National Institute of Pharmaceutical Education and Research (NIPERs)

Research Compendium

released on
28th February, 2023
on occasion of
1st NIPER Council Meeting

Department of Pharmaceuticals (DoP)
Ministry of Chemicals and Fertilizers
Govt. of India

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डॉ. मनसुख मांडविया
DR. MANSUKH MANDAVIYA

सत्यमेव जयते

आज़ादी का अमृत महोत्सव

मंत्री
स्वास्थ्य एवं परिवार कल्याण
व रसायन एवं उर्वरक
भारत सरकार
Minister
Health & Family Welfare
and Chemicals & Fertilizers
Government of India

MESSAGE

I take this opportunity to express my appreciation for the exemplary work done by the seven National Institutes of Pharmaceutical Education and Research (NIPERs) functioning under the aegis of the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India.

Bench to bedside or lab to health care philosophy is ingrained in the pharmaceutical sciences. It provides the platform for the development of medicinal products and technologies for their delivery, while advanced pharmacy practices result in the delivery of the benefits of the pharmaceutical products to the patient.

NIPERs have been established with a clear vision for realizing this idea via producing quality manpower and creating an innovation rich translational research and entrepreneurship ecosystem in the country, with the goal of making India a global front-runner in pharmaceuticals.

I am confident that NIPERs will lead and provide guidance in drug discovery and development in the country through education, research, innovation, and entrepreneurship. I have no doubt that with the talent, dedication and hard work of the students, faculty, and staff members of the NIPERs, this goal will be achieved.

Research & Development is one of the crucial pillars of a country's economy. Let us all work towards nation-building in line with Hon'ble Prime Minister Narendra Modi Ji's vision of 'Jai Jawan, Jai Kisan, Jai Vigyan and Jai Anusandhaan.' Research and Innovation are a necessity for the sustained growth of the pharmaceuticals sector. NIPERs are playing a crucial role in strengthening India's health & pharma sector.

I extend my warm greetings to the students, faculty, and staff members for their commendable initiative and wish them success in all their endeavours.

(Dr. Mansukh Mandaviya)

22 February 2022

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भगवंत खुबा
ಭಗವಂತ ಖೂಬಾ
BHAGWANTH KHUBA

सत्यमेव जयते

Azadi Ka Amrit Mahotsav

रसायन एवं उर्वरक एवं
नवीन एवं नवीकरणीय ऊर्जा राज्य मंत्री
भारत सरकार
Minister of State for
Chemicals & Fertilizers and
New & Renewable Energy
Government of India

23.02.2023.

MESSAGE

I congratulate NIPERs on this initiative of bringing together the research and development activities of all the institutes in one document.

I take this opportunity to extend my greetings to all the seven NIPERs, their students, faculty and staff members for their praiseworthy initiative and wish them grand success in all their endeavours.

NIPERs have been set up with a vision to produce skilled manpower to cater to the pharma industry of India and to create global innovation and entrepreneurship ecosystem in the country so as to make India a global leader in the field of Pharmaceuticals. The academia industry linkage established by NIPERs with leading pharma Industries is expected to play a critical role in pharma R & D.

In the coming days the government expects the NIPERs to provide leadership in Drug Discovery and development in the country through education, research, innovation and entrepreneurship.

(Bhagwanth Khuba)

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Secretary

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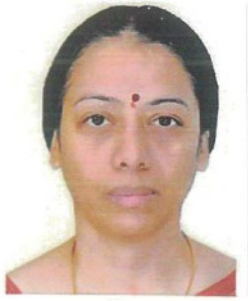
रसायन और उर्वरक मंत्रालय
औषध विभाग
Government of India
Ministry of Chemicals & Fertilizers
Department of Pharmaceuticals



23rd February, 2023

MESSAGE

The Department of Pharmaceuticals presents the NIPER Research Compendium 2022, a compilation of research projects and associated publications, book chapters, and patents, generated by the even National Institutes of Pharmaceutical Education and Research (NIPERs), institutes of national importance under the aegis of the department.

This collection showcases the diverse range of scientific inquiry and innovation and represents a testament to the ground-breaking work being conducted by the researchers at NIPERs and their commitment to advancing the field of constantly evolving Pharmaceutical Sciences.

NIPERs are premier institutions dedicated for advancing the frontiers of knowledge in the field of pharmaceuticals and related disciplines. The collaboration of these institutions represents a major milestone in the progression of the field, and demonstrates the commitment of the NIPERs in promoting innovation and improving human health and wellness.

The projects featured in this compilation span a wide range of topics, from natural products to synthetic analogues, drug discovery to drug delivery, pharmacology to bioinformatics, animal studies to clinical research, traditional medicines to AI based medicines, exploration of the underlying mechanisms of disease to the optimization of existing treatments. The resulting publications, book chapters, and patents demonstrate the impact and reach of this research, and showcase the innovative thinking and collaboration that are at the heart of the NIPERs mission. The research ecosystem will be further strengthened by the specialized fields like bulk drugs, medical devices, anti-viral research and phytopharmaceuticals that the NIPERs have taken up for development of Centres of Excellence.

This compilation is a valuable resource for pharmaceutical industry and indeed anyone interested in the field of Pharmaceutical Sciences, providing a comprehensive overview of the cutting-edge research being carried out at NIPERs and the impact of that research on the wider community. The need for product-oriented translational research, especially in the wake of the recent pandemic, is critical and NIPERs are well-positioned to fill the gap between new products and their affordability to the masses. I have no doubt that it will serve as an inspiration to those seeking to contribute to the field and make a difference in the lives of people everywhere.

I express my appreciation to all of the researchers and faculty involved in compiling this Compendium and commend their efforts in promoting innovation that contributes to improve human health and wellbeing.

(S. Aparna)

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CONTENTS

Executive Summary

National Institute of Pharmaceutical Education and Research (NIPER) was established under the aegis of Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Govt of India. From the first institute at S A S Nagar Punjab, the institute has grown to a group of seven Institutes spread all over the India.Aimed at becoming world leader in providing quality education in Pharmaceutical field and generation of a specialized human resource be it pharmacists, researchers or academicians, NIPERs are fast becoming an integral part of both higher studies as well as Pharmaceutical industry in India and abroad.

This compendium of NIPERs is compilation of research activities being carried out at NIPERs (Ahmedabad, Guwahati, Hajipur, Hyderabad, Kolkata, Raebareli and S A S Nagar) and outputs indices like publications, Book chapters and Patents.Through varied interest in research domains, NIPERs have produced 694 research publications, 109 book chapters and 28 patents and have175 ongoing extramural/industry projects for the year 2022.

Starting with a nascent vision of becoming a global brand in the areas of pharmaceutical education and research to achieve a globally recognised status, NIPER has proven itself,evident from its alumni placed at prestigious positions, national and international organizations.

NIPERs are exploring different areas of pharmaceutical research and development ranging from drug discovery from natural products using HIT to LEAD development (HIT identification, validation, and optimization),new drug synthesis and drug delivery through modern technologies including advanced drug delivery system& pharmaceutical additive manufacturing/3D & 4D printing. Other areas of research include cell based therapy as biopharmaceuticals, API synthesis and formulation strategies, disease pathogenesis, drug mechanisms, target identification, and therapeutic intervention in chronic and complex diseases like cancer, diabetes, obesity, inflammation, and infectious diseases.

To cater the healthcare sector and to overcome hurdles in drug discovery and development for ever evolving disease scenario, identification of druggable targets using AI based technologies are being utilized along with computational biology and *in silico* drug design methodologies.

NIPERs are taking strides in conducting pilot scale studies in API and dosage forms to facilitate data packaging and to transfer the same to industry partner. These initiatives have fortified the industry academia partnership for drug discovery and development.

Synthesis and semi synthesis of new compounds using natural products scaffolds and evaluation of promising molecules are accomplished using various experimental models. NIPERs have undertaken advanced drug delivery research for improving biopharmaceutical profile, DMPK studies, pre-formulation profiling, scale-up of NCEs for pre-clinical efficacy studies to overcome challenges in drug development. With the growing impetus of biopharmaceuticals, NIPERs have initiated several programs using proteins, peptides, and nucleic acids based therapies for various diseases including rare diseases.

NIPERs have an important emphasis on technology commercialization in which NIPER S A S Nagar has commercialized 4 technologies including: compositions and methods for trapping and inactivating pathogenic microbes and spermatozoa Phexxi (by EvoFem Inc.) and quick disintegrating taste masked composition Zinc Sulphate Tablets (by IDPL). Further, licensed out technologies include: a novel one-step process for preparation of nanocrystalline solid dispersions (NanoCrySP technology) and Pharmaceutical Compositions for Enhancing Anticancer Efficacy of Tamoxifen. NIPER Hyderabad has commercialized an Improved Process for a Noble Effervescent Formulation of an Anti-Aging Agent (to LiveactivusPvt. Ltd. Hyderabad).

NIPERs are working in all frontiers of pharmaceutical sciences employing most advanced tools and technologies. The institutions represent the modern approach to discover and develop pharmaceutical product under one roof. The NIPERs are striving hard to become centers of excellence in niche areas and serve the mankind as a whole.

Compendium on
Ongoing Research Project, Research Papers/ Book Chapters published and granted Patents for the year 2022

Sr No.	NIPER	Projects	Research Publications	Book Chapters	Patents
1.	**Ahmedabad**	11	108	34	-
2.	**Guwahati**	35	89	5	6
3.	**Hajipur**	4	43	4	3
4.	**Hyderabad**	58	158	17	6
5.	**Kolkata**	7	81	11	1
6.	**Raebareli**	12	81	25	4
7.	**S A S Nagar**	48	134	13	8
	TOTAL	**175**	**694**	**109**	**28**

अहमदाबाद
AHMEDABAD

NIPER, AHMEDABAD

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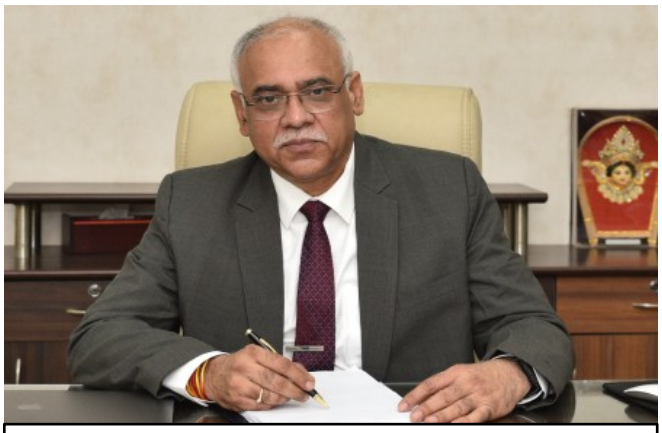
From the Director's Desk



Prof Shailendra Saraf

It gives me immense pleasure to welcome you to NIPER-Ahmedabad (NIPER-A). The institute is in the second decade of establishment that comesunder the aegis of Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India to promote quality education and research in the field of Pharmaceutical Sciences and Management. The Institute has an outstanding track record of producing excellent leaders serving as pharmacists, researchers, and academicians. NIPER-A has been functioning independently through transient building of its own campus at Gandhinagar since 2016 and will be shifting to its main campus very soon. NIPER-A has a state of art research facilities including central instrumentation and other academic facilities, animal house and a canteen. Presently, NIPER-A offering Masters programme in eight streams viz. Biotechnology, Natural Products, Pharmaceutics, Pharmaceutical Analysis, Medicinal Chemistry, Pharmacology & Toxicology, Medical Devices and Pharmaceutical Management and PhD programme in all streams except Pharmaceutical Management**.** NIPER-Ahas introduced industry relevant course curriculum and academic programme. The admissions to NIPERs are being made through the national level Joint Entrance Examination for post graduate and doctoral courses.

The pharmaceutical education has played a vital role in human resource development, catalyzing the growth of life sciences and healthcare industry. Enthusiastic and entrepreneurial efforts have turned Gujarat into the hub of Pharma manufacturing, Research and Development activities. The innovative and translational approach of the Indian scientists resulted in the paradigm shift from the industrial age to knowledge enriched economy. To cater the requirements, NIPER-Ahmedabad has established a state-of-the-art facility for quality research and education with a goal of providing analytical and drug development related support to Industries, MSMEs, and start-ups. The major research domains for NIPER-A include Drug Discovery which is focused on the new drug synthesis and/or identifying from natural products in the disease area through modern technologies. The new chemical entities are evaluated through in-vitro and animal testing. NIPER-A is also focusing on cell therapy as biological drugs. The Drug Development team is working on API synthesis and formulation strategies. The API development is helping for identifying new synthetic routs for existing drugs, which will help to decrease the dependency of Indian manufacturers from other countries. NIPER-A is also working on development of platform technologies for drug delivery and complex generics. Medical Device Development is focusing on product development of orthopaedic implants, ocular devices and diagnostic devices and their testing facilities.

The interdisciplinary courses and cultural diversity at NIPER-A spark the spirit of innovative research and all-round development of its students. The location of the Institute ensures a symbiotic association with Pharmaceutical Industries, Medical centers, and technological universities. The institute has achieved ranking in top 10

pharmacy institutes of the country since last three years in the NIRF ranking of MHRD. In the recent release of ARIIA Ranking, NIPER-A was placed in Band A category of public funded Institutes. NIPER-A aspires to serve as a good launching platform to revamp the Pharmaceutical Education and Research and to initiate the new era of translation of Pharmaceutical and Biomedical Sciences.

FUNDED EXTRA-MURAL RESEARCH PROJECTS

S.N.	Project Title	Principal Investigators and Centre coordinator's	Funding Agency	Funding Amount	Duration
1.	Electro-conductive and Immunomodulatory Macroporous Hydrogel Conduit for Faster Spinal Cord Regeneration	Akshay Srivastava and Hemant Kumar	DST, SERB	62 lakhs	3 years
	Worldwide more than a million people are suffering from spinal cord injury (SCI). In India, the average annual incidence of SCI is 15000 with a prevalence of 0.15 million. There are no current satisfactory treatments for SCI that could mitigate the neurological impairments and enhance long-term SCI survival rate. Since spinal cord nerves have poor regeneration potential and neuro-inflammation is the major barrier for nerve regeneration. Various biomaterial and stem cell based therapies have been developed to promote neuronal regeneration. However, the functional recovery was found to be comparatively low because developed biomaterial scaffold failed to provide appropriate microenvironment with limited capacity of MSCs survival and differentiation for the axonal regeneration in the spinal cord. Presence of highly pro-inflammatory microenvironment in spinal cord lesion sites after injury remained a challenge for faster and functional regeneration. Recently, electrical stimulation (ES) and electrical conductive-based conduits also showed potential effects in promoting neurite and axonal growth in vitro and in vivo. Conclusively, SCI pathology is multifaceted, and synergistic approach might provide better protection and achieve functional recovery. We propose to fabricate a novel electro-conductive and immuno-modulatory graphene incorporated collagen hydrogel that will possess a well-interconnected porosity with mechanical and electrical cues for prospering a faster axonal regeneration and complete functional recovery. The proposed hydrogel is a viable clinical solution for patients with complete paralysis to shorten their duration of stay on bed and lessen economic and social burden.				
2.	Characterization of transcriptional landscape and its functional role in Gingivo-Buccal oral squamous cell carcinoma (GB-OSCC) for targeted drug discovery.	Dr. Amit Mandoli	GSBTM	78.25 Lakh	3 years
	Oral Cancer is the second leading cause of cancer-related mortality in India. Using next-generation omics assays and CRISPR-Cas9 gene editing tools this project aims to identify the biomarkers and targeted drugs for precision therapy,				

	and better management of GB-OSCC patients. We will perform a clinical trail with the outcome of the study.				
3.	Slow afterhyperpolarization is the mechanism that determines the differential excitability pattern of dorsoventral hippocampal neurons, a potential target for temporal lobe epilepsy	Giriraj Sahu	SERB	30.27 lakh	2 Years
	Faculty with this Project has left NIPER-Ahmedabad.				
4.	Formulation development and evaluation of miRNA nanoformulation for obesity	Rakesh Tekade	DST, SERB	30 Lakhs	3 years
	The proposed project possesses tremendous scope for translational industrial application considering adopting simple, translatable, and scalable technologies in this work. The labs of Tekade and Prof. Kalia at NIPER-Ahmedabad regarding expertise have assimilated to execute the critical milestones for this project. The dendrimeric template approach as patented by PI Tekade Lab; NIPER-Ahmedabad (Indian Patent Appln no. 201821043610; 201921019898) backed by the expertise of his lab in executing miRNA and gene delivery; Quality-by-design (QbD), scale-up expertise liposome and obesity mouse model research expertise available at NIPER-Ahmedabad holds huge commitment to execute the science required for industrial translation of this work.				
5.	To investigate Green Photothermal Nanomaterials for Laser-directed Diabetic Wound Healing in Mice Model	Rakesh Tekade	ICMR	30 Lakhs	3 years
	"This project aims to develop a novel alternative and innovative laser-guided approach for diabetic wound healing applications in diabetic mice Model. The approach will confer a drug-free synergistic strategy for improving wound healing efficacies without using any harmful therapy (drugs, surgery, etc.). The project will develop a patentable drug-free wound care products for enhancing wound healing activities. The resultant product would be cost-effective and non-toxic that could be useful for patients as well as health care systems. The development of wound dressings may be effective due to the excellent antimicrobial and antidiabetic activities of the chosen nanomaterials as well as plant materials. In the field of dermatology, especially for wound care, the developed approach could serve as a next-generation candidates for wound dressings application.				
6.	Fiber Reinforced Poly (l-lactic acid) for the Fabrication of Bioabsorbable, and	GovindaKapusetti and Rajesh Nadiminti	ICMR	40 lakh	3 years

	Antibiotic Surgical Staples for Wound Closing				
	Currently, thousands of surgical interventions are being performed in the world every day; among them, more than 80% of the clinical operations need some kind of wound closing set-up at the end of the intervention. The available options for wound closing include surgical sutures, glues, adhesive strips, and staples(metal-based). All the options have one or the other shortcoming associated, like secondary infection, scar formation, delayed healing, secondary hospital visit for the removal of the wound closing system, etc. The proposed bio-absorbable polymeric staples can be a stronger option to resolve the issues related to current wound closing strategies. The unique architecture and design of the staples computationally validated through Finite Element Analysis (FEA) as per regulatory guidelines. The preliminary studies are suggesting that the designed model offers stronger resistance to crack propagation, holding strength with skin, and uniform stress distribution over the available commercial designs. Moreover, the biodegradability of staples not required secondary intervention to removal as in metallic staples. The staples will be coated with antibiotics to avoid the infections effectively.				
7.	Investigational study for the precipitate generation over stability in the formulation.	Ravi Shah and DerajramBenival	Virbac Animal Health India Pvt Ltd.	3 lakh	6 months
	It is an industry project in progress. Confidential Information				
8.	Killing two birds with one stone: dual blockade of tumor pyruvate kinase M2 and dihydrofolate reductase through hybrid molecule in oral cancer	Dr. Amit Shard	ICMR	42 Lakh	3 years
	Hybrid compounds are essence of medicinal chemistry. They may be potent enough against two or more targets. Here we have planned to snthesize hybrid molecules which may target two enzymes crucial of cancerous cell growth. One target is DHFR and another selected is pyruvate kinase M2. (Project has not started as funding is not received)				
9.	Targeting Sweet Spot in Oral Cancer: Development of Novel Project Title Quinazolinones for Electrophillic Modification of Tumor Pyruvate Kinase M2	Dr. Amit Shard	Gujarat State Biotechnology Mission	48 Lakh	3 years
	The project involves design and deveopment of novel molecules against oral				

	cancer. The oral cancer is a burgeoning problem of Gujarat as well as India. The treatmnet options are limited and are flanked with problems of chemoresistance and adverse side effects. In this regard, the molecules will be aimed at tumor pyruvate kinase M2 a typical metabolic conduit in oral cancer.				
10.	Age-dependent development of progressive mouse model of Parkinson's disease by stereotaxic injection of rotenone in the olfactory bulb and its validation through diffusion kurtosis imaging	Amit Khairnar	ICMR	47.76 Lakh	3 years
11.	A industrial consultancy project on systematic analysis of stability studies and related impurities of biotin and pantothenic acid.	SiddheshwarChauthe	Proctor and Gamble Healthcare Limited, Mumbai	1.8 Lakh	--
	Project completed, This is an industrial project, Details of the project could not be disclosed as per the CDA agreement with company.				

PUBLICATIONS (RESEARCH/ REVIEW):

Pharmaceutical analysis

1. Pillai, Megha Sajakumar, Sree Teja Paritala, Ravi P. Shah, Nitish Sharma, and Pinaki Sengupta. "Cutting-edge strategies and critical advancements in characterization and quantification of metabolites concerning translational metabolomics." Drug Metabolism Reviews 54, no. 4 **(2022)**: 401-426.
2. Sahu, Amit Kumar, Tarang Jadav, Niraj Rajput, Manish Kumar Sharma, and Pinaki Sengupta. "Bioanalysis by LC-MS/MS and preclinical pharmacokinetic interaction study of ribociclib and oleanolic acid." Bioanalysis 14, no. 15 **(2022)**: 1051-1065.
3. Jogpethe, Ashish, Tarang Jadav, Niraj Rajput, Amit Kumar Sahu, Rudradip Das, Astha Gupta, Amit Shard, and Pinaki Sengupta. "LC/Q-TOF MS and LC/QQQ MS based bioanalysis of a new ferrocene derivative as a potential anticancer lead with promising drug-like characteristics." Journal of Chromatography B 1210 **(2022)**: 123469.
4. Palshikar, Mrunal, Tarang Jadav, Niraj Rajput, Amit Kumar Sahu, and Pinaki Sengupta. "Surrogate peptide selection and internal standardization for accurate quantification of endogenous proteins." Bioanalysis 14, no. 13 **(2022)**: 949-961.
5. Rachmale, Megha, Niraj Rajput, Tarang Jadav, Amit Kumar Sahu, Satyasheel Sharma, and Pinaki Sengupta. "High resolution mass spectrometry-driven metabolite profiling of baricitinib to report its unknown metabolites and step-by-step reaction mechanism of metabolism." Rapid Communications in Mass Spectrometry 36, no. 22 **(2022)**: e9385.

6. Deore, Jayshri, Niraj Rajput, Tarang Jadav, Amit K. Sahu, and Pinaki Sengupta. "Hot Stage Microscopy-based Method for Determination of Particle Size in Reverse Engineering: Establishment of a Platform Technology Employing Carvedilol as a Model Drug." Current Analytical Chemistry 18, no. 10 **(2022)**: 1117-1130.
7. Gangakhedkar, Shriya, Harsh Thakkar, Ravi P. Shah. Hydrogen-Deuterium Exchange in LC-MS – Simple & Powerful Tool for Differentiating Protein Conformers, SpincotechCuttingEdge. **(2022)**:16-18.
8. Sharma, Nitish, ShivrajGiri, Amit kumarSahu, Sidheshwari More, Pinaki Sengupta, and Ravi P. Shah. "LC-Q/TOF-HRMS and NMR based structural characterization of the major photodegradation impurity of difluprednate." Chromatographia 85, no. 7 **(2022)**: 605-615.
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11. Jain, Sonali, ShivrajGiri, Nitish Sharma, and Ravi P. Shah. "LC and LC-HRMS studies on stability behavior of molnupiravir an anti-COVID 19 drug." Journal of Liquid Chromatography & Related Technologies 44, no. 15-16 (2021): 750-759.
12. Rajput, Niraj, Fatema Soni, Amit Kumar Sahu, Tarang Jadav, Satyasheel Sharma, and Pinaki Sengupta. "Degradation kinetics and characterization of major degradants of binimetinib employing liquid chromatography-high resolution mass spectrometry." Journal of Pharmaceutical and Biomedical Analysis 215 **(2022)**: 114753.
13. Bhangare, Dhiraj, Niraj Rajput, Tarang Jadav, Amit Kumar Sahu, Rakesh K. Tekade, and Pinaki Sengupta. "Systematic strategies for degradation kinetic study of pharmaceuticals: an issue of utmost importance concerning current stability analysis practices." Journal of Analytical Science and Technology 13, no. 1 **(2022)**: 7
14. Rachmale, Megha, Niraj Rajput, Tarang Jadav, Amit Kumar Sahu, Rakesh K. Tekade, and Pinaki Sengupta. "Implication of metabolomics and transporter modulation-based strategies to minimize multidrug resistance and enhance site-specific bioavailability: a needful consideration toward modern anticancer drug discovery." Drug Metabolism Reviews 54, no. 2 **(2022)**: 101-119.18.
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17. Sonawane, Dipali, Amit Kumar Sahu, Tarang Jadav, and Pinaki Sengupta. "UHPLC–Q-TOF–MS/MS-based metabolite profiling of duvelisib and establishment of its metabolism mechanisms." Biomedical Chromatography 36, no. 4 **(2022)**: e5314.

Pharmaceutics

18. Janrao, Chetan, Shivani Khopade, AkshayBavaskar, Shyam Sudhakar Gomte, Tejas Girish Agnihotri, and Aakanchha Jain. "Recent Advances of Polymer Based Nanosystems in Cancer Management." *Journal of Biomaterials Science, Polymer Edition* just-accepted **(2022)**: 1-73.
19. Sisodia, Yashi, Komal Shah, Adil Ali Sayyed, Meenakshi Jain, Syed Ansar Ali, Piyush Gondaliya, Kiran Kalia, and Rakesh Kumar Tekade. "Lung-on-chip microdevices to foster pulmonary drug discovery." *Biomaterials Science* (2023).
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21. Kalyane, Dnyaneshwar, Suryanarayana Polaka, Nupur Vasdev, and Rakesh Kumar Tekade. "CD44-Receptor Targeted Gold-Doxorubicin Nanocomposite for Pulsatile Chemo-Photothermal Therapy of Triple-Negative Breast Cancer Cells." *Pharmaceutics* 14, no. 12 **(2022)**: 2734.
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From the Director's Desk

Prof USN Murty

National Institute of Pharmaceutical Education & Research (NIPER) Guwahati is currently running with eight important departments *viz*, Pharmacology and Toxicology, Biotechnology, Pharmacy Practice, Pharmaceutics, Pharmaceutical Analysis, Medicinal Chemistry, Pharmaceutical Technology (Formulations) and Medical Devices. Department of Pharmacology and Toxicology emphasizing an integrated view of experimental pathology, pharmacology, and physiology, to work towards a better understanding of how the human body functions and to alleviate human diseases including the efficacy, safety, toxicity, and pharmacokinetic parameters. Department of Pharmacy Practice has been actively involved in patient care management by collaborating with other healthcare professionals in Govt. and Private Hospitals in and around Guwahati. This department also plays an active role in uplifting the health and wellness of the North-East population by conducting health screening and awareness programs. Biotechnology department is dedicated to understanding disease pathogenesis, drug mechanisms, target identification, and therapeutic intervention in chronic and complex diseases like cancer, diabetes, NAFLD, and cardiovascular diseases. Department of Pharmaceutics research interest on translational cutting-edge advanced pharmaceutical research in the field of micro/nano emulsions, meso-porous silica nanoparticles, nanomedicines & pharmaceutical additive manufacturing/3D & 4D printing. Department of Pharmaceutical analysis is dealing with various aspects of drug development viz to identifying drug targets, uncovering the mechanism of action of drugs, and assessing (or infer) their side effects by different omics approaches, drug degradation, and impurity profiling, toxicological evaluation, bioanalytical chemistry, drug metabolism studies. Identification of druggable targets, target validation, rational drug design, structural biology, computer-aided drug design, HIT to LEAD development (HIT identification, validation, and optimization), method development (chemical, biochemical, and computational), modelling reaction mechanism, extraction, and isolation of bioactive natural product compounds, molecular characteristics of drug action, establishing the relationship of chemical structure to the drug action and effects of metabolism on the drug structure, etc. are in the scope of research under medicinal chemistry department. Preformulation studies, solid state pharmaceutics, and development of an appropriate formulations are the purview of department of Pharmaceutical Technology (Formulations). Finally, recent department of Medical Devices involves in mechanical characterization of hypodermic needles, Single use syringes, catheters and Class A, & B Medical Devices, etc.

FUNDED EXTRA-MURAL RESEARCH PROJECTS

S.N.	Project Title	Principal Investigators and Centre coordinator's	Funding Agency	Funding Amount	Duration
1.	Exploration of drug development for psychological stress mediated IBD from the Indigenous medicinal plants of NE- India.	Dr. USN Murty and Dr. VGM Naidu	DRDO	41.65 Lakh	2018-22
	Explored the medicinal plants endemic to NE India for their effect on stress-aggravated intestinal inflammation in pre-clinical models and found that alcoholic extracts of two medicinal plants (Litsea and Mesua) showed good activity and also developed polyherbal formulation by integrating reverse pharmacological approaches to the Ayurveda concept. Three international publications were published, and one patent was granted from this project.				
2.	Development of novel liquid-retentive and reconstitutable solid-dry powder topical formulations containing oil-in-water nanosized cationic emulsions loaded with or without cyclosporine A to manage the moderate to severe dry eye syndrome.	Dr. S. Tamilvanan	DBT	34.38 Lakh	2018 -22
	In the new fashioned life-style, every human being in all age-groups is obsessed to use of computers and mobile phones. The prolonged or extended time spent in front of modern user friendly electronic gadgets (computers, mobile phones, etc.) causes an ocular disease condition termed as Dry Eye Syndrome (DES) or kerotoconjunctivitis sicca (KCS). In general, the people suffering from dry eyes will feel a gritty sandy sensation in their eyes and even seemingly paradoxical watering eyes. Conventional contrived solutions (tear substitutes) require frequent instillation into eyes to correct or treat DES. Oily eye drops are also not acceptable to patient due to visual disturbance following instillation of oily drops into eyes. The dispersing the oil in water with the help of emulsifier molecules to make patient-friendly emulsion product is the main aim of this project.				
3.	Hit to lead optimization of	Dr. VGM Naidu	DBT	57.23 Lakh	2018-22

	Novel Triazine analogues as potential autophagy modulators for the prevention of cancer.				
	Delineated the role of PIP5 kinases in colon and hepatic cancers and discovered the ligands (IITZ01, NGTZ17, 25 and 27) against the PIP5k β isoform and showed potential anticancer activity in in vitro models as alone and in combination with existing chemotherapeutic drugs which causing resistance by autophagy mechanism as a chemosensitizer. Some of the Publications are under progress as an outcome from the project				
4.	Systematic and Scientific investigation of selected medicinal plants from north eastern part of India for rheumatoid arthritis and derivation of mechanism of action using bioguided fractionation methods besides identification and characterization of lead molecules using liquid-liquid separation technique.	Dr. USN Murty and Dr. VGM Naidu	NER Programme, DBT	50 Lakh	2018-22
	Explored the medicinal plants endemic to NE India for their effect on FCA induced arthritis in pre-clinical models and found that alcoholic extracts of two medicinal plants (Litsea and Mesua) showed good activity and further formulation studies are under progress for their translation usage as herbal products. Three international publications were published from this project.				
5.	Medicated skin patch to mitigate destructive pulmonary tuberculosis in six districts of Assam.	Dr.Subham Banerjee	Assam S&T EnvironCouncil (ASTEC), Govt. of Assam	2.9 Lakh	2019-22
	Quercetin in combination with polyvinylpyrrolidone (PVP) was found to limit the spreading of necrosis to unaffected tissues in tuberculosis-infected mice. Therefore, we hypothesized that 3D printed medicated skin patch incorporated with a quercetin-PVP combination would provide an appropriate therapeutic drug concentration with desired sustained release profile. We fabricated quercetin-PVP 40 extruded-filaments by hot-melt extrusion (HME) technique				

	along with Eudragit® RSPO and tri-ethyl citrate and further printed it to make medicated skin patches using fused deposition modeling (FDM) based 3D Printing technology. Various characterizations were performed to optimize the 3D-printed patch formulation. One granted patent & one international publications were published from this project.				
6.	Development of Targeted Gut Lymph angiogenesis nanomedicine for treatment of Liver Cirrhosis.	Dr.Subham Banerjee	DST	50.25 Lakh	2019-23
	Runt-related transcription factor (RUNX1) regulates inflammation in non-alcoholic steatohepatitis (NASH). We performed in vivo targeted silencing of the RUNX1 gene in liver sinusoidal endothelial cells (LSECs) by using vegfr3 antibody tagged immunonano-lipocarriers encapsulated RUNX1 siRNA (RUNX1 siRNA) in murine models of methionine choline deficient (MCD) diet-induced NASH. MCD mice given nanolipocarriers-encapsulated negative siRNA were vehicle, and mice with standard diet were controls. Two international publications were published from this project.				
7.	Integrated information system to interpret, integrate and mitigation of cardio metabolic health care in North East tribes of Assam and Mizoram.	Dr. USN Murty Dr.Ramu Adela	ICMR	70 Lakh	2019-23
	We are collecting clinical information from Northeast tribes and identifying the cardio metabolic risk by using machine learning models.				
8.	Pharmacoengineered lipid core-shell nanoarchitectonics to enhance macrophages uptake for potential translational therapeutic outcome.	Dr.Subham Banerjee	SERB, DST	34.70 Lakh	2019-23
	Macrophage uptake and modulation based on nanoparticle characteristics are key areas for improving the internalisation process and successfully delivering the drug to intracellular organelles where Mycobacterium tuberculosis resides and persists. Lipid core–shell nanoarchitectonics were prepared using the double emulsification method, and their size, zeta potential, surface morphology, thermal and crystalline behaviour, and pyrazinamide (PZA) payload and release were determined. In human alveolar macrophages, comparative uptake, intracellular and compartmental colocalisation, and effectiveness against Mycobacterium smegmatis-infected macrophages were examined. In total six				

	peer-reviewed publications were made through this project				
9.	Developing a public health informatics platform in India for a systems view of health & diseases under epidemiology data analytics (EDA) of interdisciplinary cyber physical systems (ICPS) programme.	Dr. USN Murty	DST	175 Lakh	2019-23
	A public health informatics platform was developed in India for a systems view of health & diseases under epidemiology data analytics (EDA) of interdisciplinary cyber physical systems (ICPS) programme.				
10.	Development of WNT-Signaling Based Anti-Evolution and Anti-Metastatic Therapies Against Resistant Cancers (Under Ramalingaswami Re-entry Fellowship).	Dr.Purusottam Mahapatra	DBT	113.6 Lakh	2020-25
	The link between tumor heterogeneity, cancer cell clonal evolution, and metastasis is still not understood properly and it is believed that the key to early cancer diagnosis and effective cancer treatment lies in the understanding of these above-mentioned events during cancer progression. In this project, we are interested to understand how cancer cell evolves into different sub-clones in a chemotherapy-induced microenvironment. We are looking at the interplay of different molecular regulators of WNT signalling which are probably involved with the process of clonal evolution and drug resistance in cancers. This understanding will shed light on the key molecular mechanisms involved with clonal evolution which could further lead to the identification/development of novel diagnostic and therapeutic procedures for aggressive metastatic cancers.				
11.	Identify the DNA adduct and associated metabolic alteration in upper aerodigestive tract cancer with smokeless tobacco chewers in the Northeast Region of India: A Metabolomics	Dr. Roshan Borkar	SERB, DST	37.36 Lakh	2020-24

	Approach.				
	In the northeast region of India (NERI), upper aerodigestive tract (UADT) cancers account for a significant proportion of all cancers, and tobacco-related cancers are very common. The habit of chewing smokeless tobacco with betel nut or areca nut is very common in NERI. Moreover, NERI is a distinct region with a different lifestyle, food habits and chewing tobacco with betel nuts is a customary habit in the different socio-cultural and ethnic groups in NERI. Presently, potential biomarkers for smokeless tobacco-induced UADT cancer for early detection and risk stratification of developing UADT cancer through liquid-chromatography tandem mass spectrometry (LC-MS/MS) metabolomic and bioinformatic approach are not documented in India. In this project we aimed to integrate state-of-the-art metabolomics approaches to develop a first-generation non-invasive panel of a biomarker in the urine of UADT cancer for early detection and stratification of smokeless tobacco with betel nuts people at risk of developing UADT cancer. This will be the first study using a metabolomics approach to describe a strong connection between altered methylation, perturbed xenobiotic metabolism, and UADT cancer in connection with smokeless tobacco with betel nuts. Furthermore, developing smoke-associated perturbed metabolic pathways specific to UADT cancer could be further bound to develop better treatment strategies or combinatorial therapy with the existing drugs to overcome tobacco-induced chemo-resistance.				
12.	Generation of 3D printed multi functional customized drug delivery systems: in vitro and in vivo evaluation.	Dr.Subham Banerjee	ICMR	24.27 Lakh	2020-22
	Field of pharmacology and pharmacogenomics focuses on developing drug delivery systems designed to address the unique characteristics of individual patients. Three-dimensional printing technology can be used to fabricate personalized drug delivery systems with desired release properties according to patient needs. Norfloxacin (NOR)-loaded micropellets (MPs) were fabricated and filled inside a stereolithography (SLA) 3D printing technology–mediated hollow capsular device in accordance with a standard size of 09. The prepared 3D-printed hollow capsular device filled with pristine NOR and NOR-loaded MPs were characterized in terms of both in vitro and in vivo means. One IPR & two papers are obtained through this research.				
13.	Synthesis and characterization of standards of certain drugs and their metabolites.	Dr. USN Murty	NDTL	110 Lakh	2020-23
	Six reference standards were made under this project & handed-over to NDTL, New Delhi to regain the recognition & accreditation from World Anti-doping Agency (WADA)				
14.	Understanding the relationship	Dr. S. Sudhagar	ICMR	18.89 Lakh	2020-23

	between metabolic stress and acquired tamoxifin resistance in breast cancer cells.				
	The proposed work focuses on understanding the molecular cross-talk that links mitochondrial dynamics to acquired tamoxifen resistance under biochemical tumor microenvironments, such as low nutrition and hypoxia. We indent to explore the functional significance of tamoxifen-induced mitochondrial dynamics in response to cellular adaptation to nutrition deprivation/hypoxia and to establish its link to the development of acquired resistance to Tamoxifen. The knowledge acquired from this work will help in the identification of novel targets and the development of anticancer therapies which could overcome acquired resistance and improve the quality of life.				
15.	Exploiting the electron transfer parameters for the prediction of selectivities in Cytochrome P450 catalyzed bio-transformations of industrial importance.	Dr. Vaibhav A. Dixit	National Supercomputing Mission (NSM), DST	19.17Lakhs	2021-24
	Directed evolution of Cytochrome P450 (CYP450) mutants often enables novel reactions of industrial importance (oxidations, cyclopropanation and nitrations). However, reliable and routine predictions of selectivity remains challenging. Directed evolution, offers limited insights into; why only some mutations, which are often outside the active site, give high selectivity? Structure-based methods offer retrospective rationalizations but redesign of CYP450s is rarely fruitful with this approach. Among the main reasons is lack of reliable Marcus electron transfer (ET) parameters (driving force; ΔE° and reorganization energies; λ) that determine the reaction rates. Reliable estimation of ET parameters for CYP450s mutants requires quantum chemical and molecular dynamics simulations which are penta and exascale computations. This project, aims to demonstrate a HPC-application called "CYPWare" for the estimation of ET parameters to unravel factors that drive reaction selectivities. After initial development, and validations CYPWare will be utilized for predictions of novel activities which will be tested in the PI and co-PI laboratories.				
16.	Deep Learning assessment for identification of novel diagnostic and prognostic biomarkers for prediction of diabetic retinopathy in north east population.	Dr.Ramu Adela	ICMR	45.00 Lakh	2021-24

	We are identifying biomarkers by integrating clinical markers with retinal imaging of diabetic retinopathy patients using machine learning models.				
17.	Bioactive reprogrammed nano-herbal formulation for photothermal therapy-based cancer theranostics.	Dr. Deepak Bharadwaj PVP	BIRAC, DBT	25 Lakhs	2021-23
	According to 'cancer registry India' statistics, over 800,000 new cancer cases will be diagnosed in India each year. Cancer incidence in India is expected to climb by 12% in the next five years, at any one time, the load is likely to be three times that of the 240,000 instances (www.ncdirindia.org). This includes prevalently superficial cancers. Considering the current situation we intend to develop a Nano herbal gel which is having both the beneficial properties of anticancer agent CfAc and light-based thermal therapy. This non-invasive targeted approach can be targeted, sustainable and affordable for the management of superficial tumors, especially in our country. To encounter the issue, the use of a multifunctional Nano-herbal product has a better scope to evolve as an effective marketable product. Pharmaceutical corporations, such as GlaxoSmithKline GSK and Abbott have started venturing into the development of herbal-based products. In countries like India, the development of and availability of this kind of product for the non-invasive therapy and treatment of tumors will be a solution for the cost-effective management of site-specific cancers.				
18.	Deciphering pharmacodynamics of Ayurvedic formulations used in the treatment of neurodegerative diseases by integrating reverse pharmacological approaches.	Dr. VGM Naidu	Ministry of Ayush	1.48 Crores	2021-23
	We are exploring the effect of ayurvedic formulations sponsored by the CCRAS, Ministry of ayush in in vitro and in vivo models of Parkinsons and Alzheimers diseases. Standardisation of formulations and models are under Progress.				
19.	Evaluating the therapeutic effect of *Musa balbisiana* fruit powder on non-alcoholic fatty liver disease in rats.	Dr. Sanjay K Banerjee	ICMR	20 Lakhs	2021-23
	Non-Alcoholic Fatty Liver Disease (NAFLD) is a major challenge in front of the healthcare system all over the world. Due to modern lifestyle changes, the western diet and other factors leads to disease burden increases day by day.				

	There is no FDA approved drug is available in the market that can treat the chronic stage of fatty liver disease. Alternatively, researchers are looking into plant- derived extract to treat the metabolic disorders. According to mythological facts and traditional culture of medicine Musa balbisiana has been reported potentially therapeutic effects on different types of metabolic disorders such as Diabetes Mellitus and inflammatory diseases. Therefore, we are exploring Musa balbisiana that could be a potential pharmacological approach to treat the fatty liver disease. So in this research study we were focussed on the pathophysiology of Non-Alcoholic Fatty Liver Disease (NAFLD) further progression of the disease without any treatment leads to NASH and liver cirrhosis condition. There are certain mechanism are unclear till now we focussed on certain parameters such as fatty acid transporter protein (FATP1, FATP2, FATP3, FATP4, FATP5), lipid droplets associated proteins specially perilipins, Comparative gene identification 58 (CGI58), Fat specific protein 27 (FSP27), and PPAR- alpha regulated genes such as Carnitine Palmitoyl Transferase (CPT-1) and Forkhead box protein O1 (FOXO1, which play a major role in fat deposition in hepatocytes. Furthermore, we are also trying to elucidate the possible pharmacological activity of Musa balbisiana on these targets which mention above.				
20.	Investigating the interplay of Kidney-Heart inflammatory axis and the role of histone deacetylase 6 (HDAC 6) signaling in chronic kidney disease.	Dr.Bidya Dhar Sahu	SERB, DST	31.47 Lakhs	2021-23
	The prevalence of cardiovascular disease (CVD) in chronic kidney disease (CKD) patients is nearly 70%, which is almost double the prevalence of CVD in the non-CKD population, and many patients with CKD do not reach dialysis because they die of heart disease. This association between CKD and CVD is often called a cardio-renal syndrome. The current therapeutic options (drugs acting on the renin- angiotensin system) for this progressive condition are limited and often ineffective. Also, there remains no clear etiology for these issues and a better understanding of the pathophysiology of CKD-associated CVD is urgently needed to address the dire need for new therapies. The central hypothesis of our project is to target renal inflammation to improve cardiac health in CKD conditions.				
21.	Ultrathin 2D Nanomaterials Based Biosensor for multiplexed detection of breast cancer biomarkers.	Dr. Saurabh Kumar	DST	17.04 Lakh	2021-23
	Breast cancer is the most common invasive cancer in females worldwide. Currently employed breast cancer detection techniques such as immune-histopathology, ELISA, Mammography, and biopsy require highly skilled personnel to operate them. Additionally, they are expensive for patients, time-consuming and poor sensitivity, and limited early disease diagnosis potential. Although the electrochemical biosensing protocols are available in breast cancer				

	detection, all of them are limited to single biomarker detection, which is not sufficient to predict breast cancer. There is a panel of biomarkers that should be studied for proper disease diagnosis. Every individual diagnosed with breast cancer has to go through a triple marker test (ER, PR, and HER2). Early detection of these biomarkers helps in early diagnosis, monitoring, and treatment strategies (Endocrine or Trastuzumab therapy). Addressing this issue, Efforts are being made to realize the automation and simultaneous detection of these biomarkers in a single chip that extend immunocapture beyond single marker recognition.				
22.	Enhancement of the chemotherapeutic potential of anticancer drug: Biothiol-stimulated fluorogenic strategies for adjuvant delivery of anticancer drug and GSTP1 inhibitor.	Dr. VGM Naidu	ICMR	4.00 Lakhs	2021-23
	This project is under collaboration with Chemistry department of IITG toward the development of biothiol based ligands for anti-cancer activity. Synthesis and characterisation of molecules are under progress				
23.	Pre formulation, formulation characterization and preclinical study of Dillenia indica linn extract against diabetes and diabetic complications.	Dr. Naveen Chella	ICMR	19.90 Lakhs	2021-23
	Dillenia indica Linn. also called as Elephant apple, mainly grows in Northeast India and other Asian countries. Various parts of the plant are reported to have a plethora of pharmacological activities, especially the fruit extract is reported to possess activity against Diabetes and its complications. However, no data exists about its physicochemical characterization, which helps to develop successful dosage forms and further preclinical and clinical testing of potent molecules from the natural source. Physicochemical properties such as solubility, permeability, and stability play a critical role in achieving the therapeutic effectiveness of any molecule. Many natural molecules fail to reach the market due to their poor physicochemical properties that, lead to therapeutic failure. Hence, for the first time, we want to perform preformulation screening, and formulation development followed by preclinical evaluation for a standardized fraction of hydroalcoholic extract of Dillenia indica fruit having potential activity against diabetes and its complications.				
24.	Exploration of coumarin-derivatives in treating diabetic	Dr.Bidya Dhar Sahu	ICMR	19.95Lakhs	2021-23

	nephropathy.				
	Nephropathy is an important complication of diabetes mellitus which accelerates the progression to end-stage renal disease. Diabetic nephropathy represents a major cause of morbidity and mortality, occurring in between 30 and 47% of patients with diabetes mellitus. Current therapies for diabetic nephropathy are limited, often ineffective, and have not decreased the risk of death, or renal disorders. Hence, the exploration of new pharmacological agents provides new hope for the treatment of diabetic nephropathy and may address the dire need for new therapies. Coumarins are natural products with promising pharmacological activities and have been widely used as complementary and alternative medicines. In the present proposal, we will explore and investigate whether natural occurring coumarin derivatives, Imperatorin and Scopoletin protects diabetic nephropathy in mice, and identify its possible molecular mechanisms.				
25.	Finding the mechanistic link between the progression of Non-alcoholic fatty liver disease and cardiac complication.	Dr. Sanjay K Banerjee	ICMR	8.31 Lakhs	2021-22
	NAFLD is a spectrum of liver disease which is characterized by increased lipid accumulation, inflammation and fibrosis of the liver. This proposal is focusing on to develop NAFLD in SD rats. Choline- deficient diet has been used to induce moderate to severe NAFLD in rat model. We are going to evaluate NAFLD-induced insulin resistance and cardiac phenotype during NAFLD progression. As there is close association among NAFLD, insulin resistance and ectopic lipid accumulation, insulin resistance may lead to myocardial structure abnormality and cardiac dysfunction by altering metabolic pathway in the heart. NAFLD often associated with ectopic fat accumulation in other sites such as in the epicardium. This accumulation may result from an alteration in uptake, synthesis and oxidation of fatty acids. Also, these ectopic fat depots might release various pro- inflammatory mediators and could cause structural and functional derangements of the myocardium. Lipidomic study has been performed to explore the alteration in homeostasis of cardiac lipids during progression of NAFLD. The study will elucidate the molecular mechanism of NAFLD-induced metabolic disorder and find target to prevent cardiac complication.				
26.	Therapeutic Significance of MARCKS signalling Axis in ovarian cancer Metastasis: A precision Anti-Metastatic Therapy approach.	Dr.Purusottam Mohapatra	SERB, DST	60.01 Lakhs	2022-25
	The metastatic signaling in ovarian cancer is not studied properly in Indian patient samples and probably therefore, there are no anti-metastatic therapeutic molecules available to obstruct ovarian cancer metastasis. In the present project				

	proposal, we aim to develop a therapeutic strategy against metastatic ovarian cancer by using a modified MARCKS phosphorylation-specific peptide candidate. Our results will shed light on the mechanism of MARCKS activation and the development of novel anti-metastatic peptide-based chemotherapeutic agents to inhibit ovarian cancer metastasis.				
27.	Evaluating role of SERCA activation in febrile seizure and its relation-ship with proinflammatory cytokine release	Dr.Awanish Mishra	SERB, DST	31.94 Lakh	2022-2024
	This study is proposed to investigate the effect of heat stress on the expression of calcium release- related proteins, to understand the relationship between febrile seizures, and expression of SERCA in different brain regions (thalamus, cortex, and hippocampus), and the effect of SERCA modulation in febrile seizures. This study will also establish a link between proinflammatory cytokines and SERCA expression in different brain regions (particularly, thalamus, cortex, and hippocampus) and will improve our understanding about febrile seizures.				
28.	Development of laser scribed graphene based biomedical device for multiplex	Dr. Saurabh Kumar	SERB-DST	31.87 Lakh	2021-24
	For the development of biomedical devices, a rational design and fabrication process play a key role. Multiple detection of cancer biomarkers steps involve in device fabrication and the use of the additive in printing material compromised device performance. Moreover, during device fabrication, functional structures (e.g., electrodes) are co-planar, although these are good electronic conductors but limited ionic property, which limits the efficacy of the electrochemical devices. This proposal demonstrates a scalable, fast, and direct writing approach that provides versatile device design, ease of pattern, and excellent electrochemical properties. The so-called "on-chip printed electrodes" possess excellent electronic and ionic charge carriers. Further, this versatility will be used for the fabrication of electro-chemical devices for multiplexed detection of cancer biomarkers				
29.	Synthesis and Evaluation of the Anti-metastatic Properties of Novel HuR (ELAVLl)-inhibitors Against Metastatic Breast	Dr. Kalyan Kumar Sethi	DST-SERB	28.58 Lakh	2022-24

	Cancers.				
	The objective of the project involves Synthesis and Characterization of novel HuR inhibitors. Evaluation of cellular toxicity, activity, and anti-metastatic effects of the HuR inhibitors against metastatic breast cancer cells.				
30.	Low-cost scalable process optimization for the development of ginger oleoresin, high pure gingerols, and shogaols from Assam-based ginger variety	Dr. Pramod Kumar	BIONEST NIPER Guwahati	1 lakh	2023
	Gingerols and shogaol are being isolated from the root of Zingiber Officinalis which is locally known as ginger (Adrak). Two major gingerols and shogaols are widely available in local ginger, which is 6,8,10 gingerol and 6,8,10 shogaol, and are reported to be used for the management of various diseases antinausea, antiemetic, anti-inflammatory, antioxidant, anti-tumor, and anticancer effects. Gingerols and shogaols are widely used in the food, cosmetic, and pharmaceutical industries. The global ginger market size attained a value of USD 2.48 billion in 2021. Active pharmaceutical compounds that are highly pure and certified as reference material are quite expensive. The Indian Pharmacopoeia Commission, which is part of the ministry of family and health welfare, is actively creating herbal reference materials in India, although these materials for gingerols and shogaols are not yet available. These plant-based markers have high commercial potential as APIs as well as reference material for routine QAQC for herbal industries that are actively involved in the production of ginger extract and ginger-based finished products. Therefore, it is proposed to establish a lab-scale model for ginger oleoresins, pure gingerols, and shogaols with maximum purity.				
31.	Bioengineered bilayer 3D printlets for segregated compartmental delivery of fixed dose ATDs combinations.	Dr.Subham Banerjee	NECBH DBT	11.90 Lakh	2019-21
	World Health Organization (WHO) recommends the use of first-line anti-tuberculosis drugs, that is, rifampicin (RIF) and isoniazid (INH) fixed-dose combination (FDC) therapies in tuberculosis (TB) disease. The absorption of RIF from an FDC incorporates INH, and it is significantly compromised due to its reaction with INH, resulting in a severe loss of RIF under gastric stomach pH condition. Such reduction in the dose of both drugs from FDC formulations has been alleged to be one of the chief obstacles in effective TB treatment. This emphasizes a need to develop suitable cutting-edge advanced bioengineered				

	delivery devices that can attenuate this severe problem to mitigate this chief obstacle. Therefore, we designed, prototyped, and characterized bioengineered 3D printed housing devices in the form of printed tablets adopting print and fill strategy for segregated compartmental delivery. A granted patent along with 01 publication were obtained as a outcome of this project.				
32.	3D-printed microneedles for improving antibiotic treatment adherence.	Dr.Subham Banerjee	TEQIP-III, MoE	3.0 Lakh	2019-21
	A 3D printed assembly of hollow microneedles (HMNs) array, conjoined with a reservoir void, was designed and additively manufactured using stereolithography (SLA) technology utilizing a proprietary class-I resin. The HMNs array was utilized for transdermal delivery of high molecular weight antibiotics, i.e., rifampicin (Mw 822.94 g/mol), which suffers from gastric chemical instability, low bioavailability, and severe hepatotoxicity. HMNs morphology was designed with sub-apical holes present in a quarter of the needle tip to improve its mechanical strength and integrity of the HMNs array. One ational publications were published from this project.				
33.	Responsive Self-folding Feedstock for Pharmaceutical 4D Printing Applications.	Dr.Subham Banerjee	SERB-SIRE	8.27 Lakh	2022-23
	In this study, we synthesised and characterised a poly(n-isopropyl acrylamide-4-acryloyloxy benzophenone) i.e., p(NIPAM-4ABP) based thermo-responsive self-folding shape-memory polymer with an excellent shape-memory behaviour. The lower critical solution temperature (LCST) of the synthesised p(NIPAM-4ABP) was determined using dynamic light scattering (DLS) analysis to determine the effect of the addition of 4-ABP to the pNIPAM network. Fourier transform infrared spectroscopy (FT-IR) was used to understand the reversibility of the shape-memory mechanism of the synthesised feedstock. A swelling study in different solvents was performed as a driving force to further encapsulate the drug molecules into p(NIPAM-4ABP) network. Finally, the shape memory behaviour of this synthesized polymer was established via converted it into p(NIPAM-4ABP) feedstock to validate the excellent shape memory features. Two Publications are communicated as an outcome from the project				
34.	Prototyping of Transdermal Patches by Innovative 3D Printing Platform Technology.	Dr.Subham Banerjee	AMTZ Vizag	10 Lakh	2022-23
	The drug-loaded polymeric constructs fabricated using the powder based extrusion-based innovative 3D printing techniques proved that the drug delivery systems could be produced to have high loading efficiency and good				

	stability of the incorporated drug, even if the drug was subjected to high temperatures during the manufacturing process. We hypothesize that a 3D-printed transdermal patches containing a drug could be easily manufactured through innovative powder extrusion process as feedstock through innovative technology mediated deliver platform, and can easily be applied to the skin surface via reducing the extreme hazards associated with extensive fast-pass metabolic effect of drug through oral delivery. In addition, it's believed to be non-invasive, needle free, painless with high treatment adherence.				
35.	Biofilament derived 3D Printed Antimicrobial Wound Dressing for Advanced Wound Care.	Dr.Subham Banerjee	AMTZ Vizag	10 Lakh	2022-23
	Based on the AMTZ call for proposal mandate under the areas of innovation viz. 3D Bioprinting in Advanced Wound Care, we hypothesized that biofilament derived 3D printing could possibly revolutionise patient care by allowing custom-manufacture of devices for individual patients and it is the exploration of this concept, applied specifically to wound dressings, that is the focus of this work. A potential biofilament will be feeded into the FDM mediated 3D printer to fabricate advanced wound dressings against virtual CAD templates of a target wound. Then, further the antimicrobial efficacy of the proposed advanced wound dressings needs to be assessed using an *in-vitro* assay.				

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From the Director's Desk

Prof. V. Ravichandiran

NIPER Hajipur is established to meet the country's healthcare needs by providing pharmaceutical education and research. Institute offers MS (Pharm) and Ph.D. programs in six departments: Biotechnology, Pharmacy Practice, Pharmacology and Toxicology, Pharmaceutics, Pharmaceutical Analysis, and Regulatory Toxicology.

The scholars are being trained with strong basics and analytical skills development in the relevant field as per the country's requirement of human resources as an "Atamnirbhar Bharat" The institute is continuously striving hard to enhance the quality of education of existing programmes as per the current requirements of invention and innovation and also to meet the global standards and to attain India's recognition as a "Pharmacy of the World".

The institute has also been recognized in the band of "Band Beginners" under the category "Institute of National Importance & Central Universities/CFTs (Technical)" in ARIIA 2021 by the Ministry of Education, Govt. of India. NIPER Hajipur is among the top 100 colleges of Pharmacy in India, ranking 75th on the NIRF Ranking 2022. The institute has also been recognized as Adverse Drug Reaction Monitoring Center (AMC) under the Pharmacovigilance Programme of India (PvPI) & Medical Device Adverse Event Monitoring Center (MDMC) under the Materiovigilance Programme of India by Indian Pharmacopoeia Commission, Ghaziabad.

NIPER-Hajipur's common research programme mainly focuses on the categories of biological, formulation sciences, and medical devices. In particular, it is developing 'personalized' solutions that utilize basic biology, biotechnology, pharmacology, and micro- and nano-scale technologies to enable a range of therapies for cancer and a particular focus on neurodegenerative disorders and creating a 3-dimensional patient-derived in-vitro model system for drug screening. NIPER Hajipur is working with other NIPERs to evaluate traditional Indian medicine reversing diabetes-induced neuro and nephrotoxicity. Institute has also developed murine cortical 3D cell culture/organoid, and the results have been disseminated in NIPER-PHARMACON 2022.

I am sure that in the coming years, NIPER Hajipur will attain greater heights in the areas of advanced pharmaceutical sciences.

EXTRA-MURAL RESEARCH PROJECTS:

S. N.	Project Title	Principal Investigators and Centre coordinator's	Funding Agency	Funding Amount	Duration
1.	Development of enzyme-mimicking polymeric nanomaterials for biomedical applications	Dr. Abhishek Sahu	DST-SERB	30 Lakhs	2 years
	Enzyme mimicking system that can alleviate oxidative stress has enormous potential as future generation of nanomedicine against many diseases. Nanozyme is an emerging field of research, anticipated to grow exponentially and open up new avenues for various biomedical fields such as biosensing, bioimaging, and theranostic. In this project the objective is to synthesize biocompatible/biodegradable polymer-based nanosystems with enzyme-mimetic activities that can be applied for the treatment of various acute and chronic diseases. The biocompatibility and biodegradability aspect of the proposed polymer-based nanozyme system makes it attractive for clinical development as well as commercialization.				
2.	Efficient process development strategies for prevalent "Rare disease" drugs	Murali Kumarasamy Co-PI, Dr.Vipan Parihar (co-PI)	DST Rare Disease Program Grant	700 Lakhs INR	5 years
3.	Modulation of fluoride-induced histopathological, cognitive-behavioural alteration in adult and developing rodents by naringin	PI: Dr. Nitesh Kumar, PT, NIPER Hajipur Dr. V. Ravichandiran, NIPER Hajipur, Dr. Smitha Shenoy, Department of Pharmacology, KMC,MAHE, Manipal, Dr. Ravindra Shantakumar Swamy, Department of Anatomy, MMMC, MAHE, Manipal	ICMR	29.92 Lakh	3 Years
	Recent literature have some publications indicating chemicals or alkaloids effective in fluorosis. One of the recent publication (Atmaca et al, 2014) have shown biochemical and histological effect of Resveratrol on sodium fluoride 100ppm induced deficits in brain tissue of experimental rat. The present research is much more novel, unique and different in the following ways. The present research emphasizes on the behavioural changes brought about by				

	minimum dose of sodium fluoride such as anxiety, depression, attention deficit hyperactivity syndrome and cognition deficits. The present study attempts to evaluate the effect of sodium fluoride on mitochondria and endoplasmic reticulum with the help of Bax/Bcl2 ratio and caspase estimation. The present study attempts to find prenatal and postnatal effect of sodium fluoride on behavioural, Histopathological and biochemical changes and its ameliorative effect by Naringin. Histology of brain tissue includes Golgi stain which quantifies dendritic arborisation, branching point and spine density in hippocampus, prefrontal cortex and locus coeruleus to determine and confirm the behavioural and cognitive changes due to sodium fluoride and its amelioration by Naringin. For the first time locus coeruleus is being investigated for its histological changes such as neurodegeneration and dendritic arborisation induced by sodium fluoride. None of the above have been studied in the Atmaca et al, 2014 or any previous study. Moreover the dose of sodium fluoride used in those studies is 100ppm which is much higher as compared to human exposure. In India 66 million are at risk of fluoride contamination. Excess Fluoride in drinking water results in Dental fluorosis, skeletal fluorosis and Behavioural changes along with learning and memory deficits. Attention deficit hyperactivity disorder, depression, anxiety, decreased learning ability and low IQ has been observed in children due to excess fluoride contamination in drinking water. Dietary supplement with citrus fruits containing Naringin will help avoid and reverse fluorosis induced behavioural changes as a result of its antioxidant, anti-inflammatory and neuroprotective effect.				
4.	Role of sirtuins in the gender based neurodevelopmental toxicity in fluorosis: a preclinical study	Dr. Smitha Shenoy, HOD, Department of Pharmacology, KMC, Manipal Dr. Nitesh Kumar, PT, NIPER Hajipur (CO-PI), Dr. Sivakumar G Kasturba Medical, College, Manipal, Karnataka, Dr.Somasish Ghosh Dastidar, Kasturba Medical College, Manipal, Karnataka	ICMR	30.13 Lakh	3 Years
	Developing brain is highly vulnerable to environmental toxins. Consumption of beetroot, a rich source of vitamins, minerals and other phytoconstituents has been encouraged as part of nutritional enrichment strategy in fluorosis. Objective of the study is to evaluate the protective effect of betanin on fluoride induced neurotoxicity. The novelty of the study is its focus on a natural product betanin as a preventive intervention against adverse behavioural and neurochemical alterations caused by fluoride in neonates and adult rats. Betanin is present in beetroot which is currently a part of dietary intervention in fluorosis prevalent areas. Docking study: All the phytochemicals will be screened using standard precision and extra precision mode in flexible ligand docking in glide. For each ligand, the docking score and binding energy will be recorded. Molecular dynamic simulation study: Selected modulator will be used for				

	molecular dynamics simulation on selected sirtuin 1. In-vitro study: SHSY5Y cells will be treated with sirtuin 1 modulator + sodium fluoride (NaF) and compared versus untreated control cells and NaF alone treated cells. Wistar rats will be taken for this study. Wistar rats were divided into 7 groups. Group I (Control) will be administered with drinking water. Group II received NaF (10mg/kg). Group III and IV received Betanin (100 and 200mg/kg) respectively. Group V, VI and VII received Betanin (50, 100 and 200mg/kg) along with NaF (10mg/kg). All treatment will be administered orally for 8 weeks both prenatal and postnatal exposure. Novel object recognition test, Open field test and Morris water maze test was performed at 8th and 12th week followed by molecular and biochemical estimations.

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UTILITY PATENT APPLICATION:

1. Pranay Wal, V. Ravichandiran, Ankita Wal, Ashwini K. Rai, Krishna murti, Nitesh Kumaer, Sameer Dhingra, Harshit Chaurasia. Title: "A chewing Gum Disolution apparatus for improved drug release study. Indian Patent Number-40222 Application Number 2021110567886 A. Date of Filing: 7/12/2021, Publication Date 17/12/2021

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From the Director's Desk

Dr Shashi Bala Singh

NIPER Hyderabad started its journey in 2007. The institute has a total of eleven academics departments [M.S. (Pharm.) (Medicinal Chemistry, Pharmaceutical Analysis, Pharmacology and Toxicology, Pharmaceutics, Regulatory Toxicology, Natural Products, Pharmacoinformatics, Regulatory Affairs & MTech (Process Chemistry & Medical Devices) and MBA (Pharm.)], which hosts more than 363 students pursuing post-graduate studies. About 138 PhD Students are pursuing their research for doctoral degree programmes.

The continuous efforts made in the last few years by NIPER Hyderabad have resulted in the 2nd rank (Score: 79.46) in the 'Pharmacy' category in the National Institutional Ranking Framework (NIRF) ranking during the year 2021-22.

The Institute faculty is active in a broad spectrum of research in cancer, inflammation, arthritis, diabetes, neurodegenerative and infectious diseases, and anti-microbials, starting from Drug Discovery to Formulation Development and Preclinical studies. Some of the key research areas of NIPER, Hyderabad is:

- Synthesis of New Chemical Entities (NCEs) for Anti-Cancer, Anti-inflammatory etc.
- Innovative strategies for the synthesis of natural/unnatural or key intermediates/ building blocks
- Combinatorial chemistry and Computer Aided Drug Design (CADD)
- Green chemistry protocols for pharmaceutical importance and to preserve nature.
- Biocatalysis and Biotransformation, which include a biocatalytic route to synthesise APIs
- Diabetes and diabetic neuropathy research
- Peptidomimetics as therapeutic agents and Drug Delivery Systems
- Impurity Profiling and Analytical Method Development
- Standardization of Herbal drugs
- Stability Improvement Methods
- In vitro and In vivo Screening of New Chemical Entities (NCEs) for various activities
- Drug Metabolism and Pharmacokinetic studies (DMPK)
- Novel Drug Delivery Systems and Nanomedicine
- Improvement in Bioavailability
- Application of QBD in Formulation Design and Processing
- Bioavailability improvement using nanotechnology, lipid-based systems and crystal engineering techniques.
- Co-crystal, polymorphism and amorphism study and characterisation
- Thermal characterisation of drugs and small molecules

- Affordable Medical and PoC Devices such as Paper-based Microfluidic Devices (PBMD), Lateral Flow Immunoassay (LFIA), Polymer Microfluidic devices and their application in clinical diagnosis.
- Portable/handheld electronic devices, Dual chamber injectors (Epi-injections) and Dual chamber pediatric dosing system
- Organoids and Organ-on-a-chip, as platform technology as an alternative to animal testing for high throughput drug screening and as Disease models
- 3D bioprinting and microfabrication

EXTRA-MURAL RESEARCH PROJECTS

S.N.	Title of the Project	PI and Co PI	Name of Funding Agency	Sanctioned Amount	Duration of the project
1.	Lateral Flow Immunoassay based Point-of-Care Oral Cancer Diagnostic kit (OCDk)	Dr. Vivek Borse	Department of Science and Technology, Govt. of India	110 Lakh	5 years
	The proof of concept is to be established through the project for POC detection of oral cancer biomarkers. The project deal with the developmen of a PoC Later flow detection systysmt for detection of oral cancer using oral cancer markers such is IL6 and IL8 etc.				
2.	Comprehensive three-dimensional structural analysis of macrocyclic peptide disulfides by biophysical methods	Dr. Rajesh Sonti	DST-SERB-SRG	27.30 Lakh	2 years
	The project deals with the determination of 3D solution structure of this first-in-class peptide drug using NMR Studies. The study incorporates aromatic, D-amino acids and prolines at strategic positions to generate different macrocyclic rings by using synthetic peptides. Based on above data structures will be calculated and the role of disulfide conformations will be evaluated using NMR				
3.	Structure elucidation of Ibuprofen related 2 unknown impurities	Dr. Rajesh Sonti	Granules India Ltd	3.87Lakh	0.16 Years
	The project deals with the structure elucidation of Ibuprofen-related two unknown impurities, which funding company Granules India Ltd would like to do. The structure elucidation of these impurities will be done using NMR and Mass.				
4.	Determination of PDMS in the octreotide formulation using qNMR	Dr. Rajesh Sonti	Orbicular Pharmaceutical Technologies Pvt. Ltd.	0.45 Lakh	0.08 Years
	M/s Orbicular Pharmaceutical Technologies Pvt provides the project. Ltd, wherein they would like to determine and quantify PDMS content in the octreotide formulation using qNMR".				
5.	NMR Feasibility studies for a comparative study	Dr. Rajesh Sonti	Orbicular Pharmaceutical	1.5Lakh	0.08 Years

	between their drug product and innovator product		Technologies Pvt. Ltd.		
	Orbicular Pharmaceutical Technologies Pvt. Ltd has given this project to establish NMR-based studies comparative study between their drug product and innovator product.				
6.	To study the efficacy of therapeutic plant molecule in animal models to treat Chronic Obstructive Pulmonary Disease (COPD) by the lung regeneration/repair process	Dr. Dharmendra Kumar Khatri	NBI Bioascience PVT LTD. Gurgaon	24.27 Lakh	1 year
	To study the efficacy of therapeutic plant molecule in animal models to treat Chronic Obstructive Pulmonary Disease (COPD) by the lung regeneration/repair process. The COPD model was successfully developed using smoking of 5 cigarettes/group per day and pollution (Burning smoke of Saw dust)/day for a period of 30 days. The animals were treated with the formulation for 60 days provided by the sponsored and showed significant recovery. The project deals with the efficacy of therapeutic plant molecules in animal models to treat Chronic Obstructive Pulmonary Disease (COPD) through the lung regeneration/repair process. The COPD model was successfully developed using the smoking of 5 cigarettes/group per day and pollution (Burning smoke of Saw dust)/per day for a period of 30 days. The animals were treated with the formulation for 60 days provided by the sponsor and showed significant recovery.				
7.	To perform the stereotaxic surgery using rotenone to create mice model of Parkinson's Disease	Dharmendra Kumar Khatri	Sai Life Sciences, Hyderabad	1.77 Lakh	0.2 Years
	The main objective of this project was to develop Rotenone-induced mice model of Parkinson's disease using a stereataxic instrument. The methodology employed in the present project is the chronic surgical procedure. The duration of reach bilateral surgery is 40-50 minutes. The surgical procedure is very complex as it requires expert to perform this surgery and the number of animals living after post-operation is critical.				
8.	Development of Parkinson's model in mice utilizing stereotaxic	Dharmendra Kumar Khatri	Sai Life Sciences, Hyderabad	3.70 Lakh	0.3 Years

	equipment via ICV injection				
	The present proposal involves the ICV injection of chemical to induce PD mouse model which is very well established and practiced both national and globally for pre-clinical drug discovery. This chemical-induced PD model is used extensively to screen drug candidates having anti-Parkinson's activity. The animal model performed with ICV injection using the stereotaxic instrument and was done successfully The present proposal involves the ICV injection of chemical to induce PD mouse model which is very well established and practiced both national and globally for pre-clinical drug discovery. This chemical-induced PD model is used extensively to screen drug candidates having anti-Parkinson's activity. The animal model performed with ICV injection using the stereotaxic instrument and was done successfully				
9.	Evaluation of Efficacy of Test compound in U87-MG (Human glioblastoma) orthotopic mouse model	Dharmendra Kumar Khatri	Sai Life Sciences, Hyderabad	0.84 Lakh	0.3 Years
	The present proposal involves the ICV injection of chemical to induce PD mouse model which is very well established and practiced both national and globally for pre-clinical drug discovery. This chemical-induced PD model is used extensively to screen drug candidates having anti-Parkinson's activity. The animal model performed with ICV injection using the stereotaxic instrument and was done successfully The present proposal involves the ICV injection of chemical to induce PD mouse model which is very well established and practiced both national and globally for pre-clinical drug discovery. This chemical-induced PD model is used extensively to screen drug candidates having anti-Parkinson's activity. The animal model performed with ICV injection using the stereotaxic instrument and was done successfully				
10.	Role of age- and sex-specific gut microbiota in brain injury for microbiome-based therapeutics	Dr. Manoj P. Dandekar	DST-SERB	32.69 Lakh	2 years
	Assessment of intestinal microbial communities in the regulation of neurological and neuropsychiatric consequences in age- and sex-dependent manner after brain injury? Investigation of changes in gut-microbiome brain signaling Brains and blood samples will be processed for the neuroinflammatory, neuronal cell death and proliferation marker and CRF expression. We have been analyzing the specific gut microbial communities to design potent bacteriotherapy. The results of this project may help to derive the microbiome-based therapy for addressing the gender-specific neurological and neuropsychiatric behaviors occurs post-TBI.				

	The project Investigates changes in gut-microbiome brain signalling Brains, and blood samples will be processed for the neuroinflammatory, neuronal cell death and proliferation marker and CRF expression. In project NIPER, Hyderabad analyses the specific gut microbial communities to design potent bacteriotherapy. This project's results may help derive the microbiome-based therapy for addressing the gender-specific neurological and neuropsychiatric behaviours that occur post-TBI.				
11.	To examine the therapeutic potential of pan-bacteria + glutamine in the management of obsessive-compulsive disorders (OCD) in Wistar rats. 2. To assess the safety of 2 probiotics (*Streptococcus salivarius* and *Bacillus subtilis*) products in Sprague-Dawley rats.	Dr. Manoj P. Dandekar	Unique Biotech	7.5 Lakh	10 months
	To examine the therapeutic potential of Cognisol (pan-bacteria + glutamine) in the management of obsessive-compulsive disorders (OCD) in Wistar. rats. To assess the safety of 2 probiotics (Streptococcus salivarius UBSS-01 and Bacillus subtilis UBBS-14) products in Sprague-Dawley rats. WE found promising effects of probiotic in OCD model. Streptococcus salivarius UBSS-01 and Bacillus subtilis UBBS-14 found safe in rat study. In this project, the therapeutic potential of Cognisol (pan-bacteria + glutamine) in managing obsessive-compulsive disorders (OCD) in Wistar rats is being investigated. This will help assess the safety of 2 probiotics (Streptococcus salivarius UBSS-01 and Bacillus subtilis UBBS-14) products in Sprague-Dawley rats. It was found that promising effects of probiotics in the OCD model. Streptococcus salivarius UBSS-01 and Bacillus subtilis UBBS-14 were safe in the rat study.				
12.	To examine the therapeutic potential of multi-strain probiotic + glutamine and Bacillus coagulans Unique IS-2 in vascular dementia model of rats	Dr. Manoj P. Dandekar	Unique Biotech	5.0 Lakh	10 months
	To examine the therapeutic potential of multi-strain probiotic + glutamine and Bacillus coagulans Unique IS-2 in vascular dementia model of rats.				

	We are testing the efficacy of this probiotic in rat model of vascular dementia. In this project, the therapeutic potential of multi-strain probiotic + glutamine and Bacillus coagulans Unique IS-2 in a vascular dementia model of rats. Apart from therapeutic potential, the efficacy of this probiotic in a rat model of vascular dementia.				
13.	NHC catalyzed asymmetric synthetic transformations with allene compounds	Vinaykumar Kanchupalli	DST	128.6 Lakh	5 years
	Synthesis and characterization of various derivatives of allene compounds • Synthesis and characterization of various imine compounds • Optimization with different Chiral NHC catalysts • Generality and substrate scope of methodology • Mechanistic studies for the important reaction The project deals with developing NHC catalysed asymmetric synthetic transformations with allene compounds. The project also deals with the Synthesis and characterisation of various as-synthesis imine compounds and Optimization with different Chiral NHC catalysts				
14.	Development, evaluation and characterization of hydrophobic nanoparticles impregnated fabrics to be assessed as dress materials for defence	Dr. Saurabh Srivastava and Dr.Neelesh Kumar Mehra	DRDO, TEZPUR	9.9 Lakh	1 year
	The project has been successfully completed with development and evaluation of Fabric with Impregnated hydrophobic Nanoparticles. The project is related to developed and evaluation of Fabric with Impregnated hydrophobic Nanoparticles for defence applications.				
15.	Development and evaluation of oral drug delivery systems for colon targeting of drugs for the local & systemic actions	Dr. Saurabh Srivastava and Dr. Dharmendra Kumar Khatri	NBI Elements Gurugram	8. 26 Lakh	1 year
	Development and evaluation of oral drug delivery formulation, which will target colon targeting of drugs for the local & systemic actions The project is NBI Elements Gurugram funded for the development as well as evaluation of oral drug delivery formulation, which will target colon targeting of drugs for the local & systemic actions				
16.	Enterpreneurship Development	Dr B Lakshmi	DBT-TSCOST	48 Lakh	3 years

	Program				
	TSCOST To train 10 participants for entrepreneurship for Six months duration Conduct the program as defined Outcomes: Successful completion of the training and certification by Life Sciences Sector Skill Development Council (LSSSDC) The project deals with training 10 participants in entrepreneurship in Six months duration in the Life Sciences Sector.				
17.	Developing the novel P450 enzymes for aromatic nitrations	Dr. Priyanka Bajaj	DST	112.4 Lakh	5 years
	Developing novel nitrating p450 for API synthesis In this DST-funded project, NIPER, Hyderabad, is developing novel P450 enzymes for aromatic nitrations for API synthesis.				
18.	Development of biocatalytic cyclopropanation process for the synthesis of pharmaceuticals precursors at gram scale.	Dr. Priyanka Bajaj and Dr. Vikas Tyagu, TIET, Patiala	DBT-BIRAC	50 Lakh	2 years
	Engineering Myoglobin for API synthesis This DBT-BIRAC-funded project is to develop a biocatalytic cyclopropanation process for synthesising pharmaceuticals precursors Myoglobin for API synthesis at the gram scale.				
19.	Biocatalytic synthesis of Eslicarbazapine	Dr. Priyanka Bajaj and Dr. Vinay Kumar, NIPER, HYD	Amilife Sciences	42 Lakh	0.5years
	Biocatalytic synthesis of Eslicarbazapine In this project team of NIPER, Hyderabad was involved in developing a biocatalytic route to synthesise Eslicarbazepine for Amilife Sciences				
20.	Exploiting the electron transfer (ET) parameters for the prediction of selectivities in Cytochrome P450 (CYP450) catalyzedbiotransformations of industrial importance”	Dr. Vaibhav Dixit and Dr. Priyanka Bajaj	IISC, Bangalore	19.16 Lakh	2 years

	Elucidation of mechansim of Electron Transfer in P450BME3 The project deals with Exploiting the electron transfer (ET) parameters for the prediction of selectivities in Cytochrome P450 (CYP450) catalysed biotransformations for industrial importance process				
21.	Building Innovative Ecosystems: Lesson from a Comparative Study on Pharmaceutical and Medical Devices Industries of India and Taiwan	Dr. B. Lakshmi	Indian Council of Social Science Research (ICSSR), Ministry of Education	118.2Lakh	2 yrs
	Collaboration with Institute of Management of Technology, National Yang Ming Chiao Tung University, Taiwan Objectives: Comparative Study of Pharmaceutical and Medical Devices innovation eco-system in India and Taiwan Deliverables: Develop research instruments to collect data from the Indian & Taiwan Pharmaceutical & Medical Devices Companies, policy bodies, and research organizations in both countries. Analyze the data and report the conclusions and suggestions for the way forward. The project deals with a comparative study of the Pharmaceutical and Medical Devices innovation eco-system in India and Taiwan and analyses the data and reports. To suggest the way forward to improve the ecosystem				
22.	Targeting the cytochrome bd oxidase for the development of rational drug combination for tuberculosis	Nitin Pal Kalia	Department of Biotechnology, New Delhi, Govt of India	113.6 Lakh	5 years
	Indentification and characterization cyt-bd inhibitors. Effect of cyt-bd inhibitors on potency of Q203. Combination of cyt-bd inhibitors with other anti-tuberculosis drugs targeting oxidative phosphorylation. Target validation and characterization for cyt-bd inhibitors.Objective 5. Efficacy of combinations on animal model of tuberculosis. In this project, NIPER, Hyderabad targets the cytochrome bd oxidase to develop a rational drug combination for tuberculosis. The project starts with the identification and characterisation of cyt-bd inhibitors, followed by the effect of cyt-bd inhibitors on the potency of Q203. Later, the project will deal with the combination of cyt-bd inhibitors with other anti-tuberculosis drugs targeting oxidative phosphorylation. Eventually, the team will perform target validation and characterisation for cyt-bd inhibitors, followed by an efficacy study of combinations on an animal model of tuberculosis.				
23.	Identification of Novel Topoisomerase Inhibitors	Nitin Pal Kalia	SERB-DST, New Delhi, Govt of India	31.66 Lakh	2 years

	targeting Pseudomonas aeruginosa				
	Identification of novel scaffolds targeting Type II Bacterial Topoisomerase in P. aeruginosa. Target validation, characterization, and in vitro safety of Type II topoisomerase inhibitors. Effect of Type II topoisomerase inhibitors on biofilm formation in P. aeruginosa. *In vivo* efficacy of identified type II topoisomerase inhibitors of *P. aeruginosa*. The project deals with identification of Novel Topoisomerase Inhibitors targeting Pseudomonas aeruginosa. Once identified the in vivo efficacy of identified type II topoisomerase inhibitors of P. aeruginosa will be carried out.				
24.	Generation and Structural Characterization of Modified Solid-state Forms of APIs (Grant for PhD Fellowship)	Amol G. Dikundwar	Bristol Myers Squibb Company, USA	7.44 Lakh	1 year
	Generation and Structural Characterization of Modified Solid-state Forms of various APIs This deals with the generation and structural characterisation of modified solid-state various APIs				
25.	Tracing a Root Cause for the Formation of N-methyl Impurity in Norfloxacin	S. Gananadhamu and Amol G. Dikundwar	Nakoda Chemicals Limited, Hyderabad	1.8 Lakh	0.5 years
	To identify the Root Cause for the Formation of N-methyl Impurity in Norfloxacin in this project niper, team is trying to identify the cause and mechanism for the formation of n-methyl impurity in norfloxacin				
26.	Quantification of Polymorphic Impurity in Famotidine API (advisory project)	Amol G. Dikundwar	Nakoda Chemicals Limited, Hyderabad	0.70 Lakh	0.5 years
	Quantification of polymorphic impurity in an API The project is an advisory project to help Nakoda Chemicals Limited, Hyderabad, quantify Polymorphic Impurity in Famotidine API.				
27.	To explore the Mycobacterium tuberculosis transcription terminator factor Rho mediated lethality for drug discovery	Nitin Pal Kalia	ICMR	22.08Lakh	3 years
	To identify Mycobacterium tuberculosis transcription terminator factor, Rho				

	mediated lethality for drug discovery In this project, PI is exploring the Mycobacterium tuberculosis transcription terminator factor Rho mediated lethality which can be used for drug discovery				
28.	Biocatalytic Process optimization for synthesis of Sitagliptin	Dr. Priyanka Bajaj	AmilifeSciences	30.33 Lakh	0.5 years
	Process optimization for synthesis of Sitagliptin In this project, NIPER, Hyderabad faculty has developed and optimised a biocatalytic Process for the synthesis of Sitagliptin for the Amilife Sciences				
29.	A Workshop on Preclinical and Molecular Neuropharmacology Training	Dr. Manoj Dandekar	SERB	4.00Lakh	3 months
	Preclinical and Molecular Neuropharmacology Training" scheduled on September 12-19, 2022 We provided training to 21 students participated from all over the India. The project was to conduct a workshop on preclinical and molecular neuropharmacology to train the 21 participants from all over India				
30.	To Examine the Role of Gut Microbiome in the Manifestation and Treatment of Depression Using Preclinical and Clinical Studies	Dr. Manoj Dandekar	IBRO	5.18 Lakh	1 year
	To Examine the Role of Gut Microbiome in the Manifestation and Treatment of Depression Using Preclinical and Clinical Studies This is a collaborative research grant to visit the University of Cork, Ireland. This is collaborative research with the University of Cork, Ireland to Examine the Role of Gut Microbiome in the Manifestation and Treatment of Depression Using Preclinical and Clinical Studies				
31.	Decoding the catalytic mechanism and active site of very unique and novel Nitrating P450 with the aim of developing an efficient artificial metalloenzyme for regio- and chemospecific aromatic	Dr. Priyanka Bajaj	DST-SERB-SRG	29.89 Lakh	2 years

	nitrations				
	Elucidation of the mechanism of Nitrating P450 In this project, PI is decoding the catalytic mechanism and active site of unique and novel Nitrating P450 to develop an efficient artificial metalloenzyme for regio- and them specific aromatic nitrations and elucidation of the mechanism of Nitrating P450				
32.	Co-amorphous forms for Bioavailability Enhancement of poorly soluble drugs: Design, synthesis, characterization and in vivo studies	Dr. Amol G. Dikundwar	DST-SERB-SRG	30.42Lakh	2 years
	Devemopment of co-amorphous forms of poorly water soluble drugs The project PI would like to design, synthesis, characterisation and perform in vivo studies for the Co-amorphous forms of poorly soluble drugs in order to Enhance the bioavailability				
33.	Development of Novel Eye Drops of fixed dose combination for Effective Ocular Delivery	Dr Neelesh Kumar Mehra and Dr Dharmendra Khatri & Dr Vivek Singh	DST-Nanomission	29.20Lakh	3 Years
	Main aim in the present investigation, to design, development and evaluation of novel nanoformulation for selective drug delivery in treatment of ocular disease (glaucoma). We select the hydrophilic drug and Prostaglandin analogues) for development with extensive characterization using physicochemical techniques followed by in vitro and in vivo studies for pre-clinical testing Main aim in the present investigation, to design, development and evaluation of novel nanoformulation for selective drug delivery in treatment of ocular disease (glaucoma). We select the hydrophilic drug and Prostaglandin analogues) for development with extensive characterization using physicochemical techniques followed by in vitro and in vivo studies for pre-clinical testing				
34.	Process improvement for the stage-II of Acetazolomide	Dr. Y. V. Madhavi	Nakoda Chemicals Pvt. Ltd	1.80Lakh	1 year
	Cost improvement over the existing process The project aim is to improve the process for stage II of Acetazolomide used by Nakoda Chemicals Pvt. Ltd, to make the process more affordable than the existing process				

35.	Therapeutic Potential of the Nanoformulations for Wound Healing Activity in Diabetic Foot Ulcer	Dr Neelesh Kumar Mehra	DST-SERB-SRG	26.43Lakh	2 Years
	Development of the topical formulation for Diabetic foot ulcer In this project, PI is developing topical Nanoformulations for Wound Healing Activity in Diabetic Foot				
36.	Development and Evaluation of Functional Nanoformulations for Effective Management of Colorectal Cancer	Dr Neelesh Kumar Mehra	DST inspire Department of Science and Technology, Govt. of India	24.62 Lakh	5 Years
	Development of novel formulation for colorectal cancer The project is to develop and evaluation of functional nanoformulations for effective management of colorectal cancer				
37.	Novel synthetic process and formulation development of ELIGLUSTAT tartrate	Dr. Y.V. Madhavi and Dr. K. Vinay Kumar, Dr. Pankaj Kumar Singh, Dr. Nitin Pal Kalia	DST	45 Lakh	3 years
	To develop a cost effective process for the API, Eliglustat which is used for the treatment of Gaucher's disease, a rare disease The project deals with developing a cost effective process for the API, Eliglustat which is used for the treatment of Gaucher's disease, a rare disease				
38.	Pharmacological activities and pre-clinical screening of the promising unani medicines against hepatic disease	Dr Neelesh Kumar Mehra	CCRUM New Delhi	24.53Lakh	3 years
	Development of new formulation for NASH Project involves pharmacological activities and pre-clinical screening of the promising unani medicines against hepatic disease				
39.	Determination of residual catalase and monoamine oxidase enzyme in drug sample by	Dr. Sandeep Kumar	Hikal	4.36Lakh	6 months

	sodium dodecyl sulfate polyacrylamide gel electrophoresis				
	To carryout the protein content estimation in the drug with SDS PAGE Hikal Pharmaceutical gave this project to develop a method for determining residual catalase and monoamine oxidase enzymes in drug samples by sodium dodecyl sulfate-polyacrylamide gel electrophoresis.				
40.	Synthesis of Empagliflozin Intermediate (advisory)	Dr. Srinivas Nanduri	Nakoda Chemicals Pvt. Ltd	0.70 Lakh	6 months
41.	Repurposing Oxiconazole:Alone and in combination with PUFA's as a broad spectrum antibacterial	Dr. Siddharth Chopra and Dr. Srinivas Nanduri	DBT	39.41 Lakh	3 Years
	To evluate the anti-bacterial potential of Oxiconazole, a repurposed anti-fungal drug and study its synergistsic activity with other FDA approved drugs such as Gentamycin, Amikacin & Daptomycin leading to combination drugs In this project, the NIPER team is evaluating the anti-bacterial potential of Oxiconazole, a repurposed anti-fungal drug and studying its synergistic activity with other FDA-approved drugs such as Gentamycin, Amikacin & Daptomycin leading to combination drugs				
42.	Design, synthesis and biological evaluation of new GSK3β inhibitors as promising therapeutic agents for treating Traumatic brain injury and consequent neuronal degenerative diseases	Dr. Srinivas Nanduri and Dr. Y. V. Madhavi, Dr. D. K. Khatri, Dr. Kailash Manda,	ICMR	49.90Lakh	3 Years
	To synthesize various new chemical entities targetting GSK-3B enzyme for treatment of Traumatic brain injury and consequent neurological diseases like AD and PD The project involves synthesise of various new chemical entities targeting GSK-3B enzyme for the treatment of Traumatic brain injury and consequent neurological diseases like AD and PD				
43.	Development of scalable, safe and	Dr. Y. V. Madhavi and	National Research and	10 Lakh	1 year

	cost effective process for the API of Umifenovir(Arbidol) a promising repurposed drug for COVID19 in India	Dr. Srinivas Nanduri	Development Corporation		
	To develop a cost effective and safe process for Arbidol(Umifenovir) Project involved the development of a scalable, safe and cost-effective process for the API of Umifenovir (Arbidol), a promising repurposed drug for COVID-19.				
44.	Advances in the Natural Products Research for the Treatment of Infectious Diseases and Metabolic Disorders	Dr Venkata Rao	DST-SERB Symposia/Seminar	1.50Lakh	3 Months
	Objective was to bring recent advancement in use of natural product for various treatment The project was to organise a seminar on Advances in Natural Products Research for the Treatment of Infectious Diseases and Metabolic Disorders.				
45.	Design and development of herbal formulation to improve flow properties	Dr. Pankaj K. Singh and Dr. Saurabh Srivastava	EpigeneresPvt. Ltd.	5.54 Lakh	0.33 Year
	To improve flow properties of powder formulation containing phytopharmaceutical and fill in capsule				
46.	Troubleshooting of powder formulation issues	Dr. Pankaj K. Singh	EpigeneresPvt. Ltd.	2.59Lakh	0.25 Year
47.	Analysis the role of extracellular vesicles (Exosomes) in drug tolerant persister cells and its contribution to cancer-initiation	Dr. Santosh Kumar Guru	DST-SERB	2.60 Lakh+ 4. 0 Lakh	2+1year (Extended)
	Use of Exosome in Diagnostic marker for breast cancer. In this project, PI is involved in analysing the role of extracellular vesicles (Exosomes) in drug-tolerant persister cells and its contribution to cancer initiation. The exosome discovered in this project will be used as a Diagnostic marker for breast cancer.				
48.	Targeting Chemoresistance	Dr. Santosh Kumar Guru	DHR	49.98Lakh	3 Years

	in Breast Cancer				
	To overcome chemo resistance in breast cancer Cancer is a major public health burden in both developed and developing countries. The one of the main causes of the failure of cancer treatment and increase of mortality rate during cancer is due to development of drug resistance in cancer cells. Drug resistance can be associated with some of important mechanisms, among them autophagy and neovascularisation has got more emphasise (Ringborg and Platz 1996; Szakács et al. 2006; Sui et al. 2013). The crosstalk between these two mechanisms may be cause of development of drug resistance against conventional anticancer drugs. Autophagy is a controlled, conserved physiological process of eukaryotes, which regulate cellular homeostasis via degradation of cellular components with the help of autophagy-related genes. Autophagy denoted as a tumour suppressor process in the earliest stages of growth and development of some solid tumours, like breast tumours. On the other hand, autophagy can also act as a tumour inducer (Flynn and Schiemann 2019) and facilitate drug resistance in cancer cells (Sui et al. 2013). According to Nusrat et al. 2016, in ovarian cancer chemoresistance not occur due to presence of neovascularisation. Neovascularisation, is sprouting of new blood vessels from pre-existing blood vessels, can supply oxygen and nutrients to the tumour cells for further development (Folkman 1971). However, in hypoxic condition, autophagy is induced in cancer cells by HIF-1α (Mazure and Pouyssegur 2010; Yun Lee 2018) and this HIF-1α also induce neovascularisation process by upregulating several pro-angiogenic genes (Ramakrishnan et al. 2007; Liao and Johnson 2007; Lugano et al. 2020), but the mechanisms behind the link between two process – autophagy and angiogenesis are not clear. Furthermore, HIF-1α can induce breast cancer stem cells (CSCs) via induction of Hippo pathway (Semenza 2015; Tong et al. 2018). Therefore, in this proposal, we want to resolve the mechanisms that may link the processes angiogenesis and autophagy and the catalytic activity of HIF-1α if silenced, then what happen in hypoxia process.				
49.	Identification of molecular reprogramming landscape of pre and post-neoadjuvant chemotherapy in Gastric Cancer and its therapeutic implications	Dr. Santosh Kumar Guru	ICMR	53.0 Lakh	3 Years
	Identification of molecular reprogramming landscape of pre and post-neoadjuvant chemotherapy in Gastric Cancer and its therapeutic implications Cancer drugs typically produce short-lived clinical remissions due to acquired drug resistance, which can be spontaneously reversible over time. Exposure to high doses of anticancer drugs can induce the emergence of a subpopulation of weakly proliferative and drug-tolerant cells/persister cells, which display markers associated with stem cell–like cancer cells. The crude cancer incidence rates were highest in the south, northeast states and in Delhi and Haryana. In 2016, the leading types of cancer in India those responsible for more than 5%				

	of the total cancer among both sexes combined, were gastric cancer (14%). As per recent report, Stomach and Esophageal cancer is the 4th and 6th most common cancer-related deaths in south and northeast states. Also, the regional variation exists in the rates of gastric cancer in India. Novelty and Innovation: After neoadjuvant chemotherapy the drug-tolerant cell population emerged, are highly expressed undruggable transcription factors, epigenetically silenced genes, de-novo mutations, epithelial mesenchymal transformation/autophagy. Cyclin-dependent kinase 9 (CDK9) promotes transcriptional elongation through RNAPII pause release and essential for maintaining gene silencing at heterochromatic loci. We hypothesize that targeting CDK9, reactivates epigenetically silenced genes, hypersensitize to chromatin-modifying agents within the drug-tolerant sub-population and therapeutic intervention of undruggable transcription factors in cancer by in-vitro, in-vivo model and 3D organoid model from gastric patients from Indian Population.				
50.	Noscapine and its Derivatives for the treatment of drug-tolerant persister cell in Breast cancer	Dr. Santosh Kumar Guru	ICMR	57.0 Lakh	3years
	Treatment of drug-tolerant persister cells in Breast cancer using Noscapine and its Derivatives Despite a favorable initial response, triple negative breast cancer patients will experience recurrence of disease within months or years after diagnosis. Recurrence largely arises as a result of the growth of residual cancer cells that remain after treatment. Recently it was shown that in multiple cancer types of relapses can arise due to the presence of persister cells, a subpopulation of transiently drug-tolerant cells that are able to survive therapy through reversible, non-mutational mechanisms. Tumor dormancy, stochastic cell state shifts and stem cell-like populations are amongst the mechanisms hypothesized to underlie persister phenotype. However, given the lack of high-throughput methods to concurrently track cell state and lineage, it is not currently possible to distinguish the relative contribution of each of these factors. To address this need, we will be generating the Watermelon library to study the mechanisms underlying the ability of a small population of cells to regain proliferative capacity under constant treatment with chemotherapy. The main aim of this project is how drug tolerant persister cells survive and helps tumor aggressiveness. Exposure to high doses of anticancer drugs can induce the emergence of a subpopulation of weakly proliferative and drug-tolerant cells/persister cells, which display markers associated with cancer-initiating cells (Cancer stem cells). The main objective of this project is to target these cancer-initiating cells by Noscapine and its derivatives. The development of drug resistance during treatment of cancer with chemotherapeutic agents remains a critical problem that limits the clinical benefit of cancer drug therapy. In this project we will discover a novel cellular state referred to as the drug-tolerant persister state, that appears to promote the development of tumor cells resistance to a variety of cancer drugs. By studying the mechanisms that underlie this state, we expect to develop an effective Noscapine and its derivatives based therapeutic strategy to disrupt				

	drug tolerance, thereby improving the efficacy of cancer drugs.				
51.	Product validation, preclinical testing and safety evaluation of a smart film forming topical dermal gel in the management of chemotherapy-induced peripheral neuropathy	Dr. Jitender Madan and Dr Pankaj Kumar Singh	ICMR	57.0 Lakh	3years
	Formulation and development of smart film forming topical dermal gel against peripheral neuropathy In this project, the team of investigators have developed and formulated a smart film forming topical dermal gel against peripheral neuropathy				
52.	Development of a novel mercury based organo-metallic complex for acute leukemia treatment...	Dr. Santosh Kumar Guru	ICMR	48.0 Lakh	3Years
	A novel mercury-based organo-metallic complex for acute leukemia treatment Metals are essential cellular components selected by nature to function in several indispensable biochemical processes for living organisms. Metals are endowed with unique characteristics that include redox activity, variable coordination modes, and reactivity towards organic substrates. Due to their reactivity, metals are tightly regulated under normal conditions and aberrant metal ion concentrations are associated with various pathological disorders, including cancer. For these reasons, coordination complexes, either as drugs or prodrugs, become very attractive probes as potential anticancer agents. The use of metals and their salts for medicinal purposes, from iatrochemistry to modern day, has been present throughout human history. The discovery of cisplatin, cis-[Pt(II) (NH(3))(2)Cl(2)], was a defining moment which triggered the interest in platinum(II)- and other metal-containing complexes as potential novel anticancer drugs. selected metals that have gained considerable interest in both the development and the treatment of cancer. The use of nonessential metals as probes to target molecular pathways as anticancer agents is also emphasized. Finally, based on the interface between molecular biology and bioinorganic chemistry the design of coordination complexes for cancer treatment is designed strategies and mechanisms of action are explored.				
53.	Exploration of the crosstalk between RNA methylation and YAP/ TAZ pathway in drug tolerant breast cancer persistent cells	Dr. Santosh Kumar Guru	DST-SERB	22.36 Lakh	2Years

	To understand signaling pathway between RNA methylation and YAP/ TAZ pathway in drug-tolerant breast cancer persistent cells Breast cancer (BC) is a common cause of death among the Indian women (1). Despite significant progress and achievements in the management of this disease, a significant proportion of patients continue to experience recurrence, even after adjuvant therapy. Evaluation of the drug tolerant persistent cells (DTC) have revealed the molecular profiles and imparted a better treatment regime, but still better understanding of these DTC is needed to improve therapeutic process. One of the burning illustrations of this cancer persistence was reported to be intra-tumoral heterogeneity, which may arise due to non-genetic reprograms associated with ribosome dependent RNA methylation (2). The persistent cancer cells undergo many epigenetic or transcriptional reprogramming, which drives them to attain a slow proliferative stage and hence, evade the effect of anticancer treatment (2). This slow proliferation rate is recently found to be associated with dampened protein synthesis process, and hence, ribosome dependent translation efficiency (3). One probable cause of this reduced translation efficiency was found to be epigenetic modifications (methylation) of adenosines of mRNA (4). This mRNA methylation process is mainly orchestrated by a complex of methyltransferase, primarily METTL3 (5). Consequently, the target mRNA with m6A has a higher capability of translating itself to its protein (6). This reversible and dynamic mechanism has been found to be involved in stem cell maintenance as well (6), whereby MYC, BCL2, PTEN etc target genes were methylated by elevated levels of METTL3 and promotes pluripotency among the cancer cells. YAP and TAZ oncoproteins are well known transcription factors, which on phosphorylation gets sequestered in the cytoplasm and undergo proteasomal degradation (7). Recent reports have demonstrated their role in generations of chemo tolerance in several cancers, including breast cancer (8), since these proteins are involved in stem cell maintenance as well. On the other hand, analysis of TCGA datasets unveiled frequent amplification with overexpression of both YAP and TAZ proteins in BC samples (cbioportal.org). However, details of treatment procedure in those patients were not available. Till date, several studies have been carried out to target YAP and TAZ for therapeutic interventions (3, 8), but still the mystery has been unsolved. Recently, a group has indicated the probable crosstalk between these two pathways that is YAP/TAZ and RNA methylation in chemo tolerant lung cancer cells (9), where METLL3 was found to increase the m6A level of YAP and increased its translation turnover. However, this is the only study, evaluating the probable link between these two axes, which needs to be validated independently. Further, chemotherapeutically treated primary tumors have not been analyzed, till now. Again, the effect of RNA methylation circuit on TAZ protein is still unexplored.				
54.	Evaluation of Anti-fibrotic effects of AUR101 and AUR103 Calcium in Bleomycin Induced Pulmonary Fibrosis model	Dr ChandraiahGodugu	Aurigene Discovery Technologies Ltd.	17.17Lakh	6 Months

	To evaluate the Anti-fibrotic effects of AUR101 and AUR103 Calcium in Bleomycin Induced Pulmonary Fibrosis model Aurigene Discovery Technologies Ltd funded the project., wherein the PIs group has evaluation of Anti-fibrotic effects of AUR101 and AUR103 Calcium in Bleomycin Induced Pulmonary Fibrosis model				
55.	Preclinical evaluation of UNIM-401 and UNIM-403 against experimentally induced psoriasis and UNIM-004 and UNIM-005 for their efficacy against experimentally induced vitiligo in mice	Dr ChandraiahGodugu	AYUSH	58.13Lakh	3 Years
	Preclinical evaluation of Unani formulations UNIM-401 and UNIM-403 against experimentally induced psoriasis and UNIM-004 and UNIM-005 formulatiomns against experimentally induced vitiligo in mice In this project first PIs team has experimentally induced vitiligo in mice. Later this mice model were used in the preclinical evaluation of Unani formulations UNIM-401 and UNIM-403 against experimentally induced psoriasis and UNIM-004 and UNIM-005 formulations.				
56.	Evaluation of Anti-fibrotic effects of ODM-203 alone and combination of ODM-203 with Prednisolone in Bleomycin Induced Pulmonary Fibrosis model	Dr ChandraiahGodugu	Aurigene Discovery Technologies Ltd.	17.70Lakh	6 Months
	To evaluate the Anti-fibrotic effects of ODM-203 alone and combination of ODM-203 with Prednisolone in Bleomycin Induced Pulmonary Fibrosis model The project involves the development of a Bleomycin-Induced Pulmonary Fibrosis model and its use in evaluating the Anti-fibrotic effects of ODM-203 alone and the combination of ODM-203 with Prednisolone.				
57.	An Instrument-free microfluidic system for extraction of nucleic acid based on biochemically functionalized paper platform	Dr. Amit Asthana and SowjanyaGoli	ICMR	16.60 Lakh	3 years
	To fabricate microfluidic DNA storage and extraction device				
58.	Evaluation of small	Dr	ICMR	16.60 Lakh	3 years

	molecule kinase inhibitors as novel antimicrobial and antibiofilm agents against Klebsiella pneumonia Ser/Thr kinases KpnK	Vasundhra Bhandari			
	Structure-based in silico analysis and small molecule kinase inhibitors library screening against kpnK (Serine/threonine-protein kinase) to find prospective antimicrobials against *K. pneumoniae* infections. In vitro testing of discovered kinase inhibitors against sensitive and multidrug-resistant *K. pneumoniae* strains. Decipher the function of kinase inhibition in controlling essential processes in bacteria, such as antibiotic resistance, pathogenicity, biofilm formation, or cell division. Project involved Structure-based in silico analysis and small molecule kinase inhibitors library screening against kpnK (Serine/threonine-protein kinase) to find prospective antimicrobials against K. pneumoniae infections. Later the In vitro testing of discovered kinase inhibitors against sensitive and multidrug-resistant K. pneumoniae strains.				

PUBLICATIONS (RESEARCH/ REVIEW):

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4. Rajana, Naveen, Aare Mounika, Padakanti Sandeep Chary, Valamla Bhavana, Anuradha Urati, Dharmendra Khatri, Shashi Bala Singh, and Neelesh Kumar Mehra. "Multifunctional hybrid nanoparticles in diagnosis and therapy of breast cancer." Journal of Controlled Release 352 **(2022)**: 1024-1047.
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10. Jyothi, Vaskuri GS Sainaga, Jyoti Pawar, Valencia Fernandes, Rahul Kumar, Chandni Singh, Shashi Bala Singh, Jitender Madan, and Dharmendra Kumar Khatri. "Film forming topical dermal spray of meloxicam attenuated pain and inflammation in carrageenan-induced paw oedema in Sprague Dawley rats." Journal of Drug Delivery Science and Technology 70 **(2022)**: 103195.
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NIPER, KOLKATA

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From the Director's Desk

Prof V Ravichandiran

National Institute of Pharmaceutical Education & Research (NIPER), Kolkata was established in 2007 as an autonomous body under the aegis of Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, Government of India

The Institute endeavors to provide high quality education in the areas of Pharmaceutical Sciences and to promote innovative and applied research through academic and research activities amongst the young generation, by way of introducing various courses in PG and Ph.D. level.

Initially, the Institute has operated under mentorship of premier Institute of the Council of Scientific & Industrial Research, India i.e., Indian Institute of Chemical Biology (CSIR-IICB), Kolkata. Later, in 2018 the Institute started functioning Individually at a leased campus of M/s. Bengal Chemicals and Pharmaceuticals, Kolkata situated at Chunilal Bhawan, 168, Maniktala Main Road, Kolkata – 700 054.

The Institute has started M.S. (Pharm) with three departments viz., Medicinal Chemistry, Natural Products, Pharmacoinformatics in 2007. At present, the institute has M.S (Pharm) and PhD in seven departments namely, Medicinal Chemistry, Natural Products, Pharmacoinformatics, Pharmacology & Toxicology, Pharmaceutics, Medical Devices and Pharmaceutical Analysis.

The Institute is focusing on multi-disciplinary research to bring out viable process technology/products, to identify lead molecules and to improve the efficacy and safety of pharmaceutical agents by utilizing established instrumentation facility like NMR, LC-MS, Animal Imaging, confocal microscopy, flow reactor, ultracentrifuge, Spray dryer, Real time PCR, DSC, SEM, TGA, Zetasizer, Rheometer etc. along with animal house and cell culture facilities.

Our faculty members of various departments are working in newer areas of pharmaceutical sciences to contribute towards the institute research objectives.

The Department of Medicinal Chemistry is involved in the development of Nucleic acid-based therapeutics based on promising technologies such as RNA interference technology (RNAi), antisense technology (ASO), SMaRT technology and CRISPR-Cas technology for treating Rare Diseases including various disorders. They also involved in development of process technology for the synthesis of API/KSM using green chemistry and flow chemistry and using utilizing atmospheric nitrogen for synthesis of nitrogen containing organic compounds as potential therapeutic agents. Development of static in-equilibrium peptide assembly especially peptide hydrogels for different applications like catalysis, sensing, storage and controlled release of biomolecules and therapeutics. They are also involved in the development of antibody-recruiting molecules against bacteria and cancer and development of cell penetrating fluorescent probes as diagnostic tools.

The Department of Natural Products is involved in identification and evaluation of novel secondary metabolites from natural products and studying drug herb interactions using LC-MS and CRISPR-cas mediated targeted genome editing in the context of inflammatory disorders. While ***Department of Pharmacology and Toxicology*** is involved in identifying therapeutic targets against diabetes associated CNS complication and non-alcoholic steatohepatitis (NASH). It is also involved in exosome mediated siRNA delivery against heart disease, IBD and screening of natural and synthetic compounds for anti-dengue activity. ***Department of Pharmacoinformatics*** is involved in computational study of non-covalent interactions and analyze its effect with electron-donating and withdrawing groups. It is also involved in molecular modelling and cheminformatics study to identify novel molecules against bacterial and viral targets.

Department of Pharmaceutics is involved in developing various lipid-based formulations like lipidic micelles, nanostructured lipid carrier, solid lipid nanoparticles for enhancement of oral & ocular bioavailability. It is involved in formulation development of novel topical and controlled release formulations, solid dispersions for improving the bioavailability of drugs, development of hydrogels in wound healing and haemostatic dressing applications. ***Department of Medical Devices*** is currently exploring 3D bioprinting option for organ-on-chip and disease-on-dish models and piezoelectric membranes as sensors. It is also involved in fabrication of scaffolds for tissue engineering using electrospinning, CNC machining, lyophilisation and are developing bioinspired hydrogels for accelerated wound healing.

The Institute has established ***Centre for Marine Therapeutics*** along with seven research institutes viz., NIPER Guwahati, IISER Kolkata, NIO Goa, CDRI Lucknow, JNCASR Bangalore and IIIM Jammu which is funded by DoP and DST, New Delhi.

The Institute has established "*Centre for Nucleic acid therapeutics*" along with NIPER Guwahati, Hajipur and CSIR-IACS at NIPER Kolkata to synthesis ASOs for treating rare disease and to train the students and faculty in the proposed area which is funded by Department of Pharmaceuticals and DST, New Delhi

EXTRA-MURAL RESEARCH PROJECTS

S.N.	Project Title	Principal Investigators and Centre coordinator's	Funding Agency	Funding Amount	Duration
1.	Introduction of Crispr CAS System in Lysmaniaparasite : Functional assay of Miltefosine transporter	Dr.Dipanjan Ghosh	WBDBT	37.95 Lakh	5 years
	Miltefosine, an orally administered anti-leishmanial drug, was introduced to treat mainly antimonial unresponsive cases. Within a few years, resistance to Miltefosine and relapsing cases have been reported. For Miltefosine transport in Leishmania parasites, a two-subunit amino phospholipid translocase, Leishmania donovanimiltefosine transporter (LdMT) and its specific beta subunit LdRos3, internalizes the drug. Phospholipid vesicles (liposomes) employed as carrier systems for Miltefosine, reduces its toxic side effects and there have shown correlation between the expression levels of both proteins and the parasite sensitivity towards the drug. A recent report showed that a single point mutation within the two alleles of the LdMT gene are responsible for the resistant phenotype through inactivation of the transporter protein. We also have reported that the parasite isolates from miltefosine relapsing/resistance individuals also down-regulated the miltefosine transporter genes LdMT and ROS3. So, those genes might have a role in the relapsing/resistance. This made us arrive at the hypothesis: LdMT and LdRos3 knock-out lines generated from sensitive line would be transformed into resistance line. We hope to examine the role of these two transporter genes in incurring resistance against miltefosine drug using CRISPR cas9 system. We are testing our hypothesis by knocking out these genes in sensitive strain, see how the loss of gene function affects the parasite.				
2.	Development of an efficient foodgrade genome engineering platform for Lactic Acid Bacteria using CRISPR-Cas9 of Lactobacillus fermentum M1	Prof. Swadesh Ranjann Biswas; Co PI- Dr.Dipanjan Ghosh, Dr V. Ravichandiran	DBT	65Lakh	3 years
	Lactic acid bacteria (LAB) received attention because of their food-grade status. Recently, there has been a surge in the interest in modulating the genome of LAB for applications in biomedicine and biomedical engineering to improve				

	food quality and control intractable diseases: intestinal infections, obesity, hypertension, colon cancer, etc. One of the key factors to explore LAB beyond the scope of traditional genetic engineering is intricately linked to the development of food-grade CRISPR-Cas9 genome engineering tool. Commercial CRISPR-Cas9 is not food-grade; hence it is unsuitable for human application. The project aims to develop a food-grade CRISPR-Cas9 technology using Cas9 of Lactobacillus fermentum M1, promoters, crRNAs, non-antibiotic marker, and a plasmid replicon, all from food-grade LAB and to assess its potential by targeted knock-in and knockout in vivo in Lactococcus and Lactobacillus. Products of LAB edited with this technology will have greater consumer acceptance.				
3.	Dinitrogen Fixation by Heterobimetallic Complexes under Visible Light for the Access of Organonitrogen Compounds as Potential Biological Targets	Dr. Murali Mohan Guru,	SERB	24.86Lakh	2 Years
	Dinitrogen cleavage and functionalization is a long-standing challenge for synthesis of nitrogen containing organic compounds. The conversion of dinitrogen and hydrogen to ammonia by the Haber-Bosch synthesis uses 2% of the world's energy consumption, but without this process, half of the current word population could not be fed. Therefore, more efficient ways to convert nitrogen to ammonia is still a quest of utmost importance. Equally attractive, but equally or even more challenging is the direct conversion of dinitrogen to organonitrogen compounds, thus eliminating the need to use of ammonia as an intermediate. The current research project is focused on fixation of atmospheric N2 gas into small organic molecules to synthesize analogous nitrogen containing drug compounds for the potential applications in therapeutic science.				
4.	Type 2 Diabetes associated cognitive decline: Molecular pathways and intervention strategies	Dr. V Ravichandiran, Dr. Sugato Banerjee, Dr. Somasundaram Arumugam	ICMR	55.71Lakh	3 Years
	Role of NMDA mediated increase in neuronal calcium and its effect on diabetes associated neurodegeneration is yet to be determined. The project focuses on understanding the role of NMDA receptor in diabetes associated cognitive decline. It will help us design future therapeutic strategies against diabetes associated neurodegeneration.				
5.	Elucidating Role of Mitochondrial Associated Membranes	Dr. Ashutosh Kumar	DST-SERB	31.18 Lakh	3 Years

	(MAMs) and ER Stress Associated Neuroinflammation in Experimental Diabetic Neuropathy				
	In this research project we are evaluating the role of mitochondrial associated membranes and ER stress in the pathophysiology of neuropathic pain. Diabetes is a major challenge that will be faced by the whole world and condition for India is very gloomy as it will turn out to be Diabetic capital of World in the coming decades. Diabetes induced complications make the life of diabetic patients a big challenge. Neuropathy and neuropathic pain affect more than 50-60 % of patients with diabetes. We have handful of drugs which alleviate the symptoms but have serious limitations like uneven clinical success, adverse effects and habit-forming potential. So, the avenue is open for carrying out the research for identifying novel mechanism that can be targeted for drug discovery and development. We will evaluate the nerve function and behavioural changes and study the role of mitochondrial dysfunction, if we succeed in establishing the role of mitochondrial associate membranes and ER stress in the pathophysiology of neuropathic pain then we can develop some pharmacological inhibitors to target these pathways and see their impact on amelioration of functional and sensorimotor deficits seen in diabetic neuropathy.				
6.	Development of novel membrane stabilizing antimicrobial peptidomimetics targeting carbapenem-resistant strains of Acinetobacter baumannii in ventilator-associated pneumonia	Dr. Sharada Prasanna Swain and Dr.Sidhartha Sankar Kar	DST-SERB	18.30 Lakh	3 Years
	The WHO has reported emergence of Acinetobacter baumannii and ventilator-associated pneumonia in COVID-19 patient. The objectives are (i) to design and synthesize novel membrane stabilizing antimicrobial peptidomimetics in quantitative, physicochemical terms, (ii) to study membrane disruption activity of synthesized compounds using bacterial membrane mimicking model, (iii) molecular dynamics simulation of compounds to understand interaction with bacterial cell membrane. The outcome of the project may open new avenue for development of potent biocompatible peptidomimetics for treatment of infections caused by resistant Acinetobacter baumannii.				
7.	Antibiofilm peptide-functionalized	Dr.Pallab Datta, Dr.Utpal Mohan	DST-SERB	45.36Lakh	3 Years

	titanium implants				
	Increase in human life expectancy, rising obesity amongst the population and adoption of sedentary lifestyle has increased the risk factor for diseases like osteoarthritis of load-bearing bones and joints. Arthroplasty has been a widely successful clinical intervention that has reduced chronic pain, restored mobility and improved quality of life for a large number of affected patients. On the other hand, a large number of arthroplasty patients require a revision surgery and some reports show only around 60% of the patients expect the implant life to extend beyond patient lifespan. Implant-associated infection is increasingly becoming the primary reason for revision surgeries or implant failures. Biomaterial-associated infection is caused because of ability of bacteria such as *Staphylococcus aureus, Staphylococcus epidermidis, Klebsiella pneumoniae, Escherichia coli, or Pseudomonas aeruginosa* to form biofilms, by adhering on to the implant substrates as multicellular complex enclosed within an extracellular polysaccharide. of the implanted device. Bio-films are difficult to treat as the extracellular layer prevents antibiotics to reach the bacteria. Activation of surfaces with antibiofilm peptides exhibits broad spectrum of activities, high potency and specificity, and can also show synergistic activity with conventional antimicrobials, and little tendency to for emerging antimicrobial resistance. The aim of this proposal is to develop antibiofilm-peptide coated porous titanium implants for improving the infection-resistant and osseointegration properties. The proposal will be executed in three steps: design of porous femoral stems, alveolar implants and titanium meshes matching the bone condition of the patients, selection of antibiofilm peptide most suitable for grafting on salinized titanium surfaces showing high efficacy as well as coating stability. The contact mechanics and fabrication will be carried out followed by the biological evaluation of the implants as per ISO standards. A mechanistic understanding of the role of surface adhesion thermodynamics between bacterial components and titanium substrates will also be studied.				

PUBLICATIONS (RESEARCH/ REVIEW):

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NIPER, RAEBARELI

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From the Director's Desk

Prof Shubhini A. Saraf

The National Institute of Pharmaceutical Education and Research (NIPER), Raebareli was established in **2008**. It offers doctoral and master's programs in Medicinal Chemistry, Pharmaceutics, Pharmacology & Toxicology, Regulatory Toxicology, and Biotechnology with 265 currently enrolled students. We are currently operating from our transit campus in Lucknow with a world-class Central Instrumentation facility within the premises and an animal house to perform pre-clinical studies.

NIPER-Raebareli has emerged as an Institution of significance both in academics and research particularly in Central India with modern laboratories, and highly sophisticated instruments. We have achieved several milestones and Pharma industries have shown interest in collaborating with us besides training our students on a short-term and long-term basis.

NIPER-R is actively involved in the following Research Areas:

- Neurodegenerative diseases
- Tuberculosis
- Development and evaluation of drugs using Nano formulations.
- Development of green and eco-friendly synthetic methods
- Heavy Metal Toxicity
- Japanese Encephalitis

The Institute initiated collaborative projects/ work with national and international academic and research institutes in areas of immediate importance such as *Japanese Encephalitis*, Tuberculosis, and Neurodegenerative diseases. An online portal has been created to facilitate seamless sample analysis for drug discovery.We are also providing highly skilled human resources for Indian pharmaceutical industries such as Intas, Curadev, APCER Life Science, Almelo, Piramal Jubilant Chemsys, Lupin, Patanjali, Medivisual, Novo Nordisk, etc.

- The Institute has filed **23** patents and one copyright till **2023**.
- The Institute received nearly 1.76 Cr. Rupees as an extramural research grant for research in the thematic areas of the Institute.
- Around **393** publications (Research/review articles, books and/or book chapters) have been published since 2011; out of which **276** publications are from the work of the last 3 years in journals of international repute.
- The Division of Pharmaceutics at NIPER-Raebareli developed new technologies for nano-based drug-delivery systems for better delivery of anti-psychotic and anti-tubercular drugs.
- NIPER- Raebareli has various centralized state of art facilities like a Cell Culture Facility, Central Animal Facility, Imaging facility (FT-IR spectrometer, Cary Eclipse, 12-Cell Cary 100 UV and Multi-Mode Plate Reader), and Central Instrumentation Facility**.**

- Central Instrumentation Facility has been created housing sophisticated instruments such as Nuclear Magnetic Resonance (NMR), Zetasizer, HPLC, Bioanalyzer, DSC, DSC for molecules, LC-MS (QTOF-HRMS), Hot Stage Microscope, Flow-cytometry, Animal imaging system, Lyophilizer, Calorimeter, CD Spectrometer, Digital Polarimeter, Probe Sonicator, Confocal system, etc.
- **Dr. Ashok K. Datusalia** was awarded membership of the International Society for Neurochemistry (ISN)-School Initiative. **Dr.Sapana Kushwaha** became Associate Topic Editor for Frontiers in Toxicology "Rising Stars" in Developmental and Reproductive Toxicology. **Dr.Sapana Kushwaha** was also awarded the International Union of Toxicology (IUTOX) Travel Award, **2022** by the IUTOX Education Committee, USA. **Dr.Keerti Jain** was enlisted among World's Top 2% Scientists, consecutively for the years 2020 and 2021 in the field of Pharmacology & Pharmacy, a list created by Stanford University, USA.
- **Dr. Ravinder K. Kaundal**published his research article entitled "*Large-Scale multiplexed mosaic CRISPR Perturbation in the whole organism*" in Cell Journal (**Impact factor = 66.85**). This is the highest impact factor paper in the history of all NIPERs.
- **Dr Nihar Ranjan** published his research paper in the Journal of American Chemical Society **(Impact Factor 16.3)** which is a prestigious journal of Chemistry.
- The institute also inducted faculty through the "**Ramalingaswami Re-entry Fellowship**" DBT, Ministry of Science and Technology, Government of India.

EXTRA-MURAL RESEARCH PROJECTS

S.N.	Title of the Project	PI	Name of Funding Agency	Sanctioned Amount (₹)	Duration of the project
1.	Aminoglycoside (Tobramycin) Based Hybrid Small Molecules Targeting Bacterial Rnra A-site for Developing New Anti-Tuberculosis Agent	Dr Nihar Ranjan	DST SERB	41.44 Lakh	3 years
	The main objective of this project was to synthesize Tobramycin based aminoglycoside mimics in order to develop new potent anti tuberculosis agents. The deliverables included synthesis of new molecules, its binding studies with the nucleic acids and testing antimicrobial activities. The results obtained showed that some of the developed molecules equal and in certain cases even better inhibition of bacterial strains belonging to the ESKAPE class, than control antibiotics (Tobamycin, isoniazid) thus providing new molecules for future development of antibiotics.				
2.	Comprehensive Biological Evaluation Of Different Drug Loaded Surface Engineered Dendrimer Conjugates For Treatment Of Cancer	Dr Keerti Jain	ICMR	17.40 Lakh	3 years
	The aim of the project is formulation and characterization of surface engineered drug-loaded Poly(amidoamine) (PAMAM) dendrimer, to study the effect of molecular weight, size and architecture of surface engineered dendrimer conjugates on the drug delivery and investigation of developed conjugates for targeted delivery of bioactives. The deliverables of the project will range from comprehensive examination of dendrimers-based formulation, their characterization, biological interactions, cytotoxicity, and safety at a single platform, development and characterization of ligand conjugated dendrimers and development of novel nanoformulation of anticancer drug loaded dendrimers.				
3.	Exploring the immunomodulatory activities of novel Toll-like receptor-signaling inhibitors in peripheral blood mononuclear cells from lupus patients: A study to identify TLRs as drug targets	Dr Sandeep Chaudhary	DST SERB	68.01 Lakh	3 years

	for lupus				
	Identify whether MPP analogues would inhibit spontaneous or human TLR, IL1R and IL-18R-dependent proinflammatory cytokine expression in peripheral blood mononuclear cells (PBMCs) of normal individuals, Systemic Lupus Erythematosus (SLE) and Lupus nephritis patients and further to Identify whether Myd88 in PBMCs from healthy individuals, Systemic Lupus Erythematosus (SLE) and Lupus nephritis patients is a direct target of MPP analogues.Through our study, we expect to identify MPP analogues as inhibitors of the biology of TLRs in PBMC of healthy donors, SLE and Lupus nephritis patients.				
4.	Novel Synthesis of flavonoid-hydroxypyridinone hybrids as potential anti- Alzheimer agents	Dr Abha Sharma	UPCST	9.30 Lakh	2 years
	The objective of this project is to synthesize and characterized a series of flavonoid-hydroxypyridione derivatives for their biological testing against the targets of Alzheimer's disease. The study will be delivered a series of compounds that could add a new finding in this area and help in further future plan of study. The outcome of the study would be helpful to design new molecules or modify the lead identified from this project				
5.	Regulation of Stress Response and Neuroinflammatory Markers in Diet-induced obesity and Aging	Dr Ashok Datusalia	International Society For Neurochemistry (ISN)	3.35 Lakh	1 year
	The present project will study the modulation by diet-induced obesity of the stress response in aged rats, in terms of functional, metabolic and morphological changes measured at synapses of selected brain areas. This is the first study of its kind, which will integrate an understanding of the interrelationship between stress-induced regional neuroinflammation and aging. There are several fundamental issues which will be investigated in these studies, including glutamate release dynamics and how diet-induced obesity aggravated neuro-inflammation affect neuronal brain aging.				
6.	Dual nanoengineered BBB-penetrating lipid nanoparticles for targeting cerebral carcinoma	Dr Rahul Shukla	DST SIRE	11.88 Lakh	1year
	Vincristine nanocrystals in the core shell of sphingomyelin lipids that aid in targeting to brain. It will will guide this core shell loaded nanocrystals to brain, another advantage with sphingolipids about its abundance presence in CNS and its myelination process in axons. The targeting moiety can be novel approachable way for effective drug delivery and paves the way for development of platform drug delivery systems for various drug delivery approaches for industrial application with minimum toxicity potential to				

	peripheral organs. BBB permeability of developed formulations can be tested using the in vitro model. This is an excellent screening tool before proceeding for in vivo experiments.				
7.	Toxicity Screening of Agrochemical NanoBioDAP	Dr Ashok K. Datusalia	AAL Biosciences	3.50 Lakh	1 year
	NanoBioDAP is a biologically synthesized nanofertilizer for Nitrogen and Phosphorous macronutrients to crop. The product has the nutrients present in stable nanocrystal forms, which leads to their higher use efficiency as well as longer availability to crop due to their slow release. The guidelines for evaluation of Nano-based Agri-input and Food products in India and The Fertilizer control order necessitates that all nanoproducts must be evaluated for their safety on human and environment by using test guidelines for assessment using in vitro and in vivo model systems. Both the products have been found absolutely safe when tested on human cell lines. Assessment of nanomaterials by using animal systems and by following methods for human skin corrosion and irritation test is further desired to certify the safe nature of the nanoagri-inputs.				
8.	Evaluation of the neuroprotective potential of SERCA activators in experimental models of cerebral ischemia.	Dr Ravinder K Kaundal	DST SERB	40.40 Lakh	3 years
	The Objectives of the project are to investigate the protective effects of SERCA activators in in- vitro models of ischemic neuronal injury, to evaluate the neuroprotective potential of the SERCA activators in animal models of cerebral ischemia., to study the role of SERCA in ischemic neuronal injury and elucidate the molecular mechanism associated with the protective effects of SERCA activators in *in-vitro* and *in-vivo* models of cerebral ischemia. This study will also answer if SERCA activation could be a viable neuroprotective approach for the treatment of cerebral ischemia. The proposed study will not only unveil new pathological events involved in the ischemic neuronal cell death cascade but will also open new therapeutic avenues for the treatment of cerebral ischemia. Training of manpower and Publications Development of a facility for evaluating the neuroprotective potential of pharmacological interventions/New chemical entities in in-vitro and in-vivo models of ischemic neuronal injury				
9.	Discovering the anti-inflammatory effects of novel Toll-like receptor signaling inhibitors on rheumatoid arthritis mononuclear cells and synovial fibroblasts: An in vitro study to identify TLR signal	Dr Sandeep Chaudhary	ICMR	10.81 Lakh	3 years

	To investigate the effect of MPP analogues on the MyD88 signaling complex induced by different TLRs; spontaneous and MyD88-dependent TLR signaling induced proinflammatory cytokine production; TLR3 and IL-1R induced proinflammatory responses; NF-kB and MAPK pathways induced by IL-1R and MyD88 signaling complex induced by IL-1R in rheumatoid arthritis mononuclear cells and synovial fibroblasts. There is an urgent need for more effective, cheaper therapeutics for Rheumatoid arthritis (RA). Recent evidence indicate that members of the Toll-like receptors (TLRs) play important roles in disease development. Moreover, drugs that block TLR signaling pathways are clinically not available. We have identified methylpiperidino-pyrazole (MPP) as a specific inhibitor of TLRs using an entirely novel drug screening platform. Immunomodulatory function of MPP analogues in rheumatoid arthritis mononuclear cells and synovial fibroblasts is not been investigated so far. We hypothesize that MPP analogues can inhibit TLR/IL-1R biology in rheumatoid arthritis mononuclear cells and synovial fibroblasts. Results from this study may suggest that the outcome of this grant proposal has a translational potential.				
10.	Designing of senolytic agents for the treatment of Alzheimer's disease	Dr Gopal Lal Khatik	DST SERB	394.37 Lakh	3 years
	Objectives of the current research project included design, synthesis and evaluation of senolytic agents for management of Alzheimer's disease. Utilizing in-silico and wet lab experiment this research project aimed to identify the lead lead molecule to be helpful in the possible treatment or management of Alzheimer's disease. The deliverables could be training in the synthetic and medicinal chemistry which able to generate the data for potential agents. The outcomes of the project will be patents and publications along with skilled manpower. Further the lead molecule will be optimized with good efficacy. Further these outcomes can be explored to prepare the suitable formulation to administer in animal initially and later human being.				
11.	Development of modified kynurenic acid-based scaffolds for treatment of post-traumatic stress disorder	Dr Ashok K. Datusalia	UPCST	6 Lakh	3 years
	The objectives of current research project are to synthesize kynurenic acid (KYNA)-based scaffolds and evaluate them on stress-induced neurobehavioral and functional changes in stress. The proposed research work will lead to generate novel KYNA scaffolds with potential neuroprotective activity. The research project outcomes will be patentable as kynurenic acid analogues/scaffolds as neuroprotective agents which can be beneficial in the cure and mitigation of PTSD.				
12.	Neurobehavioral and molecular neuroplasticity differences in stress response circuitry for resilience and	Dr Ashok K. Datusalia	SERB-DST	29.94 Lakh	2 years

	vulnerability for post-traumatic stress disorder				
	In this proposed work, we first plan to identify key factors responsible for acute footshock-stress induced differential changes in stress response circuit linked with vulnerable and resilient behavior. We will use qPCR assessment of miRNAs and expression of their target genes at short- and long-term after stress in stress response circuits. Finally, rescue experiments in-vivo will be carried out using pharmacological agents to validate the neurobehavioral and molecular differences in PTSD resilient and vulnerable rats. This will establish early understanding about individual differences in stress response as vulnerable and resilient. The long-term goal of PI revolves around the possibility of conversion from stress vulnerable to stress resilient.				

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2. Dr.Keerti Jain; Parth R. Patel; Teeja Suthar; Ashima Thakur; Dr.Abha Sharma **(2022)** Novel Dendrimer Conjugates For Targeted Delivery Of Drug(S) To Treat Life-Threatening Diseases. Indian Patent 202211039492.
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From the Director's Desk

Prof. Dulal Panda

National Institute of Pharmaceutical Education and Research, SAS Nagar (Mohali), is working in the areas of pharmaceutical research focused at (i) new molecular entities and (ii) enhancing affordability of medicines, with the aim of enhancing drug security within the country. Drug discovery requires multi-level strategies. At NIPER SAS Nagar, we adopt an iterativeapproach which begins with preliminary identification of targets using AI/ML, computational biology and *in silico* drug design methodologies.These are validated on the bench using tools of modern biology.Generation of ligands for these targets involves synthetic routes via chemical means or using natural products scaffolds. The Institute is working on evidence-based research in traditional medicines and phytopharmaceuticals for life style diseases including diabesity (association of obesity with diabetes).Macromolecular ligands like proteins and peptides are created using tools of recombinant DNA technology and evaluated *in vitro* using cell culture models and *in vivo* animal models. The combination of chemical and biological space to streamline drug discovery, design, development and optimization, by facilitating hit identification, hit-to-lead selection, and ADMET (absorption, distribution, metabolism, excretion, and toxicity) optimization, is well explored at the Institute. The success of this approach is seen in validation of several targets for drug repurposing, matching with our goal of making drugs affordable.

An important national priority isdiscovery of new molecules for neglected diseases affecting India. The Institute is working on identification of new druggable targets in tuberculosis (also multi-drug resistant TB, MDR), malaria, leishmaniasis (kala azar), nosocomial infections, viral infections and Antimicrobial Resistance (AMR). The diseases of high burden like neurodegenerative diseases, stroke, diabetes and its complications, cancer, etc. are being studied intensively for development of new drug molecules (chemical and biological) as well as repurposing of existing drugs.Animal models are available for these diseases. The toxicity of developed molecules is investigated in the GLP-compliant National Toxicology Centre. This facility is also used extensively by the industry.With the growing impetus on biopharmaceuticals, Institute has developed strong expertise in this area. Work is undertaken using peptides, proteins including nanobodiesand nucleic acids as well as development of stabilized protein formulations.Some of these nucleic acids are being developed as biosensors. We hope to replace antibodies in diagnostic kits, which will increase their shelf life and reduce the cost.

Computational and high throughput pharmaceutics to design chemistry-based interventions for improving biopharmaceutical profile, DMPK studies, safety pharmacology, pre-formulation profiling, scale up of NCEs, pre-clinical efficacy studies using conventional or 'enabling' animal formulations, are also in place. Development of novel drug delivery routes (nanoformulations, liposomes, etc.) as well as increasing the solubility of existing drugs are two areas where the Institute has achieved significant success and also the maximum industry participation. The molecules of Productivity Linked Incentive Scheme of Bulk drugs are explored for the research and technology

development at NIPER SAS Nagar. We perform pilot studies for APIs and dosage form and prepare 'Technical Data Package" for technology transfer to industry partner for drug development.We have not only been successful in scaling up of processes but have also been able to help the local industries by simplifying synthetic routes of their products, adopting greener and sustainable processes,thereby reducing the cost of the process. Several of the technologies developed by us in-house have been transferred to the industry and commercialized, for example: compositions and methods for trapping and inactivating pathogenic microbes and spermatozoa Phexxi (by EvoFem Inc.) and quick disintegrating taste masked composition Zinc Sulphate Tablets (by IDPL). Further, some of our technologies have been licensed out to the companies, viz. a novel one-step process for preparation of nanocrystalline solid dispersions (NanoCrySP technology) and Pharmaceutical Compositions for Enhancing Anticancer Efficacy of Tamoxifen. We also have a strong portfolio of technologieswhich are ready for licensing out to pharmaceuticalcompanies.We hope that with the participation and cooperation of the domestic pharmaceutical industry, we can work towards reducing the import burden of the country in the area of APIs and KSMs significantly.

The Institute is actively working with different tertiary care hospitals in the city and interacting with patients under clinical care. We also focus on pharmacovigilance, and HEOR (health economics and outcomes research) studies. As can be seen, NIPER SAS Nagar is undertaking research activities in India-specific and global trending areas of pharmaceutical research to ensure seamless integration of various functions to achieve translational goals.The Institute works on domain-relevant challenges and has the intellectual and infrastructure capability to address these.

EXTRA-MURAL RESEARCH PROJECTS

S. N.	Title of the Project	PI	Name of Funding Agency	Sanctioned Amount (₹)	Duration of the project
1.	Biophysical and biochemical characterization of non-human insertion in *Leishmania*-specific aminoacyl-tRNA synthetase: Possible drug target against visceral leishmaniasis'	Dr Rajat Banerjee (Calcutta University), Dr Sushma Singh (NIPER, SAS Nagar), Dr Chiranjib Pal, WBSU Kolkata	ICMR	39.67 Lakhs	03 years
	Leishmania donovani, the causative agent of visceral leishmaniasis (Kala-azar), one of the six major parasitic diseases recognized by the World Health Organization, accounts for an estimated 10-15 million cases worldwide with an annual incidence of about 2 million new cases. Of these, 90% of the confirmed cases occur in India, Nepal, Bangladesh and Sudan. Aminoacyl-tRNA synthetases are known as potential drug targets. Despite their similarity across organisms, scientists have been able to generate effective anti-infective agents based on the structural differences in the catalytic clefts of aaRSs from pathogens and humans. Recently sequenced Leishmania species also revealed that one of the aaRSs, arginyl-tRNA synthetase, contains 100-residue specific insertion which is completely absent in human. We proposed that this insertion could be developed as potential drug target. Using Biochemical, Biophysical, Molecular Biology, cell biology techniques both in vitro and in vivo we will explore the role of the insertion domain in leishmania survivability.				
2.	Development of Novel Bispecific Nano-Antibody for Clinical Use	Prof. Abhay H. Pande and Prof. G. B. Jena	DST-SERB	53.72 lakh	3 yrs
	Chronic inflammatory diseases have been recognized as the leading cause of more than half of all death in the world today. Increased levels of TNF-α and IL-23 play are key drivers of inflammation. Blocking interaction of TNF-α and IL-23 with their receptors inhibit inflammatory signaling pathways. Domain antibodies (DAbs) has emerged as a potential alternative to the conventional monoclonal antibodies (MAbs). Since, both TNF-α and IL-23 are important pro-inflammatory drivers of inflammation, so we are developing a bispecific single domain antibody that neutralize both of cytokines (TNF-α as well as IL23) simultaneously. The molecule have immense clinical importance.				
3.	Development of a generic method for aptamer-based	Prof. Ipsita Roy	ICMR	33 lakh + Manpower	Three years

	detection of protein oligomers				
	Synthesis of a molecular mimic of soluble oligomers Selection of high affinity aptamers which bind specifically to the oligomer mimic Development of 'sandwich' detection tool for oligomers formed by different proteins				
4.	Reprofiling of molecules for inhibition of aggregation of α-synuclein in vitro and in cell model of Parkinson's disease	Prof. Ipsita Roy	SERB	42 lakh	Three years
	Effect of selected approved molecules on aggregation of α-synuclein *in vitro* Effect of selected approved molecules on aggregation of α-synuclein in yeast and mammalian cells Effect of selected approved molecules on non-enzymatic glycation and aggregation of α-synuclein in vitro and in yeast and mammalian cells				
5.	Design of a switchable system for controlled activation of the proteostasis network	Prof. Ipsita Roy	DBT	158 lakh	Three years
	To express and purify N-terminal domain of Hsp90 and Hsf1 To select specific aptamers against N-terminal domain of Hsp90 To characterize the interaction between Hsf1 and N-terminal Hsp90 in the presence of selected aptamers in vitro To design 'intramer' and antidote sequences for expression of aptamers in cells To design a system for 'switchable' activation of heat shock response in cells expressing mutant huntingtin fragment with elongated polyglutamine tract and its effect on aggregation of the latter				
6.	Scaffold hopping of natural alkaloids and analog-focused strategic synthesis: Discovery of target-specific antiproliferative agents	Prof. S.K. Guchhait	CSIR, GoI	12 Lakh	3 Year
	Anticancer drug discovery research inspired by Nature's function has been considered in this project. The Nature prepares many molecules that kill cell; which are important biological process for evolution. The analogs of several such natural products are designed. Natural products Rutecarpine, Tryptanthrin, and Batracylin have been selected based on their anticancer				

	potential. The strategy includes atom or functional motif (such as “N” and “C=O”) switched analogs of these natural products and their molecular-modified derivatives to generate new, patentable and potentially anticancer molecules. The environment-friendly organic chemistry approaches are established to prepare them. Biological activities of synthesized compounds will be done.				
7.	Multifunctional ylides yielding novel masked synthons in construction of privileged heterocyclic scaffolds: A rational integration with target-based anticancer drug discovery	Prof. Sankar K Guchhait	SERB-DST, GoI	41.40 Lakh	3 Year
	The structures of marketed drugs and clinical trial agents mostly contain nitrogen heterocyclic molecular skeletons. Exploring new synthetic strategy for preparation of bioactive nitrogen heterocycles is always important. In this project, “ylide yielding masked synthon” as a new synthetic organic chemistry tool towards construction of pharmaceutically-privileged diverse heterocyclic skeletons has been considered. Previously unknown chemical reactivity feature of designed suitably-tethered various multifunctional ylides in reaction with electrophilic nucleophilic bifunctional substrates have been discovered and are being investigated. This will be rationally integrated with the natural products/drugs/bioactive agents–inspired anticancer drug discovery research.				
8.	Computational Approaches for Pharmacovigilance : An Integrated and Semantically-Enriched Frameworks Lab development and new Anti-diabetic drugs ADR Signal Detection using FAERS tool	Dr Dipika Bansal	Indian Council of Medical Research (ICMR)	38.23 Lakh	36 Months
	Preclinical and clinical studies conducted prior to drug approval can map the majority of serious adverse drug reactions (ADRs), but not all of them. A well-developed vigilance programme will detect rare and unexpected serious ADRs, which represent some of a drug's unknown safety risks. For recently approved diabetes drugs, the "Signals" of ADRs will report information on a possible causal relationship between an adverse event and a drug. The establishment of data mining lab will facilitate additionally to conduct the pilot signal generation programs with recent reports in Indian population reported by the				

	Pharmacovigilance programme of India (PvPI).				
9.	In silico, Biochemical and Structural Characterization of the Mycobacterium tuberculosis (M.tb) elongation factors (EF-Tu, EF-Ts and EF-G)	Prof. Prabha Garg and DrChaaya Iyengar Raje	ICMR	33.98 Lakh	3 years
	Mtb elongation- Tu, Ts and G factors are promising drug targets, however the structure of these proteins in Mtb is not resolved. Hence identifying their protein structure will provide a mechanism for the design of inhibitors. This study will analyse the following aspects of these elongation factors i.e. (i) in silico analysis and computational modeling (ii) purification of the recombinant Mtb proteins (iii) attempts to obtain the crystal structure (iv) design of novel inhibitors to target protein translation.				
10.	Early detection of colorectal cancer using deep learning and gene expression studies to identify target genes for drug repurposing	Prof. Prabha Garg	SERB NPDF	19.20 Lakh	2 years
	The project has three objectives first to develop an image-based prediction model for the early diagnosis of colorectal cancer. Second to identify novel genes that might regulate (up/ down) in colorectal cancer and can be used as potential targets using NGS and microarray gene expression data. Third to identify potential drug candidates (drug-repurposing) based on the selected overexpressing genes and their proteins. The project yet to start after receiving funds.				
11.	Development of scientific monograph amd quality standards for selected Indian medicinal plants	Prof. Sanjay Jachak	NMPB	25.51 Lakh	3 years
	Document published and unpublished literature: The available literature on selected medicinal plants will be documented which includes scientific name, common and local names of conserved medicinal plants, their location of collection, identified medicinal value or uses of each medicinal plant genus/species, photographs and general morphological description of each genus/species, their chemical constituents, specific plant part used for extraction of phytochemicals Develop monographs on medicinal plants characterization data and uses: The data collected, after broad morphological, anatomical and chemical examination, will be compiled in the form of a monograph for each selected medicinal plant. This will be substantiated with the data collected from the already published literature.				
12.	Pincer complexes	Prof. Prasad V.	SERB	30 Lakh/-	4 years

	from Azines and their application in Organometallic Catalysis	Bharatam		plus consumables and contingencies	
13.	Pincer complexes carry interesting coordination architecture with the transition metal interacting with three nitrogen atoms. 1,1-diaminoazines are compounds with four nitrogen atoms, of which three can easily coordinate with Pd/Fe or other transition metals forming pincer complexes. These complex can show organometallic catalysis. In this project, we propose the generate them using cost effective methods. These newly generated catalysts will be used to generated biologically important organic molecules, for example, imidazoles.				
14.	Structural and Biochemical Characterization of Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) A.baumannii and design of inhibitors.	Dr.Chaaya Iyengar And Prof TP Singh, AIIMS New Delhi, Dr. Manoj Raje (IMTECH)	ICMR	65 Lakh	4 years
INDUSTRY SPONSORED PROJECTS: For Industry sponsored projects, details could not be disclosed as per the CDA agreement with the company					
15.	Particle Size analysis of Clotrimazole and Naproxen in respective dosage forms using Hot stage microscopy	Prof. Arvind K. Bansal	Olive Healthcare	1.18 Lakh	1 month
16.	Advice on re-development of a corticosteroid	Prof. Arvind K. Bansal	Nordic Group B.V.	75 Euro/ Hour	1 year
17.	Expert Advice on Oral Solid Dosage Forms	Prof. Arvind K. Bansal	Oncogen Pharma (Malaysia) Sdn. Bhd	30,000/- and 55000/- per hour	1 year
18.	Advice on Pharmaceutial Development of Parenteral Product	Prof. Arvind K. Bansal	Nordic Group B.V.	16.31 lakh	1 year
19.	Advice on Formualtion related issues	Prof. Arvind K. Bansal	Zoetis Pharmaceutical Research	14000/- per hour	1 year

			Pvt Ltd		
20.	Expert opinion in patent related issue	Prof. Arvind K. Bansal	Rajeshwari & Associates	25000/- per hour	1 year
21.	Expert Advice on Oral Solid Dosage Forms	Prof. Arvind K. Bansal	Novugen Oncology Sdn. Bhd	30,000/- and 55000/- per hour	1 year
22.	Characterization and Comparative evaluation of Solid state properties for Reference and Test Product	Prof. Arvind K. Bansal	Gulbrandsen Technologies	2.54 lakh	1 year
23.	Identification, isolation and particle size analysis of APIs in respective dosage forms using HSM	Prof. Arvind K. Bansal	PharmaniagaREsearch Centre SDN BHD	2.06 lakh	1 year
24.	Particle size analysis of API in Reference and Test Formualtion using Hot stage microscopy	Prof. Arvind K. Bansal	Emcure Pharmaceuticals Ltd	1.42 lakh	1 year
25.	Identification, isolation and particle size analysis of APi in Reference and Test samples using Hot stage microscopy	Prof. Arvind K. Bansal	Bilss GVS Pharma Ltd(R&D Centre)	1.42 lakh	1 year
26.	IdentifIcation, isolation and particle size analysis of Brivaracetam in Briviact Tablets using Hot stage microscopy	Prof. Arvind K. Bansal	Zenvision Pharma LLP	0.70 lakh	1 year
27.	Particle size analysis of API in Formulation using Hot stage miscoscopy	Prof. Arvind K. Bansal	Barooque Pharmaceuticals Pvt Ltd	0.65 lakh	1 year
28.	Identification, isolation and	Prof. Arvind K. Bansal	Jubilant Generics	1.30 lakh	1 year

	particle size analysis of Azilsartan in Formulations using Hot Stage Microscopy		Ltd (R&D)		
29.	Identification, isolation and particle size analysis of API in Samples using Hot Stage Microscopy	Prof. Arvind K. Bansal	Arzneimittel-Alfa Private limited	1.95 lakh	1 year
30.	Particle Size analysis of Fidaxomicin in Tablets using Hot stage microscopy	Prof. Arvind K. Bansal	Torrent Pharmaceuticals Ltd	1.30 lah	1 year
31.	Particle Size analysis of Bilastine in Dosage form using Hot stage microscopy	Prof. Arvind K. Bansal	Torrent Pharmaceuticals Ltd	1.30 lakh	1 year
32.	Particle size analysis of API in Suppository Samples using Hot stage Microscopy	Prof. Arvind K. Bansal	Slayback Pharma India LLP	3.25 lakh	1 year
33.	Particle Size analysis of API in Formulations using Hot stage microscopy	Prof. Arvind K. Bansal	Natco Pharma Limited	1.41 lakh	1 year
34.	Reverse Engineering of API in Referene and test samples using Hot stage microscopy	Prof. Arvind K. Bansal	Apothecon Pharmaceuticals Pvt Ltd	1.30 lakh	1 year
35.	IdentifIcation, isolation and particle size analysis of Rivaroxaban in RLD sample using Hot stage microscopy	Prof. Arvind K. Bansal	Titan Labotarories Pvt Ltd (R&D)	0.7a lakh	1 year
36.	Particle size analysis of API in	Prof. Arvind K. Bansal	Glenmark Pharmaceu	2.60 lakh	1 year

	Formulations using HSM		ticals Ltd		
37.	Evaluation of Solid state of Indomethacin in Reference Product and Test Product Suppository Samples	Prof. Arvind K. Bansal	Slayback Pharma India LLP	3.90 lakh	1 year
38.	Particle Size analysis of API in Formulation sample	Prof. Arvind K. Bansal	DifGen Pharmaceuticals Pvt. Ltd	0.71 lakh	1 year
39.	IdentifIcation, isolation and Particle size analysis of Ibrutinib in Imbruvica Tablets using Hot stage microscopy	Prof. Arvind K. Bansal	Sakar Healthcare ltd	0.65 lakh	1 year
40.	Particle size analysis of Progesterone in Tablets using Hot Stage Microscopy	Prof. Arvind K. Bansal	Glenmark Pharmaceuticals Ltd	3.90 lakh	1 year
41.	Particle size analysis of API in Temazepam capsules using Hot Stage Microscopy	Prof. Arvind K. Bansal	JAMP India Pharmaceuticals Pvt Ltd	0.71 lakh	1 year
42.	Comparative evaluation of samples using PXRD	Prof. Arvind K. Bansal	Novick Biosciences Pvt Ltd	0.34 lakh	1 year
43.	Particle Size analysis of Clotrimazole and Naproxen in respective dosage forms using Hot stage microscopy	Prof. Arvind K. Bansal	Olive Healthcare	1.18 lakh	1 year
44.	Identification, isolation and particle size analysis of Ambrisentan, Edoxaban and	Prof. Arvind K. Bansal	PHARMACTİVE İLAÇ SAN.VE TİC.A.Ş.	2.66 lakh	1 year

	Obeticholic acid in respective dosage forms using Hot stage microscopy				
45.	Identification, isolation and particle size analysis of Nitrofurantoin in Samples using Hot Stage Microscopy	Prof. Arvind K. Bansal	Arzneimittel-Alfa Private limited	1.95 lakh	1 year
46.	Surface Area analysis of samples using BET method	Prof. Arvind K. Bansal	Sanofi-Synthelabo (india) Pvt Ltd	2.36 lakh	1 year
47.	Surface Area analysis of samples using BET method	Prof. Arvind K. Bansal	Sanofi-Synthelabo (india) Pvt Ltd	0.20 lakh	1 year
48.	Quantification of clavulanic acid production	Prof Ipsita Roy	KinvanPvt. Ltd.	4.00 lakh	0.5 year

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