Curriculum Vitae

Dr. Kashif Raees

M.Sc., Ph.D.
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➢ Career Objectives

To pursue a challenging career and be part of a progressive organization that gives scope to enhance my knowledge, skills and to reach the apex in teaching and research fields with sheer determination, dedication and hard work.

➢ Key Skills

- ✓ Designing and performing independent experimental research work.
- ✓ Strong skills for writing scientific research articles.
- ✓ Excellent interpersonal skills for interaction with peers.
- ✓ Skilled in using a number of sophisticated chemistry lab instruments like UV/VIS spectrophotometer, FT-IR, XRD, Ultra-Sonicator, TGA, DTA, shakers and rotators, precision balances, pH meter, autoclaves, incubators, *etc*.
- ✓ Proficiency on searching the internationally renowned bibliographic and citation databases like Scopus, Web of Science, PubMed and publisher databases like ScienceDirect, Emerald Insight and multidisciplinary databases like JSTOR, J-Gate, etc.

➢ Computer Skills

- ❖ *Programming Languages*: BASIC, HTML, C++ language, JAVA.
- ❖ *Office Suites: MS Excel, MS Word, MS PowerPoint, MS SharePoint.*

➢ Scholastic Records

- ❖ **Ph.D. in Applied Chemistry** from Aligarh Muslim University, Aligarh in the year 2020.
  Title of PhD Thesis: "Studies on the influence of magnetite nanocatalyst on the reaction rates".

- ❖ **M.Sc. in Industrial Chemistry** from Aligarh Muslim University, Aligarh in the year 2015 with 1st Division.
  Title of M.Sc. Dissertation: "Quality control of boneless meat and wastewater".

- ❖ **B.Sc. (Hons.) in Industrial Chemistry** from Aligarh Muslim University, Aligarh in the year 2013 with 1st Division.
  Title of B.Sc. Dissertation: "Study on groundwater quality in Aligarh district: Shri Varshney College to A.M.U. farm".

- ❖ **Senior Secondary School Examination** from Aligarh Muslim University, Aligarh in the year 2010 with 1st Division.

- ❖ **Secondary School Examination** from Aligarh Muslim University, Aligarh in the year 2007 with 1st Division.

➢ Research Interests

- ❖ Catalysis
- ❖ Surface Chemistry
- ❖ Nanotechnology
- ❖ Polymer Chemistry
- ❖ Chemical Kinetics
- ❖ Polymer-Surfactant Interactions
- ❖ Synthesis of Nanomaterials
- ❖ Drug Delivery System

➢ Publication Details

- ❖ **Published articles** : 08
- ❖ **Communicated** : 01

➢ List of Publications

1. **K. Raees**, M. S. Ansari, and M. Z. A. Rafiquee, "Synergistic influence of inhibition of PEG-surfactant on the rate of alkaline hydrolysis of procaine," *J. Mol. Liq.*, vol. 257, pp. 93–99, 2018. (Impact Factor: 5.056)

2. M. Shaban Ansari, **K. Raees**, and M. Z. A. Rafiquee, "Influence of surfactants/polyethylene glycols mixture on the kinetics of alkaline hydrolysis of tetracaine," *J. Mol. Liq.*, vol. 272, pp. 638–644, 2018. (Impact Factor: 5.056)

3. M. Jalal, M. A. Ansari, **K. Raees**, and M. A. Alzohairy, "Biosynthesis of Silver Nanoparticles from Oropharyngeal Candida glabrata Isolates and Their Antimicrobial Activity against Clinical Strains of Bacteria and Fungi," *Nanomaterials*, vol. 8, p. 586, 2018. (Impact Factor: 4.358)

4. **K. Raees**, M. S. Ansari, and M. Z. A. Rafiquee, "Inhibitive effect of super paramagnetic iron oxide nanoparticles on the alkaline hydrolysis of procaine," *J. Nanostructure Chem.*, Jun. 2019. (Impact Factor: 4.077)

5. **K. Raees**, M. S. Ansari, and M. Z. A. Rafiquee, "Influence of surfactants and surfactant-coated IONs on the rate of alkaline hydrolysis of procaine in the presence of PEG," *J. King Saud Univ. - Sci.*, Nov. 2019. (Impact Factor: 3.819)

6. M. S. Ansari, **K. Raees**, M. Ali Khan, M. Z. A. Rafiquee, and M. Otero, "Kinetic Studies on the Catalytic Degradation of Rhodamine B by Hydrogen Peroxide: Effect of Surfactant Coated and Non-Coated Iron (III) Oxide Nanoparticles," *Polymers (Basel).*, vol. 12, no. 10, p. 2246, Sep. 2020. (Impact Factor: 3.426)

7. M. Shaban Ansari, **K. Raees**, E. Aazam, M. Z. A. Rafiquee, "Influence of Fe_3O_4 and CTABr on the rate of degradation of methylene blue by H_2O_2," *Adv. Mater. Lett.*, vol. 12, no. 2, p. 21021602, Dec. 2020. (Impact Factor: 1.150)

8. M. Shaban Ansari, **K. Raees**, and M. Z. A. Rafiquee, "Inhibitive effect on the rate of hydrolysis of tetracaine by the surfactant-coated magnetic nanoparticles (Fe_3O_4)," *Adv. Mater. Lett.* vol. 12, no. 4, p. 21041619, Feb. 2021. (Impact Factor: 1.150)

9. **K. Raees**, M. S. Ansari, M. S. Ali, H. Al-Lohedan and M. Z. A. Rafiquee, "Effect of PEG-coated iron oxide nanoparticles on the rate of oxidation of adrenaline by hydrogen peroxide: Effect of non-ionic, cationic and anionic surfactants," ACS Omega. (Communicated). (Impact Factor: 2.87)

➢ Conferences/Seminar/Workshop

- ❖ Presented a poster in **"37th Annual Conference"** organized by **Indian Council of Chemists**, held in National Institute of Technology Karnataka (NITK), Surathkal (Karnataka) during December 12-14, 2018, on the topic **"Alkaline hydrolysis of procaine in the presence of magnetically recoverable iron oxide nanoparticles".**

- ❖ Participated in **"7th International Chemistry Conference"** held at King Saud University, Riyadh, Saudi Arabia from November 12-14 2018.

- ❖ Attended two days training course of **"Entrepreneurship Awareness Camp"** organized by **The National Small Industries Corporation Ltd. (NSIC)** from October 4-6 2018.

- ❖ Attended **"International Seminar on Managing Research with Effective Outcome"** held at Department of Computer Engineering, Zakir Hussain College of Engineering and Technology, A.M.U. Aligarh on August 6th 2018.

- ❖ Presented a poster in **"International Conference on Emerging Trends in Chemical Sciences"** organized by Department of Chemistry, Dibrugarh University, Dibrugarh, Assam during February 26-28, 2018, on the topic **"Studies on the influence of PEG-surfactant aggregates on the rate of alkaline hydrolysis of procaine".**

- ❖ Attended **workshop on FOSS based reference manager tool "Mendeley",** organized by Computer Science Department, A.M.U. Aligarh in collaboration with Elsevier Group of Journals on January 28th 2018.

- ❖ Presented a poster in **"National Conference on Recent Advances in Chemical Sciences"** held in Aligarh Muslim University, Aligarh on March 25-26, 2017, on the topic "**Studies on the effect of Polyethylene Glycol (PEG) and PEG-surfactants mixed micelles on the rate of Hydrolysis of Procaine".**

➢ Technical knowledge/ Expertise

Sound knowledge of various software and tools used in research work like:

- ❖ *Bibliographic and Reference Management Tools:* Mendeley, Endnote, Zotero.
- ❖ *Data Analyzing and Graphing:* Origin, MatLab, Prism.
- ❖ *Chemical Drawing Tools:* ChemDraw, Chem Sketch.
- ❖ *Writing Assistant Tools:* Grammarly, ProWritingAid.
- ❖ *Anti-Plagiarism Tools:* Turnitin, iThenticate, Urkund.

➢ Extra Curricular Activities / Other Interests

- ❖ State level Basketball player.
- ❖ Former Captain AMU Basketball Club.
- ❖ Represented AMU in Four North Zone Basketball championship.
- ❖ A-certificate in NCC.
- ❖ Volunteer in a number of university programmes.

➢ References

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➢ Personal Details

- **Father's Name** : (Late) Raees Ahmad
- **Mother's Name** : Mrs. Tasneem Raees
- **Gender** : Male
- **Date of birth** : July 04, 1991
- **Marital status** : Unmarried
- **Nationality** : Indian
- **Religion** : Islam
- **Languages** : Hindi, Urdu, English

➢ Declaration

I hereby declare that the information furnished above is true to the best of my knowledge.

(Kashif Raees)

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Synergistic influence of inhibition of PEG-surfactant on the rate of alkaline hydrolysis of procaine

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ABSTRACT

The effect of surfactants (sodium dodecyl sulphate; SDS, cetyltrimethyl ammonium bromide; CTABr, and Triton X-100; TX100) and polymeric surfactants (*viz.* polyethylene glycol; PEG) mixture on the rate of base catalyzed hydrolysis of procaine hydrochloride (2-diethylaminoethyl-4-aminobenzoic acid) has been studied under the pseudo-first-order conditions ($[OH^-] \gg [Procaine]$). The rate of hydrolysis of procaine was found to be linearly dependent upon the [NaOH] in the range from 2.0×10^{-2} mol dm^{-3} to 8.0×10^{-1} mol dm^{-3} at fixed [procaine] ($=5.0 \times 10^{-5}$ mol dm^{-3}) at 37 °C. The values of rate constant were found to be independent on [procaine] in the concentration range from 1.0×10^{-5} mol dm^{-3} to 1.0×10^{-4} mol dm^{-3} at a fixed concentration of NaOH at 5.0 $\times 10^{-2}$ mol dm^{-3}. The values of rate constant decreased with the increase in the concentrations of surfactants (SDS, CTABr and TX100). The rate of hydrolysis further decreased with the addition of PEGs of different molecular weights (1500, 4000, 6000 and 8000) in the reaction media containing surfactant. The increase in the concentration of PEGs from 1% to 5% decreased the rate of hydrolysis, thereby, increasing its stability. The increase in molecular weight of PEG also decreased the rate of hydrolysis. The kinetic parameters and binding constants (*e.g.* k_m, K_p for the different reaction media) were calculated for the reactions occurring in the aqueous and surfactant-PEG pseudophases by applying pseudophase ion exchange model. Maximum inhibition in the rate of hydrolysis was observed for PEG-TX100 aggregates.

1. Introduction

Procaine (2-diethylaminoethyl-4-aminobenzoic acid) is one of the oldest used local anesthetic and is soluble in water and alcohol. Procaine like other local anesthetics prevents the generation and conduction of nerve impulses. It is hydrolyzed into p-amino-benzoic acid and diethyl amino ethanol by cholinesterase in the plasma of cells. Procaine is effective when injected into the body but remains ineffective through surface application. Procaine is widely used because it exhibits considerably lower degrees of toxicity and irritation and it is well tolerated by majority of peoples. The drug is useful in peripheral nerve block, spinal anesthesia and infiltration anesthesia. Procaine hydrochloride injections are found useful in many severe pain conditions like Cerebral Thrombosis, Meniere's disease, Bell's Palsy, Bursitis, Herpes Zoster, Scalenous Anticus Syndrome and Arthritis with or without the addition of some other drugs. The onset of the action of procaine usually takes 2–5 min and its duration of action is also comparatively lower. The drug is a vasodilator and usually co-administered with vasoconstrictor (epinephrine) to increase its duration of action [1–4].

Loucas et al. reported that procaine degrades to 90% of its initial concentration in two days at room temperature and eleven days under refrigeration [5]. Several researches have been reported about its lower degree of stability. Many researchers have tried to raise the shelf life of procaine to store for a longer period of time without its degradation. Some of the attempts in this direction include the addition of preservatives and surfactants [4–6]. Polyethylene glycol (PEG) is soluble in water and organic solvents and is among the non-toxic safe polymer that can be used as food additives [7]. The polymer comes under the FDA's GRAS list, (compounds Generally Recognized As Safe) and can be used for internal consumption [8,9]. PEGs covers a broad range of applications from industries to medicines. They are generally used as a film coating agent and carrier solvent for food supplement and as excipient in medicines [10]. PEG is one of the most important ingredients in many skin creams and is also used in a number of toothpastes as dispersant. Moreover, the solution of PEGs can also be used as a phase-transfer catalyst in organic synthesis and as green reaction media [11]. PEGs are available in varying molecular weights ranging from 200 to >20,000. The lower molecular weight's PEGs <700 are colorless liquid, PEGs ranging molecular weights 700–900 are semi solids and above 1000 molecular weight PEGs are creamy white waxy solids or flakes. In addition, PEGs are found to be stable to acid, base, high temperature, high oxidation and reduction systems and may also be recovered from aqueous solutions

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ORIGINAL RESEARCH

Inhibitive effect of super paramagnetic iron oxide nanoparticles on the alkaline hydrolysis of procaine

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Abstract
The Super Paramagnetic Iron Oxide Nanoparticles (SPIONs) can bind drugs and act as drug-carriers. The magnetically active SPIONs can be used to deliver the drugs to the target through magnetic fields. The objective of the present work has been undertaken to study the stability, and binding behaviour of procaine with SPIONs and surfactant-coated SPIONs. Procaine is among the ester drugs and hydrolyses in the alkaline medium. The influence of SPIONs and surfactant-coated SPIONs on the rate of hydrolysis of procaine in alkaline medium may help to define the behaviour of the drug in the presence of these nanoparticles. The kinetic studies of procaine hydrolysis in the presence of SPIONs and surfactant-coated SPIONs were carried out spectrophotometrically. The concentrations of OH^- ions were taken in excess over [procaine] to keep the reaction conditions under pseudo-first-order. The presence of SPIONs and the SPIONs coated with cetyltrimethylammonium bromide; CTABr and sodium dodecylsulphate; SDS surfactants displayed an inhibitive effect on the rate of hydrolysis of procaine. The synthesised nanoparticles were characterised using X-ray diffraction (XRD), scanning electron microscopy (SEM), vibrating sample magnetometer (VSM), transmission electron microscopy (TEM) and Fourier transform infrared spectroscopy (FTIR). The k_ψ-[surfactant] profile in the presence of SPIONs was discussed using the pseudophase model in which the reactants are considered to be distributed in the aqueous and micellar media. The rate constant for the procaine hydrolysis and the binding constants of procaine with coated and non-coated SPIONs have been calculated by analysing the data for the variation in the rate constant with the change in [surfactant], [SPIONs] and [surfactant-coated SPIONs].

Extended author information available on the last page of the article

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Original article

Influence of surfactants and surfactant-coated IONs on the rate of alkaline hydrolysis of procaine in the presence of PEG

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ABSTRACT

The influence of surfactant coated iron oxide nanocomposites (Surf-IONs) and surfactants on the rate of alkaline hydrolysis of procaine hydrochloride (2-diethylaminoethyl-4-aminobenzoic acid) in the presence of poly(ethylene glycol) (PEG) have been investigated under the varying reaction conditions. The nanoparticles were synthesised using the co-precipitation method and were characterised using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Vibrating sample magnetometer (VSM) and Thermogravimetric analysis (TGA). The concentration of NaOH was taken in overabundance over [procaine] for maintaining the reactions under pseudo-first-order conditions. The kinetic effect of poly(ethylene glycol); PEG of molecular weights 1500, 4000, 6000, and 8000 with the cetyltrimethylammonium bromide; CTABr and sodium dodecyl sulphate; SDS (either free or coated on iron oxide nanoparticles) were studied. A fall in the values of the rate constant on increasing the [surfactant] or [Surf-IONs] at fixed [PEG] was observed. The k_ψ-[PEG-surfactant] profile was treated using the pseudophase model, and pseudophase ion exchange model and the kinetic parameters were determined. The binding constant of procaine with PEG-surfactant aggregates was found to be lower than the respective micelles in the absence of PEG. The increase in the molecular weights of PEG decreased the values of binding constants and equilibrium constants.

1. Introduction

The nano-sized materials have been extensively investigated in the last two decades because they owe superior physical as well as chemical properties due to their small object effect, quantum size effect, mesoscopic effect and the surface effect, as compared to their bulk counterparts (Wei et al., 2012). The nano-materials have applications in almost every field of science and technology like everyday materials and processes, biomedical applications, electronic and IT applications, and environmental remediation (Matsui, 2005; Nikitin et al., 2017; Prasad et al., 2018). Among all the nanoparticles or nanocomposites, the iron oxide nanoparticles (IONs) has drawn the attention because it is almost inexpensive, biocompatible, inert, having high magnetism, recoverable or separable using simple magnets and are reusable or recyclable (Alishiri et al., 2013; Godoi et al., 2014). IONs have applications in magnetic fluids, magnetic seals, chemical catalysis and data storage (Azharuddin et al., 2008; Frey et al., 2009; Mamani et al., 2014). The IONs are also used in clinical diagnosis and therapy (like MRI and MFH), targeted drug delivery, magnetic bioseparation and biological labels (Cole et al., 2011; Yue-Jian et al., 2010). The other advantages with IONs are that its size, shape, and morphology can be controlled as per the requirement of the application during the synthesis process (Shen et al., 2014).

The IONs are sometimes coated with materials like polymers, surfactants, organics (like oleic acid) and inorganics (like silica) to improve its properties like lowering the self-aggregation ability, and increasing the stability (Illés et al., 2015; Mahdavi et al., 2013; Maleki et al., 2019; Santra et al., 2001). The IONs usually coated with polymers and more often with natural polymers like Polyethylene glycol (PEG), Chitosan, Polyacrylic acid (PAA) and starch to lower the toxicity and also to reduce the self-aggregation (Mukhopadhyay et al., 2012; Pham et al., 2016; Sanchez et al., 2018). The complex behaviour of polymer-surfactant interactions has the property to alter the viscosity, wettability, detergency and foaming behaviour of a solution (Mace et al., 2012; Schramm et al., 2003). The polymer-surfactant aggregates have a smaller size

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Article

Kinetic Studies on the Catalytic Degradation of Rhodamine B by Hydrogen Peroxide: Effect of Surfactant Coated and Non-Coated Iron (III) Oxide Nanoparticles

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Abstract: Iron (III) oxide (Fe_3O_4) and sodium dodecyl sulfate (SDS) coated iron (III) oxide (SDS@Fe_3O_4) nanoparticles (NPs) were synthesized by the co-precipitation method for application in the catalytic degradation of Rhodamine B (RB) dye. The synthesized NPs were characterized using X-ray diffractometer (XRD), vibrating sample magnetometer (VSM), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and Fourier transform infra-red (FT-IR) spectroscopy techniques and tested in the removal of RB. A kinetic study on RB degradation by hydrogen peroxide (H_2O_2) was carried out and the influence of Fe_3O_4 and SDS@Fe_3O_4 magnetic NPs on the degradation rate was assessed. The activity of magnetic NPs, viz. Fe_3O_4 and SDS@Fe_3O_4, in the degradation of RB was spectrophotometrically studied and found effective in the removal of RB dye from water. The rate of RB degradation was found linearly dependent upon H_2O_2 concentration and within 5.0×10^{-2} to 4.0×10^{-1} M H_2O_2, the observed pseudo-first-order kinetic rates (k_{obs}, s^{-1}) for the degradation of RB (10 mg L^{-1}) at pH 3 and temperature 25 ± 2 °C were between 0.4 and 1.7×10^4 s^{-1}, while in presence of 0.1% *w*/*v* Fe_3O_4 or SDS@Fe_3O_4 NPs, k_{obs} were between 1.3 and 2.8×10^4 s^{-1} and between 2.6 and 4.8×10^4 s^{-1}, respectively. Furthermore, in presence of Fe_3O_4 or SDS@Fe_3O_4, k_{obs} increased with NPs dosage and showed a peaked pH behavior with a maximum at pH 3. The magnitude of thermodynamic parameters E_a and ΔH for RB degradation in presence of SDS@Fe_3O_4 were 15.63 kJ mol^{-1} and 13.01 kJ mol^{-1}, respectively, lowest among the used catalysts, confirming its effectiveness during degradation. Furthermore, SDS in the presence of Fe_3O_4 NPs and H_2O_2 remarkably enhanced the rate of RB degradation.

Keywords: magnetite; co-precipitation method; Rhodamine B; sodium dodecyl sulfate; wastewater treatment

1. Introduction

Mushrooming industrialization and urbanization are primarily responsible for deteriorating the surface and sub-surface water quality, causing hazardous effects on both aquatic organisms and human health. Among water contaminants, dyes and pigments, which are widely discharged from textile, pharmaceutical, paint, rubber, cosmetic, and confectionary industries effluents [1,2],

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Influence of Fe_3O_4 and CTABr on the Rate of Degradation of Methylene Blue by H_2O_2

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The kinetics of the oxidation of methylene blue (MB) by H_2O_2 in the presence of iron oxide nanoparticles has been studied. The nanoparticles of iron oxide (Fe_3O_4) were synthesized and characterized physico-chemical techniques. The XRD studies showed its crystalline nature. The VSM study was carried out to determine the values of the magnetic saturation parameter ~ 40.00 emu/g. The particle were of spherical shape with particle size distribution centered at 12 ± 2 nm. The FT-IR spectra indicated the presence of peaks at 585 cm^{-1} and 459 cm^{-1} due to Fe-O bond vibrations. The peak at 3424 cm^{-1} was assigned to the O-H stretching vibration. The H-O-H bending appeared at 1631 cm^{-1}. The Fe_3O_4 nanoparticles enhanced the rate of degradation of MB. The oxidation rate increased with the increase in Fe_3O_4. At pH 3, the maximum rate of oxidation of MB was observed. The rate of reaction increased with the increase in [H_2O_2] in the absence of Fe_3O_4. But in the presence of Fe_3O_4, the rate constant *versus* [H_2O_2] showed peaked behaviour. The CTABr increased the rate of oxidation of MB by H_2O_2 in the presence of Fe_3O_4 nanoparticles.

Introduction

Dyes are widely used in textiles industries during dyeing and printing processes and the excess amount of dyes are released into the effluent streams as waste after colouring the cloth [**1**]. The release of coloured waste water involving dyes, from textiles and other industries pollute the water and make it undesirable and may cause serious environmental problems [**2**]. These pollutants are oncogenic and mutagenic and produce the possible risk of bioaccumulation [**3**]. The wastewater containing dyes prevent light transmission and causes harm to both flora and fauna, and may cause eco-toxic hazard to human and aquatic life [**4**]. Methylene Blue chemically is commonly known as methylthioninium chloride is a heterocyclic aromatic chemical compound with molecular formula $C_{16}H_{18}ClN_3S$. MB is a cationic dye widely used in industries such as textiles, plastics, paper, cotton, silk, leather, food and cosmetics to colour products [**5**]. MB is a synthetic dye and is highly soluble, stable and has biotoxicity in water and thus can threaten the ecological balance even the survival of human being owing to their toxicity, carcinogenicity, and bioaccumulation [**6**]. MB can cause eye irritation in humans as well as in animals, allergy and cancer due to its toxicity [**7**]. If ingested the water containing MB, it will cause nausea, hard breathing, vomiting, methemoglobinemia, mental disorder and sweating [**8,9**]. Thus, it is necessary to develop new and cost-effective technologies to remove MB from wastewater.

The removal of dyes from wastewater is a primary concern for the environmentalists. Many methods are available for the removal of dyes from water such as reverse osmosis, ion exchange method, precipitation, adsorption, ozone treatment, catalytic reduction, biodegradation ultrasonic decomposition, coagulation, electro-coagulation, chemical oxidation and nano-filtration etc. [**10-13**]. Extensive studies are available on the removal of methylene blue (MB) through the applications of low-cost adsorbents from waters. The adsorption techniques are usually useful for the removal of non-biodegradable wastes but its disposal may raise the subsequent environmental issues [**14-16**]. The other factors that contribute towards the drawbacks of these techniques are high cost, long processing time, high energy consumption, regeneration difficulty, and simple transfer of pollutants from one phase to another [**17,18**]. Oxidation by the Fenton's reagent is one of the most effective methods for destroying the organic wastes. It consists of a mixture of hydrogen peroxide and iron (II) ion ($H_2O_2 + Fe^{2+}$). It plays an important role in free radical biology, medicine, environmental systems, and environment protection engineering including the wastewater treatment and remediation of groundwater.

Recently magnetic nanoparticles (MNPs), especially Fe_3O_4, are widely used catalyst for the removal of dyes from waste water solution since Fe_3O_4 NPs are inert, inexpensive, nontoxic, biocompatible, having super magnetic properties and can be reused and recycled with the help of simple magnets [**19-21**]. These special cubic spinel structure of magnetite display catalytic activity, can be useful in the removal of various dyes and organic wastes from water [**22**]. The Fe_3O_4 NPs act as Fenton-like catalyst for the degradation of MB through generating hydroxyl

nanomaterials

Article

Biosynthesis of Silver Nanoparticles from Oropharyngeal *Candida glabrata* Isolates and Their Antimicrobial Activity against Clinical Strains of Bacteria and Fungi

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Abstract: The objective of the present study was one step extracellular biosynthesis of silver nanoparticles (AgNPs) using supernatant of *Candida glabrata* isolated from oropharyngeal mucosa of human immunodeficiency virus (HIV) patients and evaluation of their antibacterial and antifungal potential against human pathogenic bacteria and fungi. The mycosynthesized AgNPs were characterized by color visualization, ultraviolet-visible (UV) spectroscopy, fourier transform infrared spectroscopy (FTIR), and transmission electron microscopy (TEM). The FTIR spectra revealed the binding and stabilization of nanoparticles with protein. The TEM analysis showed that nanoparticles were well dispersed and predominantly spherical in shape within the size range of 2–15 nm. The antibacterial and antifungal potential of AgNPs were characterized by determining minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC)/ minimum fungicidal concentration (MFC), and well diffusion methods. The MBC and MFC were found in the range of 62.5–250 µg/mL and 125–500 µg/mL, which revealed that bacterial strains were more susceptible to AgNPs than fungal strains. These differences in bactericidal and fungicidal concentrations of the AgNPs were due to the differences in the cell structure and organization of bacteria and yeast cells. The interaction of AgNPs with *C. albicans* analyzed by TEM showed the penetration of nanoparticles inside the *Candida* cells, which led the formation of "pits" and "pores" that result from the rupturing of the cell wall and membrane. Further, TEM analysis showed that *Candida* cells treated with AgNPs were highly deformed and the cells had shrunken to a greater extent because of their interaction with the fungal cell wall and membrane, which disrupted the structure of the cell membrane and inhibited the normal budding process due to the destruction and loss of membrane integrity and formation of pores that may led to the cell death.

Keywords: *Candida glabrata*; extracellular; mycosynthesis; MIC; MBC; MFC; membrane integrity; TEM; FTIR