



Appendices

List of Publications

[A-1]

1. **Khima Pandey**, Krishnan Rangan, and Anil Kumar, One-Pot Tandem Amidation, Knoevenagel Condensation, and Palladium-Catalyzed Wacker Type Oxidation/C–O Coupling Synthesis of Chromeno-Annulated Imidazopyridines, *J. Org. Chem.* **2018**, 83, 8026.
2. **Khima Pandey**, Saroj, Sunita Choudhary, and Anil Kumar, “A Facile and Convenient Synthesis of Chromenes using Reusable Sulfonic Acid Functionalized Imidazolium Salt, *ChemistrySelect* **2017**, 2, 4452.
3. **Khima Pandey**, Pinku kaswan, Saroj, and Anil Kumar, Synthesis of 2-Carbonylimidazo[1,2-*a*]pyridines via Iodine-mediated Intramolecular Cyclization of 2-Amino-N-propargylpyridinium Bromides, *ChemistrySelect* **2016**, 1, 6669.
4. **Khima Pandey**, Manoj Kumar Muthyala, Sunita Choudhary, and Anil Kumar, Imidazolium Salt-supported Mukaiyama Reagent: an Efficient Condensation Reagent for Amide Bond Formation, *RSC Adv.* **2015**, 5, 13797.
5. Sunita Choudhary, **Khima Pandey**, Saroj, and Anil Kumar, Functionalized Ionic Liquid-assisted Chromatography-free Synthesis of Bis(indolyl)methanes, *Molecular Diversity* **2017**, 21, 155.
6. Kasiviswanadharaju Pericherla, Pinku Kaswan, **Khima Pandey**, and Anil Kumar, Recent Developments in the Synthesis of Imidazo[1,2-*a*]pyridines, *Synthesis* **2015**, 47, 887. (**Review Article**)
7. Sunita Choudhary, Saroj, **Khima Pandey**, and Anil Kumar, Ionic Liquid-supported Benzyl Azide: An Efficient Soluble Scavenger for Alkyne, *RSC Adv.* **2015**, 5, 67049.
8. Sunita Choudhary, Manoj Kumar Muthyala, **Khima Pandey**, G M Shelke, M Jha, and Anil Kumar, Synthesis of Ionic Liquid-supported Diaryliodonium Salts, *Eur. J. Org. Chem.* **2014**, 2365.

J. Org. Chem. 2018, 83, 8026-8035

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Article


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One-Pot Tandem Amidation, Knoevenagel Condensation, and Palladium-Catalyzed Wacker Type Oxidation/C–O Coupling: Synthesis of Chromeno-Annulated Imidazopyridines

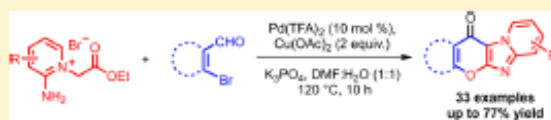
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 Supporting Information

ABSTRACT: A direct one-pot synthesis of chromeno-annulated imidazo[1,2-*a*]pyridines is achieved by the reaction of 2-amino-1-(2-ethoxy-2-oxoethyl)pyridinium salts with 2-bromoarylaldehydes using Pd(TFA)₂ as a catalyst and Cu(OAc)₂ as an oxidant. The overall strategy involves tandem base-mediated amidation and Knoevenagel condensation, followed by palladium-catalyzed Wacker type oxidation and intramolecular C–O coupling reaction. The method is simple, tolerates different functional groups, and gives moderate to good yields of chromeno[2',3':4,5]imidazo[1,2-*a*]pyridin-12-one derivatives. The developed tandem reaction was also successfully applied for the synthesis of pyrano-fused imidazo[1,2-*a*]pyridines by using 3-bromo-3-arylacrylaldehydes.



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■ Sustainable Chemistry

A Facile and Convenient Synthesis of Chromenes using Reusable Sulfonic Acid Functionalized Imidazolium Salt

Khima Pandey, Saroj, Sunita Choudhary, and Anil Kumar^{*,[a]}

An efficient synthesis of chromene derivatives was realized by the condensation of phenols and acetophenones using a reusable sulfonic acid-functionalized imidazolium salt as catalyst. The catalytic system has wide substrate scope and provided good to excellent yield of chromenes. Interestingly, the system was easily recycled and was also suitable for a gram

scale synthesis of chromene. The mild reaction conditions, absence of metal catalyst and recyclability of catalyst used makes this protocol more attractive for the synthesis of potentially bioactive compounds. The method avoids the disposal and neutralization of acidic catalyst.

■ Organic & Supramolecular Chemistry

Synthesis of 2-Carbonylimidazo[1,2-*a*]pyridines *via* Iodine-mediated Intramolecular Cyclization of 2-Amino-*N*-propargylpyridinium Bromides

Khima Pandey, Pinku Kaswan, Saroj, and Anil Kumar^{*[a]}

A facile and novel, metal free method has been described for the synthesis of 2-carbonylimidazo[1,2-*a*]pyridines by iodine mediated intramolecular cyclization of 2-amino-*N*-propargylpyridinium bromides in the presence of a base. Various

substituted imidazo[1,2-*a*]pyridine derivatives were obtained in good to excellent yields (45-89%) and good functional group tolerance was observed.



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Imidazolium salt-supported Mukaiyama reagent: an efficient condensation reagent for amide bond formation†

Khima Pandey, Manoj Kumar Muthyala, Sunita Choudhary and Anil Kumar*

A novel imidazolium salt-supported Mukaiyama reagent (2-chloropyridinium salt) has been developed and explored as an efficient coupling agent for amide bond formation. The use of an ionic liquid-supported reagent enabled isolation of the amide products by simple extraction with organic solvents in high purity and avoiding column chromatography purification.



Functionalized ionic liquid-assisted chromatography-free synthesis of bis(indolyl)methanes

Sunita Choudhary¹ · Khima Pandey¹ · Saroj Budania¹ · Anil Kumar¹

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Abstract A chromatography-free synthesis of bis(indolyl)methanes has been developed using sulfonic acid and sulfonyl hydrazine-functionalized ionic liquids as catalyst and scavenger, respectively. The employed excess aldehyde for

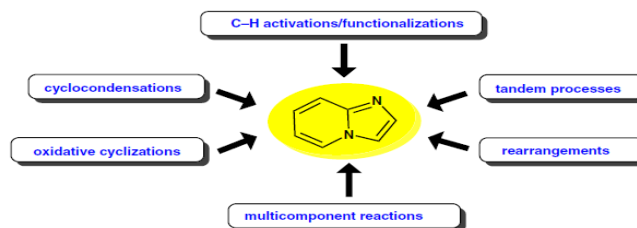
Introduction

Indole and their derivatives are important heterocyclic compounds possessing a wide range of biological activities such

Recent Developments in the Synthesis of Imidazo[1,2-*a*]pyridines

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Abstract Advances in the last decade for the synthesis of the imidazo[1,2-*a*]pyridine scaffold from various substrates employing approaches such as multicomponent reactions, tandem processes, rearrangement reactions, inter- and intramolecular oxidative/reductive cyclizations, and transition-metal-catalyzed C–H activation are summarized in this review. The mechanisms for the selected transformations are also discussed.

1 Introduction

Among nitrogen-fused azoles, imidazo[1,2-*a*]pyridines have a lead role in the literature because of their wide variety of applications in various disciplines like medicinal chemistry, organometallics, and material science.¹ Although imidazo[1,2-*a*]pyridines are structurally different from benzodiazepines, their pharmacological properties are quite similar to that of benzodiazepine drugs, hence they are termed as nonbenzodiazepines. Molecules with



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Ionic liquid-supported benzyl azide: an efficient soluble scavenger for alkynes†

Sunita Choudhary, Saroj, Khima Pandey and Anil Kumar*

An ionic liquid functionalized with benzyl azide was synthesized and its synthetic utility was evaluated by scavenging excess alkynes in the synthesis of 2,4-disubstituted quinoline *via* the Povarov reaction. The ionic liquid-supported benzyl azide gave excellent efficiency in alkyne scavenging (85–100%). Purification of the products without column chromatography, ease of monitoring, high loading of the scavenger and shorter scavenging time are some of the advantages of this approach over solid-supported scavengers.

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Synthesis of Ionic-Liquid-Supported Diaryliodonium Salts

Manoj Kumar Muthyala,^{[a],‡} Sunita Choudhary,^{[a],‡} Khima Pandey,^[a] Ganesh M. Shelke,^[a],b]
Mukund Jha,^[b] and Anil Kumar*^[a]

Keywords: Ionic liquids / Hypervalent compounds / Iodine / Supported reagents / Arylation

The synthesis of ionic-liquid-supported diaryliodonium salts is described. The synthesis is simple and practical, and the ionic liquid products require no chromatographic purification. The ionic-liquid-supported diaryliodonium salts are quite stable, and they did not show any sign of decomposition or loss of reactivity, even after being stored for one

month at 5 °C. The reactivity of these salts was explored in the phenylation of substituted phenols and carboxylic acids, and the corresponding diaryl ethers and aryl esters, respectively, were synthesized in good to excellent yields and with high purities.

List of Oral/Poster Presented in Conferences

[A-3]

❖ ORAL PRESENTATIONS

1. **Khima Pandey**, Anil Kumar, Environmental friendly synthesis of bis(indolyl)methane using sulfonic Acid and sulfonyl hydrazine functionalized ionic liquids, International Conference on Frontiers at the Chemistry-Allied Science Interface (FCASI-2016), Department of Chemistry, University of Rajasthan, Jaipur, India, April 25-26, 2016.
2. **Khima Pandey**, Anil Kumar, Synthesis of functionalized/fused imidazo[1,2-*a*]pyridines using 2-aminopyridinium salts, Chemistry Conference for Young Scientists (ChemCYS 2018), Jong-KVCV, the youth division of the Royal Flemish Chemical Society, Blankenberge, Belgium, February 21-23, 2018.
3. **Khima Pandey**, Anil Kumar, Palladium-catalyzed One-pot Tandem Approach Involving Wacker Type Oxidation/C–O Coupling: Synthesis of Chromeno-Annulated Imidazopyridines, International Conference on Frontiers at the Chemistry-Allied Science Interface (FCASI-2018), Department of Chemistry, University of Rajasthan, Jaipur, India, December 21-22, 2018.

❖ POSTER PRESENTATIONS

1. **Khima Pandey**, Manoj Kumar Muthayala, Sunita Chaudhary and Anil Kumar, Synthesis of novel ionic liquid-supported Mukaiyama reagent and its application as coupling agent in amide bond formation” 20th Indian Society of Chemist and Biologist International conference (ISCB-2014), Department of Chemistry, University of Delhi, Delhi India, March 1-4, 2014.
2. **Khima Pandey**, Manoj Kumar Muthayala, Sunita Chaudhary and Anil Kumar, Novel ionic liquid-supported Mukaiyama reagent: efficient coupling agent for amide bond formation” National Conference on Advanced Scientific Developments in Chemical Sciences (ASDCS-2014), Department of Chemistry, Deenbandhu Chhotu Ram University of Science and Technology, Murthal, India, March 14, 2014.
3. **Khima Pandey**, Sunita Chaudhary and Anil Kumar, Imidazolium-supported sulfonyl hydrazine- a highly efficient scavenger for aldehydes and ketones, 21st Indian Society of Chemist and Biologist International conference (ISCB-2015), Central Drug Research Institute (CDRI), India, February 25–28, 2015.

4. **Khima Pandey** and Anil Kumar, Sulfonic acid-functionalized imidazolium triflate-catalyzed construction of furan and 4*H*-chromene derivatives, International Conference on Nascent Developments in Chemical Sciences-opportunities for Academia-Industry Collaboration (NDCS-2015), Department of Chemistry, BITS Pilani Campus, India, October 16-18, 2015.
5. **Khima Pandey** and Anil Kumar, Sulfonic acid-functionalized imidazolium triflate-catalyzed construction of 4*H*-chromene and benzo[*b*]furan derivatives, National Conference on New Frontiers in Chemistry-From Fundamentals to Applications (NFCFA-2015), Department of Chemistry, BITS Pilani KK Birla Goa Campus, India, December 18-19, 2015.
6. **Khima Pandey**, Ganesh M. Shelke, Saroj and Anil Kumar, Imidazolium-supported sulfonic acid-mediated microwave-assisted facile synthesis of thiopyrano[2,3-*b*]indol-2-one, National Conference on Organic Chemistry in Sustainable Development: Recent Advances and Future Challenges (OCSD-2016), Department of Chemistry, BITS Pilani Campus, India, August 29-30, 2016.
7. **Khima Pandey**, Pinku Kaswan, Saroj and Anil Kumar, Iodine and base-mediated intramolecular cyclization reactions of *N*-propargyl pyridinium bromide: an easy access to 2-carbonylimidazo[1,2-*a*]pyridines and 2-methylimidazo[1,2-*a*]pyridines, 21st International Conference on Organic Synthesis (ICOS 21), Department of Chemistry, Indian Institute of Technology Bombay, India, December 11-16, 2016.
8. **Khima Pandey**, and Anil Kumar, Base-mediated C(sp³)-H sulfenylation of 2-aminopyridinium ylide: an effort towards the synthesis of 2-hydroxy-3-sulfenylimidazo[1,2-*a*]pyridines, 24th Indian Society of Chemist and Biologist International conference (ISCBC-2018), Department of Chemistry, Sikkim Manipal University, Jaipur, India, January 11-13, 2018.

Brief Biography of the Candidate

[A-4]

Khima Pandey was born in New Delhi, India. She earned her B.Sc (H) Chemistry from Sri Venkateswara College, University of Delhi, India in 2010 and completed her M.Sc. (Organic Chemistry) from the Department of Chemistry, University of Delhi, Delhi, India in 2012. She is a recipient of Indira Award-2005 and 2007 from Govt. of Delhi for her best academic achievements in CBSE class X and XII examination. She cleared the JAM-2010 with AIR-



163 and GATE-2013 with AIR-250 held by IIT, India. In, October 2013, She was awarded with CSIR-UGC Junior Research Fellowship with 82th rank through a test conducted by CSIR, New Delhi, India. In May 2013, she joined Department of Chemistry, BITS Pilani, Pilani Campus under the guidance of Prof. Anil Kumar as CSIR project fellow and registered in PhD program in August 2013. In October, 2015 she was promoted to Senior Research Fellowship (SRF). She has published eight research articles in peer reviewed international journals and presented papers in four national and seven international conferences with three oral presentation and seven poster presentation.

Her research interests involve the development of new reaction methodologies for the synthesis of small heterocyclic molecules like imidazopyridines by employing traditional and modern synthetic strategies, onium (imidazolium and pyridinium) salts as reactive partners, onium salt-supported reagents, C-H activation and tandem reactions.

Brief Biography of the Supervisor

[A-5]

Prof. Anil Kumar is Professor of Chemistry at the Birla Institute of Technology and Science, Pilani. He obtained his PhD degree from Department of Chemistry, University of Delhi, India under the guidance of Professor S. M. S. Chauhan in 2004. During his doctoral studies Dr. Anil Kumar worked on development of heterogeneous catalyst for organic synthesis with emphasis on green chemistry. He was postdoctoral fellow at Department of Biomedical and Pharmaceutical Sciences, University of Rhode Island, Kingston, USA in Prof. Keykavous Parang group during May 2004 to April 2006. In his postdoctoral studies he has worked on synthesis of novel Src kinase inhibitory agents and solid-phase synthesis. He joined Department of Chemistry, Birla Institute of Technology and Science, Pilani, India as Assistant Professor in 2006 and was promoted to Associate Professor in February 2013 and to full Professor in August 2018. He was appointed as Associate Dean, Work Integrated Learning Programmes (WILP) in May 2014 and Head of Department of Chemistry in September 2014. He has visited University of Rhode Island, Kingston, USA as visiting scientist and Acadia University, Wolfville, Canada as Harrison McCain visiting professor.



Dr. Kumar is recipient of Prof. S. Venkateswaran Faculty Excellence Award from BITSAA for 2017, Harrison McCain Foundation award from Acadia University, Canada for 2012, ISCB Young Scientist award in Chemical Sciences from Indian Society of Chemists and Biologists, Lucknow for 2013 and Dr. Aravind Kumar memorial award from Indian Council of Chemist for 2014. He has 18 year of research experience and 11 year of teaching experience. He has published over 150 research papers in international journals of repute in the area of synthetic organic chemistry, green chemistry and medicinal chemistry and contributed two book chapter and one US patent. He has participated in several national and international symposia/conferences and delivered more than 30 invited lectures. He has guided seven PhD students as supervisor and three students as co-supervisor. Currently, six PhD students, one NPDR research fellow and one INSPIRE faculty are working with him. He is editor for Canadian Chemical Transactions and member of editorial advisory board for The Open Catalysis Journal. He has completed four research projects as Principle Investigator and one as Co-PI sponsored by DST, CSIR and UGC. He has also served as a reviewer for several journals. He is life member of Chemical Research Society of India, Bangalore; Indian Society of Chemists and Biologists, Lucknow and Indian Council of Chemists, Agra.

His research interest lies in transition-metal-catalyzed C–H activation and tandem reactions, development of reaction methodology for novel catalyst, green chemistry, design and synthesis of task-specific ionic liquids and medicinal chemistry.