Date: 02.10.2020

To
The Teacher-in-Charge,
Parimal Mitra Smriti Mahavidyalaya,
Post-Mal, Dist-Jalpaiguri

Subject: Request to perform collaborative research work with University of North Bengal

Respected Ma'am,

I would like to inform you that I wish to continue my research work in collaboration with Dr. Mahendra Nath Roy, Professor Department of Chemistry, University of North Bengal. This work will not affect my allotted duties for this College.
I will be highly obliged if you kindly allow me to continue my research work.

Dr. Biraj Kumar Barman,
Assistant Professor, Department of Chemistry,
Parimal Mitra Smriti Mahavidyalaya

PARIMAL MITRA SMRITI MAHAVIDYALAYA
POST-MAL, DIST-JALPAIGURI

Date: 05.10.2020

This is to certify that Dr. Biraj Kumar Barman, Assistant Professor, Department of Chemistry is a bonafide teacher of this College and is serving this College from 25.08.2020. The undersigned has No Objection if Dr. Biraj Kumar Barman continues his research work in collaboration with Dr. Mahendra Nath Roy, Professor, Department of Chemistry, University of North Bengal after doing his normal duties of this College.

05/10/2020

Teacher-in-Charge
Parimal Mitra Smriti Mahavidyalaya
Post-Mal, Dist-Jalpaiguri

Teacher-in-charge
PARIMAL MITRA SMRITI MAHAVIDYALAYA
MAL, JALPAIGURI

UNIVERSITY OF NORTH BENGAL

PROF (DR.) M. N. ROY

FRSC (London)

Senior Professor of Chemistry, Dean of Science and Arts, NBU

Founder Vice-Chancellor of Alipurduar University

Awardee of One Time Grant from UGC, Prof. Suresh C. Ameta Award from ICS, Bronze Medal from CRSI, Shiksha Ratna, Dooars Ratna and Banga Bhushan from the Govt. of West Bengal and C V Raman Prize from MSME, Government of India

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May 02, 2022

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CERTIFICATE OF RESEARCH COLLABORATION

To Whom It May Concern

It gives me immense pleasure to certify that **Dr. Biraj Kumar Barman**, Assistant Professor of the Department of Chemistry of Parimal Mitra Smriti Mahavidyalaya, Malbazar, Jalpaiguri, West Bengal, has been continuing his research work in collaboration with me [Prof. (Dr.) Mahendra Nath Roy], Professor, Department of Chemistry, University of North Bengal, Raja Rammohanpur, Darjeeling, West Bengal, since 2020 and published research articles in various International and National journals of repute.

I wish him every success in life.

Mahendra Nath Roy
(02-05-2022)

Prof. Mahendra Nath Roy

Prof. (Dr.) M. N. Roy
FRSC (London), UK
Department of Chemistry
University of North Bengal
Darjeeling-734013, India

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Research paper

Synthesis and characterization of an industrially significant ionic liquid and its inclusion complex with β-cyclodextrin and its soluble derivative for their advanced applications

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Keywords:
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Hydroxypropyl-β-cyclodextrin or **HP-β-CyD**
Inclusion complex
Job plot
Scanning electron microscopy or **SEM**
Ionic liquid based surfactants or **ILBS**

ABSTRACT

Thermochromic also solvatochromic ionic liquid surfactant was synthesized and characterised. The surface activity, size and stability were estimated by surface tension, SEM and DLS techniques. Inclusion complexes construction of the synthesized compound with the β-cyclodextrin and derivative was explored by various techniques. Conductance, surface tension trial & Jobs obtained from the UV–vis spectra proved the formation of 1:1 inclusion complexes between the surfactant and cyclodextrins. Binding constants and thermodynamic parameters of the inclusion of the guest DMPI with both hosts were determined with UV–vis and sophisticated fluorimetric analysis. Anti bacterial properties of DMPI and its both inclusion complexes were analyzed.

1. Introductions

Ionic liquids (ILs) are basically organic nano structured molten salts having cationic organic part and anionic inorganic or organic counterpart [1] ILs have large diversity of unique physical and chemical characters such as non-flammability, minor vapour pressure, ability of dissolving large variety of compounds, high electrical conductivity, widely recognized liquid range etc. [2–6].

The all-round and useful properties of ILs have been documented in the current millennium; this led to a speedy escalation in the number of basic research on ILs. Eventually, it was recognized that these properties should also be applied to compounds that carry lengthy hydrocarbon chains, i.e., compounds with surface activity [7,8].

β-cyclodextrin (β-CyD) is made up of glucopyranosyl units attached to α-1,4-glycosidic linkages. β-CyD has broad uses in biomedical, pharmaceutical and other field of sciences e.g. for its good bioavailability, safety, stability, as a solubility enhancer and efficient carrier of the suitable guest molecule [9,10].

Though β-cyclodextrin has originality in its application but suffers from some demerits like low solubility and behave like nephrotoxins. It is crucial to use as small amount of CyDs as likely in pharmaceutical and new formulations. In this respect, aqueous solubility of α-CyD and γ-CyD is more useful than β-CyD [11,12]. Solubility of β-CyD can be considerably increased by derivatization. Hydroxypropyl-β-Cyclodextrin (HP-β-CyD) is one of the main persistent pharmaceutical formulations. HP-β-CyD like other cyclodextrins can enhance the solubility of sparingly and poor soluble drug or other molecular guest by the formation of inclusion complexes more efficiently. HP-β-CyD is with negligible amount of toxicity and may be useful in the improvement of parenteral administration of less soluble drugs [13,14].

HP-β-CyD is an alternate of α, β and γ-cyclodextrin, with better water solubility and may also be toxicologically benign. It is promptly and

Abbreviations: CyD, Cyclodextrin; CyDs, Cyclodextrins; DMPI, 1-Dodecyl-4-methylpyridinium iodide; IC, Inclusion complex; ICs, Inclusion complexes; ID, 1-Iodododecane; MPy, 4-methylpyridine; DLS, Dynamic light scattering; DSC, Differential scanning calorimetry; EDS, Energy Dispersive X-Ray Spectroscopy; FTIR, Fourier-transform infrared spectroscopy; HP-β-CyD, Hydroxypropyl-β-cyclodextrin; ILs, Ionic liquids; ILBS, Ionic liquid based surfactants; SEM, Scanning electron microscopy.

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Section A: Chemical Sciences

CODEN (USA): JCBPAT Research Article

Probing Inclusion Complex of a Dye (ISD) with Cyclic Oligosaccharide for Minimizing Harmful Effects

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Abstract: Indigo is a colouring agent used widely in various fields. The synthetic indigo has many adverse effects when it is consumed with foods and beverages. Cyclodextrin (CD) is known to have special chemical characteristics and biological activities and has a suitable cavity that can include molecule of suitable diameter. In our present study, we have outlined different modes of characterization of the inclusion complex (IC) formation between poorly water soluble dye Indigosulfonic Acid Dipotassium Salt (ISD) and β-Cyclodextrin with the help of FTIR Spectroscopy, UV-Visible spectroscopy, fluorescence spectroscopy, ^{1}H NMR study, 2D NOESY, Isothermal Titration Calorimetric study and SEM analysis. ^{1}H-NMR study and other spectroscopic analysis clearly revealed the successful formation of the (IC) which is supported by cross-peaks formed in 2D-NOESY spectrum. Comparable association constants and thermodynamic parameters obtained from both UV-Visible study and ITC study confirmed the higher stability of the IC. The solubility of the IC was found higher than the pure ISD.

Keywords: Association constant, β-Cyclodextrin, Fluorescence study, Inclusion complex, Job plot.

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Article

Synthesis and Characterization of an Inclusion Complex of DL-Aminoglutethimide with β-Cyclodextrin and Its Innovative Application in a Biological System: Computational and Experimental Investigations

Samapika Ray, Niloy Roy, Biraj Kumar Barman, Paramita Karmakar, Pranish Bomzan, Biplab Rajbanshi, Vikas Kumar Dakua, Ankita Dutta, Anoop Kumar, and Mahendra Nath Roy*

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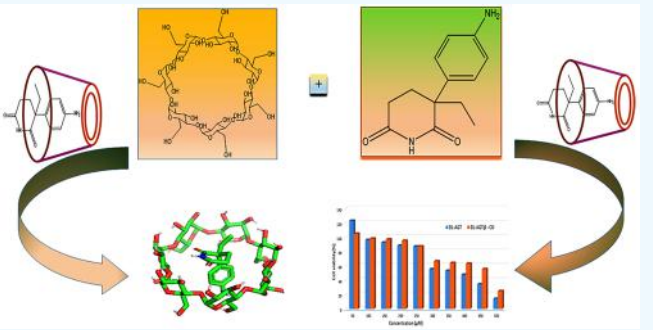
ABSTRACT: Our present study intended to investigate the encapsulation of DL-AGT within the lipophilic cavity of a β-CD molecule. The consequential inclusion system was characterized by UV−visible spectroscopy and ^{1}H NMR, PXRD, SEM, and FT-IR studies. Molecular docking was performed for the inclusion complex to discover the most proper orientation, and it was seen that the drug DL-AGT fits into the cavity of β-CD in a 1:1 ratio, which was also confirmed from the Job plot. Furthermore, a comparison was done on the basis of cell viability between the drug and its inclusion complex.



1. INTRODUCTION

The drug DL-aminoglutethimide, (±)-3-(4-aminophenyl)-3-ethylpiperidine-2,6-dione (DL-AGT) (Scheme 1), used as an aromatase inhibitor for the treatment of advanced breast cancer and Cushing's syndrome was chosen as a suitable guest molecule for this study. According to the Biopharmaceutics Classication System, it is a class 11 drug with low water solubility but good permeability.[1] DL-Aminoglutethimide can cause aromatase inhibition. It was initially introduced as an anticonvulsant but due to its side effects of acting as a potent inhibitor of several enzymes on the adrenal cortex, it was no longer used. These drawbacks of this drug changed into a clinical advantage in the treatment of Cushing's syndrome and advanced breast cancer. The growth of certain tumors depends on specific hormones, and that makes the basis of endrocrine therapy of breast cancer. DL-AGT is found to be effective in hormone-dependent breast carcinoma by suppressing the estrogen level in post-menopausal women. It inhibits the conversion of androgen to estrogen.[2] Moreover this drug is very effective in painful bone metastasis. However, aminoglutethimide has its side effects because of its toxicity,[3] such as lethargy, depression, and rash, in addition to its benefits.[4]

Currently, molecular encapsulation is an important strategy to increase the bioavailability of certain drugs to retain their therapeutic activity. Potent drug delivery systems including biocompatible polymersand nanoparticles have already been explored. Cyclodextrin-based drug delivery systems are found to be the most prominent and reliable due to their nontoxicity and biodegradability.[5,6] Cyclodextrins or cycloamyloses are polymers with a truncated-cone-shaped cavity having a minimum number of six D(+)-glucopyranose units linked through α-1,4-bonds (Scheme 1).[7] They can be natural or semisynthetic (oligosaccharides).[8] The α-, β-, and γ-cyclodextrins and their derivatives have been extensively used in pharmaceutical science. For parental drug delivery, with oral administration, cyclodextrins have been extensively used. The applications of CDs are even more numerous than those above, as they are able to make inclusion complexes with some specific molecules which will fit in the cavity. Thus, the size of the entering guest molecule is also an important parameter here.[9] The interactions between the host and the guest molecules are mainly noncovalent: e.g., ion−dipole, hydrogen-bonding and van der Waals types. The most widely accepted host for complex formation is β-CD due to its suitable cavity diameter and low production cost.[10,11] β-Cyclodextrin consists of seven α-D-glucopyranose units joined by α-1,4-linkages.[12] Cyclodextrins are able to modify the pharmacological properties of the encapsulated active substances such as solubility,

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