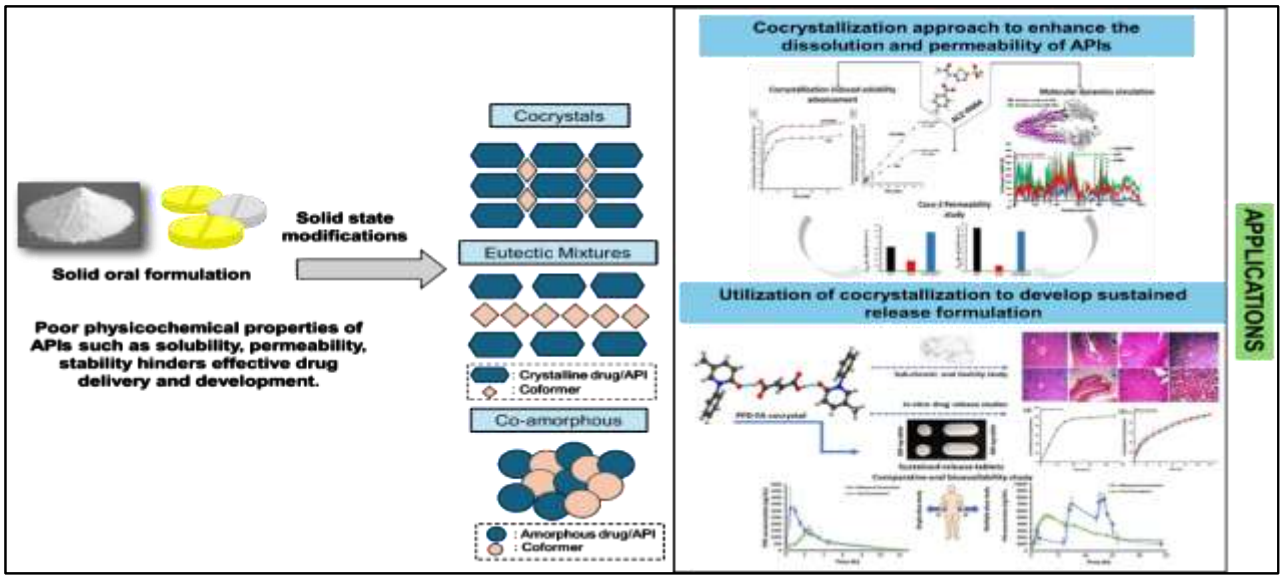
Research Group- Solid State Pharmaceutics Research Labopratory (Ssprl)

- **Name of Principal Investigator/ Group Leader**: **Dr. Animesh Ghosh**
- **Research Theme**: Solid state modification of pharmaceuticals such as cocrystals, co-amorphous, eutectics, etc., for addressing the challenges associated with their poor physicochemical properties.
- **Broad Area of Research and Scope:**
  The Solid-State Pharmaceutics Research Laboratory (SSPRL) is dedicated to addressing challenges associated with poor physicochemical properties of active pharmaceutical ingredients (APIs), which often hinder effective drug delivery and development. The lab primarily focuses on the design and development of novel solid forms such as pharmaceutical cocrystals, co-amorphous systems, and eutectic mixtures through crystal engineering and solid-state pharmaceutics. By enhancing the key properties like solubility, stability, and bioavailability, SSPRL aims to improve the therapeutic performance of poorly soluble or poorly absorbed drugs. The lab also provides deep insights into the structural and thermal behaviours of pharmaceutical compounds. The research carried out at SSPRL contributes significantly to the development of efficient drug formulations, paving the way for more effective and patient-friendly therapies.

Schematic Representation of Broad Area of Research



Total Number of Publications by the group: 90

Top 5 Articles with impact factor:

1. Pandey N, Tiwari A, **Kundu S**, Mondal SK, Michalchuk AA, **Kumari N**, Roy P, Higashi K, Jain A, **Ghosh A**. Elucidating the Mechanistic Shortcomings of Acetazolamide Cocrystals in Harnessing the Anticipated Solubility and Permeability Advantages. Crystal Growth & Design. 2025 May 9; 25(10): 3425-3440. (IF:3.2)
2. **Kumari N**, Roy P, Roy S, Wang C, Das S, Pandey N, Mondal SK, Bose A, Sun CC, **Ghosh A**. Development of direct compression Acetazolamide tablet with improved bioavailability in healthy

human volunteers enabled by cocrystallization with p-Aminobenzoic acid. International journal of pharmaceutics. 2024 Mar 5;652:123793. (IF:5.3)
3. **Kumari N**, Roy P, Roy S, Parmar PK, Chakraborty S, Das S, Pandey N, Bose A, Bansal AK, **Ghosh A**. Investigating the role of the reduced solubility of the pirfenidone–fumaric acid cocrystal in sustaining the release rate from its tablet dosage form by conducting comparative bioavailability study in healthy human volunteers. Molecular Pharmaceutics. 2022 Mar 15;19(5):1557-72. (IF:4.5)
4. Pandey N, **Kumari N**, Roy P, Mondal SK, Thakur A, Sun CC, **Ghosh A**. Tuning Caco-2 permeability by cocrystallization: insights from molecular dynamics simulation. International journal of pharmaceutics. 2024 Jan 25;650:123666. (IF:5.3)
5. Roy P, Chakraborty S, Pandey N, **Kumari N**, Chougule S, Chatterjee A, Chatterjee K, Mandal P, Gorain B, Dhotre AV, Bansal AK, **Ghosh A.** Study on Sulfamethoxazole–Piperazine Salt: A Mechanistic Insight into Simultaneous Improvement of Physicochemical Properties. Molecular Pharmaceutics. 2023 Sep 7;20(10):5226-39. (IF:4.5)

Patents by the group:

S. No	Title and Inventors	Application No. & Date	Status
1.	Novel Pharmaceutical Acetazolamide based compounds and method of preparation thereof. (**Nimmy Kumari**, Parag Roy, Noopur Pandey, **Animesh Ghosh**)	548706 (27.08.2024)	Granted
2.	Pharmaceutical co-crystal composition of piperazine and sulfamethoxazole and method thereof. (Parag Roy, **Animesh Ghosh)**	539514 (13.12.2022)	Granted
3.	Matrix type transdermal patch formulations. (Subham Banerjee, Pronobesh Chattopadhyay, **Animesh Ghosh**, Vijay Veer)	319521 (30.08.2019)	Granted

Research Projects:

Title	Role	Funding Agency		Amount (in Lacs)	Duration
To develop a low dose acetazolamide tablet containing acetazolamide-p-amino benzoic acid cocrystal and to finalize the dosing range bioequivalent to 250 mg marketed tablet through pharmacometrics study	PI	BIRAC-PACE-AIR		41.35	2024-2026
Mitigation of poor physical and chemical properties of SGLT2 inhibitor by drug-drug cocrystallization with DPP4 inhibitor and comparative pharmacokinetic study with their respective co-administered drug products	PI	SERB-CRG		28.43	2023-2026
To modulate the aqueous solubility of poorly water soluble pharmaceuticals by crystal engineering technique and understand the mechanistic approach of solubilization	PI	AICTE-RPS		24.12	2019-2022
Prophylactic Transdermal Patch Against Neurotoxin Poisoning Biological Warfare Situations	PI	BIRAC-SRISTI (PMU) (Society for Research)		15	2017-2021
To develop chemically modified non-toxic bio polymers for therapeutically effective controlled drug delivery system	PI	EMR, SERB-DST		36.76	2015-2018

Industry/Academia Collaborations:

Academic collaborations:

1. Graduate School of Pharmaceutical Sciences, Chiba University, Japan
2. School of Chemistry, University of Birmingham, U.K.
3. Pharmaceutical Materials Science and Engineering Laboratory, Department of Pharmaceutics, College of Pharmacy, University of Minnesota, United States
4. Solid State Pharmaceutics Lab, Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Sector-67, S.A.S Nagar, Mohali 160062, Punjab, India
5. BAM Federal Institute for Materials Research and Testing, Richard-Willstatter-Strasse 11, 12489 Berlin, Germany

Industry Collaboration:

1. Globela Pharma Pvt. Ltd., Plot No. 357 & 358, Road Number 3, Near Ginza Industries, GIDC, Sachin, Surat, Gujarat 394230, India

Targeted Application Area: Pharmaceutical Technology

Achievements:

1. Fellow of the Indian Chemical Society
2. Member of the National Academy of Sciences (NASI)
3. Received an International Travel Grant from SERB to participate in the 12th Crystal Forms Convention
4. Received IPA-ACG-SciTech Award 2024 in the category of Best Innovative Development of a Solid Dosage Formulation.

Project 1: Mitigation of poor physical and chemical properties of SGLT2 inhibitor by drug-drug cocrystallization with DPP4 inhibitor and comparative pharmacokinetic study with their respective co-

Problem Statement

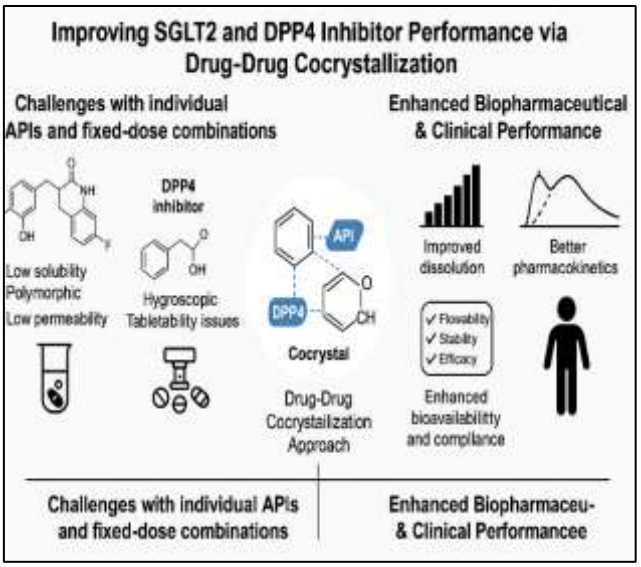
SGLT2 inhibitors, commonly used for the management of type 2 diabetes, possess poor physicochemical properties such as low solubility, poor permeability, hygroscopicity, and polymorphism, which affect their bioavailability, manufacturability, and stability. Similarly, certain DPP4 inhibitors also possess challenges in pharmaceutical processing and therapeutic efficacy. Conventional fixed-dose combinations (FDCs) of these drug classes do not adequately address these limitations. Therefore, there is a critical need for innovative strategies to overcome these challenges.

Strategy

Drug-drug crystallization offers a promising approach to enhance the biopharmaceutical performance of these APIs through improved solubility, permeability, stability, and manufacturability, potentially leading to enhanced pharmacokinetics, therapeutic efficacy, and better patient compliance compared to traditional FDCs or co-administered formulations.

Applications

- Pharmaceutical Technology
- Healthcare

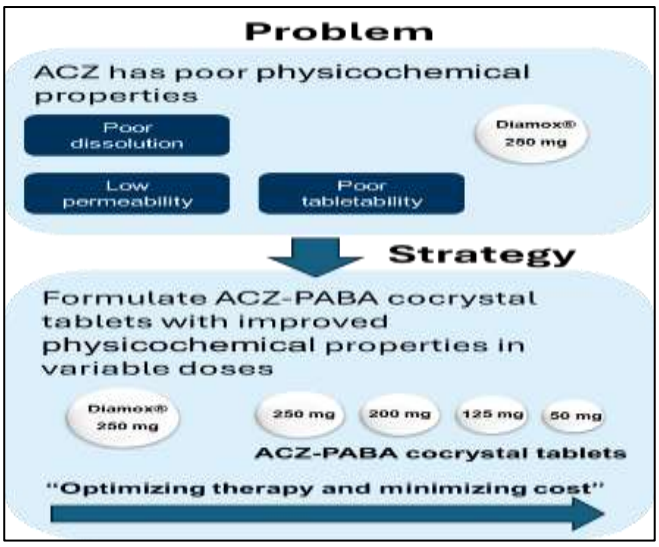


Project 2: To develop a low dose acetazolamide tablet containing acetazolamide-p-amino benzoic acid cocrystal and to finalize the dosing range bioequivalent to 250 mg marketed tablet through pharmacometrics study

Problem Statement:
Acetazolamide (ACZ), a diuretic and carbonic anhydrase inhibitor, suffers from poor biopharmaceutical performance due to limited dissolution rate, low permeability, and poor flow properties. These limitations result in suboptimal bioavailability and manufacturing challenges, ultimately affecting therapeutic efficacy, and cost-effectiveness.

Applications:
- Pharmaceutical Technology
- Healthcare

Strategy/ Approach/ Technique used to solve:
The strategy involves formulating an ACZ cocrystal with para-aminobenzoic acid (PABA), which has improved the physicochemical properties of ACZ, such as enhanced dissolution, permeability, and tabletability. The improved physicochemical properties of ACZ through cocrystallization allow for dose reduction and support a cost-effective direct compression manufacturing process.



Group Members

Alumni


Dr. Santanu Kaity
Assistant Professor
NIPER Kolkata


Dr. Subham Banerjee
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NIPER Guwahati


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Dr. Mahesh Kumar Posa
Associate Professor
Jaipur National University


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Research Manager
SUN PHARMA


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Assistant Professor
BIT MESRA


Dr. Parag Roy
Postdoctoral fellow
Newcastle University, UK


Dr. Noopur Pandey
Associate Scientist
Aragen Life Sciences

Current Members


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Amit Raj


Puja Lal


Arvind Jha


Aritra Saha


Pranav Vivek


Saiswari Dwibedi