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MEMORANDUM OF UNDERSTANDING BETWEEN R. C. PATEL ARTS, COMMERCE AND SCIENCE COLLEGE, SHIRPUR

AND

H. R. PATEL INSTITUTE OF PHARMACEUTUCAL EDUCATION AND RESEARCH

FOR THE DEVELOPMENT OF ACADEMIC AND RESEARCH COOPERATION

The present MoU is signed on 1st Aug 2016 between R. C. Patel Arts, Commerce and Science College, Shirpur AND H. R. Patel Institute of Pharmaceutical Education and Research, Shirpur.

The MoU has following objectives:

1. To promote the research collaborations among the faculty of both the institutes.
2. To share the research and laboratory facilities of the institute.
3. To facilitate training for the PG students and the faculty
4. To undertake interdisciplinary research projects for the PG students of both the institute.

Duration of the MoU:

The duration of the MoU will be FIVE years and upon review it can be further extended for TWO years.

Coordinators:
Bothe the institute will appoint a person in charge for the MoU who will take the responsibility of the agreement.

IPR benefits:
IPR benefits of the joint research work will be shared by both the institutes.

Signatures

On behalf of

R. C. Patel Arts, Commerce and Science College, Shirpur

On behalf of

H. R. Patel Institute of Pharmaceutical Education and Research, Shirpur.

R. C. Patel Educational Trust's
R. C. Patel Arts, Commerce and Science College
Karvand Naka, Shirpur 425405, Dist - Dhule, Maharashtra
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President
Hon. Bhupeshbhai Patel

Principal
Dr. D. R. Patil

Name of Institute/Industry :- SES'S HR Patel Institute of Pharmaceutical Education and Research, Shirpur

Year of Signing Linkage/ MoU :- 2019

Duration of Linkage/MoU :- 05 Years

List of Activities carried out under MoU with SES'S HR Patel Institute of Pharmaceutical Education and Research, Shirpur

Authorized signatures:

Principal
H.R.Patel Institute of Pharmaceutical Education & Research, Shirpur Dist Dhule (M.S.) 425 405

H.R.Patel Institute of Pharmaceutical Education & Research Shirpur OFFICE SEAL

R.C.E.T's R. C. Patel Arts, Commerce and Science College Shirpur SEAL

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Chapter 4
Recent Updates on In Silico Screening of Natural Products as Potential Inhibitors of Enzymes of Biomedical and Pharmaceutical Importance

Mohini Patil, Samadhan Patil, Vijay L. Maheshwari, Laxmikant Zawar, and Ravindra H. Patil

Abstract Natural products from medicinal plants have been increasingly used in modern medicine due to their safety, efficacy, and lesser toxicity. World over, a large number of natural compounds are evaluated for the desired bioactivity. A wide range of phytoconstituents such as alkaloids, terpenoids, tannins, steroids, etc. have been recognized for their varying biological activities. However, obtaining the natural products with the desired bioactivity is a time-consuming and commercially difficult process. Molecular docking is used for screening known as well as novel drugs to identify novel compounds by predicting their binding mode and affinity. Moreover, in silico molecular docking can be performed to analyze their binding capabilities into the 3D structure of proteins. AutoDock and AutoDockTools are open-source techniques that have been extensively cited in the literature as essential tools in structure-based drug design. These methods are fast enough to permit the virtual screening of ligand libraries containing tens of thousands of compounds. This article highlights the recent developments in the virtual screening of enzyme inhibitors using various docking tools and their significant applications in designing potent inhibitors for the management of various metabolic and infectious diseases.

Keywords Natural products · Virtual screening · Molecular docking · In silico · AutoDock and AutoDockTools

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Scientific paper

Design of "Turn-Off" Fluorescent Nanoprobe for Highly Sensitive Detection of Uric Acid using Green Synthesized Nitrogen-Doped Graphene Quantum Dots

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Abstract

Green synthesized graphene quantum dots (GQD) have been doped with nitrogen in an attempt to boost their optical characteristics and application sectors. In the present investigation, the blue luminescent nitrogen-doped GQDs (N-GQDs) were synthesized by single-step hydrothermal synthesis using tamarind shell powder as a precursor. The particle size and zeta potential of N-GQDs were found to be 11.40 nm and be –35.53 mV, respectively. A quantum yield as high as 23.78 % was accomplished at an excitation wavelength of 330 nm at neutral pH. It gets quenched sensitively in the existence of uric acid (UA) combining static quenching, electron transfer, and an inner filter effect mechanism. A linear range was obtained for UA from 10 µM to 100 µM, with a limit of detection (LOD) of 401.72 ± 0.04 pM. Additionally, the N-GQDs were selective toward UA in presence of metal ions and biomolecules that indicated its impending use to monitor UA in clinical samples. In conclusion, this work demonstrates that the N-GQDs as a sensing probe for UA recognition with notable advantages including socioeconomic, simple, and less time-consuming methods as compared to other methods. In the future, it can be potentially explored as a biosensor for UA detection in clinical samples.

Keywords: Graphene Quantum Dots; N-GQDs; Uric acid; Biosensor; Tamarind Shell Powder

1. Introduction

Principally, UA (2.6,8-trihydroxypurine) is the primary product of purine synthesis.[1] As per literature, in the general population, UA is referred to between 0.13 mM to 0.46 mM and 2.49 mM to 4.46 mM in serum and urine, respectively.[2] As we know, the abnormal levels of such metabolites in body fluids can cause several diseases.[3] Plentiful literature revealed that the increased UA levels in body samples are indicative of hypertension, gout, cardiovascular disease, kidney disease, high cholesterol, and many more.[4] In comparison, low concentrations of UA are also connected with multiple sclerosis and oxidative stress.[5,6] In diagnosis and healthcare, it is crucial to quantify metabolites in blood or other biological samples. Therefore, a rapid, responsive, precise, and cheap method of assessment must be developed to track such metabolites in body fluids including serum and urine.[5]

Literature survey reported that electrochemical sensing,[7] a colorimetric method,[8] a chromatographic method,[9] etc. are currently engaged detection techniques for UA in different body fluid samples. However, some in-conveniences such as complicated synthesis or challenging extraction, advanced equipment, expensive and tedious limiting their practical uses, are present in these approaches.[5] There are no exceptions for benefit of fluorescence. It is highly sensitive, and it shows a fast reaction, and operative simplicity in contrast to the oth-

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Short communication

Design of graphene quantum dots decorated MnO_2 nanosheet based fluorescence turn "On-Off-On" nanoprobe for highly sensitive detection of lactoferrin

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ARTICLE INFO

Keywords:
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Periodontal disease
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ABSTRACT

Lactoferrin estimation is increasingly acquiring prominence as a novel biomarker for the diagnosis of periodontal disease. To date, diverse lactoferrin detection methods which include electrochemical, surface-enhanced Raman scattering, colorimetric, and others have been extensively portrayed. Unfortunately, these systems have significant shortcomings including low sensitivity, selectivity, high cost, arduous and time-consuming technique, and so forth. Recently, the fluorescence-based method shows remarkable uniqueness that overcomes the demerits of traditionally reported techniques. Therefore, graphene quantum dots (GQDs) and manganese dioxide nanosheets (MnO_2-NS) based simplistic, highly sensitive, and selective fluorescent turn 'Off-On' mediated GQDs@MnO_2-NS nanoprobe was designed. Herein, MnO_2-NS addition demonstrated the quenching of GQDs containing fluorescence through inner filter effects (IFE) and strong interaction between GQDs and MnO_2-NS. The lactoferrin addition destroyed the MnO_2-NS and fluorescence emission of GQDs reappeared which may be because of redox reaction between lactoferrin and prepared MnO_2-NS. Herein, nanoprobe offers a wide concentration range and low limit of detection of 5 to 1600 ng/ml. and 1.69 ng/mL, respectively. As fabricated GQDs@MnO_2-NS nanoprobe sensor demonstrated high selectivity, good stability, and reproducibility towards lactoferrin that assuring applicability of biosensor. Therefore, the GQDs@MnO_2-NS nanoprobe will offer a simplistic sensor with adequate sensitivity to achieve highly responsive and selective detection of lactoferrin.

1. Introduction

Periodontal disease is common in many countries [1], and is frequently produced by microbial infection. It stimulates the adherence of connective tissue and the prevention of bone surrounding the teeth at the onset of illness [2,3]. Despite this, its following inflammatory response adds to the loss of periodontal tissues in a patient. As a result, it is a prolonged inflammatory illness in people that causes not only regional mouth diseases but also systemic organ abnormalities [3]. Importantly, periodontal disease if remain untreated, the illness progresses to gradual bone damage, resulting in tooth movement and eventual tooth loss. As per literature, periodontal disease affects more than half of the grownup people in the United States, with around 10% suffering from serious disease those results in earlier tooth loss [4]. To prevent additional severances of periodontal disease, it is critical to accurately diagnose it. In this regard, biomarker detection is essential in the prediction of health difficulties, and scientists are presently investigating novel biomarkers for sickness diagnosis. In latest days, advances in the science of diagnosing oral as well as periodontal illness have evolved into ways for measuring periodontal threats employing quantifiable evidence kind of as biomarkers [5].

Lactoferrin (family: transferrin) is an iron-binding glycoprotein found in secondary neutrophil granulocytes [6]. As per literature, it demonstrates responsiveness to acute inflammation [3]. In addition, lactoferrin is observed in tears and saliva [6]. Lactoferrin estimation has received a lot of attention during the last two decades as a new biomarker [7] for the diagnosis of periodontal disease. Furthermore, it may be recommended for the diagnosis of various inflammatory illnesses [8]. Several identification studies have proposed various approaches for lactoferrin detection. Mainly, single radial

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Scientific paper

Zinc Metal-Organic Frameworks- Graphene Quantum Dots Nanocomposite Mediated Highly Sensitive and Selective Fluorescence "On-Off-On" Probe for Sensing of Quercetin

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Abstract

The current study presents a fluorescence-based 'On-Off-On' nanoprobe composed of rose petal-derived graphene quantum dots embedded in zinc metal-organic frameworks (RP-GQDs@Zn-MOFs) as a proof of concept for quercetin sensing. The particle size and HR-TEM analysis confirmed the synthesis of a uniformly distributed nanosized probe, while the zeta potential (+33.03 mV) verified its good stability. The fluorescence analysis confirmed that the introduction of copper ions (Cu^{2+}) resulted in fluorescence quenches, while the inclusion of quercetin forms quercetin-Cu^{2+} complex, leading to recovery of quenched fluorescence in RP-GQDs@Zn-MOFs due to static quenching. The nanoprobe demonstrated a wide concentration range and a low detection limit of 100 ng/mL to 1400 ng/mL ($R^2 = 0.99$) and 37.8 ng/mL, respectively. Selectivity analysis highlighted pronounced specificity for quercetin, attributed to Cu^{2+} coordination between carbonyl oxygen atom and the 3-OH group of quercetin. Furthermore, designed probe exhibited excellent stability, repeatability (RSD < 5), and potential for real-time analysis.

Keywords: Zinc metal-organic frameworks; graphene quantum dots; copper ions; quercetin; high sensitivity; high selectivity

1. Introduction

Metal-organic frameworks (MOFs) are preferred for various applications, including biomedical and environmental uses. This preference stems from their distinctive characteristics, such as their ability to modify surfaces, their large surface area, and their adjustable structure.[1] It provides a highly porous structure through the association of metal ions with carefully selected organic linkers via strong bonding.[2] To date, various types of MOFs have been developed for numerous applications, including drug delivery, biosensing, chemical sensing, gas separation, and more.[3,4] At present, they are widely employed for biosensing purposes, offering low detection limits, high sensitivity, excellent responsiveness, and good stability, among other benefits.[4] Despite these groundbreaking merits, MOFs suffer from major drawbacks, primarily the collapse of their structure and pore shrinkage.[2] As a result, there is a need for complementary nanoparticles that can help overcome these significant drawbacks while preserving the original features of MOFs.

Currently, significant efforts are underway to develop innovative MOFs-centered composites to address the genuine needs of the scientific community. Encapsulating nanosized components within MOFs represents a novel advancement in the biomedical field.[5,6] In this context, it is worth noting that fluorescence-mediated sensing tech-

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Bovine serum albumin-derived poly-L-glutamic acid-functionalized graphene quantum dots embedded UiO-66-NH_2 MOFs as a fluorescence 'On-Off-On' magic gate for *para*-aminohippuric acid sensing

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ARTICLE INFO

Keywords:
Bovine serum albumin
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ABSTRACT

Evaluating *para*-aminohippuric acid (PAH) is emerging as a promising biomarker for the diagnostics of renal disease and other kidney-related illnesses. The present study aims to develop novel bovine serum albumin-derived poly-L-glutamic acid (PLGA) functionalized graphene quantum dots (PLGA-fGQDs) embedded in UiO-66-NH_2 metal-organic frameworks (PLGA-fGQDs@UiO-66-NH_2 MOFs) for monitoring of PAH. Initially, GQDs were achieved from bovine serum albumin (green precursor) via the single-step hydrothermal method. Here, functionalization with PLGA offers a tremendous increment in optical properties of GQDs. Then, highly luminescent UiO-66-NH_2 MOFs were achieved using zirconium tetrachloride ($ZrCl_4$) and 2-Aminoterephthalic acid (2-ATA) as a metal ion source and organic linker. Here, surface modification of GQDs with PLGA offered high quantum yield (QY), and responsiveness. Also, luminous UiO-66-NH_2 MOFs afford a wide surface area for decorating of PLGA-fGQDs. The addition of gallium ions (Ga^{3+}) into the probe solution resulted in fluorescence quenching (Turn-Off) whereas the incorporation of PAH resulted in fluorescence recovery (Turn-On). It is because of interaction with carboxylic functionality of PAH to Ga^{3+} followed by Ga-PAH complex formation. Herein, the wide concentration range and lowest limit of detection (LOD) were found to be 10 ng/mL to 900 ng/mL and 15.88 ng/mL, respectively. The specificity and real-time analysis in artificial urine validated the real-time adoption of a sensor for PAH detection. As well, it demonstrated good intraday/interday precision, stability analysis, and repeatability. In near future, the bundled illuminating PLGA-fGQDs@UiO-66-NH_2 MOFs nanoprobe will be an attractive preference for tracking PAH in clinical specimens.

1. Introduction

Renal diseases have already been considered a major public health concern around the globe. In this shade, the scientific community constantly committed to the advancement of screening methods [1]. In this ray, *para*-amino hippuric acid (PAH, 4-amino derivative of hippuric acid) is utilized in the assessment of renal plasma flow (RPF) as a diagnostic agent [2]. Hence, PAH is a valuable agent for accurately measuring effective renal plasma flow (ERPF) in clinical and laboratory research to evaluate renal functioning [3,4]. Basically, PAH is an amide derivative of glycine and *para*-aminobenzoic acid. It doesn't naturally occur in humans. As a result, it must be injected via intravenous (IV) prior to diagnosis. As an outcome, at low plasma concentrations (1 mg to 2 mg/100 mL), the kidneys can remove 90 % of aminohippurate from the renal circulating blood in a single circulation. As a function, PAH can be exploited to examine renal function as an essential indicator [5]. The renal extraction ratio of PAH in a normal individual is between 0.92 and 1.65 mL/min/kg [6]. Traditionally acknowledged indications of renal dysfunction encompass high uric acid levels and an imbalance in PAH levels [7]. In this regard, numerous analytical techniques, such as HPLC with UV detection [6], colorimetric detection [8], tandem mass spectrometry [9], and electrochemical detection [10], have been proposed

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POLYMER-PLASTICS TECHNOLOGY AND MATERIALS
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Fabrication and characterization of colon specific eudragit coated graphene oxide microsphere for sustained delivery of tramadol hydrochloride

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ABSTRACT

Present investigation reports a straight forward method for synthesis of graphene oxide (GO) followed by fabrication of graphene oxide microsphere (GMS) using water in oil (w/o) emulsification technique. For colon specific drug delivery, enteric coating is desirable, which was done using Eudragit S100 and characterized by Fourier transform Infrared Spectroscopy (FTIR). The surface morphology of fabricated microsphere was confirmed using scanning electron microscopy (SEM). Drug loaded microspheres demonstrated a high payload capacity for model drug tramadol hydrochloride (TmH). The comparative *In-vitro* drug release showed around 72.37% release from uncoated microspheres, whereas eudragit coated microspheres retarded the drug release upto 10 h.

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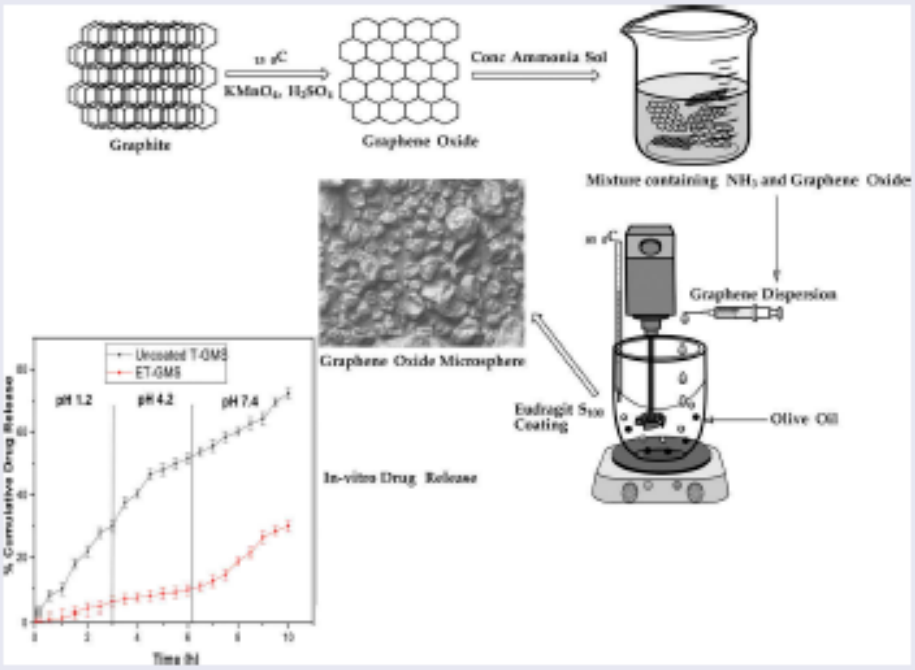
Graphene oxide; microsphere fabrication; colon targeted drug delivery system; irritable bowel disease



1. Introduction

An inflammatory Bowel disease (IBD) intensifies in many traumatic conditions such as ulcerative colitis, Crohn's disease, amebiosis, colonic cancer, etc. Specifically, IBD is most common functional disorder in colon region.[1] Due to many transportation barriers such as acid reach environment in stomach, differential pH condition and larger micro flora in small intestine, therapeutic agent is unable to reach at the colon site.[2] It seems to be very difficult for

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Historical dilemmas of coronavirus disease (COVID-19): Public health emergency, management perspectives and global impacts

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Abstract

A neglected disease originated from Wuhan (China) conquered all worlds with doubt and fear. The current outbreak of viral coronavirus disease (COVID-19) quaked the world with the anxiety of economic and healthcare disturbances. The risk of further spread compelled the World Health Organization (WHO) to declare it as a national emergency and other countries obligated the decision with the provincial lockdown. In the present review, we have discussed the various aspects of pandemic spreads, its historical context and the latest investigations demonstrating the current scenario of COVID-19 in the world. Besides, we have highlighted the various aspects regarding the COVID-19 like preparedness and necessary aspects which will help for risk assessment and crisis management. Rapid sharing of scientific information is an effective way to implement awareness and response. In this perspective, we are providing frontline facets that can be helpful for epidemiologists and research scholars for further assessment and real-time guidance.

Top

Keywords

Coronavirus disease (COVID-19), Transmission chain, Historical context, Risk assessment, Global impacts.

Top

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Research Article

Fabrication of N-Doped Graphene@TiO_2 Nanocomposites for Its Adsorption and Absorbing Performance with Facile Recycling

Pravin Onkar Patil[1], Sopan Namdev Nangare[1], Pratiksha Pramod Patil[1], Ashwini Ghanashyam Patil[2], Dilip Ramsing Patil[2], Rahul Shankar Tade[1], Arun Madhukar Patil[2], Prashant Krishnarao Deshmukh[3], Sanjay Baburao Bari[1]

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DOI: 10.5101/nbe.v13i2.p179-190.

Abstract

The present work aims to synthesize nitrogen-doped reduced graphene oxide-titanium dioxide nanocomposite (N-rGO@TiO_2) using a simple, eco-friendly method and its applications in spectroscopic detection of heavy metal ions such as lead (Pb^{2+}), mercury (Hg^{2+}), and chromium-VI [Cr(VI)] in potable water. Initially, TiO_2 nanoparticles loaded N doped rGO sheets were fabricated by an ecological method using *Gossypium hirsutum* (cotton) seeds extract as a green reducing agent. Then, the N-rGO@TiO_2 nanocomposites were subjected for characterizations such as spectroscopic techniques, particle size analysis, zeta potential analysis, and spectroscopic sensing. Notably, the results of this study confirmed that N-rGO@TiO_2 exhibited countless stupendous features in terms of sensing of an analyte. Briefly, the UV-visible spectroscopy and Fourier transform infrared (FTIR) spectroscopy confirmed the successful synthesis of N-rGO@TiO_2. The SEM images showed the wrinkled, folded, and cross-linked network structures that confirmed the surface modification and nitrogen doping in the rGO sheet and synthesis of N-rGO@TiO_2. The EDAX study confirmed the elemental composition of the N-rGO@TiO_2 nanocomposite. Finally, due to the larger surface area, porous nature, high electron mobility, etc. the N-rGO@TiO_2 probe provides the lower detection limit for Pb^{2+}, Hg^{2+} and Cr (VI) as low as 50 nM, 15 µM, and 25 nM, respectively. Concisely, our study affirms the admirable sensitivity of N-rGO@TiO_2 nanocomposite to the Pb^{2+}, Hg^{2+} and Cr (VI) in potable water can provide better environmental remediation.

Keywords: Graphene oxide, N-rGO@TiO_2, Nanocomposite, Cotton-seed, Heavy metals, Biodegradable, Sensing

Introduction

Over the past two decades, graphene-based materials are gaining tremendous attention from a scientific fraternity in various fields [1-3]. It may because of its astonishing properties and potential to revolutionize the scientific sector [3-5]. Graphene can be used to fabricate several dimension materials such as 1D nanostructure [6], 2D layer stacked films [7], 3D graphene hydrogel [7-9], and aerogel [10-13], etc. Out

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ORIGINAL ARTICLE

Eco-friendly synthesis of surface grafted Carbon nanotubes from sugarcane cubes for the development of prolonged release drug delivery platform

Rahul Narkhede[1], Mahesh More[2], Swapnil Patil[1], Pravin Patil[3], Ashwini Patil[4], Prashant Deshmukh[5*]

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Abstract

Surface grafting of nanocarriers could modulate their properties and characteristics. As carbon nanotubes synthesis is a very tricky process and requires high-end methods, hence the present investigation was aimed to develop an eco-friendly method for synthesis carbon nanotubes (CNTs) and subsequent surface grafting for enhanced drug delivery application. The present study elaborates two-step chemical modifications; wherein the first step is catalytic cleavage of natural precursor in the presence of ferrocene and the second step involve chemical grafting of Acyclovir (ACV) as a model drug to understand the drug release behaviour. The catalytic cleavage of sugarcane cubes (natural precursor) was carried out in a closed copper tube, which prevents oxidation and results in a conversion of tubular nanostructures to amorphous carbon. The covalent attachment of ACV on purified CNTs (fCNTs) was done using carbodiimide chemistry. The preliminary Uv-Vis absorbance spectra defined at 260 nm was arised due to π-π* stacking of aromatic C-C bonds. The Fourier Transforms Infrared Spectroscopy (FTIR) indicates the hydroxyl stretch at 3300 cm-1 while amide I bond formation was observed at 1672 cm^{-1}. The XRD spectra confirmed successful synthesis of CNTs. The calculated average crystallite size (Scherer equation) of synthesized CNTs was found to be 42.84 and 44.45 nm; it was also in accordance with the morphological observation as confirmed simultaneously using SEM analysis. The covalently attached ACV was released up to 80% during 8h of *in vitro* drug release study. The surface grafting potential of CNTs was found to be promising compared to other nanomaterials.

Keywords: *Acyclovir; Amorphous Carbon; Carbodiimide Chemistry; Natural Precursor; Purification.*

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INTRODUCTION

Even though the investigation on allotropic forms of carbon was begun before 1990, but the most intuitive form of carbon allotrope i.e. carbon nanotubes (CNTs) were reported in 1991[1]. Numerous classical approaches for the synthesis of CNTs are reported by academic researchers and industry experts for their promising physicochemical properties. In case of CNTs, the

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Review Article

Surface architectured metal organic frameworks-based biosensor for ultrasensitive detection of uric acid: Recent advancement and future perspectives

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ABSTRACT

Gout is the world's most popular inflammatory arthritis and the prevalence of gout is rapidly rising worldwide. Typically, gout develops in a single joint as excessive swelling and intense pain wherein excessive deposition of uric acid (UA) crystals results in inflammation of the joint. Accordingly, UA is considered an effective biomarker to diagnose gout. Recently, the use of innovative sensors has attracted great attention, as it is effortless, responsive, quick, and powerful. While the traditional sensors for UA assessment are widely used, they pose many limitations and hurdles in terms of sensitivity, selectivity, and simplicity. In this vein, metal ions and organic ligand-based metal–organic framework (MOF) have gained much attention for the recognition of UA due to its larger surface area, porosity, high sensitivity, and defined selectivity. In this review, we provide details on the latest developments of MOF-centered biosensors for sensitive detection of UA. The status of gout, fundamentals of MOF, and MOF availed for detection of UA have been elaborated. Besides, we highlighted the nanoparticles and conjugates that rely on advanced strategies along with MOF that boost the sensitivity and selectivity towards the UA. Interestingly, different surface architectured MOFs biosensors showed a lower detection limit for UA from μM to nM. Finally, the threats and potential opportunities for MOF-based UA biosensors have been summarized. Therefore, based on ongoing research, the commercialization of this advanced platform for the biosensing of diverse biomarkers will open a new door for the *in vitro* diagnosis of assorted diseases.

1. Introduction

From its inception, arthritis is a severe health issue of a joint in almost all developed and developing nations. Arthritis is a term that derives from the Greek word "disease of the joint." Commonly, it can be stated as acute inflammation or chronic inflammation of the joint that is sometimes with the effect of pain and sometimes co-exists with structural damage [1]. As many as 100 classes of arthritis have been characterized according to the research. Generally, it can be classified into two type's namely non-inflammatory arthritis and inflammatory arthritis. In the first category, non-inflammatory arthritis is commonly known as osteoarthritis, while inflammatory arthritis is categorized

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Green synthesis of Fe-doped Ag-loaded reduced graphene oxide ternary nanocomposite for efficient photocatalytic degradation of toxic dyes

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Abstract

The green synthesis of iron nanoparticles (FeNPs) doped and silver nanoparticles (AgNPs) loaded reduced graphene oxide (rGO) (Fe-Ag@rGO) nanocomposite and its applications in methylene blue (MB), malachite green (MG), rhodamine B (RB) degradation were reported. Initially, AgNPs loaded rGO (Ag@rGO) nanocomposites were synthesised simultaneously by an ecological method using *Tamarindus indica* shell extract as a green reducing agent. Then, the doping of FeNPs into rGO@Ag nanocomposites afforded Fe-Ag@rGO nanocomposite. Interestingly, the finding of this study confirmed that the Fe-Ag@rGO nanocomposites exhibited countless stupendous features in terms of dye degradation. Briefly, the UV-visible spectroscopy and Fourier-transform infrared spectroscopy (FTIR) study confirmed the synthesis of Fe-Ag@rGO nanocomposite. The scanning electron microscopy (SEM) images showed the spherical shape with cross-linked network structures that confirmed the surface modification and synthesis of Fe-Ag@rGO nanocomposite. Finally, the dye degradation potential of the photocatalyst was found to be 97.20%, 98.43%, and 97.33%, for MB, MG, RB, respectively. Herein, the improved photocatalytic performance of the Fe-Ag@rGO was found due to the larger surface area, porous nature, high electron mobility, and synergistic effect of the Fe-Ag@rGO nanocomposite. Additionally, the effective interfacial hybridisation of 'Ag', and doping of 'Fe' on the rGO sheet extended the duration of the photogenerated electron (e^-) hole pairs that can also be contributing to dye degradation. Conclusively, the present experiment provides the new Fe-Ag@rGO nanocomposite to the dye degradation, which could be improved environmental remediation.

Keywords: dye degradation, nanocomposite, Fe-Ag@rGO, Tamarindus indica shells, graphene oxide, Green synthesisClassification numbers, 2.00, 5.00, 5.11

1. Introduction

Today is the era of accelerated industrialisation, which has seen rapid developments and has played an essential role in

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Green synthesis of graphene based manocomposite for sensing of heavy metals

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Abstract
A simple and green ecofriendly approach was revealed for the synthesis of silver-reduced graphene oxide nanocomposites (Ag@rGONCs) using jambul seed extract. The synthesized composites were characterized by UV–visible spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Particle size and zeta potential analysis. The surface morphology and elemental analysis of synthesized Ag@rGONCs was done using scanning electron microscopy (SEM/EDX). The modified graphene can efficiently adsorb heavy metal ions and selectivity was precise due to presence of embedded silver ions on surface. The *in situ* decoration of silver ions on graphene oxide (GO) was accomplished in single step via one pot methodology using green precursor. The catalytic action of jamun seeds helps to reduce the GO to rGO and simultaneous decoration of silver nanoparticles. It also provided capping ability to avoid aggregation. The resultant nanocomposites (NCs) shown good selectivity towards the determination of Pb^{2+}, Hg^{2+}And Cr (VI) ions with the recognition limits of 50 nM, 15 nM and 500 nM, respectively

Keywords: Graphene oxide, Green catalysis, Hevay metal sensing, Jambhul seeds.

Introduction
In the recent years the industrial pollution owing to heavy metals and dyes is a serious threat to us and is increasing day by day. This increase in environmental hazards is crucial for human, animals, fish and invertebrates.[1] The effluents from industries such as industries such as paper, pesticides, battery built-up manufacturing, fertilizer, mining, metallurgical, fossil fuel, tannery etc. were wastewater contains potential heavy metals.[2] Plastic manufacturing industries was another big hurdle in increasing the pollution day by day, which is non-biodegradable in nature. Industrial effluents come in contact with soil or water can possibly being contaminated with heavy metals, which further come in contact with animals or plants, it gets accumulated into tissue or organs.[3] A specific catalyst is required for catalyzing the free heavy metal in wastewater. The heavy metal pollutants majorly contain Pb^{2+}, Ni, Hg^{2+}, Cr and Cd. These types of heavy metals accumulate in the human body and cause serious health effects. The accumulation of heavy metals found in kidney, liver, lungs, etc. might be responsible for initiation of cancer.[4] Acute and chronic arsenic toxicity involves adverse impacts on the nervous, cardiovascular, respiratory, gastrointestinal, hepatic, renal, hematopoietic, immunological, and dermatologic systems.[5] Cadmium, lead and manganese have found a variety of uses in industry and farming owing to their physical and chemical properties. Poisoning induced by high concentration of these metals adversely influence on kidney, hematopoietic cells, nervous system, and bones.[6]

A green chemistry or synthesis methodology was emerging in 21 century due to vast demand and lesser hazardous nature of reactions. Biosynthesis of many metal nanoparticles was accomplished using many natural precursors. The green synthesis approaches can effectively substitute physical or chemical methods of synthesis.[7] Green methods were easy to enhance and can have a extensive variety of applications along with the colloidal stability of nanomaterials. Green agents from natural base comprise different kinds of

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Graphene-based nanocomposites for sensitivity enhancement of surface plasmon resonance sensor for biological and chemical sensing: A review

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ABSTRACT

Surface plasmon resonance (SPR) offers exceptional advantages such as label-free, *in-situ* and real-time measurement ability that facilitates the study of molecular or chemical binding events. Besides, SPR lacks in the detection of various binding events, particularly involving low molecular weight molecules. This drawback ultimately resulted in the development of several sensitivity enhancement methodologies and their application in the various area. Among graphene materials, graphene-based nanocomposites stands out owing to its significant properties such as strong adsorption of molecules, signal amplification by optical, high carrier mobility, electronic bridging, ease of fabrication and therefore, have established as an important sensitivity enhancement substrate for SPR. Also, graphene-based nanocomposites could amplify the signal generated by plasmon material and increase the sensitivity of molecular detection up to femto to atto molar level. This review focuses on the current important developments made in the potential research avenue of SPR and fiber optics based SPR for chemical and biological sensing. Latest trends and challenges in engineering and applications of graphene-based nanocomposites enhanced sensors for detecting minute and low concentration biological and chemical analytes are reviewed comprehensively. This review may aid in futuristic designing approaches and application of graphenenous sensor platforms for sensitive plasmonic nano-sensors.

1. Introduction

From its inception, surface plasmon resonance (SPR) technique plays a prevailing role in the field of optical sensors. The SPR has evolved from a moderately impenetrable physical phenomenon to an optical tool that is widely used in chemical and biological investigations (Slavík et al., 1999; Yamamoto, 2008; Zeng et al., 2014) to study the binding events between two molecules of interest. Since its first intervention in 1990 by a Biacore group (GE Healthcare), the technology has established exponential growth in the last years, which is evident from the increase in the number of publications as well as the number of the methodology developed, till 2019, total of 24,148 papers are published as per PubMed search database (Fig. 1).

SPR technique is advantageous in terms of an *in-situ*, label-free methodwitheconomical and ease of fabrications as compared with the electrochemical and other methods (Merwe, 2001). The SPR phenomenon occurs in between the metal surface of sensorgram with specific molecule recognition element and a medium either vacuum/air or liquid.Whenever there is recognition of the particular molecule specific to the site/scaffold/receptor of this element, it results in the change of the surface of the metal, causing an angle shift as shown in Fig. 2(i). The shift resulted due to the changes in the refractive index (RI) at the surface of the metal. A usual SPR sensor either works in the angular interrogation mode or the wavelength interrogation mode. At the resonance wavelength or angle, the dispersion relation of the incident light matches with that of the surface plasmon, at which the reflectance shows a dip as seen in Fig. 2 (ii). The reflectance dip is attributed to the transfer of energy possessed by the photons incident to the surface plasmon and is more sensitive to the changes in the dielectric medium adjacent to the sensor surface (Ekgasit et al., 2004; Vasić et al., 2013).

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Research Article

Preparation and Characterization of Solid Dispersion by Microwave and Freeze Drying Method for Solubility and Dissolution Rate Enhancement of Poorly Soluble Drug Ziprasidone

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ABSTRACT

Abstract
The aim of the present study was to enhance the solubility, dissolution rate and thus oral bioavailability of a poorly soluble, BCS class II drug Ziprasidone hydrochloride (ZPH), using its solid dispersions (SDs) with poloxamer 188 (PX) and HPMC E15.Solid dispersions were prepared by co-grinding, kneading, freeze drying and microwave methods. The dispersions were evaluated for various *in vitro* parameters such as solubility study, dissolution study, fourier transform infrared spectroscopy (FT-IR), differential scanning calorimetry (DSC), X-ray powder diffraction (XRD), scanning electron microscopy (SEM). Microwave generated solid dispersions in 1: 5 ZPH - PX ratio exhibited significant improvement in solubility and dissolution rate compared to that of pure drug. The superior dissolution profile observed for microwave induced solid dispersions is attributed to amorphization of the drug by microwaves, improved surfactant and wetting characteristics of the carrier with the drug. Thus, microwave technology offers a simple, efficient, solvent free promising alternative method to prepare solid dispersion of ZPH with significant enhancement of the *in vitro* dissolution rate.

INTRODUCTION

The oral route of drug administration is the most common and preferred route of drug delivery due to convenience and ease of ingestion. The formulation of poorly water-soluble drugs has always been a challenging problem faced by pharmaceutical scientists and it is expected to increase because approximately 40% or more of the new chemical entities being generated through drug discovery programs are poorly water soluble [1]. Limited drug absorption resulting in poor bioavailability is paramount amongst the potential problems that can be encountered when delivering an active agent via the oral route. Hence, two areas of pharmaceutical research that focus on improving the oral bioavailability of active agents include enhancing solubility and dissolution rate of poorly water-soluble drugs and enhancing the permeability of poorly permeable drugs [2]. In recent years it has been estimated that up to 40% of the new drugs discovered by the pharmaceutical industry are poorly water soluble or lipophilic compounds [3].

Following are the class permeability of drugs according to solubility according to Biopharmaceutical Classification System such as High solubility High permeability, Low solubility High permeability, High solubility Low permeability and Low solubility Low permeability [4].

The Solid Dispersion is one of the best and convenient method which is used for the increased solubility of poorly water soluble drug. The Solid Dispersion is used to be reduced particle size, improve wettability, improve porosity of drug, decrease the crystalline structure of drug in to amorphous form, improve dissolvability in water of a poorly water-soluble drug, mask the taste of the drug substance,

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