentage of Dye degradation:

The dye degradation percentage can be evaluated by calculating the difference between " initial concentration" of absorbance and final concentration of absorbance and dividing it with initial concentration by using the given formulae:

{(Co – Ct)/ Co* 100}

Where Co is initial concentration of dye & Ct is concentration of dye after t hours of sun exposure.

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

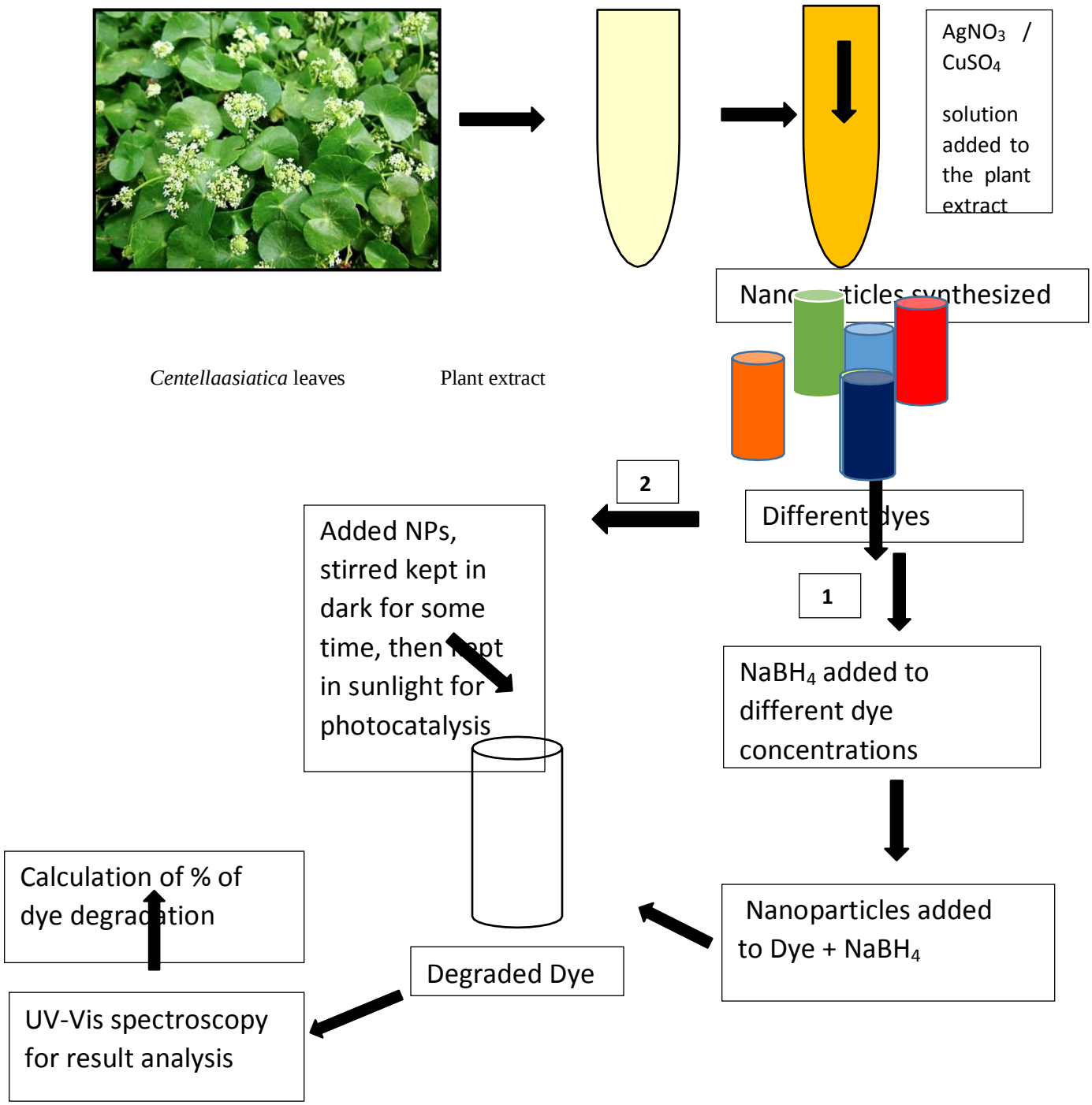


Figure 2: Schematic representation of the synthesis and catalytic degradation

5. CONCLUSION

When organic dyes are discharged into municipal waste water, they are one of the biggest environmental issues because, unlike municipal organic waste, they remain stable in the water and end up in the finished product that is

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

utilised in agricultural areas. As a result, the water dyes wind up contaminating soil and harming local wildlife and flora. The dyes in the soil are also taken up by plants along with other essential nutrients and minerals. A harm to the environment and to human health is posed by colours used in textiles or dyes dumped into waterways by any industry. There must be a way to eliminate pollution from the source, and that answer must be found. In the field of water treatment, nanoparticles have demonstrated to have potent catalytic characteristics that can be put to good use. When it comes to competing with other physical and chemical processes, metallic nanoparticles generated from green synthesis is the way to go. Copper nanoparticles had a better probability of degrading dyes than silver nanoparticles since they gave a better degradation percentage with sodium borohydride than silver nanoparticles with the same catalyst. Copper nanoparticles are also more affordable than silver nanoparticles.

Acknowledgements

We would like to express our gratitude to the Principal of Deshbandhu College, Kalkaji, New Delhi for providing us with the laboratory space and equipment needed to carry out this study.

REFERENCES

Arya, G., Sharma, N., Ahmed, J., Gupta, N., Kumar, A., Chandra, R. and Nimesh, S., 2017. "Degradation of anthropogenic pollutant and organic dyes by biosynthesized silver nano-catalyst from Cicer arietinum leaves". *Journal ofPhotochemistry and Photobiology B: Biology*, *174*. pp. 90-96.

Baily E., 1945. "Treatment of leprosy", *Nature*, pp. 155:601.

Bar, Harekrishna, et al. 2009. "Green synthesis of silver nanoparticles using latex of Jatropha curcas", *Colloids and surfaces A Physicochemical and engineering aspects* 339.1. pp. 134-139.

Bogireddy, N.K.R., Anand, K.K.H., and Mandal, B.K., 2015. "Gold nanoparticles—synthesis by Sterculia acuminata extract and its catalytic efficiency in alleviating different organic dyes", *Journal of Molecular Liquids*, 211, pp.868-875.

Bokare, A.D., Chikate, R.C., Rode, C.V., Paknikar, K.M., 2008. "Iron-nickel bimetallic nanoparticles for reductive degradation of azo dye Orange G in aqueous solution", *App. Catal.* B 79, pp. 270–278.

Callegari, A., Tonti, D., and Chergui. M., 2003. "Photochemically grown silver nanoparticles with wavelength-controlled size and shape", *Nano Letters* 3.11. pp. 1565-1568.

Chandran, S., Prathap, et al. 2006. "Synthesis of gold nanotriangles and silver nanoparticles using Aloevera plant extract", *Biotechnology progress* 22.2. pp 577-583.

Cobley, C.M., Skrabalak, S.E., Campbell, D.J. and Xia, Y., 2009. "Shape- controlled synthesis of silver nanoparticles for plasmonic and sensing applications", *Plasmonics*, 4(2). pp. 171-179.

Daniel, S. C., et al. 2011. "Green synthesis and transfer of silver nanoparticles in a food chain through Chiranamous Larva to zebra fish—a new approach for therapeutics", *Int. J. Nanosci. Nanotechnol* 2. pp. 159-169.

Devi, H.S., and Singh, T.D., 2014. "Synthesis of copper oxide nanoparticlesby a novel method and its application in the degradation of methyl orange". *Adv Electron Electr Eng*, *4*(1). pp.83-88.

Edison, T., Jebakumar Immanuel, and Sethuraman, M. G., 2012. "Instantgreen synthesis of silver nanoparticles using Terminalia chebula fruit extract and evaluation of their catalytic activity on reduction of methylene blue", *Process Biochemistry* 47.9. pp.1351-1357.

Forgacs, E., Cserhatia, T., Oros, G., 2004. "Removal of synthetic dyes from wastewaters, A review, *Environ. Int.* 30. pp.953–971.

Ghosh, A.W., and Datta, S., 2002. "Molecular conduction: paradigms and possibilities", *Journal of Computational electronics*, 1(4). pp.515-525.

Golka, K., Kopps, S., Myslak, Z.W., 2004. "Carcinogenicity of azo colorants: influence of solubility and bioavailability", *Toxicol. Lett.* 151. pp.203–210.

Gonawala, K.H., and Mehta, M.J., 2014. "Removal of color from different dye wastewater by using ferric oxide as an adsorbent", *Int J Eng Res Appl*, 4(5). pp.102-109.

Hagemann RC, Burnham TH, Granick B, Neubauer D. St. Louis, MO, 1996. "Facts and Comparisons Division. J. B. Lippincott Co;. Gotu Kola, In", *The Lawrence Review of Natural Products: facts and comparisons.* pp.41–2.

Heidari M, Jamshedi AH, Akhondzadeh SH, Ghaffari NM, Sadeghi MR, Khansari GM, et al. 2007. "Evaluating the

ISSN:0975-3583,0976-2833 VOL12,ISSUE06,2021

effects of *Centella asiatica* on spermatogenesis in rats", *Med J Reprod Infertility* 7. pp.367–74.

Hosseini, M., Momeni, M.M. and Faraji, M., 2010. "Electrochemical fabrication of polyaniline films containing gold nanoparticles deposited on titanium electrode for electro-oxidation of ascorbic acid", *Journal of materials science*, 45(9). pp.2365-2371.

Jagtap UB, Bapat VA, 2013. "Green synthesis of silver nanoparticles using Artocarpus heterophyllus Lam Seed Extract and its antibacterial activity", *Ind Crop Prod* 46. pp. 132–137.