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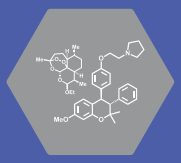
CSIR CENTRAL DRUG RESEARCH INSTITUTE

Annual Report 2018-19

www.cdri.res.in

Captions for the pictures included in the cover page



Chemical structure of Centchroman (Contraceptive) and Arteether (Antimalarial) – proud contributions of CSIR-CDRI for the National Family Planning Program and National Malaria Program respectively.

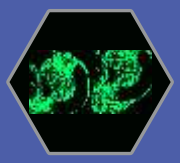
Golden Jubilee Shanti Swarup Bhatnagar Memorial Tournament (SSBMT 2018) Zonal-II (Indoor & Outdoor) held during November 26-29, 2018 at CSIR-CDRI

Nutraceutical formulation of *Spinacea oleracea* for Joint health launched for marketing by our licensee M/s. Pharmanza Herbal Pvt. Ltd. Gujarat on 13 March 2018.

Study visit of the Departmental-related Parliamentary Standing Committee on Science & Technology, Environment & Forests to CSIR-CDRI on 3 December 2018 under the Chairmanship of Hon. Shri Prasanna Acharya, Member of Parliament, Rajya Sabha. Prof. Tapas K. Kundu described traditional knowledge based drug discovery process.

CSIR-CDRI provided the first experimental evidence for a functional SUF pathway for [Fe-S] biogenesis in the *Plasmodium falciparum*

A view of the Jigyasa programs organized at CSIR-CDRI during the year



S008-399 enhanced bone formation in bone regeneration. Technology transferred to OrthoRegenics Pvt Ltd Hyderabad, (ORPL) on 26 September 2018.

Editorial Board

Acknowledgement

We sincerely thank all who have extended their generous support, advice and help, in the preparation of the Annual Report 2018-19. The effort of each and every person who has contributed in the making of this report is hereby acknowledged. We are grateful to all the Area Coordinators and Heads/ In Charge of Divisions/ Units, Administration for timely submission of data and for the support.

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ANNUAL REPORT
2018-19

CSIR-Central Drug Research Institute

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Organizational Structure

Shri Narendra Modi
Hon'ble Prime Minister &
President, CSIR

Dr. Harsh Vardhan
Hon'ble Union Minister for Science
& Technology and Earth Sciences &
Vice President, CSIR

Dr. Shekhar C. Mande
Director General, CSIR & Secretary, DSIR

Research Council → **DIRECTOR, CSIR-CDRI** ← **Management Council**

State of the Art Facilities

- GLP Test Facilities
  - Acute Toxicity
  - Safety Pharmacology
- National Laboratory Animal Facility
- Sophisticated Analytical Instrument facility
- Knowledge resource Centre
- Tissue & Cell Culture Laboratory

Technical Infrastructure Divisions/Units

- Academic Affairs Unit
- Business Development and Intellectual property Unit
- Computer Centre
- HRD Unit
- Laboratory Engineering Services
- Other Lab Services
- Scientific Directorate

R&D Divisions

- Biochemistry
- Endocrinology
- Ethnobotany
- Medicinal and Process Chemistry
- Microbiology
- Molecular & Structural Biology
- Parasitology
- Pharmaceutics & Pharmacokinetics
- Pharmacology
- Toxicology & Experimental Medicine

General Administration and Facilities

- Administration
- Accounts
- Stores & Purchase
- CSIR Dispensary
- Canteen

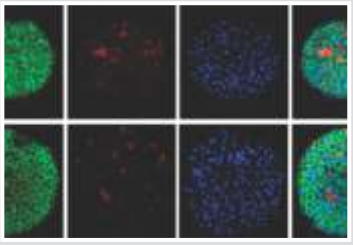
Field Station

- CDRI Clinical Pharmacology Unit, Seth G.S. Medical College, Mumbai
- KGMU, Lucknow
- PGIMER, Chandigarh

Contents

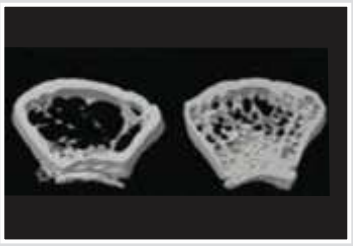
Thrust Areas of Research

1. Malaria and other Parasitic Diseases



- Development of new drugs/drug combinations as therapeutic interventions for malaria, leishmaniasis and filariasis;
- Identification of unique targets and pathways for future interventions;
- Investigations on parasite biology and host-parasite interactions.

2. Bone Health and Metabolic Bone Diseases



- Development of novel agents for fracture healing and management of osteoporosis through modern drug design, scientific validation of traditional remedies and generation of new knowledge.

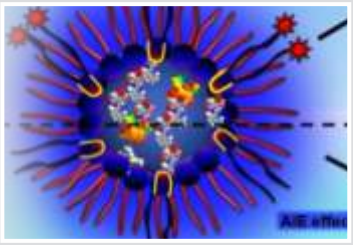
3. Antimicrobial Resistance

- Drug discovery studies against drug-resistant mycobacterial infections and ESKAPE pathogens;
- Discovery of new therapeutic strategies/interventions/diagnostic approaches by Advancing Knowledge Frontiers.

4. CVS, CNS, Cancer & Reproductive Health

- Development of novel therapeutic agents for CVS, CNS and related disorders, Cancer and Reproductive health;
- Carry out excellent basic research to delineate the molecular mechanisms of these pathologies / abnormalities so as to identify suitable targets for drug discovery, as well as to analyze the possible mechanism(s) of action of the candidate drugs;

5. Pre-clinical Studies & Translation



- Pre-clinical and clinical development of drug substances and drug products for diseases of national importance, international relevance and public health needs;
- Provision of services to the pharmaceutical industry, especially micro, small and medium enterprises and public sector manufacturers;
- Continued engagement with drug regulation and pharmaceutical policymaking in India as well as internationally.

From the Director's Desk

I am delighted to present the Annual Report 2018-19 of CSIR-Central Drug Research Institute, a premier drug research Institute of India with glorious past and making strident advancements in all aspects of biomedical research relevant to the Indian population with global significance. Though, I was associated with CSIR-CDRI for last many years in different capacities, mostly as invitee or as expert, but after taking over the charge of this Institute as Director, I witnessed the immense innate potential inbuilt in this Institute towards leading the biomedical as well as translation research in India. I was humble to join this glorious Institute to lead from the front as a companion in its endeavor to meet the unmet medical needs in the areas of national priority, develop highest quality human resource and scientific inquisitiveness driven research. One-day Symposium on Past, Present and Future of Drug Discovery and Development in India, exclusively by the former Directors of CSIR-CDRI, held soon after my joining to this Institute gave a futuristic direction to lead the drug development program of CSIR-CDRI. I am extremely thankful to my predecessors for sharing their valuable thoughts.

The CSIR-CDRI, which was established right after the independence of India with an aim for technological independence of the Nation, revolutionized the pharmaceutical sector in India, which was almost non-existent at the time of independence. Institute made available the much needed process technologies, highly qualified human resource and consultancy to the then budding Indian pharma sector. Over the years, Institute incessantly modernized its competencies, positioned itself for the future challenges. Today, it has evolved into a unique institution possessing end-to-end expertise in the domain of new drug development. Its manpower and infrastructure today is second to none. Besides being the breeding ground of huge highly trained human resource for the drug development and manufacturing (for which largely India become the 'Pharmacy of the Developing world'), out of 20 new drugs discovered, developed and approved in the post-independent India, 11 (8 synthetic + 3 phytopharmaceuticals) are contributions of CSIR-CDRI, Lucknow. These include Centchroman, Arteether, Centbucridine, Gugulipid, Bacosides Enriched Standardized Extract of Bacopa, etc. Centchroman (Ormeloxifene), a non-steroidal contraceptive with almost no toxicity, is now part of the National Family Program, whereas α-β Arteether (antimalarial) is included in the National Malaria Program.

The year 2018-19 has been one of the productive happening year for us in all aspects of its mandate, including new technologies, new knowledge generation and human resource development. In a first ever breakthrough in the area of Osteoarthritis, our scientists have discovered and developed a standardized nano-formulation from Spinacea oleracea. This product not only had the ability to form bone but it also possessed an intrinsic ability to bed more of cartilage cells at the affected site. On 13 March 2018, this product was formally launched for the domestic market by our licensee M/s. Pharmanza Herbal Pvt. Ltd., Gujarat with a brand name "Joint Fresh". Currently, it is being sold in many states as a dietary supplement.

In the area of Osteoporosis, we have discovered a novel osteo-inductive agent CDRI S008-0399. On 26 September 2018, transferred this technology to M/s OrthoRegenics Pvt. Ltd., Hyderabad for further development and commercialization as a medicated bone implant material for fracture healing. Another team of our scientists has developed a standardized fraction of a plant (219C002) for the treatment of glucocorticoid-induced osteoporosis and muscular atrophy. We licensed this Knowledge base to M/s. Pharmanza Herbal Pvt. Ltd., Gujarat on 17 February 2018. These successful developments and transfer of technologies has given a new impetus to our researchers towards knowledge driven drug discovery and development for the targeted unmet medical needs.

At present, we are having highly promising pipeline of leads for diseases including Thrombosis, Osteoporosis, Malaria, Leishmania, Microbial infections, Dyslipidemia and Colon cancer. Several of these are in advance stages of development and should be seeing the light of the day soon. For most of these promising molecules / phytopharmaceuticals, we are in touch with industry and clinician. Besides these, scientists at CSIR-CDRI have several promising discoveries at least some of which will surely going to be the reality in very near future.

I am very happy to report that during the year 2018; Institute has performed very well in terms of the measurable performance parameters. Published 306 research papers with average IF 3.46. Filed 2 patents in India and 2 abroad. Seven Indian patents and Two foreign patents were granted. A total of 77 PhD scholars submitted their PhD thesis. A total of 40 candidates received skill development training under CSIR Skill Development initiative. About 143 post graduate students received 4 – 6 months training in the biomedical research. A total of 44 new extra mural research projects, funded by DST, DBT, ICMR, DRDO, MoES, etc., with a total approval budget of Rs. 22.36 Crore have been initiated. Institute received ECF of Rs. 14.32 Cr. and generated Rs. 1.32 Cr. as LRF. Some of the major state-of-the-art facilities established during the year include Electrophysiology set-up, MicroCT for live CT Scanning, Powder X-ray diffraction (PXRD) facility and Flow cytometer. Institute researchers and research scholars continued to fetch prestigious honors & awards from national and international agencies. I congratulate entire CSIR-CDRI family for their distinct accomplishments.

As a part of CSIR Scientific Social Responsibilities, during the year, Institute has organized multiple societal activities including health awareness programs, Students motivation programs & Jigyasa. Under Student motivation program, more than 2100 students and >100 teachers visited CSIR-CDRI. As a part of Jigyasa program, >500 students and about 50 faculties from 18 Kendriya Vidyalayas visited CSIR-CDRI. Through lectures, videos and live demonstration, institute scientists tried to inculcate the culture of inquisitiveness and scientific temper among the students. Institute also played key role in organizing India International Science Festival 2018 at Lucknow, which witnessed a large number of visitors from Lucknow and other cities. This year, we received opportunity to host the SSBMT Zonal tournament, which was participated by 10 CSIR laboratories. It was a reinvigorating experience for the entire CSIR-CDRI family. We thank CSIR Sports Promotion Board for giving us this opportunity.

During the year, the Departmental-related Parliamentary Standing Committee on Science & Technology, Environment & Forests visited our Institute on 3 December 2018 under the Chairmanship of Hon. Shri Prasanna Acharya, Member of Parliament, Rajya Sabha. Committee complemented the accomplishments of Institute in its long journey of more than 6 decades in making the healthcare affordable in India. Committee desired that Institute shall take up research activities in the

area of viral diseases as nation is frequently facing the viral epidemics. We are happy to report that Institute has already taken up the initiative to venture into newer and most relevant disease areas including viral infections, ageing biology and neurobiology envisioning the healthcare challenges for India 20 years from now. Institute also envisages setting up of super specialty hospital to give impetus to biomedical research activities of the Institute.

Scientific lectures, seminars, symposia are powerful tools for inculcating the academic culture to give impetus to the research activities. With an aim to create a platform for scientific discussions, during the year, Popular Health Talk series, Nobel Symposium and Scientific Lecture series were initiated. Popular health talks, a bimonthly lecture series, is being delivered by eminent clinicians who have made outstanding contributions to the biomedical research. While, objectives of the Nobel symposium is to provide a platform to discuss and share the excitement of events which led to World's highest scientific award during the year. In this series, lectures on Nobel prize winning work will be delivered by the Institute research scholars. CSIR-CDRI Scientific Lecture Series was initiated with an aim to create an interacting platform among the scientists of the institute and eminent contributors in the field of drug discovery and development / disease biology / other related field. I am very happy to note that these three initiatives have given a very positive impact on research environment of the Institute and succeeded in inculcating academic culture.

I am delighted to report that in the next week, we are organizing the 7th International Symposium on Current Trends in Drug Discovery Research (CTDDR-2019). CTDDR-2019 is aimed to provide a forum for the interchange of innovative ideas among scientific, academic fraternity and industries through presentations and discussions on new opportunities, innovations in drug discovery & development and cutting-edge advances in drug discovery and development. I am glad to note that more than 450 delegates including distinguished experts from India and abroad are participating in this symposium. I hope, participants will get an excellent opportunity to address issues related to the healthcare in areas like tropical, infectious diseases as well as life style diseases and cancer. I wish all the delegates will not only appreciate the scientific interactions, but also the cultural heritage of Lucknow; the historical city famous for its etiquette. I extend my heartiest compliments to the organizing team and wish the symposium a grand success.

The influence of science on people's lives is rising. Inevitably expectations are snowballing. There is an unprecedented demand for newer technologies to support the emerging economy of the Nation as well as unmet needs of the society. Scientific community is expected to perform multifarious role including societal activities having direct bearing on society and high end innovative science to achieve global benchmarks to accelerate India's march towards achieving socio-economic transformation. I believe, we can meet the immediate expectations of the nation in all fronts, as well as we will equip for the challenges of future.

I take this opportunity to convey my heartfelt thanks to all the staff and students for their valuable contributions and am confident that they shall continue to work even harder during the years ahead to make it a most productive Institute.

(Tapas K. Kundu)

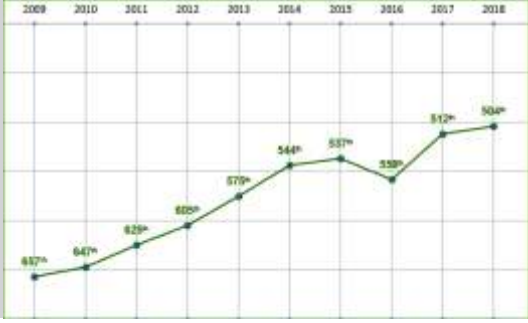
17 February 2019

Highlights of Achievements

Products & Technologies		
Technology Launched for Market	:	**1** *(Nutraceutical "Joint Fresh")*
Technologies Licensed to Industries	:	**2** *(CDRI219C002 & S008-0399)*
IND Filed	:	**1** (S007-867 – Antithrombotic)
Publications in SCI Journals	:	306
Average Impact Factor	:	3.46
Publications with >5 Impact Factor	:	40
Patents		
Filed Abroad	:	2
Filed in India	:	2
Granted Abroad	:	2
Granted in India	:	7
Human Resource Development		
Ph.D. Thesis Submitted	:	76
Post graduate trainings	:	143
Skill Development Trainings	:	40
ECF & Earnings	:	
Grant-in-Aid Projects Initiated	:	44
Total cost of Approved GAP Projects	:	Rs. 22.36 Crore
Earning from Industry	:	Rs. 2.51 Crore
Total External Budgetary Resources	:	Rs. 15.64 Crore

Performance Report


ACS APPLIED MATERIALS & INTERFACES
Research Article
Anisamide-Anchored Lyotropic Nano-Liquid Crystalline Particles with AIE Effect: A Smart Optical Beacon for Tumor Imaging and Therapy
Multifunctional Glycoconjugate Assisted Nanocrystalline Drug Delivery for Tumor Targeting and Permeabilization of Lysosomal-Mitochondrial Membrane
siRNA Delivery Using a Cationic-Lipid-Based Highly Selective Human DNA Ligase I Inhibitor
Green Chemistry
Zinc oxide-NP catalyzed direct indolation of in situ generated bioactive tryptanthrin
Chemical Communications
A nickel-catalyzed anti-carbometallative cyclization of alkyne–azides with organoboronic acids: synthesis of 2,3-diarylquinolines
JACS
Communication
Asymmetric Pd-Catalyzed Alkene Carboamination Reactions for the Synthesis of 2-Aminoindane Derivatives
Copper–catalyzed decarboxylative regioselective synthesis of 1,5-disubstituted 1,2,3-triazoles
CHEMISTRY A European Journal
Direct Transformation of Arylamines to Aryl Halides via Sodium Nitrite and N-Halosuccinimide
Free online access



CSIR-CDRI

A multidisciplinary hub for drug discovery and development to serve humanity

The CSIR-Central Drug Research Institute (CDRI), Lucknow, was the seventh in the chain of CSIR labs that were established in India right after independence, aiming for technological independence of the Nation. CSIR-CDRI was broadly mandated with the task of developing the indigenous pharmaceutical industry, which was practically non-existent at that time. The mandate included working for enhancing drug accessibility and affordability. Thus, soon after its establishment on 17 February 1951, CSIR-CDRI started serving as a "think tank" and took up a critical and multifaceted role aimed at affordable healthcare for all through: (i) advising government on important policy initiatives for starting and promoting drug R&D in India from scratch; (ii) developing process technologies and new products; (iii) generating the much needed human resource requirements of the pharmaceutical industry, academia and government agencies. The institute has produced hundreds of scientists and science managers, who rose to the top positions in their respective organizations.

During the 1960s, the Institute licensed over 70 low-cost process technologies for manufacture of generic drugs, significantly contributing to drug affordability for the common people of the Nation. Thereafter, in the 1970s and 80s, it was the national priority to discover new drugs for diseases affecting millions of Indians. CSIR-CDRI responded with discoveries addressing unmet medical needs, including contraception. In this period, Institute successfully commercialised 10 new drugs and four diagnostics. The launch of four drugs for marketing in 1987 by the then Prime Minister of India Shri Rajiv Gandhi has been a milestone moment of the Institute.

During the 1990s, with the advent of globalisation and opening up of the economy, the Institute focused on modernization of its capabilities and infrastructure to compete with multinationals and international organisations even as it continued to be relevant for the Nation's specific needs. The emphasis was on compliance with international standards and regulatory guidelines. It was the beginning of era of knowledge based innovation. The major priority for research at the dawn of the 21st century was occupying a firm position in the intellectual space, apart from generation of high quality human resource and knowledge base. Setting up of a new, state-of-the-art drug research institute was also envisioned during this period.

Today, CSIR-CDRI has evolved into a unique institution possessing end-to-end expertise in the domain of new drug discovery and development –its human resource and infrastructure today is second to none. The very latest techniques and methodologies are being employed at this institute for developing drugs, diagnostics and vaccines to combat diseases prevalent among humankind in general and the Indian population in particular. Possessing a cutting edge knowledge base, CDRI has the distinction of developing Eleven out of Twenty new drugs developed so far in independent India and licensing of more than 80 process technologies. CDRI publishes over 300 papers every year and has a robust patent portfolio

Priority Areas

For new drug discovery

- Parasitic diseases (Malaria & Leishmaniasis)
- AMR (MDR Mycobacteria & ESKAPE pathogens)
- Bone health

For advancing knowledge frontiers

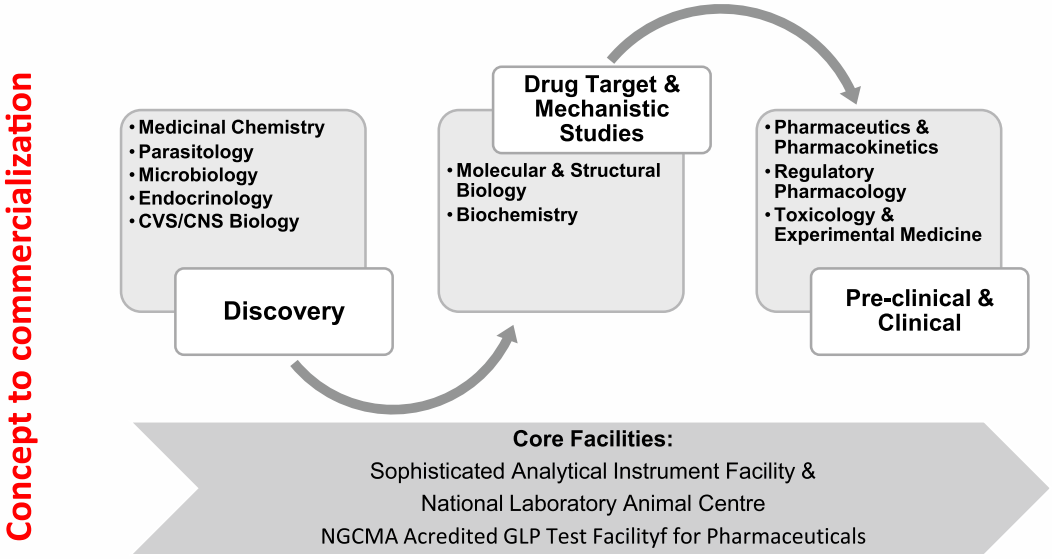
- Parasitic diseases (Malaria & Leishmaniasis)
- AMR (MDR Mycobacteria & ESKAPE pathogens)
- Bone health & Reproductive Biology
- CVS & CNS Biology
- Cancer Biology.

The institute continues to nurture high quality human resources, awarding over 80 PhDs every year. Many of its alumni occupy important positions in scientific and pharmaceutical R&D institutions, academia and the industry. The Institute has also significantly contributed to drug policy formulation and oversight of the Government of India and the UP State Government. The Director of the Institute is a member of the Drug Technical Advisory Board, while faculty members serve on advisory committees of the Central and State Drug Control Administrations.

CSIR-CDRI products have made a real impact in healthcare and the economy of the nation. Centchroman, a non-steroidal oral contraceptive for women was initially licensed to M/s. HLL Lifecare Ltd., Thiruvananthapuram (marketing it as 'Saheli'). In the year 2016, Centchroman was included in the National Family Planning Program and is being distributed free of cost as 'Chhaya.' Arteether, a fast acting anti-malarial, was launched by the then Prime Minister Shri AB Vajpeyee. It was licensed to M/s. Themis Medicare and is being marketed as E-Mal. This drug is manufactured for the Indian and export markets by more than 80 MSMEs, earning approximately ₹30 crore of foreign exchange annually. It is included in the National Vector-Borne Disease Control Programme, particularly for severe malaria.

CSIR-CDRI is currently involved in multifarious activities including new Drug development, Technologies, New knowledge and Intellectual space generation, High quality Human Resource development, Societal activities and also play a role in policy matters at various levels. However, major mandate of the Institute is new drug development for unmet medical needs.

With state-of-the-art infrastructure for New Drug Discovery and Development from 'Concept to Commercialisation', Institute is poised to become a global leader through cutting edge science & technology. It is positioned to meet the expectations of unmet medical need as well as expectations of the Industry.



Breakthrough Achievement in 2018-19

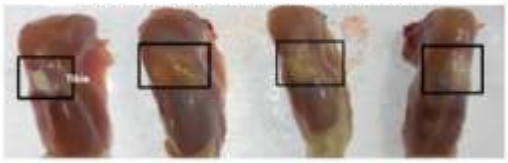
Commercial Launch of Dietary Supplement "Joint Fresh"

In a first ever breakthrough in the area of osteoarthritis, a most common chronic condition of the joints that afflicts mainly the weight-bearing joints such as hips and knees, and causes physical disabilities, CDRI Scientists have developed a standardized nano-formulation from *Spinacea oleracea* commonly known as Palak in hindi. This product not only had the ability to form bone but it also possessed an intrinsic ability to bed more of cartilage cells at the affected site. In the rodent model of osteoarthritis, the *Spinacea oleracea* formulation repaired and cured the degenerated cartilage.

Global statistics reveal, over 100 million people worldwide suffer from Osteo-arthritis. The prevalence for osteoarthritis in India is 22% to 39%. Nearly, 45% of women above 65 years' have symptoms while 70% of women over 65 years have radiological evidence of osteoarthritis

The lab scale technology was earlier licensed to M/s. Pharmanza Herbal Pvt. Ltd. for further developmental studies and commercial launch with due approval of the regulatory authorities. On 13 March 2018, the product was formally launched for the domestic market. Currently, it is being sold in many states of the country as a dietary supplement

***Spinacea oleracea* formulation prevents cartilage atrophy at knee joints**

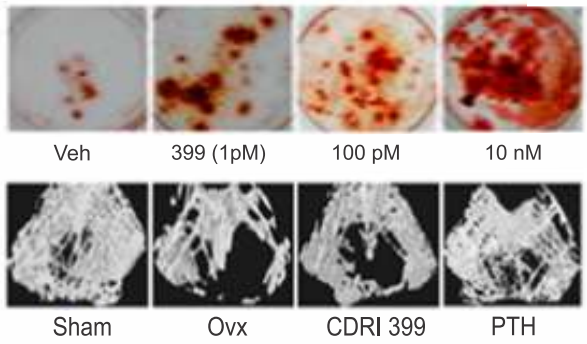


Joint Fresh launched for marketing on 13 March 2018

Breakthrough Achievement in 2018-19

Transfer of Technology of Novel Osteo-inductive Agent CDRI S008-0399 as Medicated Bone Implant Material for Fracture Healing

India has the worst traffic accident rates worldwide with over 130,000 deaths annually. Many of these accidents lead to fractures of delayed union or non-union type that can result in multiple surgeries. CDRI compound S008-0399 promotes osteoblast differentiation and mineralization at dose as low as 1 picomolar concentration and increases bone mineral density (BMD), mineral apposition rate (MAR) and bone formation rate (BFR) in osteopenic rat model. This bone inducing agent improves bone quality and restores trabecular micro-architecture in ovariectomized osteopenic rats and enhances bone healing in cortical bone defect animal model.



New bone formation in normal and osteopenic SD rats

The molecule was licensed to M/s OrthoRegenics Pvt. Ltd., Hyderabad and technology of the product was transferred for fabrication of orthopaedic implants in combination with biodegradable bone inducing materials to enhance healing at the fracture site. These low cost medicated biodegradable bone implants will also reduce the cost of bone implant surgery as compare to metallic bone implants because they are biodegradable and will be resorbed during the process of new bone formation at the facture site. There will be no need for re-surgery to remove the implants or some other infection and wear and tear issue debris as in case of non-degradable implants.

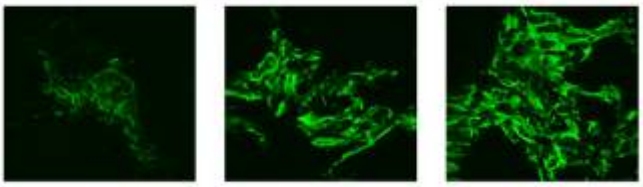
Technology of the product S008-399 was transferred to M/s. Ortho Regenics Pvt. Ltd., Hyderabad, on 26 September 2018 during 76th CSIR Foundation Day celebrations

Breakthrough Achievement in 2018-19

Licensing of Standardized Fraction 219C002 for Treatment of Glucocorticoid-induced Osteoporosis

A team of Scientists from CSIR-CDRI has developed a standardized fraction of a plant (219C002) for the treatment of glucocorticoid-induced osteoporosis and muscular atrophy. Millions of people in India suffer from pulmonary, rheumatologic, gastrointestinal, dermatologic and autoimmune diseases and have to be treated with chronic glucocorticoid. Globally glucocorticoid is the third biggest cause of osteoporosis. Therefore, an osteogenic (bone forming) therapy such as standardized extract 219C002 will benefit a vast population across all ages in reducing the risk of fracture caused by the use of synthetic glucocorticoids. Moreover, long-term use of glucocorticoid is also detrimental to muscle and the standardized extract 219C002 protects against such insult.

219C002 Formulation to Enhance Bone Regeneration



Vehicle 219/C002 219/C002-F

The Knowledge base was licensed to M/s Pharmanza Herbal Pvt. Ltd., Gujarat on 17 February 2018 for further development and commercialization of this product in the Indian & US market after getting necessary clearances from the regulatory authorities.

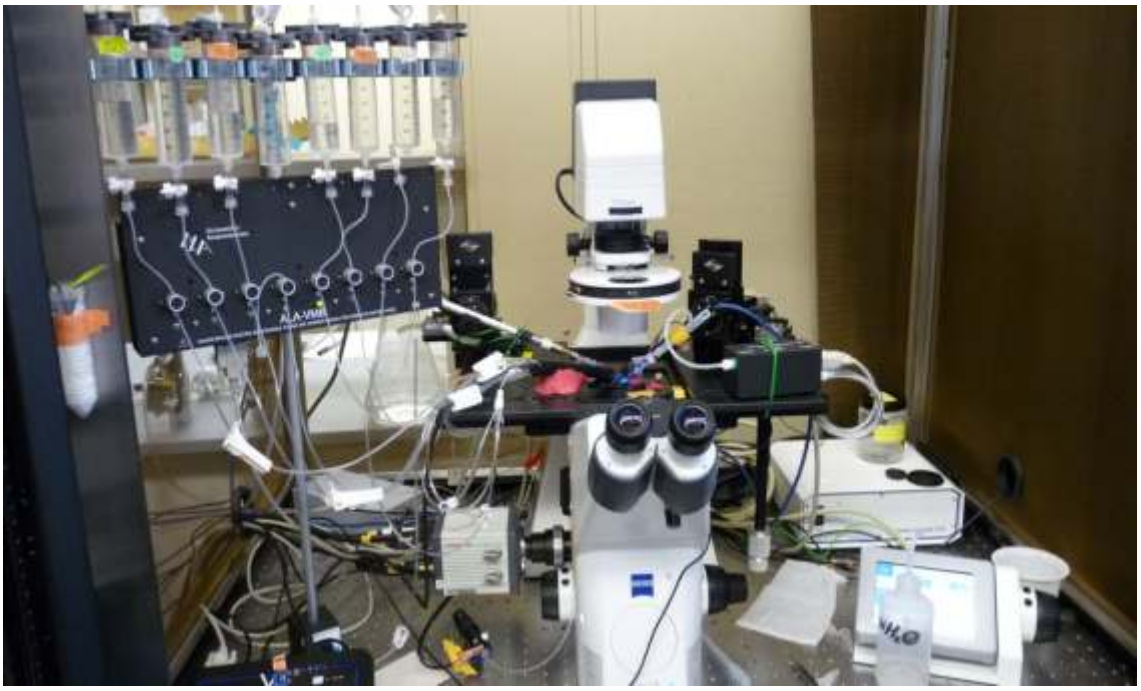
Knowledgebase licensed to M/s. Pharmanza Herbals Pvt. Ltd., Gujarat on 17 February 2018 during CSIR-CDRI Annual Day Celebrations

Advances in Drug Discovery & Developmental Studies

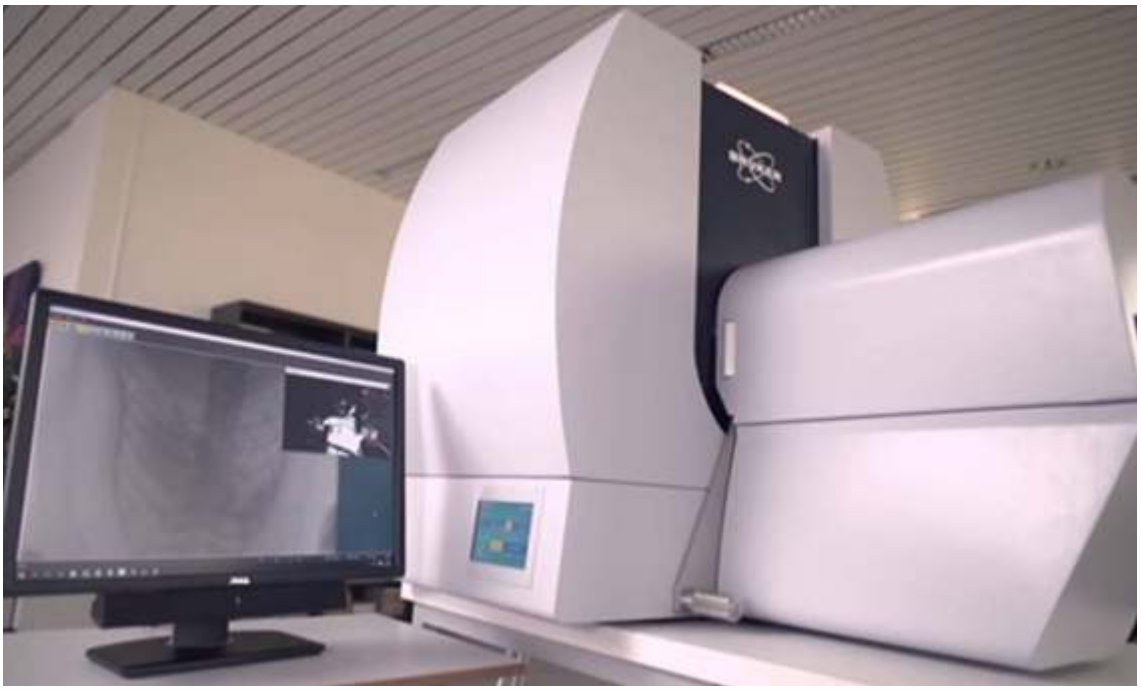
Nature & Name	Indication	Current Developmental Stage
Synthetic Compound		
S007-0867	Antithrombotic	IND filed
S007-1500	Fracture healing	Toxicity studies in dog ongoing
S011-1793	Antimalarial	Pre-clinical regulatory toxicity studies ongoing
96-261	Antileishmanial	Pre-clinical regulatory toxicity studies ongoing
GS/IICT5-6	Antiangiogenic	Pre-clinical studies ongoing
S015-2448	Anti-depressant KOR Antagonist	*In vivo* efficacy in rodent model
S017-0594	Dyslipidaemia (PCSK-9 inhibitor)	Efficacy studies ongoing
S017-0327	Anti-Obesity (5-HT2C PAM)	Efficacy studies ongoing
Phytopharmaceutical		
CDR219C002	Glucocorticoid induced osteoporosis	Pre-clinical regulatory toxicity studies
CDR267-F018	Antidyslipidemic / Cardioprotective	IND enabling studies ongoing
NMITLI-118R(T+)	Anti-stroke	IND enabling studies ongoing
CDRI1703F003	Anti-PCOS	*In vivo* efficacy in rodent model
Mucuna pruriens extract	Anti-male infertility	*In vivo* efficacy in rodent model
Picroliv	NAFLD	*In vivo* efficacy in rodent model
Peptide		
S016-1348	Anti-cancer Smac mimetic	*In vivo* efficacy in rodent model
LP4	Systemic bone growth enhancer	*In vivo* efficacy in rodent model
S016-1271	Antimicrobial and anti-endotoxin peptide	*In vivo* efficacy in rodent model
AYUSH		
CDRI4655	Dyslipidemia	*In vivo* efficacy in rodent model
CDRI 0135/C002	Cognitive impairments	*In vivo* efficacy in rodent model
Formulations		
Dry powder inhalation for pulmonary TB	Antituberculosis	Phase-1 trial documents under preparation
SMEDD formulation of Arteether and Fansidar	Antimalarial	Efficacy studies in Monkey model is to be done
Repurposing of Known drugs		
Anti-leprosy drug	Leukemia	Efficacy established in leukemia stem cells from drug resistant patients.
Pentoxifylline	Bone health	Efficacy established in rodent models
Centchroman	Breast cancer	*In vivo* efficacy studies in rodent models

New Facilities Established

Electrophysiology Set-up



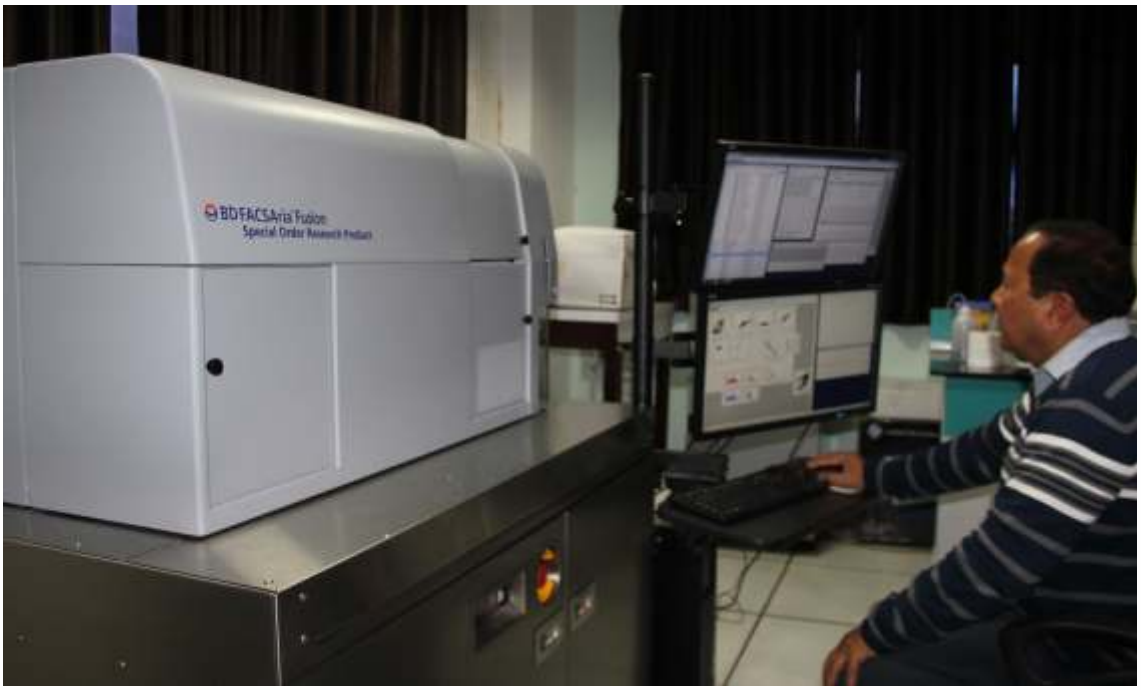
SkyScan-1276: State of Art MicroCT for live CT Scanning



New Facilities Established

Powder X-ray Diffraction (PXRD) Facility

Flow Cytometer



Sports & Recreational Facilities

On Annual Day of CSIR-CDRI, 17 February 2018, Dr. Girish Sahni, DG, CSIR inaugurated Cricket Stadium, Badminton Court and Volleyball Court

Some Important Publications - 2018

Chemical Sciences

Sl. No.	Author	Title	Journal Vol.(Iss), PP	IF
1.	Rai B, Shukla RD and Kumar A	Zinc oxide-NP catalysed direct indolation of in situ generated bioactive tryptanthrin	**Green Chemistry** 20(4), 822-826	8.58
2.	Urandur S, Banala VT, …..Trivedi R, Ramarao P and Mishra PR	Anisamide-anchored lyotropic nano-liquid crystalline particles with AIE effect: A smart optical beacon for tumor imaging and therapy	**ACS Applied Materials & Interfaces** 10(15), 12960-12974	8.09
3.	Pandey G, Mittapelly N, Banala VT and Mishra PR	Multifunctional glycoconjugate assisted nanocrystalline drug delivery for tumor targeting and permeabilization of lysosomal-mitochondrial membrane	**ACS Applied Materials & Interfaces** 10(20),16964-16976	8.09
4.	Bathula SR, Sharma Komal, . …. … …. …. .. Deshmukh AL and Banerjee Dibyendu	siRNA delivery using a cationic-lipid-based highly selective human DNA ligase I inhibitor	**ACS Applied Materials & Interfaces** 10(2), 1616-1622	8.09
5.	Pratap K and Kumar A	Palladium-catalyzed intermolecular dehydrogenative carboamination of alkenes with amines and N-substituted isatin	**Organic Letters** 20(23), 7451-7454	6.49
6.	Kumar GR, Kumar R, Manda R and Reddy MS	A nickel-catalyzed anti-carbometallative cyclization of alkyne-azides with organoboronic acids: synthesis of 2,3-diarylquinolines	**Chemical Communications** 54(7), 759-762	6.29
7.	Kumar N, Ansari MY, Kant R and Kumar A	Copper-catalyzed decarboxylative regioselective synthesis of 1,5-disubstituted 1,2,3-triazoles	**Chemical Communications** 54(21), 2627-2630	6.29
8.	Maurya RK, Patel OPS, Anand D and Yadav PP	Substrate selective synthesis of indole, tetrahydroquinoline and quinoline derivatives via intramolecular addition of hydrazones and imines	**Organic Chemistry Frontiers** 5(7), 1170-1175	5.45
9.	Mukhopadhyay S and Batra S	Direct transformation of arylamines to aryl halides via Sodium Nitrite and N-halosuccinimide	**Chemistry: A European Journal** 24(55), 14622-14626	5.16
10.	Ahmad A, Dutta HS, Khan B, Kant R and Koley D	Cu(I)-catalyzed site selective acyloxylation of indoline using O-2 as the sole oxidant	**Advanced Synthesis & Catalysis** 360(8), 1644-1649	5.12
11.	Singh R ,Thopate Y, Equbal D and Sinha AK	Synergistic cooperative effect of L-Arginine-[bmim]Br in cascade decarboxylative Knoevenagel-Thia-Michael addition reactions: Green approach towards C=S bond formation with *in situ* generated unactivated α,β-unsaturated ester	**Advanced Synthesis & Catalysis** 360, 4412-4421	5.12
12.	Lavekar AG, Equbal Danish, Saima and Sinha AK	Synergistic cooperative effect of Sodium Borohydride-Iodine towards cascade C-N and C-S/Se bond formation: One-pot Regioselective synthesis of 3-Sulfenyl/Selenyl Indoles and mechanistic insight	**Advanced Synthesis & Catalysis** 360(1), 180-185	5.12

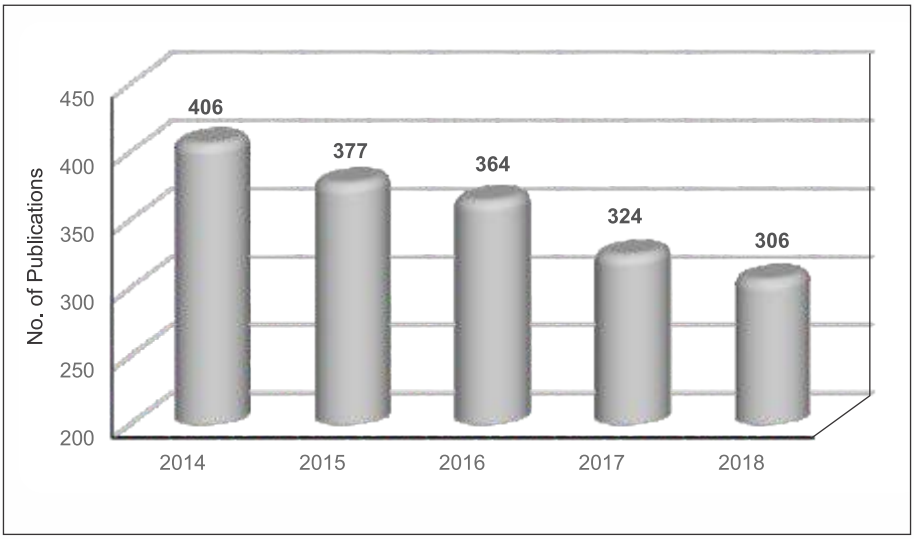
Some Important Publications - 2018

Biological Sciences

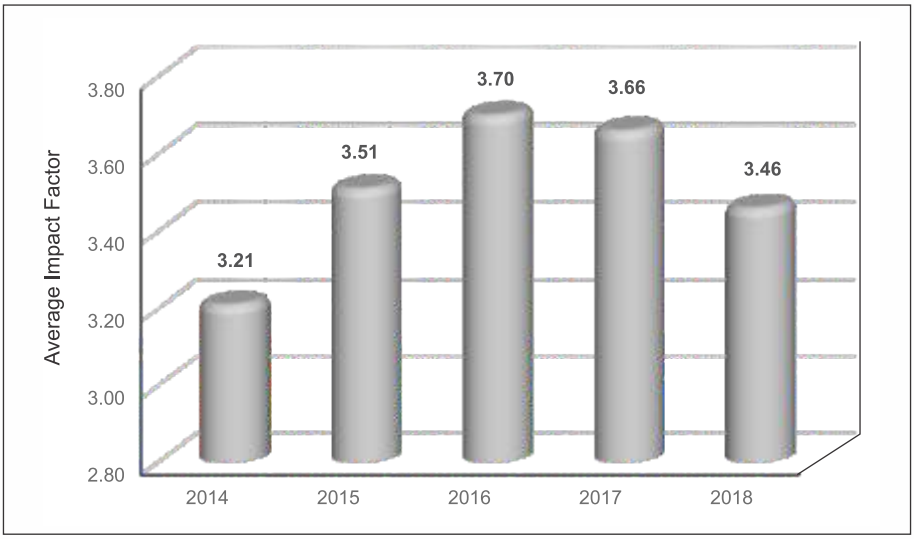
Sl. No.	Author	Title	Journal Vol.(Iss), PP	IF
1.	Awasthi H, Mani D, Singh D and Gupta A	The underlying pathophysiology and therapeutic approaches for osteoporosis	**Medicinal Research Reviews** 38(6), 2024-2057	8.29
2.	Gupta P and Barthwal MK	IL-1 Beta genesis: The art of regulating the regulator	**Cellular & Molecular Immunology** 15, 998-1000	7.55
3.	Vishwakarma P, Parmar N, Chandrakar P, Sharma T, Kathuria M, Agnihotri PK, Siddiqi MI, Mitra K and Kar S	Ammonium trichloro [1,2-ethanediolato-O,O']-tellurate cures experimental visceral leishmaniasis by redox modulation of *Leishmania donovani* trypanothione reductase and inhibiting host integrin linked PI3K/Akt pathway	**Cellular and Molecular Life Sciences** 75(3), 563-588	6.72
4.	Tandon A, Harioudh MK, Ishrat N, Tripathi AK, Srivastava S and Ghosh JK	An MD2-derived peptide promotes LPS aggregation, facilitates its internalization in THP-1 cells, and inhibits LPS-induced pro-inflammatory responses.	**Cellular and Molecular Life Sciences** 75(13), 2431-2446	6.72
5.	Singh S, Mishra A, Mohanbhai SJ, Tiwari V, Chaturvedi RK, Khurana S and Shukla S	Axin-2 knockdown promote mitochondrial biogenesis and dopaminergic neurogenesis by regulating Wnt/β-catenin signaling in rat model of Parkinson's disease.	**Free Radical Biology and Medicine** 129, 73-87	6.02
6.	Kumar Y, Biswas T, … …. …. …. …Sanyal S, Chattopadhyay N, Bandyopadhyay A and Trivedi AK	BMP signaling-driven osteogenesis is critically dependent on Prdx-1 expression-mediated maintenance of chondrocyte prehypetrophy.	**Free Radical Biology and Medicine** 118 ,1-12	6.02
7.	Kaushal JB, Popli P, Sankhwar P, Shukla V and Dwivedi A	Sonic hedgehog protects endometrial hyperplasial cells against oxidative stress via suppressing mitochondrial fission protein dynamin-like GTPase (Drp1)	**Free Radical Biology and Medicine** 129, 582-599	6.02
8.	Rajan S, Satish S, Shankar K, Pandeti S, … …. ….. …. … … R, Balaramnavar VM, Narender T and Gaikwad AN	Aegeline inspired synthesis of novel beta3-AR agonist improves insulin sensitivity *in vitro* and *in vivo* models of insulin resistance	**Metabolism** 85, 1-13	5.96
9.	Banala VT, Sharma S, Barnwal P, Urandur S, Shukla RP, Kalleti N, Mitra K, Rath SK, Trivedi R and Mishra PR	Synchronized ratiometric codelivery of Metformin and Topotecan through engineered nanocarrier facilitates in vivo synergistic precision levels at tumor site	**Advanced Healthcare Materials** 7(19), e1800 300	5.60
10.	Sharma A, Sharma P, Ganga L, Satoeya N, Mishra S, Vishwakarma AL & Srivastava M	Infective larvae of *Brugia malayi* Induce polarization of host macrophages that helps in immune evasion	**Frontiers in Immunology** 9, 194	5.51
11.	Reddy SS, Agarwal H and Barthwal MK	Cilostazol ameliorates heart failure with preserved ejection fraction and diastolic dysfunction in obese and non-obese hypertensive mice	**Journal of Molecular and Cellular Cardiology** 12(3), 46-57	5.29

Publications

Total No. of Publication



Average Impact Factor of the Publications



*** Data as on Jan 2019**

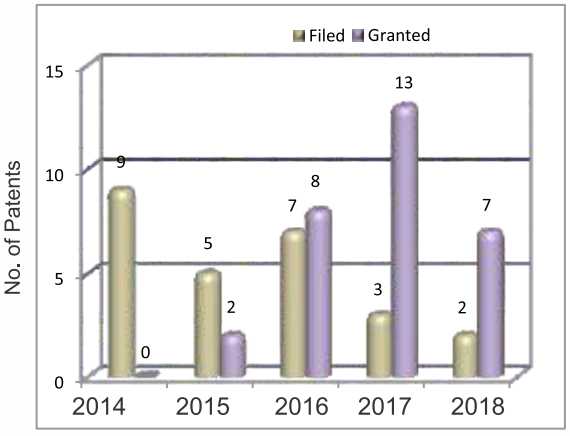
SCIMAGO Institutions Global Ranking

Current ranking of CSIR-Central Drug Research Institute is 504th

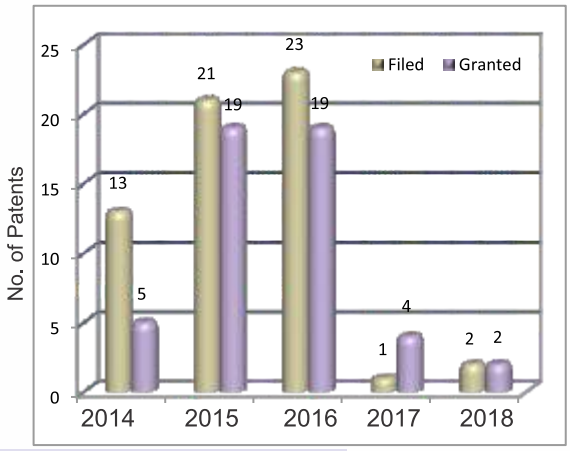
Methodology: *The SCIMAGO Institutions Rankings (SIR) is a classification of academic and research-related institutions ranked by a composite indicator that combines three different sets of indicators based on research performance, innovation outputs and societal impact measured by their web visibility.*

Intellectual Property

Indian Patents

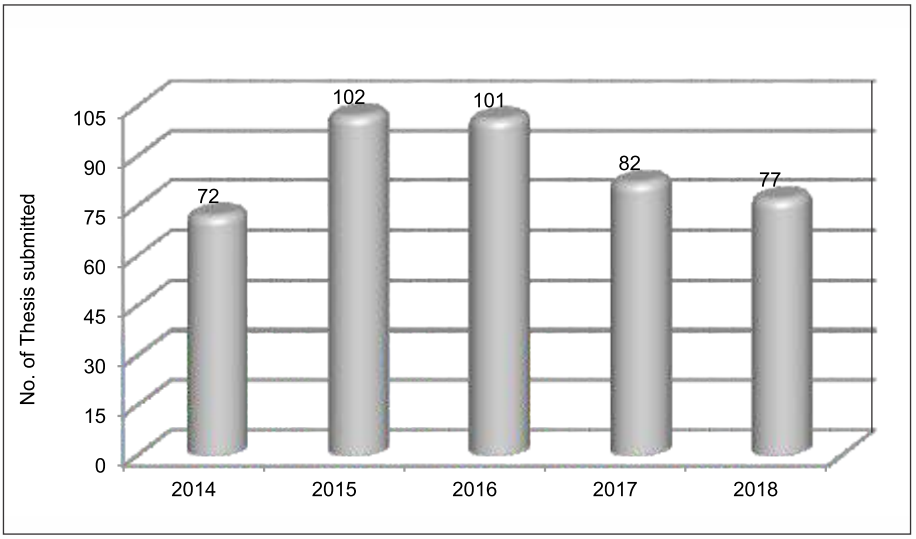


Foreign Patents

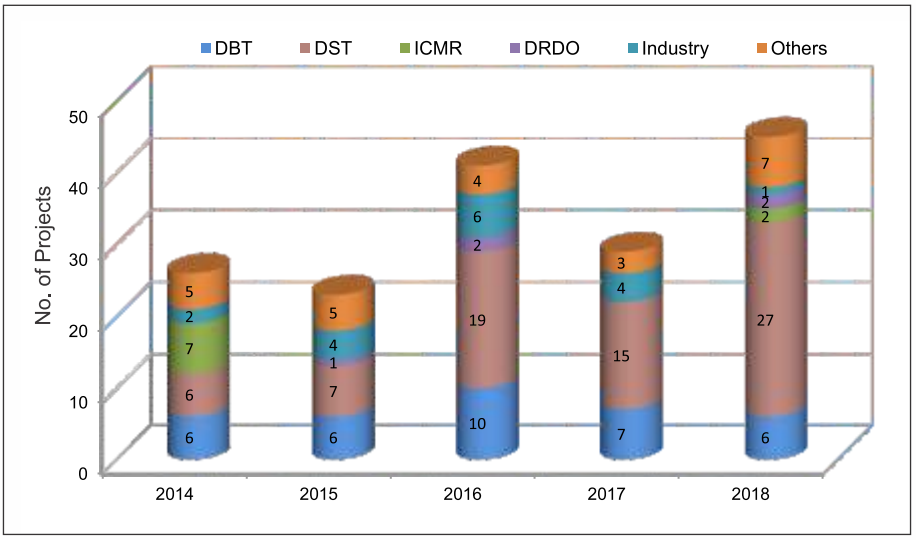


Total Number of Patents In-force	:	167
Number of In force patents licensed	:	55

Ph.D. Thesis submitted



Number of Extramural Projects Initiated



Industry / Academia Partnership

Number of Agreements executed

National	41
International	11
University/Institution	13
Pharmaceutical Industry	22
Funding Agency	2

Nature of Agreements Executed

Agreement	Nos
Agreement	3
Memorandum of Understanding	3
Sponsored Agreement	1
License Agreement	1
Secrecy Agreement	15
Material Transfer Agreement	11
Memorandum ofAgreement	10
Collaborative Agreement	1
Testing Services	6
Consortium Agreement	1

Our Collaborators and Industry Partners

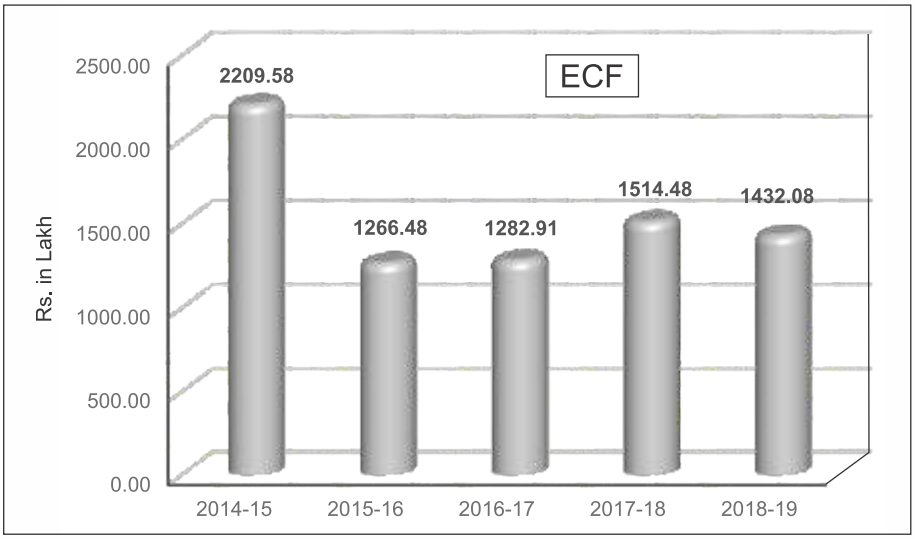
Budget

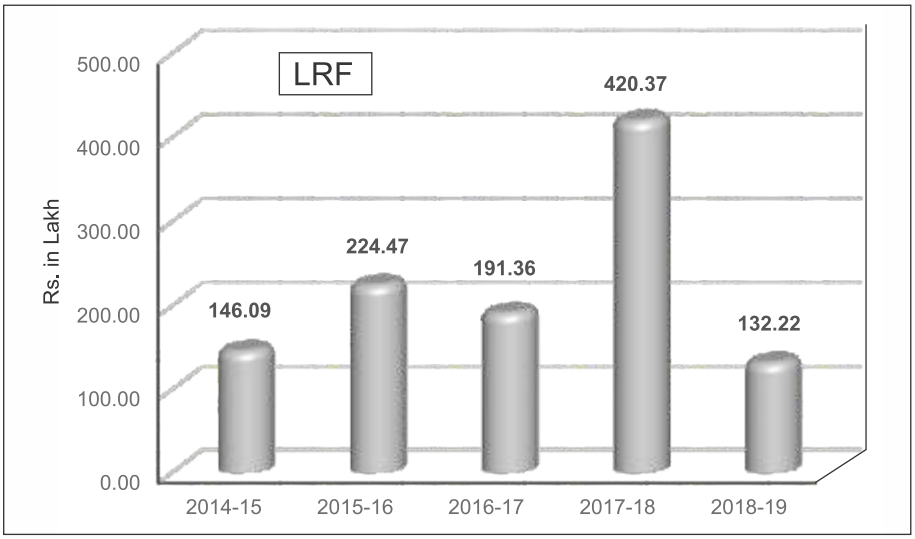
Rs. in lakh

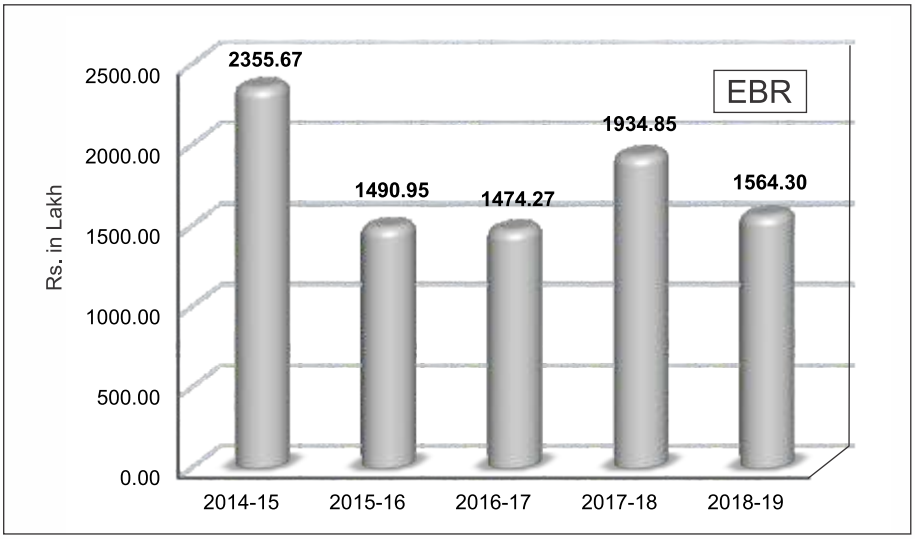
Heads		2014-15	2015-16	2016-17	2017-18	2018-19* (Allocation)
(A)	**Recurring**					
1	Pay and Allowances	4834.234	4916.152	4920.500	5462.718	5093.000
2	Contingencies	1011.075	1386.000	1018.000	1529.995	1328.010
3	HRD	-	-	0.800	-	-
4	Maintenance	560.000	732.000	718.000	925.800	954.910
5	Chemical and Consumables	860.000	1189.152	1323.000	1329.000	854.500
	Sub-Total	**7265.309**	**8223.304**	**7980.300**	**9247.513**	**8230.42**
(B)	**Capital**					
1	Works and Services / Electrical Installation	7.189	56.547	200.000	80.060	100.00
2	Apparatus and Equipments/ Computer Equipments	650.000	1183.946	1203.000	1084.000	271.00
3	Office Equipments, Furniture and Fittings	-	3.825	-	-	-
4	Library Books and Journals	250.000	250.488	75.000	330.186	162.135
	Sub-Total	**907.189**	**1494.806**	**1478.000**	**1494.246**	**533.135**
	Total (A+B)	**8172.498**	**9718.11**	**9458.300**	**10741.759**	**8763.555**
(C)	**Special Projects HCP/ BSC / CSC / ISC / PSC / NCP / FTT / FBR, etc.**	**2199.945**	**3662.966**	**2060.318**	**218.895**	**1282.100**
(D)	**CMM0015 (New CDRI)**	**4000.000**	**1097.000**	**-**	**-**	**-**
(E)	**CSIR-800 (Societal Activities)**	**-**	**-**	**100.00**	**-**	**-**
	Grand Total (A+B+C+D)	**14372.443**	**14478.076**	**11618.618**	**10960.654**	**10045.655**

*Data up to 31 January 2019

External Budgetary Resources







CSIR-CDRI Scientific Social Responsibility Programs

JIGYASA – Quest for Curiosity

The Jigyasa programme is inspired by Prime Minister Narendra Modi's vision of a new India and Scientific Social Responsibility (SSR) of Scientific Community and Institutions. The Council of Scientific and Industrial Research (CSIR) is implementing the programme in collaboration with Kendriya Vidyalaya Sangathan.

During the year, as a part of JIGYASA, more than 500 students and about 50 teachers from 18 Kendriya Vidyalayas from different States visited CSIR-CDRI.

Students Motivation Programs

As a part of CSIR's Scientific Social Responsibility, with an aim to promote experimentation and innovativeness in education and bringing confidence to society about relevance of Institute in terms of Social Impact, various motivation programs were organized during the year. Under this program, during the year, more than 2100 students and more than 100 faculties from Schools and colleges across India visited CSIR-CDRI. During the visit, students and faculties are appraised with the Institutes accomplishments in the service of nation, ongoing R&D programs and visits to important facilities and R&D laboratories.

Health Awareness and Outreach Programs

As a part of CSIR's Scientific Social Responsibility, CSIR-CDRI conducts awareness programme in villages on different disease areas. During the year, Institute scientists stepped-out for villages and organized following Health Awareness and Outreach Programs:

- Two days' health awareness and outreach programs in village Parenda, Block Miyanganj, Distt. Unnao from 6-7 April 2018.
- Health awareness program and free health check-up camp at village Begampur, Block Chittora, Distt. Bahraich on 6 July 2018.
- Health Awareness Program and free health check-up camp at village Gajadharpur, Block Fakarpur, Distt. Bahraich in association with CARE India.

Research Council

Chairman

Dr Rajiv Modi,
Chairman & Managing Director,
Cadila Laboratories, Ahmadabad

Members

Prof. N K Ganguly
Ex-DG ICMR
Visiting Professor of Eminence
Translational Health Science and
Technology (THSTI), Faridabad

Dr. Rajesh Jain
Jt. Managing Director
Panacea Biotech Ltd.
New Delhi

Dr. G N Qazi
Director General
HIMSR
Hamdard Nagar
New Delhi

Dr. Altaf Lal
Senior Advisor Global
Health and Innovation
Sun Pharma
USA

Prof. Gautam R Desiraju
Solid State and Structural
Chemistry Unit
IISc, Bengaluru

Prof. Ashwani Nangia
Director
CSIR-NCL
Pune

Dr. G N Singh
Secretary-cum-scientific director
Indian Pharmacopoeia Commission
Ghaziabad

Dr. Anil Koul
Director
CSIR-IMTech
Chandigarh

Dr. Vijay Chauthaiwale
Healthcare-Biotech Consultant,
45, South Avenue,
New Delhi

Prof. Tapas Kumar Kundu
Director,
CSIR-CDRI
Lucknow

Dr. Renu Swarup
Secretary,
DBT, New Delhi

Secretary
Dr. Aamir Nazir
Senior Scientist
CSIR-CDRI

Management Council

Chairman

Prof. Tapas K. Kundu
Director
CSIR-Central Drug Research Institute
Lucknow – 226 031

External Member

Dr. Ram A. Vishwakarma
Director
CSIR-Indian Institute of
Integrative Medicine
Jammu

Members

Dr. A K Sinha
Chief Scientist
Medicinal Process Chemistry
CSIR-CDRI
Lucknow– 226 031

Dr. R Ravishankar
Senior Principal Scientist
Molecular Structural Biology
CSIR-CDRI
Lucknow– 226 031

Dr. Anil N Gaikwad
Principal Scientist
Pharmacology
CSIR-CDRI
Lucknow– 226 031

Mr. Naseem Siddiqui
Senior Scientist &
Head, Business Development
CSIR-CDRI
Lucknow– 226 031

Dr. Namrata Rastogi
Scientist
Medicinal Process Chemistry Division
CSIR-CDRI
Lucknow – 226 031

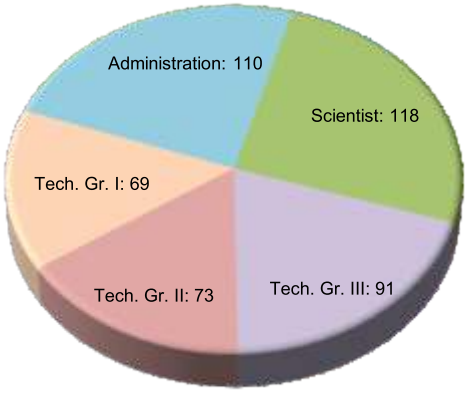
Dr. Kavita Singh
Senior Technical Officer
SAIF
CSIR-CDRI
Lucknow – 226 031

Mr. Baljeet Singh
Controller of Finance & Accounts
CSIR-CDRI
Lucknow– 226 031

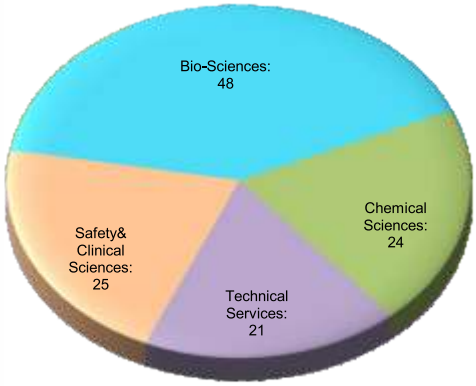
Member Secretary
Mr. C.P Arunan
Controller of Administration
CSIR-CDRI
Lucknow – 226 031

Manpower

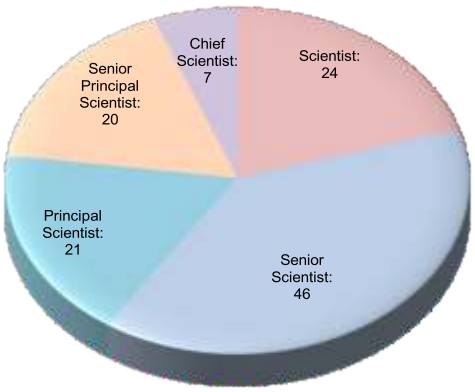
Total Staff (461)



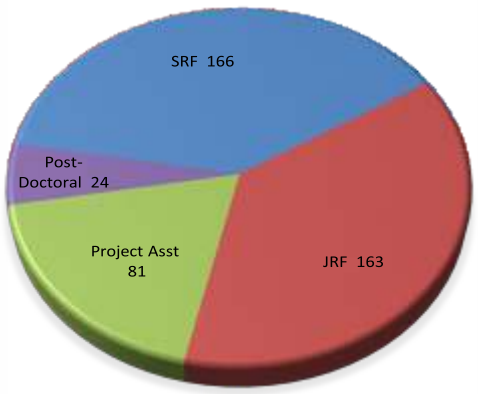
Area-wise Strength of Scientists (118)



Designation-wise Strength of Scientist (118)



Research Fellows and Project Assistant (434)



Data as on 01-01-2019

Announcement

CDRI Awards 2019 for Excellence in Drug Research

The prestigious CDRI Awards 2019 for Excellence in Drug Research in **Chemical Sciences** category has been awarded to **Dr. Seergazhi Gopalan Srivatsan**, Associate Professor, IISER, Pune & **Dr. T Govind Raju**, Associate Professor, JNCASR, Bengaluru.

In **Life Sciences** category, awarded to **Dr. Amit Singh**, Associate Professor, IISc, Bengaluru & **Dr. Dipyaman Ganguly**, Senior scientist, CSIR-IICB, Kolkata.

Our heartiest congratulations to the awardees!

The Award Oration and Felicitation ceremony will be held on 26th September 2019

Cordial Welcome to Newly Joined Scientists to CSIR-CDRI Family

Dr. Neelanjana Majumdar
Senior Scientist
Medicinal & Process
Chemistry Division

Dr. Sachin Kumar
Senior Scientist
Pharmacology Division

Dr. Ravindra Kumar
Senior Scientist
Medicinal & Process
Chemistry Division

Dr. Amit Lahiri
Senior Scientist
Pharmacology Division

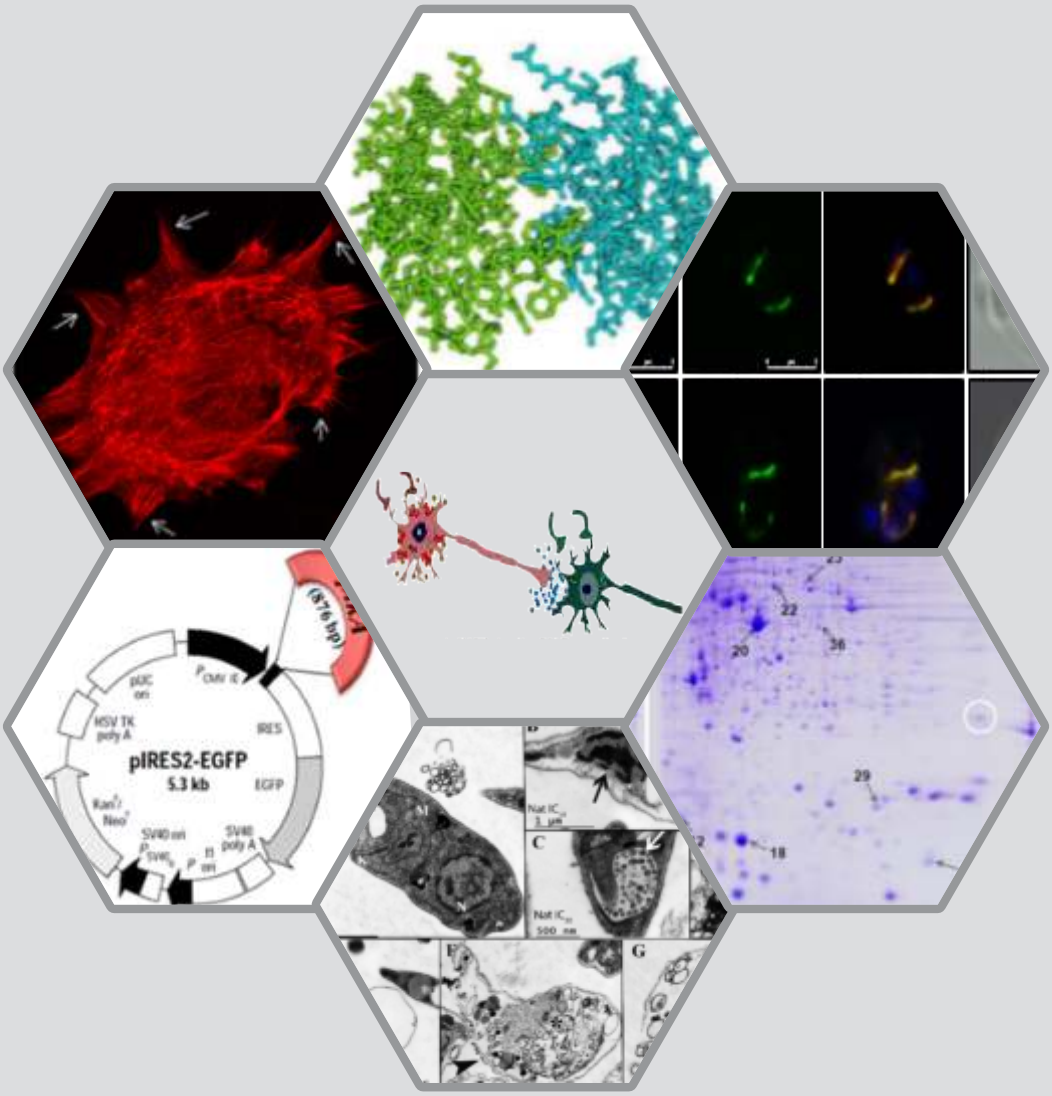
Dr. Nayan Ghosh
Scientist
Medicinal & Process
Chemistry Division

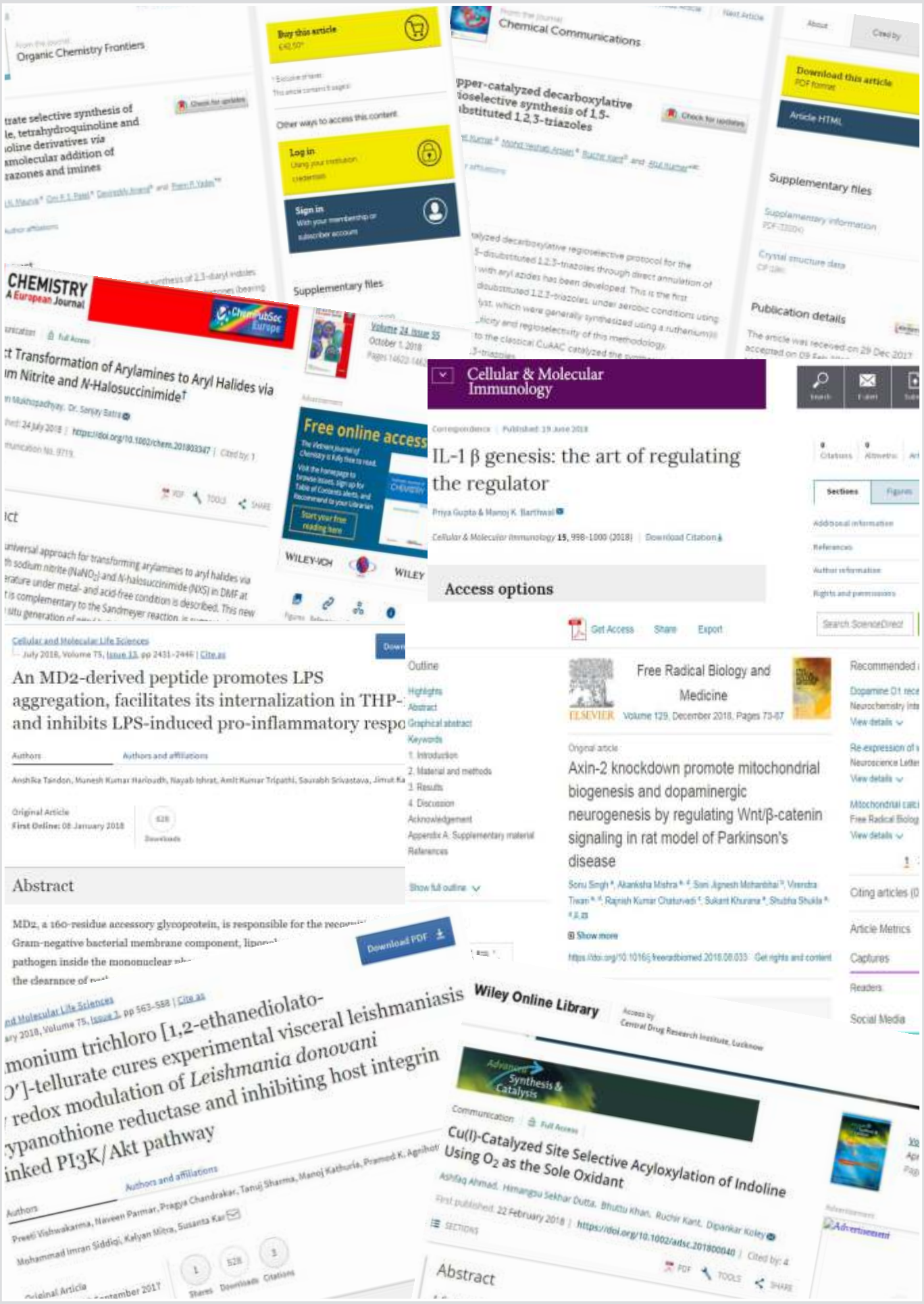
Dr. Shrikant Mulay
Scientist
Pharmacology Division

Dr. Ramesh Chintakunta
Scientist
Medicinal & Process
Chemistry Division

Dr. Shashi Kumar Gupta
Scientist
Pharmacology Division

Section I
Progress in Research & Development Programs

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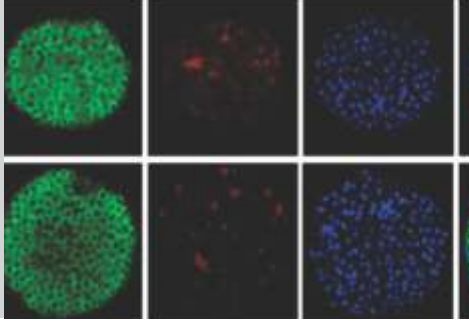
Cellular & Molecular Immunology
IL-1 β genesis: the art of regulating the regulator
Priya Gupta & Manoj K. Barthwal
Access options
Cellular and Molecular Life Sciences
An MD2-derived peptide promotes LPS aggregation, facilitates its internalization in THP-
and inhibits LPS-induced pro-inflammatory respo
Abstract
Free Radical Biology and Medicine
Axin-2 knockdown promote mitochondrial biogenesis and dopaminergic neurogenesis by regulating Wnt/β-catenin signaling in rat model of Parkinson's disease
Wiley Online Library
Cu(I)-Catalyzed Site Selective Acyloxylation of Indoline Using O2 as the Sole Oxidant
Abstract

1 Addressing Biological Processes for Designing new Strategies of Intervention in Parasitic Diseases and Anti-parasitic Drug Discovery



Area coordinators:

Dr. Saman Habib

Dr. Sanjay Batra

Vision and Goal:

- Development of new drugs/drug combinations as therapeutic interventions for malaria, leishmaniasis and filariasis;
- Identification of unique targets and pathways for future interventions;
- Investigations on parasite biology and host-parasite interactions.

Core Competencies and Activities:

- Design and synthesis of novel molecules as potential parasiticidal agents;
- Bioevaluation of synthetic molecules and natural products for antimalarial, antileishmanial and antifilarial activities against *in vitro* and *in vivo* models;
- Preclinical development of combination therapy regimens with novel compounds/ known drugs;
- Mechanism of drug action / drug resistance;
- Characterization of drug targets using molecular approaches;
- Development of immunoprophylactic modalities;
- Development of improved screening models/drug delivery systems.

1.1 Malaria
1.2 Leishmaniasis
1.3 Filariasis

Research Team

L to R standing- Dr. Nilanjana Majumdar, Dr. Malleshwar Rao Kuram, Dr. Kishore Mohanan, Dr. Ravindra Kumar, Dr. Damodar Reddy, Dr. M I Siddiqi, Dr. Saman Habib, Dr. Susanta Kar, Dr. Mrigank Srivastava, Dr. Satish Mishra, Dr. Ramesh Chintakunta

L to R sitting- Dr. Namrata Rastogi, Dr. Niti Kumar, Dr. Prem Prakash Yadav, Dr. Sanjay Batra, Dr. W Haq, Dr. Neena Goyal, Dr. K V Sashidhara, Dr. Pintu Kumar Mandal

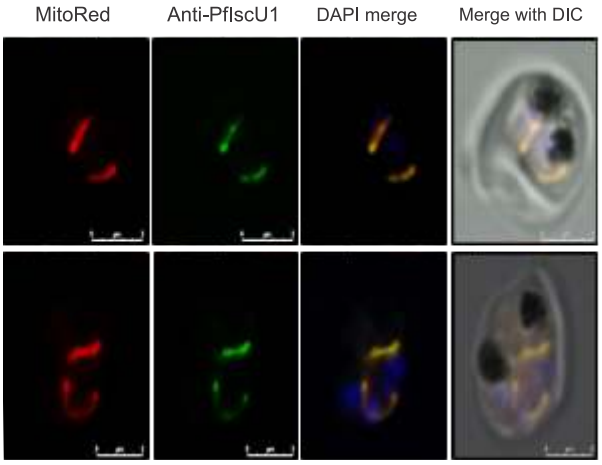
1.1 Malaria

1.1.1 Factors in biogenesis of reduced mitoribosomes of the malaria parasite

Apicoplast and mitochondria of the malaria parasite are sites of active protein synthesis but exhibit differences in ribosome composition and translation factor requirement in comparison with organelles of other eukaryotes. *Plasmodium* mitochondria have highly fragmented rRNA and are predicted to carry a reduced ribosomal protein repertoire. Our exploration of ribosome biogenesis GTPases EngA and Obg1 in the parasite mitochondrion was extended to the universally conserved ribosomal RNA adenine dimethyltransferase (rAD) KsgA/Dim1 family wherein eukaryotic rADs are separated into distinct cytosolic Dim1 and organellar KsgA/TFB homologs. Among the two putative KsgA proteins encoded by the *Plasmodium falciparum* genome, *Pf*KsgA1 was dually localized in the cytoplasm and the mitochondrion. The protein interacted specifically with small ribosomal subunit as detected by ribosome pull-down using anti-*Pf*KsgA1 antibodies. Recombinant PfKsgA1 exhibited methyltransferase activity which was further confirmed by complementation in an *Escherichia coli* KsgA knockout strain. Similar to the human mitochondrial KsgA homologs that can additionally function as transcription regulators, *Pf*KsgA1 also interacted with DNA in a sequence non-specific manner suggesting more than one functional role of an important ribosome biogenesis protein in *Plasmodium* ***(Mol. Biochem. Parasitol. PMID: 29909066)***

1.1.2 Dissecting function of seemingly overlapping constituents of the mitochondrial ISC [Fe-S] complexation pathway

Several proteins that are critical for mitochondrial function require assembly of [Fe-S] complexes in order to mediate electron transfer reactions. All components of the *P. falciparum* ISC [Fe-S] pathway are nuclear-encoded. We confirmed mitochondrial targeting of IscU1 and A2, and established that IscS is a cysteine desulfurase whose activity is enhanced ~15-20 fold by Isd11. Amongst the four putative cluster assembly and transfer proteins-IscA1, A2, U1, U2, only U1 and A2 could transfer assembled [Fe-S] complexes onto the target apo-protein. Of these, only U1 could function as a [4Fe-4S] assembly scaffold. Our results also establish that the cysteine desulfurase IscS-Isd11



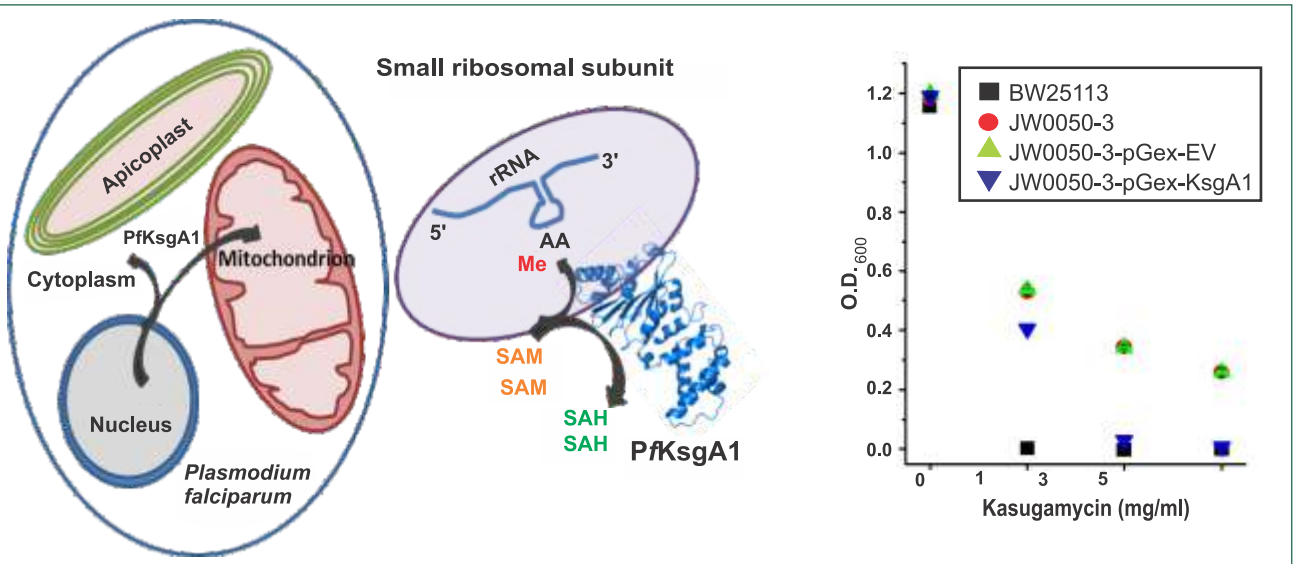


Fig. 1. Dual targeting and SSU rRNA methyltransferase activity of PfKsgA1. Functional complementation of *E. coli* KsgA rAD activity by PfKsgA1 in the presence of kasugamycin.

associates with IscU1 in an assembly scaffold for generation of [4Fe-4S] complexes. Delineation of the complete pathway by *in vitro* assembled complexes and confirmation of association *in vivo* is underway.

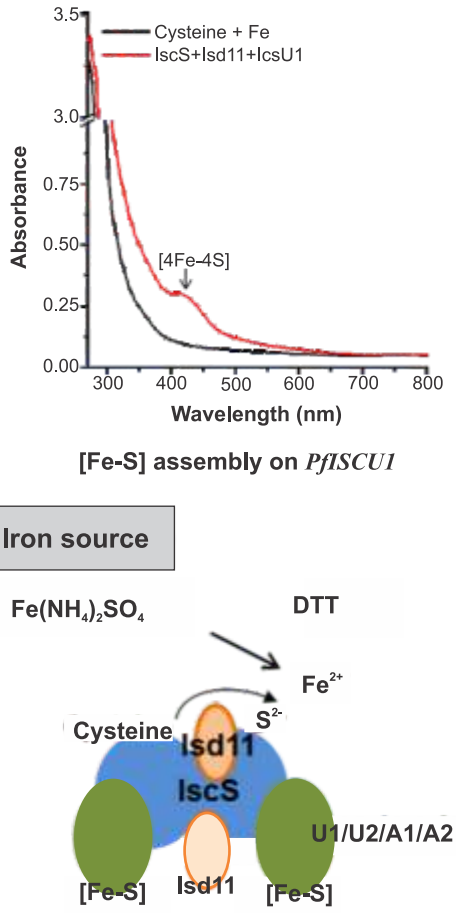


Fig. 2. *Pf*IscU1 targets to the parasite mitochondrion and functions as a [Fe-S] assembly scaffold in association with IscS-Isd11.

1.1.3. Investigating the functional diversity of HSP40 family in human malaria parasite

P. falciparum encounters frequent environmental challenges during its sexual and asexual lifecycle which makes its metastable proteome extremely vulnerable to aggregation. Interestingly, the parasite has evolved dynamic surveillance system to limit protein misfolding and to maintain its proteome in functional state. In cellular protein folding, HSP70-HSP40 forms the central hub of chaperone network. Our proteome-wide phylogenetic analysis revealed that parasite's HSP40 family has diverged significantly from their human orthologs and have acquired additional interaction interfaces to facilitate both canonical and non-canonical interactions. We have investigated the foldase, holdase and oligomer remodeling activity of plasmodial HSP40 (Ydj1) and compared its activity with human orthologs. Our comprehensive biochemical experiments suggest that Pf-Ydj1 and Pf-HSP70 keep the substrates in folding competent state which allows better refolding of heat denatured luciferase (Fig. 3 A & B) and they also show better oligomer remodeling activity (Fig. 3C) than human orthologs.

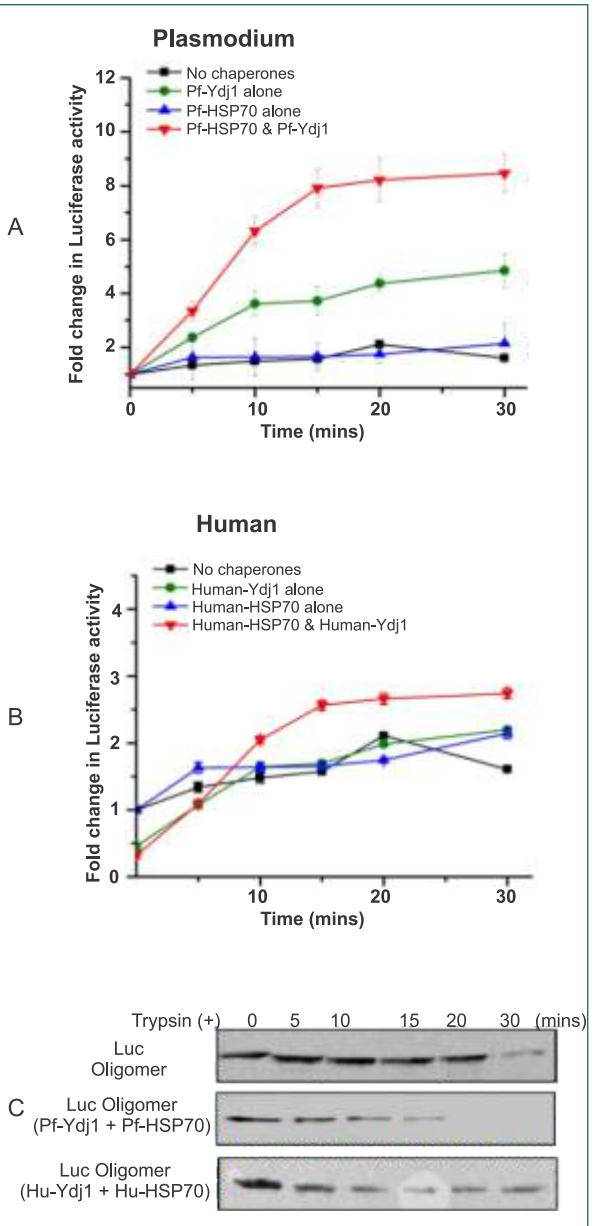


Fig. 3: (A & B) Assessing the ability of refolding of heat denatured luciferase by Plasmodial and human chaperones (Ydj1 and HSP70) (C) Investigating the oligomer remodeling activity by Plasmodial and human chaperones (Ydj1 and HSP70)

1.1.4 Development of novel therapies against malaria: A reverse genetics approach

To develop novel therapies against malaria, we extensively characterized the Secreted Protein with Altered Thrombospondin Repeat (SPATR) using conditional mutagenesis system. We show that SPATR plays an essential role during blood stage. Mutant *Spatr* salivary gland sporozoites exhibit normal motility, hepatocyte invasion, liver stage development and rupture the parasitophorous vacuole membrane to egress from hepatocytes in the form of merosomes. Furthermore, mutant hepatic merozoites failed to establish a blood-stage infection *in vivo*. We provide direct evidence that SPATR is not required for hepatocyte invasion but plays an essential role during the blood stages of *P. berghei*.

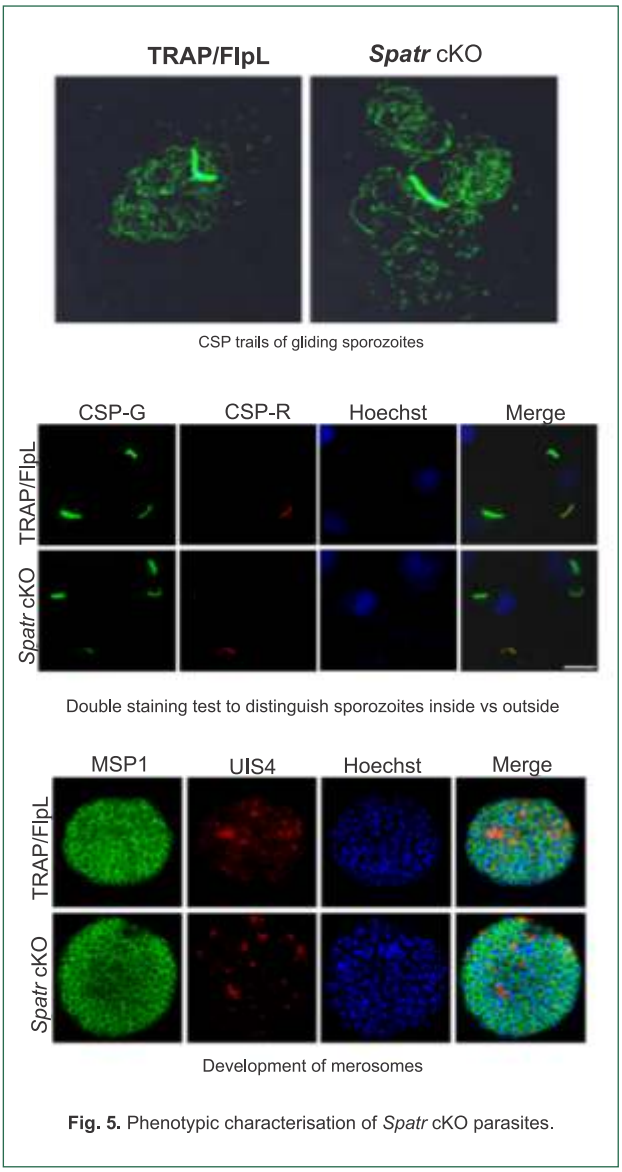


Fig. 5. Phenotypic characterisation of *Spatr* cKO parasites.

1.1.5. Investigating the role of chaperone assisted proteins in *Plasmodium*

Plasmodial molecular chaperones such as Hsp70, Hsp90 play essential role in growth and development of malaria parasite. Co-chaperones are proteins that assist chaperones in protein folding and other functions. These are also involved in the regulation of chaperone machinery in cellular stress response. Some of the co-chaperones are still unexplored in malaria parasite. One of them is Chaperone-assisted protein, which is a multiligand and multifunctional protein. It is a component of ubiquitin-mediated proteolysis, and could bind the Skp1-Cul1-F box protein complex. It may be responsible in cell proliferation, ROS scavenging, cytoskeleton organization, protein ubiquitination and protein dephosphorylation. In *Plasmodium spp.* chaperone-assisted protein has ~35% similarity with human and other eukaryotes. The detailed study of chaperone-assisted protein from malaria parasite has not been performed till date. We have cloned, over-expressed and purified the chaperone-assisted protein from rodent malaria parasite *Plasmodium yoelii MDR*. Polyclonal antibody will be raised for further detailed characterization. We hypothesized that the chaperone-assisted protein might play important role in survival of malaria parasite and in the development of multidrug resistance.

1.2 Leishmaniasis

1.2.1 Leishmania donovani exploits Tollip, a multitasking protein, to impair TLR/IL-1R signaling for its persistence in the host

Interleukin-1 receptor /Toll like receptor signaling play a significant role in sensing harmful foreign pathogens and mounting effective innate and adaptive immune responses. However, the precise mechanism by which *Leishmania donovani,* an obligate intra-macrophagic pathogen, breaches IL-1R/TLR signaling and host-protective immunity remains obscure. Herein we report the novel biphasic role of Toll-interacting-protein (Tollip), a negative regulator of IL-1R/TLR pathway, in the disease progression of experimental visceral leishmaniasis. We observed that during early hour of infection, *L. donovani* induced phosphorylation of IRAK-1, resulting in the release of Tollip from IRAK-1 complex in J774 macrophages which then acted as an endocytic adapter on cell surface IL-1R1 and promoted its lysosomal degradation. In the later stage, Tollip shuttled back to IRAK-1, thereby inhibiting IRAK-1 phosphorylation in association with IRAK-M to neutralize downstream TLR signaling in infected macrophages. Moreover, during late infection *L. donovani* enhanced nuclear translocation and

recruitment of transcription factors Egr2, Nrf2 and Ahr on Tollip promoter for its induction. SiRNA-mediated silencing of Tollip in infected macrophages significantly enhanced NF-κB activation and induced host-defensive interleukin-12 and Tumor necrosis factor-alpha synthesis, thereby reducing amastigote multiplication. Likewise, abrogation of Tollip in *L. donovani* -infected Balb/c mice resulted in STAT-1, IRF-1 and NF-κB mediated upregulation of host-protective cytokines and reduced organ parasite burden, thereby implicating its role in disease aggravation. Taken together, we conclude that *L. donovani* exploited the multitasking function of Tollip for its own establishment through downregulating IL-1R1/TLR signaling in macrophages ***(The Journal of Immunology; PMID: 29907707).***

1.2.2 Ammonium trichloro [1, 2-ethanediolato-*O*, *O*']-tellurate cures experimental visceral leishmaniasis by redox modulation of *Leishmania donovani* trypanothione reductase and inhibiting host integrin linked PI3K/Akt pathway

In an endeavor to search for affordable and safer therapeutics against debilitating visceral leishmaniasis, we examined antileishmanial potential of ammonium trichloro [1, 2-ethanediolato-*O*, *O*']-tellurate (AS101); a tellurium based non-toxic immunomodulator. AS101 showed significant *in vitro* efficacy against both *L. donovani* promastigotes and amastigotes at sub-micromolar concentrations. AS101 could also completely eliminate

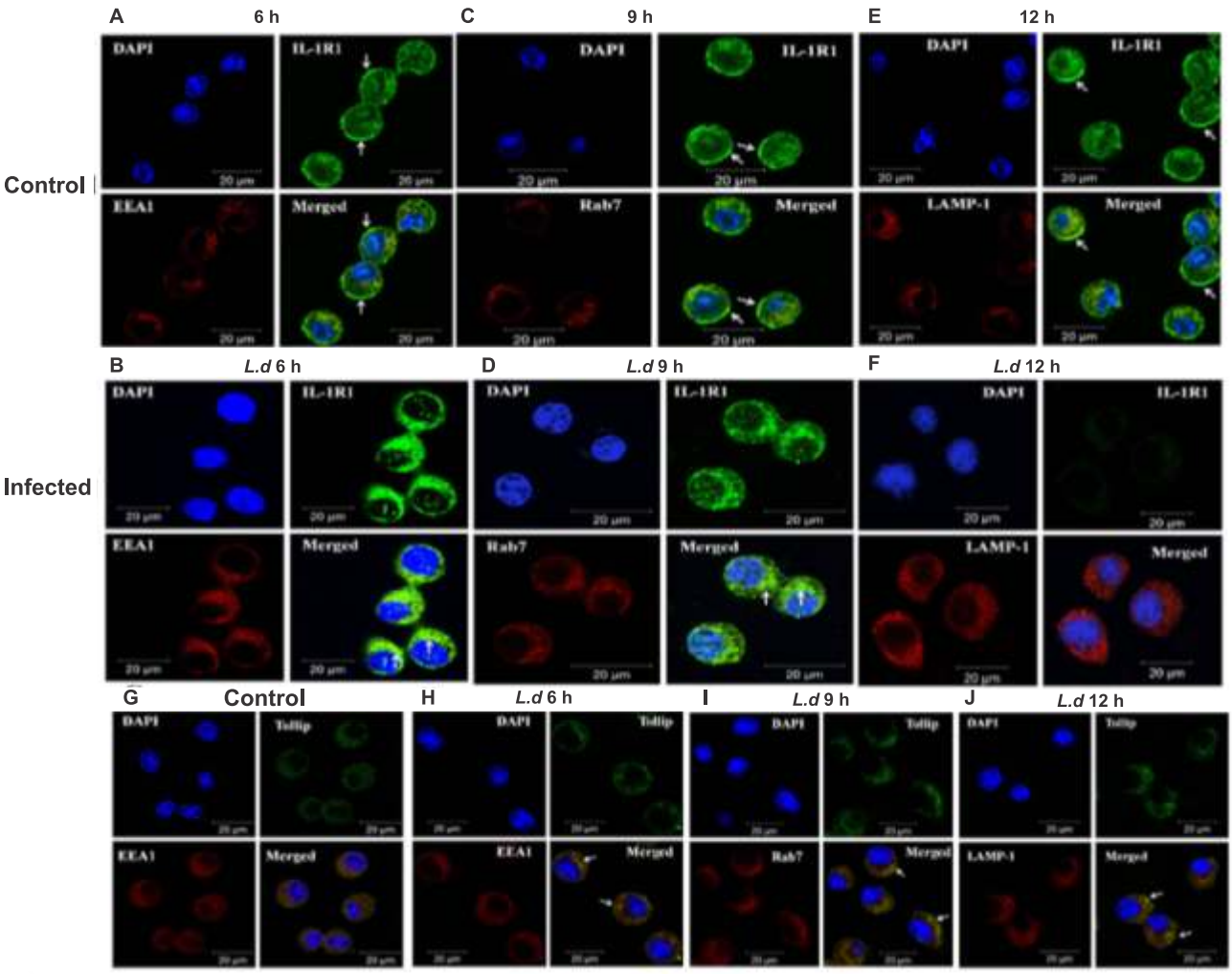


Fig. 6. Trafficking and localization of IL-1R1 and Tollip following *L. donovani* infection in J774 macrophages. **(A-F)** Confocal fluoroscence microscopy showing co-localization of IL-1R1 with anti-EEA1, anti-Rab7 and anti- LAMP1 in early endosomes (B), late endosomes (D) and lysosomes (F) respectively in infected macrophages after immunostaining as indicated by arrows (merged panel). A, C and E represent localization of IL-1R1 in control macrophages when co-stained with the markers for early endosomes (A), late endosomes (C) and lysosomes (E) in uninfected macrophages. **(G-J)** J774 macrophages were infected with *L. donovani* promastigotes for the indicated time period. Fixed cells were immunostained to detect trafficking of Tollip in early endosome (H), late endosome (I) and lysosome (J) by using anti-EEA1, anti-Rab7 and anti-LAMP1 antibodies, respectively. For uninfected cells Tollip trafficking was observed in early endosome (G).

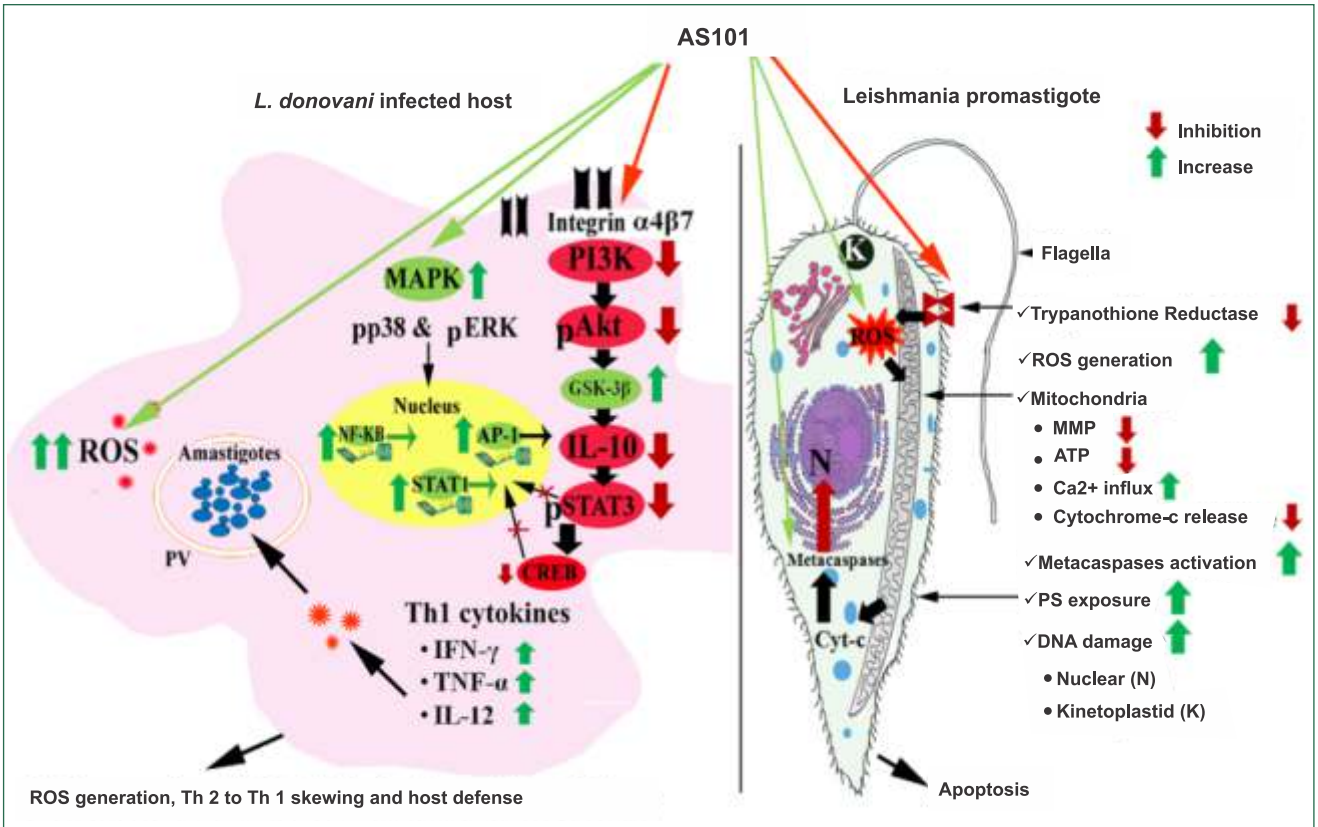


Fig. 7. Mode of action of AS101 against experimental visceral Leishmaniasis

organ parasite load from *L. donovani* infected Balb/c mice along with significant efficacy against infected hamsters (~93% inhibition). Analyzing mechanistic details revealed that the double-edged AS101 could directly induce apotosis in promastigotes along with indirectly activating host by reversing T-cell anergy to protective Th1 mode, increased ROS generation and anti-leishmanial IgG production. AS101 could inhibit IL-10/STAT3 pathway in *L. donovani* infected macrophages via blocking α4β7 integrin dependent PI3K/Akt signaling and activate host MAPKs and NF-κB for Th1 response. *In silico* docking and biochemical assays revealed AS101's affinity to form thiol bond with cysteine residues of trypanothione reductase in *Leishmania* promastigotes leading to its inactivation and inducing ROS-mediated apoptosis of the parasite via increased Ca^{2+} level, loss of ATP and mitochondrial membrane potential along with metacaspase activation. Our findings provide the first evidence for mechanism of action of AS101 with excellent safety profile and suggest its promising therapeutic potential against experimental visceral leishmaniasis (***Cell Mol Life Sci., PMID: 28900667***).

1.2.3. Effect of overexpression of *Ld*MAPK1 on *Leishmania* proteome

Mitogen-activated protein kinases (MAPKs) are well-known mediators of signal transduction of eukaryotes, regulating important processes like proliferation, differentiation, stress response, and apoptosis. In Leishmania, MAPK1 has been shown to be consistently downregulated in antimony-resistant field isolates, suggesting that it has a role in antimony resistance. It negatively regulates the expression of P-glycoprotein-type efflux pumps in the parasite thus results in increase in antimony accumulation in the parasite, making it more vulnerable to the drug (***Antimicrobial Agents and Chemotherapy, PMID: 25870075*****).** Aiming to identify the LdMAPK1 regulated pathways, comparative proteome analysis of two cell type, wild type (Dd8+/+) and over-expressing (Dd8++/++) mutants was performed. A total of 152 and 148 spots were detected from Dd8+/+ and Dd8++/++ gels, respectively. Out of these spots, 46 spots were upregulated in Dd8++/++ while 5 spots were upregulated in Dd8+/+. Moreover, 9 spots were uniquely

present in (Dd8+/+) and 5 spots in (Dd8++/++), respectively. This shows that the expression of MAPK1 has a major effect on protein expression in the parasite.

Upregulated identified proteins were functionally classified into 9 groups related to metabolism, signaling, DNA synthesis, RNA synthesis, protein synthesis, transport proteins, chaperones, motor and cytoskeletal proteins.

1.2.4 Functional characterization of TCP1 of *L. donovani*

T-complex polypeptide-1 (TCP1), a group II chaperonin class of protein (HSP60 family) consists of eight different subunits, is involved in intracellular assembly and folding of various proteins. In Leishmania, only the TCP1 subunit has been cloned and characterized from our lab. LdTCP1 formed high-molecular-weight complexes and is arranged into two back-to-back rings of seven subunits each and refolds luciferase in ATP dependent manner. LdTCP1 interacts with actin and tubulin proteins, suggesting that the complex may have a role in maintaining the structural dynamics of the cytoskeleton of parasites [*FEBS J*, 2015]. For validation of LdTCP1 as drug target, mutant cell lines that either over-express or under express LdTCP gene were developed. Modulation of expression of LdTCP1 in mutant cell lines was confirmed by RT-PCR and western blot analysis. Over-expressing mutants exhibited 6 fold increased expression of LdTCP1 as compared to wild type cells while single allele deletion mutant showed 1/3 expression of LdTCP1. It has been observed that underexpression of LdTCP severely retard the growth of parasite while over-expression did not affect the growth pattern. However, efforts to get double knock out parasites failed inspite of several attempts suggesting that LdTCP is essential for survival of parasite. Further, LdTCP1 over-expressing cells (Dd8++/++) exhibited significantly increased infectivity to macrophages as compared to wild type cells (Dd8+/+) and vector control promastigote while single allele deletion mutants Dd8+/- exhibited significantly decreased infectivity. The study confirmed that LdTCP1γ can be developed as a new drug target.

1.2.5. The antifungal drug natamycin shows promising *in vitro* anti-proliferative activity in *Leishmania donovani*

Natamycin, an FDA approved anti-fungal drug and a food additive was evaluated for anti-leishmanial activity since it is known to specifically bind to ergosterol, which is a major constituent of plasma membrane sterols found in fungi and trypanosomatids. Anti-proliferative activity was observed in both promastigote and intracellular amastigote forms of the parasite with IC_{50} values of 15 µM and 8 µM respectively and a selective index of 12.5. Our work supports the occurrence of apoptosis-like cell death in unicellular organisms like *Leishmania* and demonstrates the role of disruption of Ca2+ homeostasis in mediating caspase-like protease dependent cell death involving mitochondrial dysfunction. Along with the safety profile of an existing anti-fungal drug, natamycin may be further investigated for repurposing it as a possible drug candidate against Leishmaniasis.

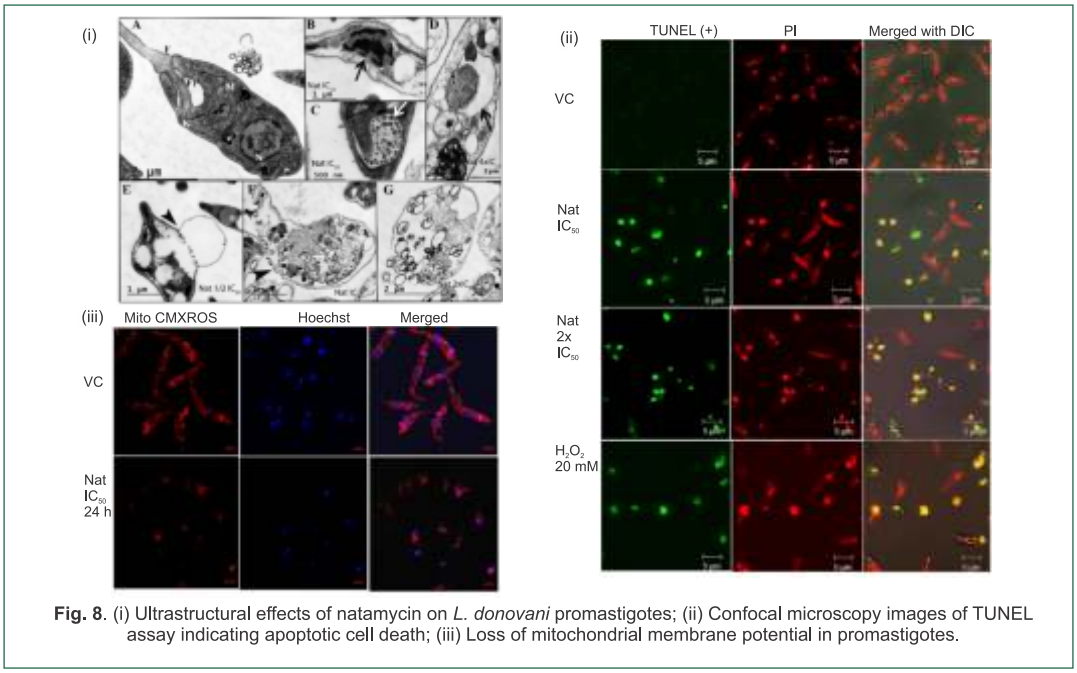


Fig. 8. (i) Ultrastructural effects of natamycin on *L. donovani* promastigotes; (ii) Confocal microscopy images of TUNEL assay indicating apoptotic cell death; (iii) Loss of mitochondrial membrane potential in promastigotes.

1.2.6. Enhancing the copy number of *Ldrab6* gene in *Leishmania donovani* parasites mediates drug resistance through dibenzalacetone/ thiol conjugate dependent Multidrug Resistance Protein A (MRPA)

Rab GTPases, belong to the RasGTPase superfamily and are the key regulators of intracellular vesicular trafficking. RabGTPases are involved in resistance to chemotherapeutic drugs. From our whole genome sequence (WGS) of *Leishmania donovani* (clinical Indian isolate; BHU 1220, GenBank: AVPQ00000000.1) we identified Ldrab6 gene, and in the present study, we have experimentally proven that the Ldrab6 gene of Leishmania imparts drug-resistant phenotype to wild-type (sensitive) Leishmania on transfection. trans-Dibenzalacetone (DBA), a synthetic analog of curcumin, was used to determine its antileishmanial activity in wild-type parasites and parasites transfected with Ldrab6 gene. Flow cytometric analysis revealed that transfectants exhibited elevated level of intracellular non protein thiols as compared to wild type parasites under DBA treated condition. To assess the functional activity of multidrug resistant-associated protein (MRP) pump in transfectants, we determined the accumulation of calcein, which is a known MRP pump substrate and probenicid as MRP pump regulator. So it can be confirmed that Ldrab6 gene in Leishmania conferred resistance by the well-established mechanism of drug/thiol conjugation and sequestration by ABC transporter multidrug resistance-protein A (MRPA). Leishmania parasites transfected with Ldrab6 gene can be used as an experimental cell line for the screening of lead molecules prone to developing drug resistance.

1.2.7. Development of Leishmania vaccine

Several Th1 stimulatory proteins that have been identified earlier and have shown prophylactic potential were evaluated for their therapeutic efficacy. Out of four evaluated proteins, two (enolase and aldolase) have shown considerably good therapeutic efficacy. These two proteins were then further evaluated as combination with either BCG (as an immunomodulator) or Ambisome (as an antileishmanial drug) as well as fusion proteins to optimize their therapeutic effect in *L. donovani*-infected hamsters.

Treatment with proteins + BCG, especially in rLdAld+BCG treated hamsters, initially offered a ~75% inhibition of parasitic load but later declined steadily to ~50% by day 90 p.i. when the experiment was terminated. A significant increase in the immunological parameters – DTH, lymphoproliferative as well as cytokine responses (IFN-γ, TNF-α and IL-12 in the splenic tissue samples as well as in the sera samples) also supported the above observations. These results, therefore, are strongly indicative of rLdAld being the potential therapeutic vaccine candidate which, however, further needs to be optimized with other strong potent Th1 stimulatory adjuvant. Further, when these proteins were used in adjunct with the suboptimal dose of Ambisome, substantial reduction in parasitic load particularly in rLdAld+Ambisome treated hamsters was seen. It was further corroborated by the significant increase in DTH and *Leishmania*-specific proliferative response. Additionally, level of all the Th1 (IFN-γ, TNF-α, and IL-12) was found to be up-regulated while Th2 (IL-4 and TGF-β) cytokines decreased both in tissue as well as sera samples in rLdAld+Ambisome treated hamsters associated with the development of immunity to the parasite. The work with fusion proteins is underway.

1.3 Filariasis

1.3.1. Immunobiology of lymphatic filariasis

1.3.1.1 Infective larvae of human filarial nematode *Brugia malayi* induce polarization of host macrophages

Filarial parasites suppress, divert, or polarize the host immune response to aid their survival. However, mechanisms that govern the polarization of host MΦs during early filarial infection are obscure. To understand these phenomena, we infected BALB/c mice with infective larvae stage-3 of the human filarial nematode *Brugia malayi* (Bm-L3) and studied its effect on the polarization of host MΦs. We found that splenic MΦs displayed M2-phenotype as early as day 3 post infection (p.i.) that was characterized by upregulated levels of cytokine IL-4, but reduced IL-12 and Prostaglandin-D2 secretion. Increased arginase activity, higher arginase-1 but reduced NOS2 expression and poor phagocytic and antigen processing capacity was also observed. M2 MΦs supported T-cell proliferation and characteristically upregulated p-ERK but downregulated NF-κB-p65 and NF-κB-p50/105. Notably, Bm-L3 synergized with host regulatory T-cells (Tregs) and polarized M2 MΦs to regulatory MΦs (Mregs) by day 7 p.i., which secreted copious amounts of IL-10 and prostaglandin-E2. Mregs also showed upregulated expression levels of co-stimulatory and maturation markers viz. MHC-II, CD80, and CD86 and exhibited increased antigen-processing capacity but displayed impaired activation of NF-κB-p65 and NF-κB-p50/105. Studies carried out using specific MAP Kinase inhibitors confirmed the role of p-ERK in the polarization of MΦs. Taken together, these results showed that infective larvae deftly utilized the functional plasticity of host MΦs to establish themselves inside the host ***(Frontiers in Immunology, PMID: 29483912)***.

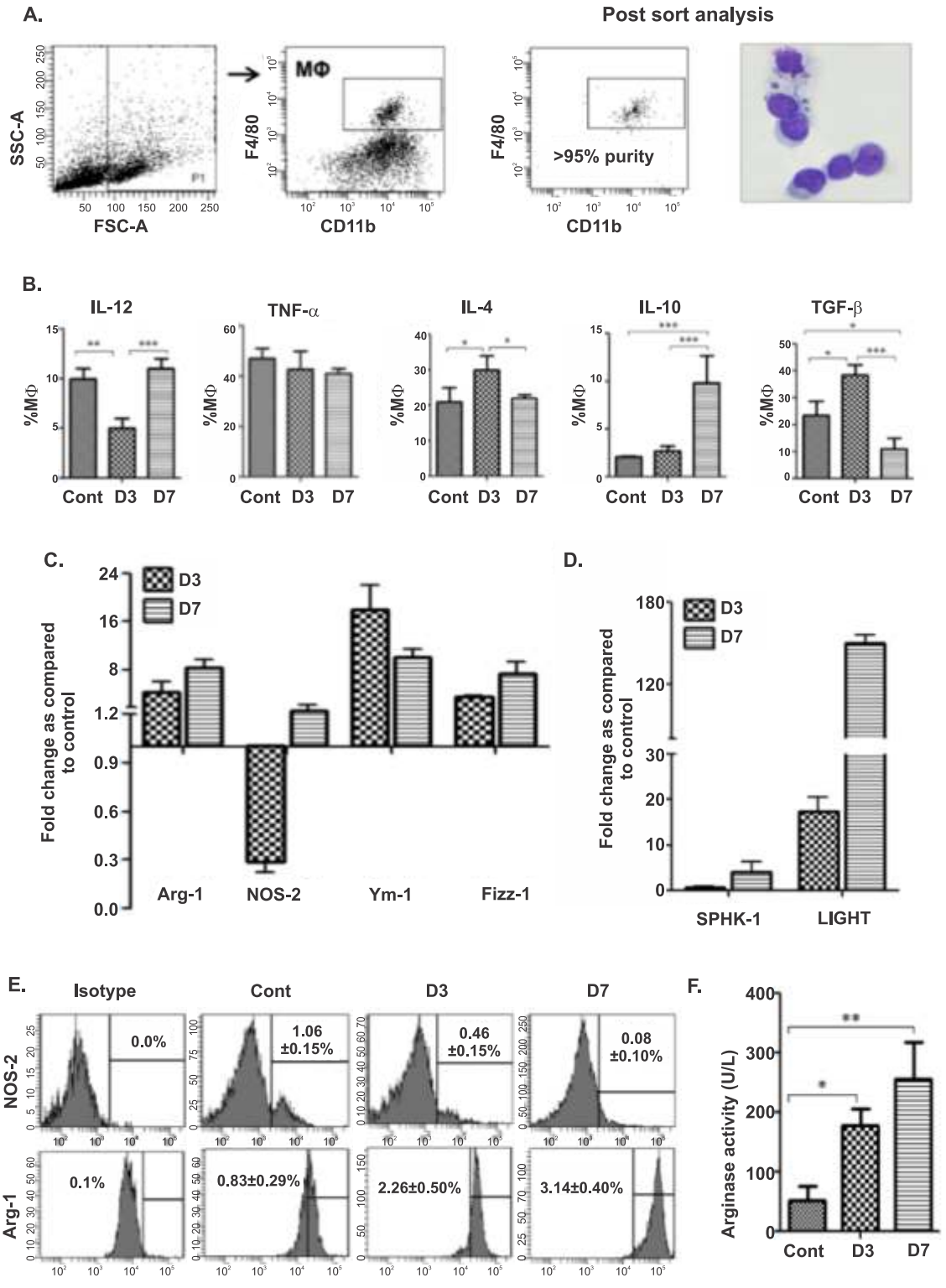


Fig. 9. (A) Gating strategy for the identification and sorting of splenic MΦs. Post sort dot plot, and May-Grunwald–Giemsa-stained cytospins illustrate very high purity (≥95%) of sorted cells. **(B)** Percentages of splenic MΦs secreting different cytokines **(C, D)** Fold change in the transcript levels of Arg-1, iNOS, Ym-1, Fizz-1, Sphingosine kinase-1 (SPHK-1) and LIGHT from FACS-sorted splenic MΦs as compared to control. **(E)** Histograms show intracellular expression of Arg-1 and NOS-2 as determined by flow cytometry. **(F)** Arginase activity in FACS-sorted splenic MΦs.

1.4. Medicinal Chemistry

1.4.1 Synthesis of antimalarial compounds

1.4.1.1 Design, synthesis and evaluation of a novel class of aminopropanols as PfAQP inhibitors

In our efforts to identify molecules to target PfAQP by designing novel molecules analogous to glycerol that might block the channel, we successfully synthesized a novel series of densely functionalized aminopropanol derivatives. Out of the 25 compounds screened against 3D7 and K1 strains, 15 compounds were found to be active within a range of 0.1-0.2 μM for both the strains. The compound S018-0087 which has shown promising activity against 3D7 and K1 strain is currently being evaluated for *in vivo* activity. The synthesis of more compounds for the *in vivo* evaluation is underway

1.4.1.2 Other compounds

Besides Synthesis of several new α-carboline analogous to neocryptolepine was accomplished and these compounds were submitted for antimalarial screening. Simultaneously, some new 1,2,4-triazole derivatives were prepared.

1.4.2 Synthesis of new antileishmanial agents

During the reporting period, 71 compounds were synthesized and submitted for antileishmanial assay. These belong to different chemical classes which include 3-nitroisoxazoles, β-carbolines, hexane-1-ones and 1,2,4-triazoles and were prepared to target the nitroreductase and the Trypanothione reductase enzymes of Leishmania. Several compounds displayed activity against the promastigote and the amastigote stage of the parasites. These are S-018-96 to 98, S-018-273, 271, 269, 274, 347-348, 161-164 with IC_{50} in the range of 3.0 μM-15 μM with SI of 4.1 to 14.5. Besides this, bulk synthesis for compound 96-261 for carrying out the IND-enabling studies was carried out.

1.5 Anti-parasitic screening for drug discovery

1.5.1 Malaria

1.5.1.1 In-vitro screening against *P. falciparum*

Synthetic compounds: A total of 414 synthetic compounds prepared in CDRI, 10 compounds received under DBT twining project and 31 compounds received from different research organizations across the country, were screened against *P. falciparum* in cell-based assay for lead discovery. Of these, 46 in-house compounds, 10 from DBT twining project and 18 compounds from external source elicited promising antiplasmodial activity. These compounds belonged to diverse chemical classes such as 4-aminoquinoline, aminobenzimidazole, phenolic phenanthrene, aminopropanol, 4-one quinoline, nitropyridine and phenoxy phenyl benzamide derivatives. Twelve 4-aminoquinoline derivatives were found to exhibit the IC_{50} between 0.06-0.88 μM against CQ sensitive (*Pf*3D7) strain and 0.10 to 0.82 μM against CQ resistant (*Pf*K1) strain. Nine aminobenzimidazole derivatives exhibited IC_{50} values between 0.07 - 0.98 μM against *Pf*3D7 strain and 0.07-0.70 μM against *Pf*K1. One phenolic phenanthrene compound exhibited IC_{50} value 0.54 μM against *Pf*3D7 and 0.59 μM against *Pf*K1. Thirteen aminopropanol derivatives exhibited IC_{50} values between 0.07-0.58 μM against *Pf*3D7 and <0.07 to 0.28 μM against *Pf*K1 strain. Seven 4-One quinoline derivatives exhibited IC_{50} values between 0.03-0.4 μM against *Pf*3D7 and <0.07 to 0.85 μM against *Pf*K1. One compound of phenoxy phenyl benzamide class exhibited IC_{50} of 0.29 μM against *Pf*3D7 and 1.46 μM against *Pf*K1; a nitropyridine compound exhibited IC_{50} of 0.08 μM against *Pf*3D7 and 0.09μM against *Pf*K1 strain. Other scaffolds like S016-0815 and S016-0816 have IC_{50} in *Pf*3D7 as 0.5 μM and 0.15 μM, respectively and in K1 strains IC_{50} values were 0.476 μM and 0.25 μM, respectively.

Ten compounds received under DBT Twining project exhibited IC_{50} values between 0.04 - 0.35 μM against *Pf*3D7 and 0.22 to 0.99 μM against CQ resistant *Pf*K1.

Compounds from outside CDRI - Compounds received from Bharti Vidyapeeth, College of pharmacy and CSIR- National Chemical Laboratory Pune were screened and results shared.

Natural Products: Extracts of 24 plants received from Acharya Nagarjuna University, A.P., KIET School of Pharmacy, Ghaziabad were screened for antiplasmodial efficacy against 3D7 and K1 strains of *P. falciparum*. Eleven extracts exhibited IC_{50} values between 0.78 and 10 μg/ml against *Pf*3D7 and *Pf*K1.

Formulations: Four formulations of Artemether and Lumefantrine received from Nagpur University were evaluated for efficacy.

1.5.1.2 In-vivo screening against *P yoelii* MDR & N67 in Swiss mice.

A. CSIR-CDRI synthetic compounds: Nine compounds allied to 4-aminoquinoline, phenolic phenanthrene and aminopropanol class were subjected to *in vivo* evaluation. Although a few compounds displayed parasite inhibition between 99.99 - 44.10% on the 4th day of compound

administration, none of them (except S017-0642 which showed 40% mice survival on day 28) had curative effect for 28 days of observation period.

B. DBT compounds Screening: Five compounds received under DBT twining project showed 89.3 - 50.5% parasite suppression on day 4 but none was curative till day 28.

C. Outside CDRI – *In vivo* screening:

Four formulations received from Nagpur University and one compound received from CSIR- National Chemical Laboratory, were evaluated for *in vivo* efficacy in the *P. yoelii*-mouse model.

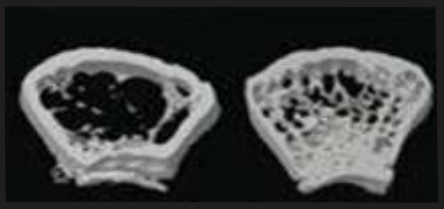
1.5.2 Anti-leishmanial screening

Novel synthetic moieties representing several prototypes viz., quinoline, chalcones, stilbenes, phenyl allylindole, pyrolo quinolinone, imidazo pyrolo quinolone derivatives were synthesized and tested for their efficacy against experimental model of visceral leishmaniasis. Sixty synthetic compounds were evaluated at 50 µM and 25 µM concentrations respectively against *in vitro* macrophage-amastigote model for lead identification. Compounds belonging to chalcone (S-018-0192) and quinoline (S-017-1000) series showed significant anti-amastigote activity (>80% inhibition of amastigote multiplication and SI >5). Half-maximal inhibitory concentrations (IC_{50}) of S-017-1000 and S-018-0192 were found to be 1.92 µM and 2.1 µM respectively against intracellular amastigotes. S-018-0192 and S-017-1000 will be further evaluated for their anti-leishmanial activity in *L. donovani*- golden hamster model.

150 Novel synthetic moieties representing several prototypes viz., quinazoline tetrazole, 1H- pyridoindole, Betacarboline Isoxazole, Fulconazole, Quinozoline, Isoxazole amide, Quinazoline, Hexene 1,3-dione, Indolyl spiro, Indenones, Oxazoles, Quinolines, Aminopropanol were screened *in vitro* against promastigotes and amastigotes. Out of these 24 compounds exhibited IC50 < 10µM and SI index > 5. Nine compounds were evaluated for their *in vivo* efficacy in *L. donovani* / hamster model at 50mg/Kg I.P. However, none of the compound showed potent anti-leishmanial activity in *in vivo*.

Screening of 96/261 *and its analogues*: 21 analogues of anti-leishmanial candidate molecule CDRI 96/261 were evaluated for their antileishmanial efficacy under *in vitro* condition. *In vivo* antileishmanial efficacy of 96/261 was evaluated in the mouse model. It exhibited potent activity in this model too in dose dependent manner.

2 Research on Anabolic Skeletal Targets in Health and Illness: Bone Health and Metabolic Bone Diseases



Area coordinators:

Dr. Naibedya Chattopadhyay

Dr. Atul Goel

Vision and Goal:

- Development of novel agents for fracture healing and management of osteoporosis through modern drug design, scientific validation of traditional remedies and generation of new knowledge.

Core Competencies and Activities:

- Design, synthesis and bioevaluation of novel molecules/isolates from natural sources for new lead generation and/or development of agents for the management of osteoporosis, and bone related disorders
- Scientific validation of traditional remedies
- Molecular mechanism of action of promising agents;
- Advancing in knowledge frontiers

2.1 New Drug discovery & development

2.2 Advancing Knowledge Frontiers

Research Team

L to R- Dr. Prem Prakash Yadav, Dr. Brijesh Kumar, T. Narender, Dr. J. R. Gayen, Dr. K.V. Sashidhara, Dr. Prabhat Ranjan Mishra, Dr. Atul Goel, Dr. Ritu Trivedi, Dr. Divya Singh, Dr. J. K. Ghosh

2.1 New drug discovery and development

2.1.1 New drug discovery

Total 45 new synthetic compounds and 4 natural products were prepared in the area of osteoporosis and bone biology research during last one year. These compounds (synthetic compounds-45; plant derived- 4) were submitted for bone anabolic activity *in vitro* (osteoblast differentiation, mineralization, proliferation and mechanism of action studies) and *in vivo* (osteopenic mice and rat) models. Among various synthesized compounds, a few synthetic compounds and 1 natural product showed promising activity in preliminary screening in osteoblast ALP model and further studies are underway. To our delight, standardized extract of *Cassia occidentalis* has been licensed to Pharmanza Herbal Pvt. Ltd., Gujarat. Another orally active fracture healing compound CDRI S007-1500 has been found safe in regulatory toxicology and regulatory pharmacology studies and will soon be ready for filing IND application.

2.1.2 S007-1500: Fracture healing agent

Compound S007-1500 leads to rapid fracture healing male and female SD rat models. The efficacy was further tested in New Zealand male and female rabbits in a cortical defect model. A cortical defect was created in dorso-medial surface of tibia. Treatment of compound was given orally at 1.0 and 2.0 mg/kg daily for one month. Digital radiography was done at day 0 and end point. Bones were collected for microCT and confocal microscopy. Digital radiography follow-up showed enhanced osteogenesis and callus formation at the defect site in both male and female rabbits.

2.1.3 Development of a standardized extract from stem of *Cassia occidentalis* L. for mitigating glucocorticoid-induced bone loss

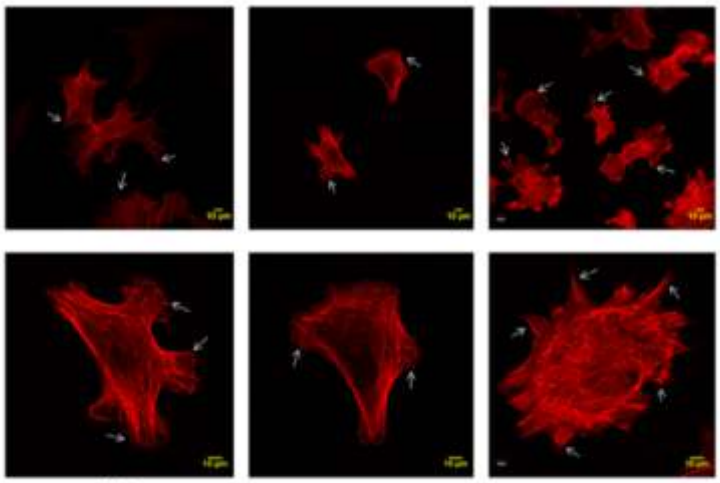
Cassia occidentalis L. (belongs to *Caesalpiniaceae* family) is an annual plant. Pursuing a lead from a folk practice prevalent since the late nineteenth century in Andhra Pradesh, a Southern state of India, of use of *Cassia occidentalis* leaf and stem for treating patients with fracture and bone diseases, we have not only confirmed its fracture healing activity but also demonstrated efficacy in preventing glucocorticoid-induced osteoporosis (GIO), the commonest form of medication-induced bone loss caused chiefly due to impairment of bone formation.

Presently, the standardized extract of the *Cassia occidentalis* stem is undergoing IND-enabling studies for filing phase I clinical trial approval to DCG(I) under the recently launched Phyto-pharmaceutical mode. To this effect acute and sub-acute toxicity and essential safety studies are being carried out on cGMP batch of the extract.

2.2 Advancing the knowledge frontiers

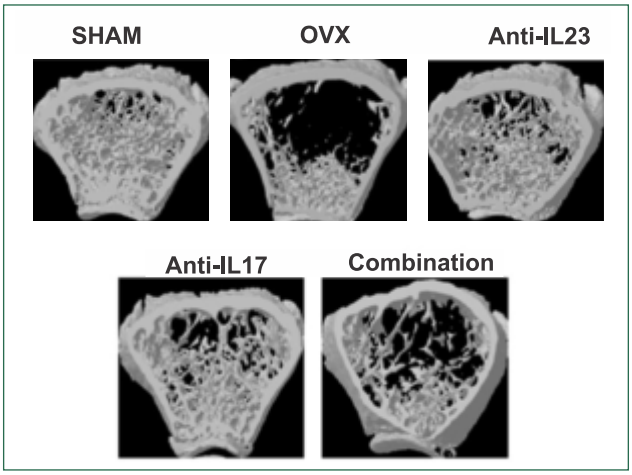
2.2.1 Identification of novel microRNA inhibiting actin cytoskeletal rearrangement thereby suppressing osteoblast differentiation

This study reports the role of miR-1187 in regulation of osteoblast functions. Over-expression of miR-1187 inhibited osteoblast differentiation. Target prediction analysis tools and experimental validation by luciferase 3′ UTR reporter assay identified BMPR-II and ArhGEF-9 as direct targets of miR-1187. ArhGEF-9 activates Cdc42 which has a major role in actin reorganization. BMP-2 also induces actin polymerization. Role of miR-1187 in actin reorganization was determined by protein expression and *in vivo* gene silencing studies. Reduced protein levels of BMPR-II, activated Cdc42, and downstream signaling molecules were observed in miR-1187-transfected osteoblasts. miR-1187 over-expression resulted in decreased actin polymerization. Silencing of miR-1187 in ovariectomized BALB/c mice led to significant improvement in trabecular bone microarchitecture. Overall, miR-1187 functions as a negative regulator of osteogenesis by repressing BMPR-II and ArhGEF-9 expression thus suppressing non-Smad BMP2/Cdc42 signaling pathway and inhibiting actin reorganization. We propose that therapeutic approaches targeting miR- 1187 could be useful in enhancing the bone formation and treatment of pathological conditions of bone loss ***(J Mol Med (Berl), PMID: 29523914- Article chosen as cover page of Journal).***



2.2.2 Efficacy of anti-IL-23 monotherapy versus combination therapy with anti-IL-17 in estrogen deficiency induced bone loss conditions

The role of IL-23 has not been studied in estrogen deficiency induced bone loss. We studied the effect of IL-23 neutralization in ovariectomized (Ovx) estrogen deficient mice on various immune and skeletal parameters. It was also determined whether the combination of anti-IL-23 and anti-IL17 has enhanced osteoprotective effects compared to monotherapies. Treatment of anti-IL-23 and its combination with anti-IL-17 suppressed Th17 cell differentiation and promoted development of T regulatory cells. Anti-IL-23 and its combination with anti-IL-17 prevented bone loss. However, the individual monotherapies of anti-IL-23 and anti-IL-17 were more effective than combination therapy. Our studies thus support bone protective effects of anti-IL-23 and that the monotherapies of neutralizing antibodies against IL-17 and IL-23 may be a more accepted mode of treatment in management of post-menopausal bone loss rather than combination therapy ***(Bone, PMID: 29414600).***



2.2.3 The wakefulness promoting drug Modafinil causes adenosine receptor-mediated upregulation of receptor activator of nuclear factor κB ligand in osteoblasts: Negative impact of the drug on peak bone accrual in rats

Modafinil (2-[(diphenylmethyl)sulfinyl]acetamide) is a psychostimulant that is different from other stimulants such as amphetamine and methylphenidate by being less addictive, less likely to cause withdrawal symptoms or put added strain on the heart. As a result, this drug is considered safe over other psychostimulants and its use is on the rise. In particular, modafinil use has considerably increased among young adults (college goers) who are still accruing bone and have not attained peak bone mass. Modifying peak bone mass has direct consequence on skeletal fragility in old age. Indeed, one standard deviation increase in peak bone mass curtails osteoporosis risk by 50% later in life. We show that modafinil causes loss of bone mass and strength in young rats by upregulating an osteoclastogenic cytokine receptor activator of nuclear factor kB ligand (RANKL) from osteoblasts signaling through adenosine receptors. Our preclinical data calls for assessing the skeletal effects (BMD testing and fracture rate assessment) of this drug in young adults. ***(Toxicology and Applied Pharmacology, PMID: 29649498)***

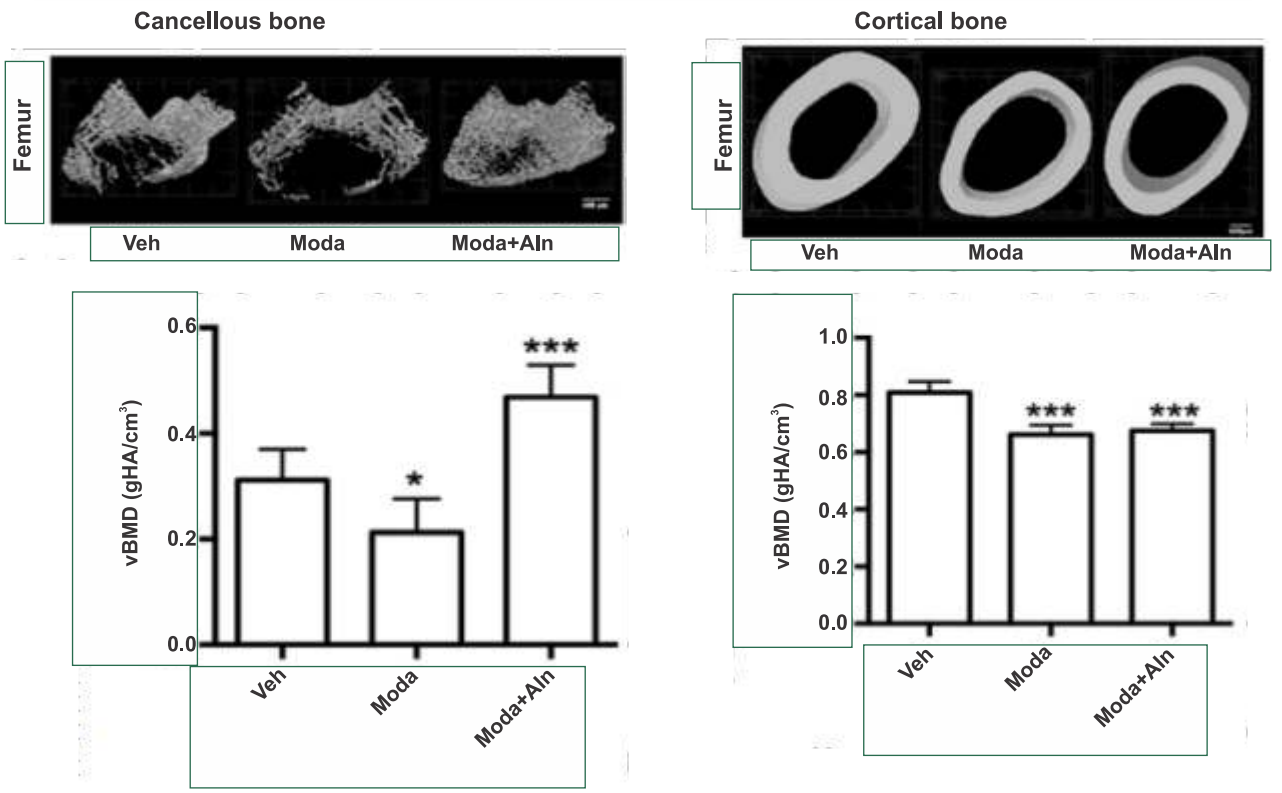


Figure Showing bone loss caused by Moda (modafinil, 12mg/kg which equivalent to recommended human dose of 100mg/kg) at cancellous and cortical parts of femurs of adult rats. Aln (alendronate, 3mg/kg) was used as a standard drug to prevent bone loss.

2.2.4 BMP signalling dependent expression of Prdx1 maintains pre-hypertrophic chondrocytes

We, for the first time demonstrate that BMP signaling promotes expression of Prdx1, one of the Peroxiredoxin ROS scavengers, specifically in the pre-hypertrophic cells and thus helps to maintain pre-hypertrophic state. We further demonstrated that downregulation of Prdx1 expression is critical for the transition from pre-hypertrophic to hypertrophic stage while loss of Prdx1 expression leads to loss of pre-hypertrophic cells.

BMP signaling is known to be necessary as well as sufficient for endochondral bone formation. But, in spite of the bulk of literature regarding the role BMP signaling in bone development, the exact step(s) of the process in which BMP signaling is critically needed is not clear.

In this study, we compared the proteome of BMP deficient osteoblasts with wild type osteoblasts to identify Prdx1 as a molecule expressed in a BMP signaling dependent manner in osteogenic cells. We then conducted a variety of *in vitro* and *in vivo* experiments to demonstrate that BMP signaling regulates transcription of Prdx1 in the pre-hypertrophic cells of developing chick embryonic skeleton. Further, we demonstrated the positive correlation between osteogenesis and Prdx1 expression levels using different *in vitro* and *in vivo* systems. Interestingly, ROS levels were even higher than H_2O_2 treated positive control osteoblasts samples when compared to *Bmp2* and *Bmp4*depleted cells. Thus *Prdx1* expression pattern, taken together with our analysis of ROS level in osteoblast cells, is in agreement with the existing literature, where hypertrophic chondrocytes have been shown to have higher ROS abundance as compared to other chondrocytes. Our data thus suggested that BMP signaling is critical for maintenance of pre-hypertrophic state through transcriptional stimulation of Prdx1. ***(Free Radical Biology & Medicine, PMID: 29452246)***

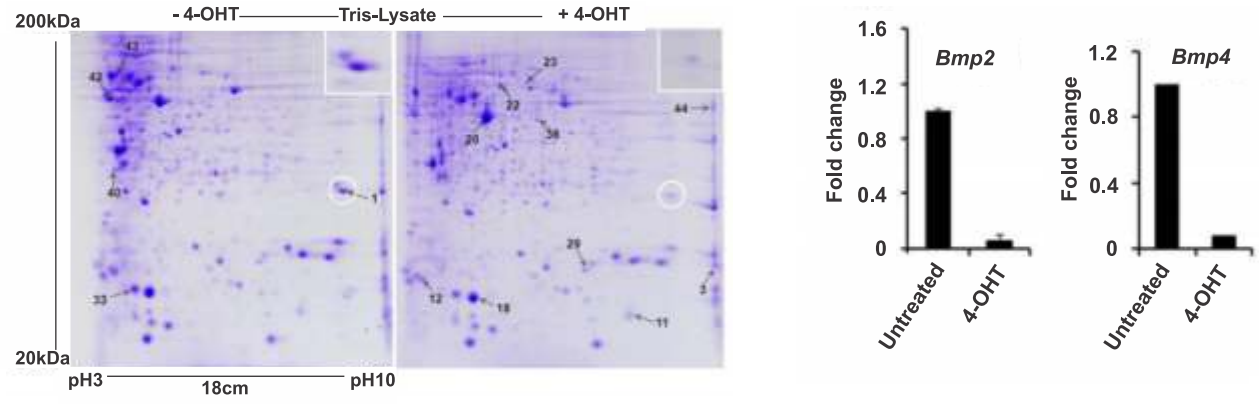
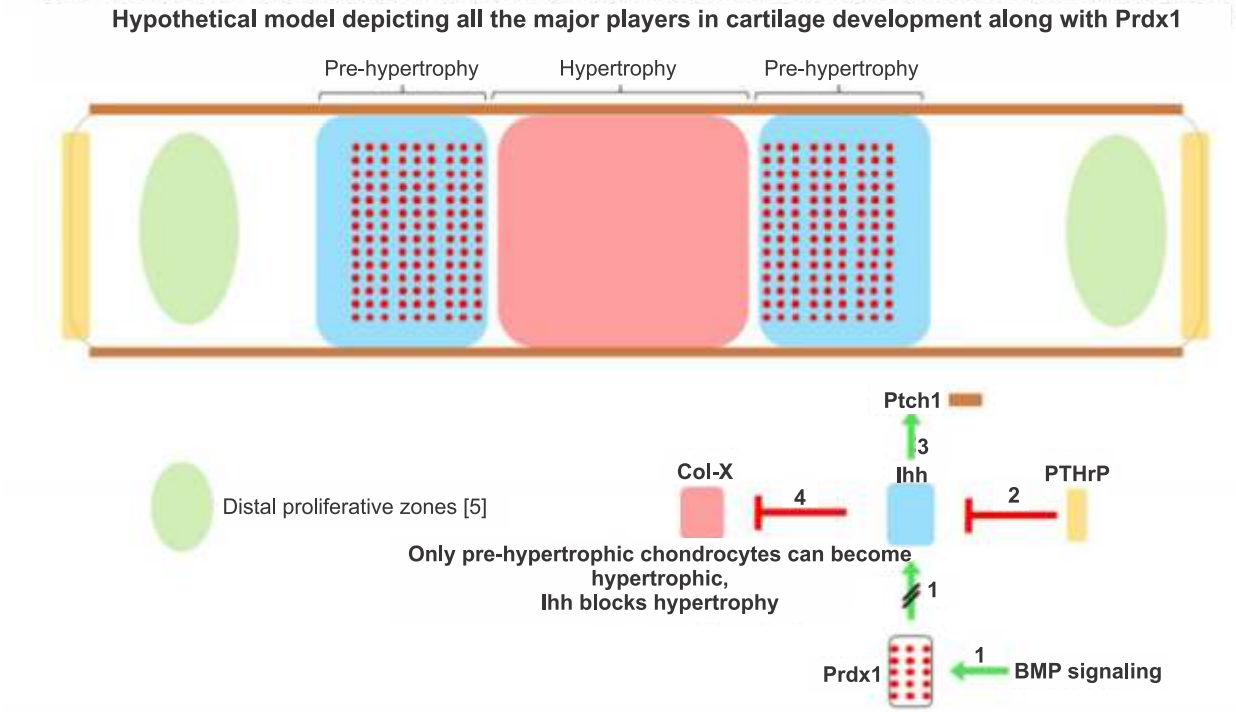
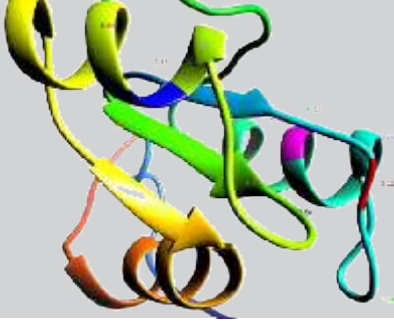


Fig. Proteomics revealed that 4-OH tamoxifen-induced Bmp2/4 knockdown leads to down regulation of Prdx1.



3 AMR: Drug Resistant-Mycobacterial Infections & ESKAPE Pathogens



Area coordinators:

Dr. Atul Kumar

Dr. Ravishankar R

Vision and Goal:

The World Health Organization(WHO) has defined Antimicrobial resistance (AMR) as the ability of a microorganism to stop an antimicrobial from working against it. As a result, standard treatments become ineffective, infections persist and may spread to others. It has further stated "AMR is of particular concern in developing nations, including India, where the burden of infectious disease is high and healthcare spending is low. The country has among the highest bacterial disease burden in the world. Antibiotics, therefore, have a critical role in limiting morbidity and mortality in the country." WHO in the 2017 report categorically states that tuberculosis and some gram-negative infections caused by ESKAPE (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and Enterobacter species) pathogens fall in the highest critical priority category and have to be treated with utmost urgency.

The global objectives of CSIR-CDRI program:

i) Drug discovery studies against drug-resistant mycobacterial infections and ESKAPE pathogens

ii) Discovery of new therapeutic strategies/interventions/diagnostic approaches by Advancing Knowledge Frontiers

Core Competencies and Activities:

The AMR team uses several cutting edge drug discovery platform technologies involving screening, molecular & structural biology, chemistry, computational biology and allied areas. The team has characterized several novel targets and has identified several new scaffolds through early target discovery and research that feeds into the drug discovery pipeline of the institute.

Research Team

L to R standing- Dr. Amogh Anant Sahasrabuddhe, Dr. Malleshwar Rao Kuram, Dr. Mukesh Pasupuleti, Dr. Ravindra Kumar, Dr. Ajay Kumar Srivastava, Dr. P K Shukla, Dr. Sidharth Chopra, Dr. Tejender S. Thakur, Dr. Sudheer Kumar Singh, Dr. Kalyan Mitra

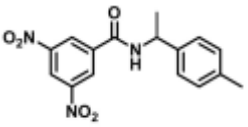
L to R sitting- Dr. Y. K. Manju, Dr. Nayan Ghosh, Dr. Gautam Panda, Dr. Mohammad Imran Siddiqi, Dr. Ravishankar R., Dr. Atul Kumar, Dr. B. N. Singh, Dr. K. K. Srivastava, Dr. Vinita Chaturvedi

3.1 New Drug Discovery

3.1.1 Design and synthesis

3.1.1.1 Benzamide and their analogs as antitubercular agents

Whole cell screening lead to the identification of IS 305 and IS 331 belonging to substituted N-alkylphenyl-3,5-dinitrobenzamides as possessing potent antimicrobial activity against non-tubercular mycobacteria. IS 305 and IS 331 exhibited concentrations dependent bactericidal activity against *M. fortuitum* and synergized with amikacin, while not interacting with levofloxacin. Additionally, IS 305 and IS 331 reduced the bacterial load in macrophages in the intracellular killing assay equivalent to Amikacin. When tested in a murine neutropenic *M. fortuitum* infection model, IS 305 and IS 331 caused a significant reduction in bacterial load in kidney and spleen, which is comparable to amikacin. These two compounds were synthesized in gram scale as well as 15 analogs were prepared to find out better compounds than the identified lead.



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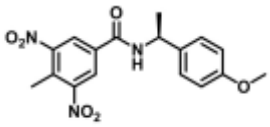
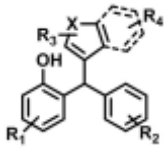


305

3.1.1.2 Trisubstitutedmethanes (TRSMs) as antitubercular agents

Under this heading twenty new compounds were synthesized and efforts are on to find out the asymmetric green catalytic synthesis of TRSMs without the use of any solvent. Using indium (III) triflate as a mild Lewis acid catalyst, the Friedel Crafts alkylation of o-hydroxybisbenzylic alcohols with aromatic /heteroaromaticarenes under solvent free conditions was achieved to give the corresponding unsymmetrical triarylmethanes in high yields (up to 80% yield). Calculation of the different green metrics for the above reaction revealed it to have high atom economy (94-96%), high reaction mass efficiency (66-77%) and high carbon efficiency (70-80%). The Lewis acid was found to be air and moisture tolerant. The protocol was found to be operationally simple and can be carried out in an "open-flask" leaving behind water as the sole by product. Gratifyingly the Lewis acid catalyst could be recycled and reused up to 5 catalytic cycles without compromising much on the yield thus further highlighting the importance of the protocol (***Tetrahedron Letters,* https://doi.org/10.1016/j.tetlet.2017.11.049**)

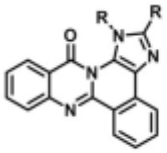


3.1.1.3 Arylsulphones and Triazole derivatives

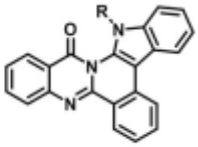
Arylsulphoneswere synthesized for evaluation as Protein Tyrosine Phosphatase B inhibitors and also for testing as anti-tubercular agents. Triazole derivatives were synthesized. These compounds are presently being evaluated for anti-TB activities

3.1.1.4 Design and synthesis of fused Imidazolo-Quinazolinone and Indolo-Quinazolinone derivatives as anti-TB agents

Heterocycles are main constituents of many drugs and drug like candidates. Tryptanthrin, a natural product isolated from Indigo plant *Strobilanthes cusiaKuntze*, which has potential antitubercular activity is a fused heterocycle of Indolo[2,1-b]quinazoline. Delamanid is nitroimidazole derivative that has shown antitubercular activity under hypoxic conditions and is currently in clinical evaluation. Here, we are designing novel fused heterocycles for the biological evaluation of anti-TB agents such as imidazole-quinazolinone and indolo-quinazolinone as shown below.



Imidazolo quinazolinone

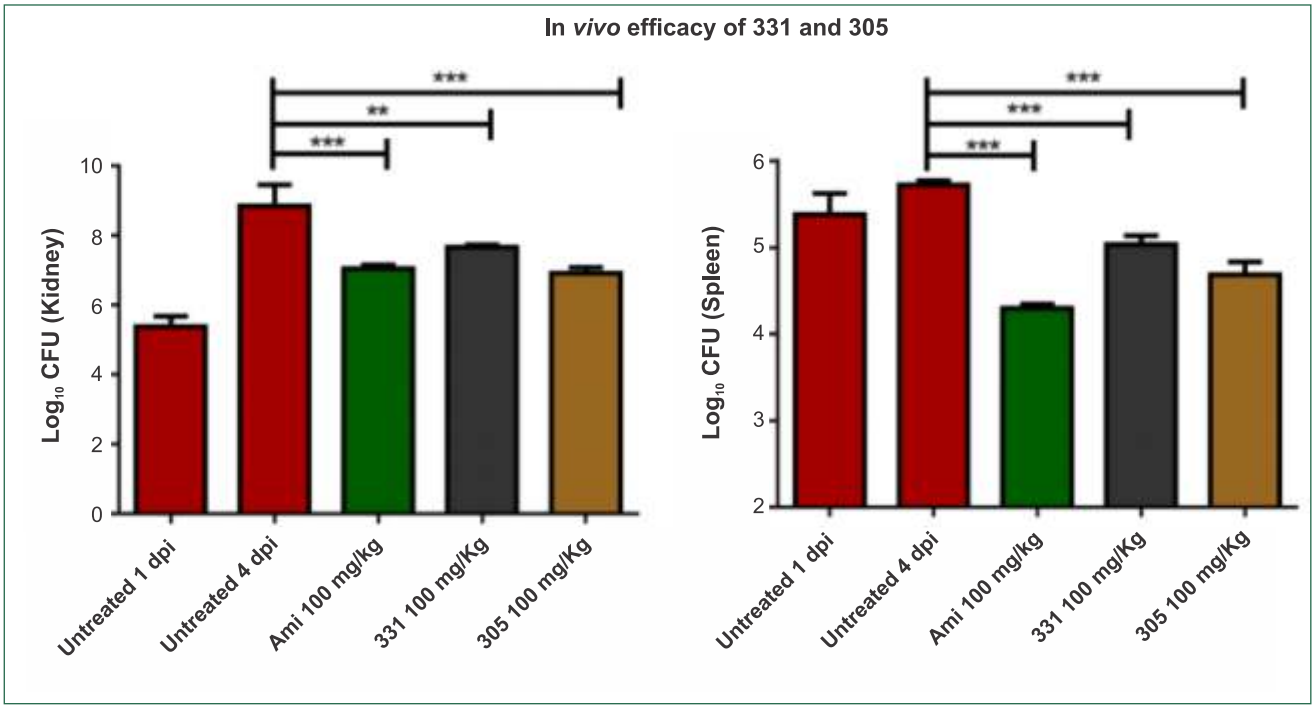


Indolo quinazolinone

3.2 Biological screening

3.2.1 Efficacy of IS 331 and IS 305 in murine infection model of *M. fortuitum*

Majority of the patients infected with NTM suffer from immunodeficiency, thus this facet must be reflected in animal models of NTM infection.[7] In brief, the mice were rendered neutropenic by cyclophosphamide injections followed by IV inoculation of *M. fortuitum* to establish bacteraemia. At 100 mg/Kg, IS 331 (1.2 $\log_{10}$) and IS 305 (1.9 $\log_{10}$) significantly reduced bacterial burden in kidney which is comparable to AMI (1.8 $\log_{10}$). Even in spleen, IS 331 (0.7 $\log_{10}$) and IS 305 (1.0 $\log_{10}$) significantly reduced bacterial burden which is comparable to AMI (1.4 $\log_{10}$). Thus, IS 331 and IS 305 are efficacious *in vivo* and are comparable to AMI in reducing the bacterial burden.



Structurally related compounds belonging to substituted N-alkylphenyl-3,5-dinitrobenzamides have been shown to be exhibit potent MIC against H37Rv including activity against drug-resistant strains of *M. tuberculosis.* However, their *in vitro* as well as *in vivo* activity of against NTM's has not been determined. These hits resemble a very potent anti-TB candidate BTZ043, which has been shown to inhibit heterodimeric decaprenyl-phosphoribose-2'-epimerase (DprE1). Intriguingly, BTZ043 has been shown to be inactive against atypical mycobacteria like *M. abscessus* owing to a mutation in DprE1, which is in agreement with our findings. Given the current status of increasing drug-resistance and paucity of drugs active against NTM's, medical treatment of NTM infections is rapidly becoming severely challenging.Thus, the identification of IS 331 and IS 305 possessing potent antimicrobial activity against *M. fortuitum* and *M. chelonae*is a step in the right direction. The low MIC, combined with very high selectivity index, concentration dependent bactericidal activity, impressive intracellular activity, ability to synergize with amikacin while not antagonizing approved drugs and demonstrating potent *in vivo* efficacy insist that IS 331 and IS 305 be projected as potential leads active against infections caused due to *M. fortuitum* and *M. chelonae*

3.2.2 Compounds screened against the MABA anti-TB assay

About 775 samples, including synthetic, natural product and external samples, were screened against the MABA anti-TB assay. One of the compound is being pursued further.

3.2.3 Screening of compounds against NTMs

About 2000 compounds received from CSIR-IIIM, Jammu and 18 compounds received from CSIR-NCL were screened against non-tubercular mycobacteria. Identified IS 305 and IS 331 belonging to substituted N-alkylphenyl-3,5-dinitrobenzamides, which exhibited concentration dependent bactericidal activity against *M. fortuitum*. Two compounds showed activity at 0.5 and 2 µg/ml against *M. fortuitum* (Mf) with SI index □10 *in vivo* efficacy studies are in progress

3.2.4 Screening of compounds against ESKAPE pathogens

During the reporting period, a total of 282 in-house compounds, 480 Maybridge library compounds were screened against ESKAPE pathogens. Twelve compounds found active against *S. aureus.* None were found active against Gram-negative bacteria

3.2.3 Progress on design of subunit vaccine against TB

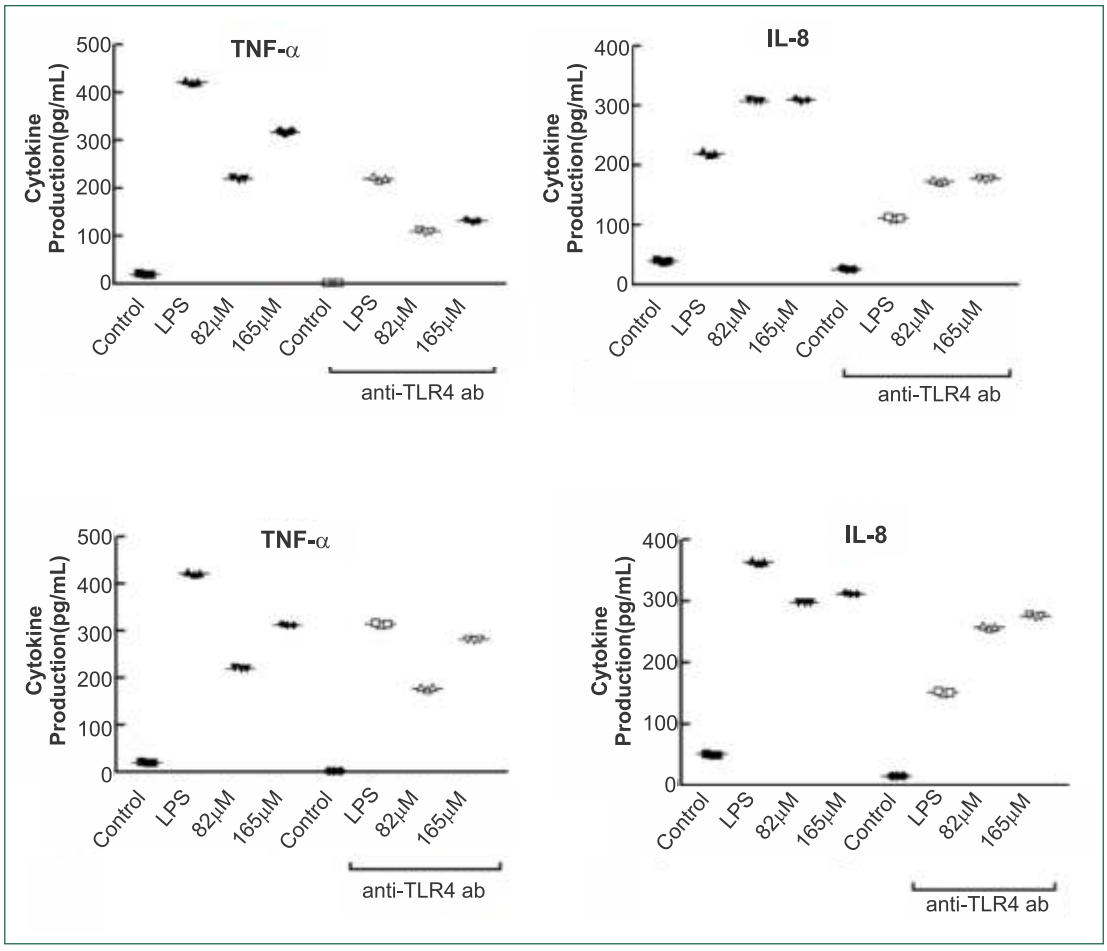
We are working on harnessing novel proteins for the development of a subunit/booster vaccine against tuberculosis. The induced immune response against a pair of ESAT-family proteins from *Mycobacterium tuberculosis* H37Rv viz. Rv3444c/Rv3445c, has been evaluated in

BALB/c mice. These proteins/antigens elicit strong IgG titers in immunized mice and are strongly seroreactive towards the sera of TB patients (**Tuberculosis (Edinb). PMID: 29559126**). Building on our earlier work, we have created chimeras of immunogenic proteins for further evaluation.

3.2.4 A TLR4-derived non-cytotoxic, self-assembling peptide functions as a vaccine adjuvant in mice

A vaccine component, namely adjuvant enhances antigen recognition by the host immune system and thereby stimulates its cellular and adaptive responses. Especially synthetic Toll-like receptor (TLR)-agonists having self-assembling properties are considered as good candidates for adjuvant development. A human TLR4-derived 20-residue peptide (TR-433), present in the dimerization interface of the TLR4–myeloid differentiation protein-2 (MD2) complex, displayed self-assembly and adopted a nanostructure. Both *in vitro* studies and *in vivo* experiments in mice indicated that TR-433 is nontoxic. TR-433 induced proinflammatory responses in THP-1 monocytes and HEK293T cells that were transiently transfected with TLR4/CD14/MD2 and also in Balb/cmice. In light of the self-assembly and proinflammatory properties of TR-433, we immunized mice with a mixture of TR-433 and either ovalbumin or filarial antigen TPP. Significant amount of IgG titres were produced, suggesting adjuvanting capability of TR-433 that was comparable to that of Freund's complete adjuvant(FCA) and appreciably higher than that of alum. We found that TR-433 preferentially activates type 1 helper T cell (T_h1) response rather than type 2 helper T cell (T_h2) responses. To our knowledge, this is the first report on the identification of a short TLR4-derived peptide that possesses both self-assembling and pro-inflammatory properties and has significant efficacy as an adjuvant,capable of activating cellular responses in mice. These results indicate that TR-433 possesses significant potential for development as a new adjuvant in therapeutic application ***(J Biol Chem. PMID: 30385503).***

TR-433 is more specific to TLR 4 than MD2. THP-1 cells were treated with or without (a, b) anti-TLR4 and (c, d) anti-MD2 antibody (2.5 mg/ml) in the presence of TR-433 and cytokines were quantified by ELISA. LPS and untreated cells served as positive and negative controls respectively.



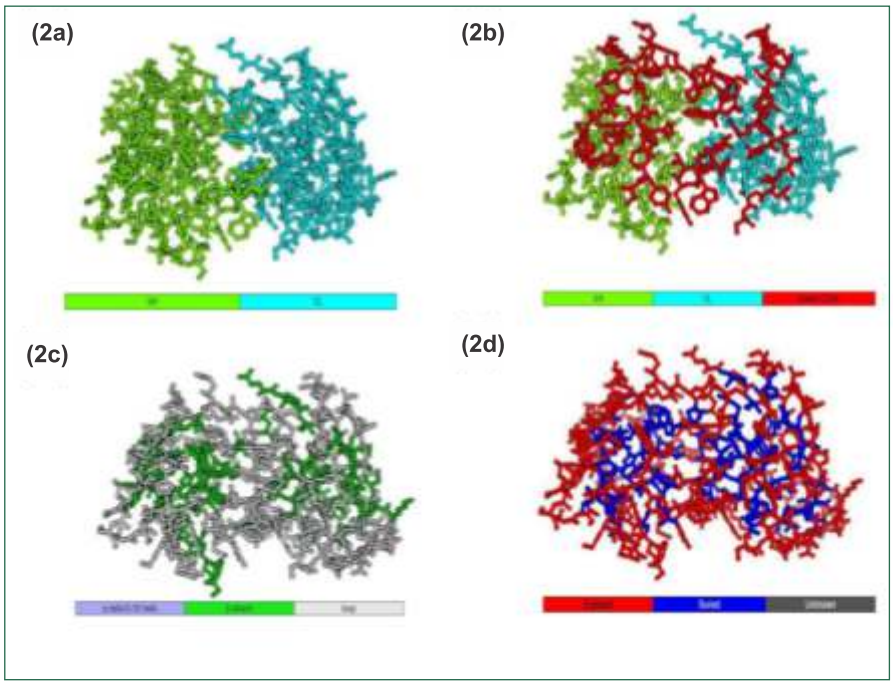
3.2.5 Antifungal and antibacterial evaluation of compounds

A total of 1603 (CBRS/synthetic 373, Maybridge Library/synthetic 1054, MoES 176, extracts) compounds/extracts were evaluated for *in vitro* antifungal and antibacterial activity by microbroth dilution method using standard protocol (as per CLSI guide lines) initially against 7 human pathogenic bacteria viz. *1. E. coli* (ATCC 9637), *2. Pseudomonas aeruginosa* (ATCC BAA-427), 3. *Staphylococcus aureus* (ATCC 25923), *4. Staphylococcus aureus* (ATCC 700699 MRSA), 5. *Staphylococcus aureus* (ATCC 29213), 6. *Staphylococcus aureus* (ATCC 33592 gentamicin resistant), 7. *Klebsiellapneumoniae*(ATCC 27736), and six human pathogenic fungi viz. 1. *Candida albicans*(ATCC-10231), 2. *Cryptococcus neoformans* (ATCC-32045), 3. *Sporothrixschenkii,* 4. T*ricophytonmentagrophytes* (ATCC-9533), 5. *Aspergillus fumigatus* (ATCC-204305), 6. *Candida parapsilosis* (ATCC-22019). One of the compounds NPL-018-0064 exhibited antifungal activity (MIC1.56-3.12 µm) *in vitro* against different species while the compounds SB/CDRI4/175, -/176, -/184, -/186, -/206, SK/IISER1/36, PS/IICT2/64 (MIC 0.39-6.25µg/ml), and compounds S-018-0405, -0407, -0408, -0409 had antibacterial activity (MIC 0.78-6.25 µm) against the 4 strains of *S. aureus* viz. *Staphylococcus aureus* (ATCC 25923), *S. aureus* (ATCC 700699 MRSA), *S. aureus* (ATCC 29213), and *S. aureus* (ATCC 33592 Gentamicin resistant).

3.2.6 Monoclonal antibodies against surface proteins of *A. fumigatus*

The immunogenic proteins recognized by monoclonal antibodies generated earlier (MAb R-5 and MAb R-15) were identified by MALDI-TOF MS analysis and PMF and MS/MS ion data obtained from MALDI-TOF MS analysis were used for identification of candidate proteins in NCBI protein database by using MASCOT software program (Matrix Sciences, London, UK) available online at www.matrixscience.com, Aspergillus Genome Database and SWISS-PROT protein sequence database which revealed that the protein recognized by MAb R-5 was enolase (47.39 kDa) allergen from *A. fumigatus* (Asp f22) and protein identified by MAb R-16 was mycelial catalase 1 (Cat 1p) (79.92 kDa).

The *in vivo* immunotherapeutic potential of MAb R-5 was evaluated in experimental female BALB/c mice challenged intravenously with *A. fumigatus* spores where the mean survival time of the mice treated with MAb R-5 had significantly increased (18.5 days) compared to the mice receiving irrelevant antibody (7 days) and DPBS (6.5 days). Antibody modeling of MAb R-5 was done using heavy chain variable sequence and light chain variable to assess thelocation and orientation of the inter-domain interactions (Fig.2a), complementarity determining regions (CDRs) (Fig.2b), secondary structures (Fig.2c), solvent exposed region (Fig.2d) as well as the overall shape of the antibody variable region.



The complementarity-determining regions (*CDRs*) of variable region sequences of MAb R-5 were joined and paratope derived peptides of 12 amino acid length were designed by leaving one amino acid of the sequences. The physiochemical properties such as charge, hydrophobicity and Iso-electric point of peptides were analysed and eight paratope derived peptide were selected and synthesized. For biological activity studies, the MICs of peptides were determined by broth microdilution technique as per the guidelines of the National Committee for Clinical Laboratory Standards (now CLSI) using RPMI-1640 media buffered with MOPS [3-(N-morpholino) propanesulfonic acid] in 96 well plates. None of the peptides were found to be active against the test fungi even at the highest concentration tested (50 g/ml). However, more critical analysis and studies are required for the development of bioactive paratope derived peptides against fungal infections.

3.3 Advancing Knowledge Frontiers

3.3.1 Structural characterization of bacterial peptidyl-tRNA hydrolase

We have characterized the crystal structure and backbone dynamics of the M71A mutant of the bacterial AMR target peptidyl-tRNA hydrolase from *Vibrio cholerae*(VcPth) **(Biochimbiophysacta Proteins Proteom. PMID: 29733913).** The crystal structure of M71A mutant has a novel form with dimer interface formed by the C-terminal of one monomer and active site of the other monomer.

3.3.2 Development of recombinant *Mycobacterium tuberculosis* with phosphatidylserine decarboxylase down-regulation

The ORF Rv0437c is annotated as a phosphatidylserine decarboxylase(PSD). The ORFs physiological significance is not known but it is thought to be involved in lipid metabolism. The function of this gene is not essential for *in vitro* survival however; its expression has been confirmed by various approaches including 1D SDS-PAGE and uLC MS/MS. We cloned it in pGEM-T Easy vector and confirmed it by PCR amplification as well as by insert release using flanking site enzymes. Further, we mobilized it in pET32a expression vector, expressed it by IPTG induction, purified it using Ni-TED column chromatography and confirmed the expressed protein by immunoblotting with anti-His antibody. Also, we developed an antisense construct by cloning a partial fragment of *psd* in antisense in pMV361 vector. This construct was confirmed by digestion with restriction enzymes and electroporated in *Mtb*-H37Ra. The recombinant was selected by antibiotic selection and was subsequently confirmed using genomic DNA of recombinant strain. Both, WT and recombinant strain were studied for their growth, biofilm formation, membarane permeability, antibiotic susceptibility and survival in macrophages. Further studies are under progress to study its tolerance to low pH and starvation as well as under persistence.

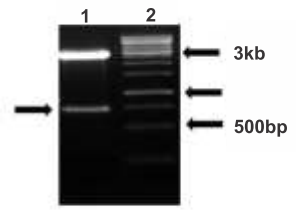


Fig. 1: Confirmation of *psd* cloning in pGEM-T Easy vector

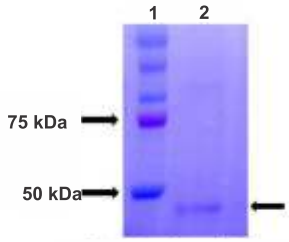


Fig. 2: Protein purification

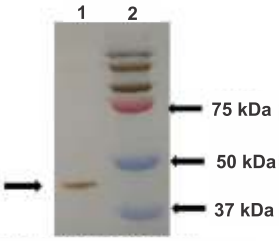


Fig. 3: Confirmation of PSD expression by immunoblotting

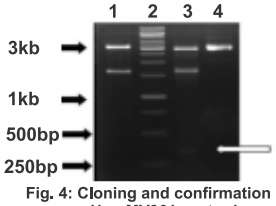


Fig. 4: Cloning and confirmation of *psd* in pMV361 vector by restriction digestion. Lane 1 shows *psD*+361 construct digested with PstI, lane 2 is DNA Ladder, lane 3 is *psd*+361 construct digested with *Pst*I/*Cla*I lane 4 is undigested *psd*+361

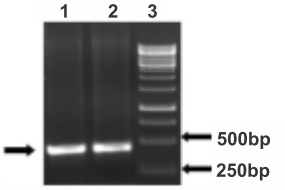


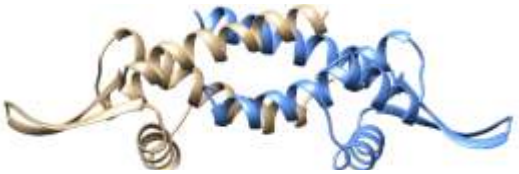
Fig. 5: Confirmation of *psd* KD by PCR. Lane 1 and 2 show PCR amplions from are *psD* recombinat *Mtb*-Ra, lane 3 is DNA ladder.

3.3.3 A MD2-derived peptide promotes LPS aggregation and inhibits LPS-induced pro-inflammatory responses by facilitating its internalization in THP-1 cells

MD2, a 160-residue accessory glycoprotein is responsible for the recognition and binding of Gram-negative bacterial membrane component, lipopolysaccharide (LPS). Internalization of pathogen inside the mononuclear phagocytes has also been attributed to MD2 which leads to the clearance of pathogens from the host. Nevertheless, not much is known about the segments in MD2 that are responsible for LPS-interaction or internalization of pathogen inside the defense cells. A 16-residue stretch (MD54) from MD2 protein was been identified that possesses a short heptad repeat sequence and four cationic residues enabling it to participate in both hydrophobic and electrostatic interaction with LPS. A MD54-analog of the same size was also designed by replacing a leucine residue at a heptadic position with an alanine residue. Only MD54 and not its analog, MMD54 induced aggregation of LPS and induced its internalization within THP-1 monocytes. Moreover, MD54 inhibited LPS-induced nuclear translocation of NF-B in PMA-treated THP-1 and TLR4/MD2/CD14 transfected HEK 293T cells and subsequently the production of pro-inflammatory cytokines. Additionally, in *in vivo* experiments, MD54 showed marked protection and survival of mice against LPS induced inflammation and death. Overall, the results show the identification of a short peptide having heptad repeat sequence from MD2 that can cause aggregation of LPS and assist in its internalization within THP-1 cells, resulting in attenuation of LPS-induced pro-inflammatory responses *in vitro* and *in vivo* ***(Cell Mol Life Sci. PMID: 29313060).***

3.3.4 Structural characterization of PadR family protein Rv3488 from *M. tuberculosis* H37Rv

Earlier studies have shown that *M. tuberculosis* is sensitive to cinnamic acid and its derivatives. Therefore, we have undertaken systematic structural and functional characterization of the phenolic acid decarboxylase repressor (PadR) family of proteins, the members of which



are associated with phenolic acid detoxification. We have determined the crystal structure of Rv3488 in the absence and presence of metal ions. Further, we have characterized the binding of Rv3488 to its promoter DNA by EMSA studies. Using *M. smegmatis* as a surrogate, we have shown that expression of Rv3488 in *M. smegmatis* imparts toxicity to sub-lethal concentrations of toxic heavy metals and also increased intracellular survival in macrophages ***(Biochem J. 2018 PMID: 30266832).***

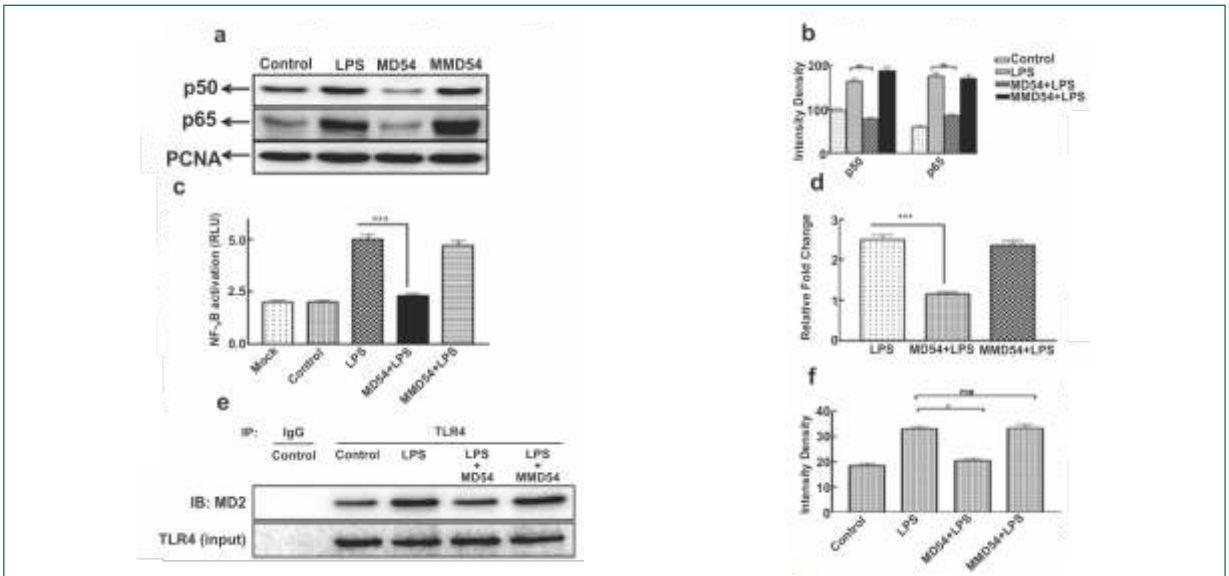


Fig. Study of effect of MD54 and MMD54 on the translocation of NF-κB into the nucleus in LPS-stimulated THP-1 and HEK 293T cells and MD54 induced attenuation of LPS-Induced Interaction between MD2 and TLR4 (a) Western blot of the nuclear fraction of LPS-stimulated THP-1 cells for p65/p50 subunit of NF-κB in the absence and presence of MD54 and MMD54. (b) Intensity graph with **P<0.01 (c) NF-κB activation in HEK293T transfected cells. (d) Relative fold change in NF-κB activation in HEK293T after treatment of LPS and peptides (RLU control=1), ***P<0.001 (e) Immunoprecipitation assay showed that MD54 pretreatment (10 μM) significantly reduced the formation of the TLR4–MD2 complex induced by 100 ng·mL^{-1} LPS. (f) Densitometric analysis was done using ImageJ software and *p< 0.05).

3.3.5 Mycobacterial protein tyrosine kinase, PtkA phosphorylates PtpA at two tyrosine residues.

Post translational modificationsare the key mechanisms for mycobacterial physiology and play critical roles in mycobacterial survival and in its pathogenesis. Mycobacteria evade host immune mechanism by inhibiting phagosome - lysosome fusion in which mycobacterial protein tyrosine phosphatase A (PtpA;TP) plays an indispensable role. Tyrosine kinase (PtkA;TK) activated by autophosphorylation; phosphorylates TP, which subsequently leads to increase in its phosphatase activity. The phosphorylated TP is secreted in phagosome of macrophage. In the present study, we have shown that the phosphorylation at two sites of TP; Y^{128} and Y^{129} are critical for TK-mediated phosphatase activity. The disruption of this interaction between TK and TP inhibits activation of later which further leads to the decrease in intracellular survival of mycobacteria. Furthermore, the proof of concept has been established using benzylbenzofurans and benzofuranamides, which inhibit the growth and intracellular survival of mycobacteria, associate with the functional sites of TP and contend with the TK. This binding was further restated by looking at the anchorage of protein-protein and the protein-inhibitor complexes in the homology-based structure models and by surface plasmon resonance analysis ***(J Drug Target, PMID: 29724125).***

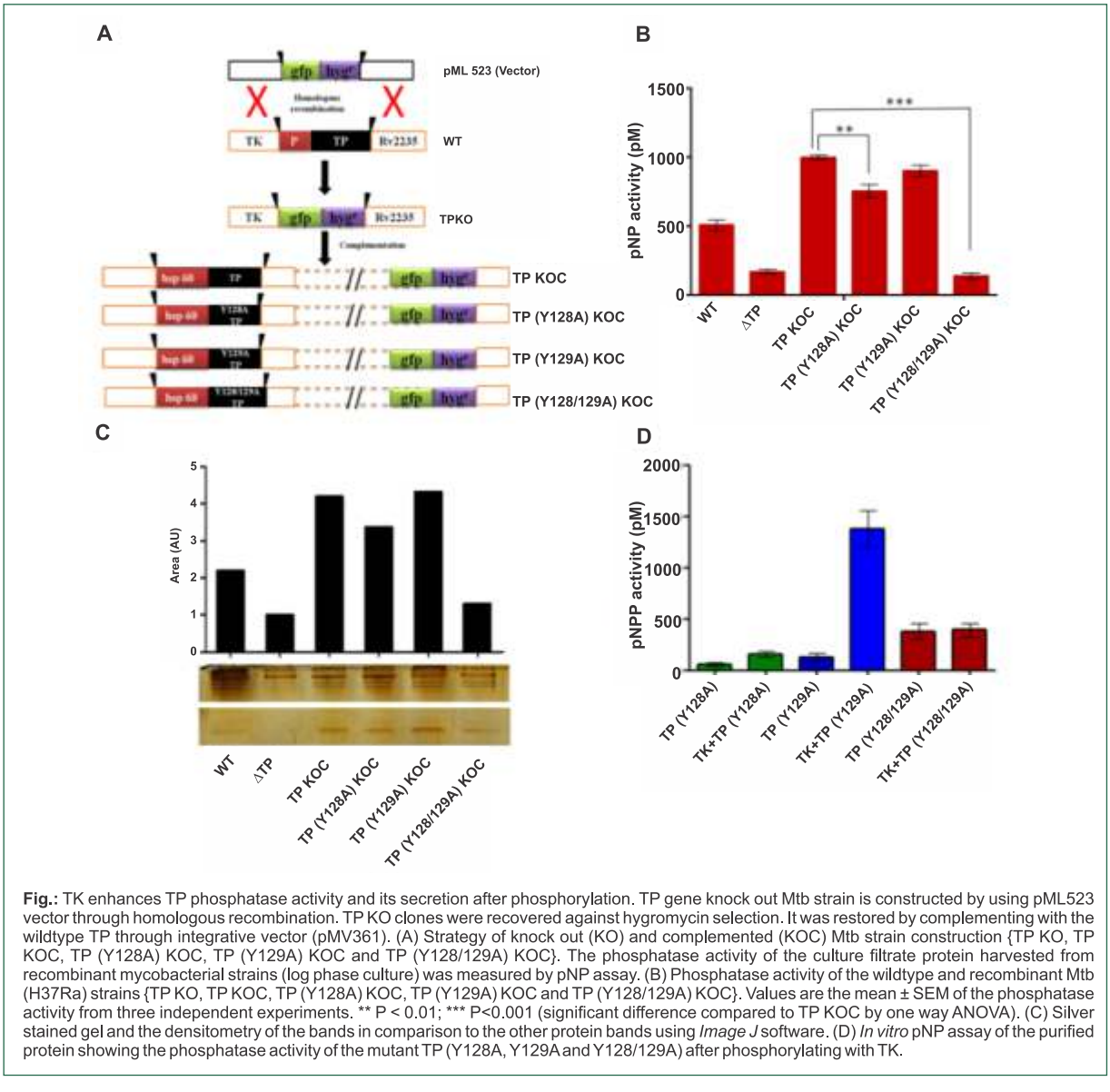


Fig.: TK enhances TP phosphatase activity and its secretion after phosphorylation. TP gene knock out Mtb strain is constructed by using pML523 vector through homologous recombination. TP KO clones were recovered against hygromycin selection. It was restored by complementing with the wildtype TP through integrative vector (pMV361). (A) Strategy of knock out (KO) and complemented (KOC) Mtb strain construction {TP KO, TP KOC, TP (Y128A) KOC, TP (Y129A) KOC and TP (Y128/129A) KOC}. The phosphatase activity of the culture filtrate protein harvested from recombinant mycobacterial strains (log phase culture) was measured by pNP assay. (B) Phosphatase activity of the wildtype and recombinant Mtb (H37Ra) strains {TP KO, TP KOC, TP (Y128A) KOC, TP (Y129A) KOC and TP (Y128/129A) KOC}. Values are the mean ± SEM of the phosphatase activity from three independent experiments. ** P < 0.01; *** P<0.001 (significant difference compared to TP KOC by one way ANOVA). (C) Silver stained gel and the densitometry of the bands in comparison to the other protein bands using *Image J* software. (D) *In vitro* pNP assay of the purified protein showing the phosphatase activity of the mutant TP (Y128A, Y129A and Y128/129A) after phosphorylating with TK.

3.3.6 Protein tyrosine kinase A modulates intracellular survival of mycobacteria through Galectin 3

Mycobacterium tuberculosis (MTB) is a successful pathogen which increases persistence inside the host macrophage by subverting its defence mechanism. Mycobacteria regulate the pathogenesis and intracellular survival by controlling its interaction with host protein(s). Galectin 3 is a member of the β-galactoside binding gene family which is involved in several biological functions. In the present study, we have expressed the mycobacterial protein tyrosine kinase (PtkA) in the cytosol of host macrophages through a eukaryotic promoter vector and found that it down-regulates Galectin 3. Infection by ptkA knocked-out (KO) mycobacterial strain shows increased level of Galectin 3 in the cytosol of macrophages. PtkA regulates Galectin 3 level and stimulates host macrophage through MEK-JNK-cJUN pathway and initiates early apoptosis in $H_{37}Ra$ infected macrophage. The ptkA KO strain showed decreased progression of apoptosis confirming Galectin 3 as anti-apoptotic molecule. The intracellular survival was also found to be impaired in the mice infected with ptkA KO mycobacteria. The hypothesis was also confirmed by looking at the intracellular survival of mycobacteria in Galectin 3 silenced macrophages. The overall findings suggest the significance of Galectin 3 and PtkA interaction in intracellular persistence of mycobacteria ***(Biochem Biophys Res Commun. PMID: 29545176)***

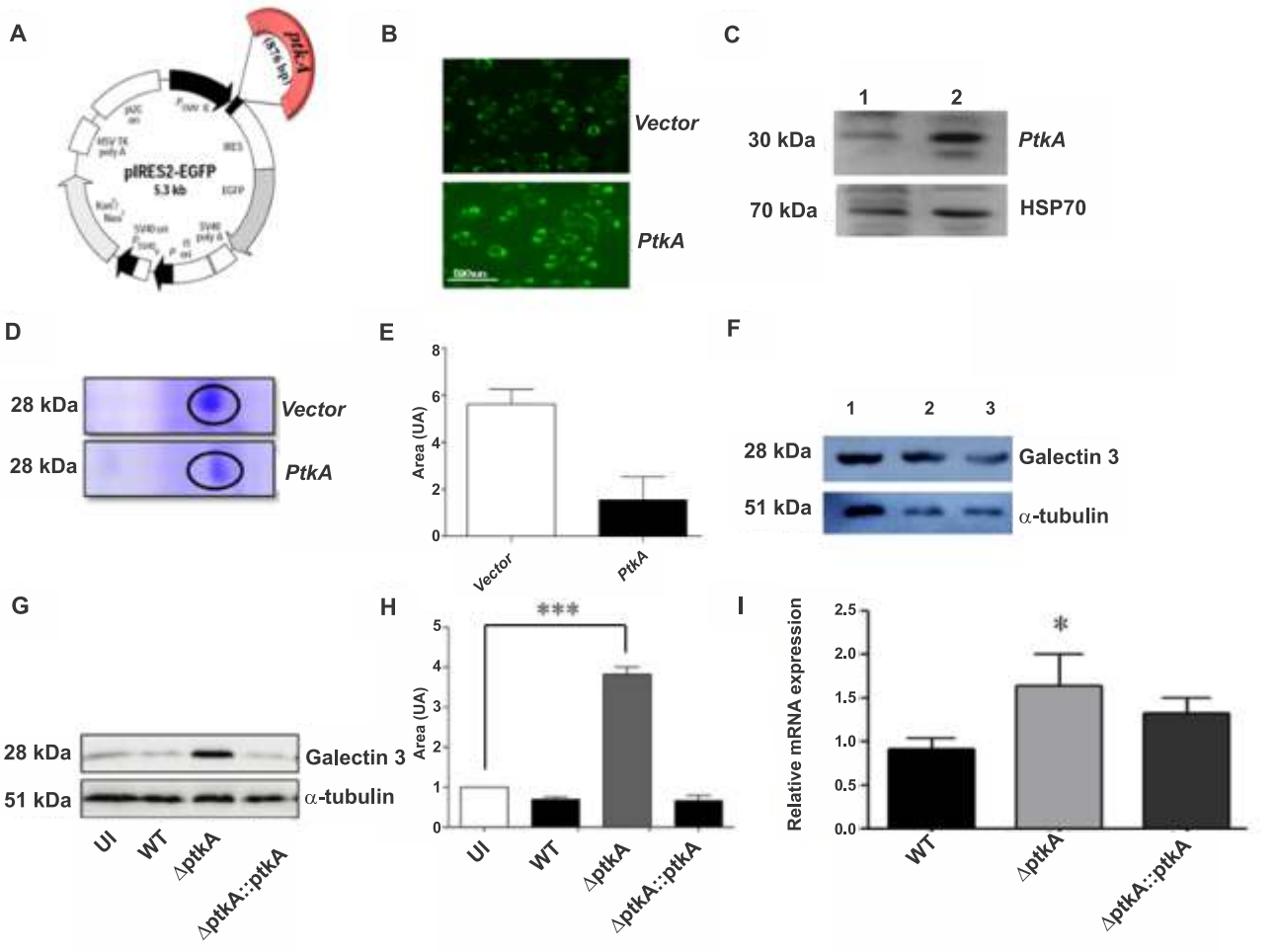


Fig.: PtkA downregulates Galectin 3 expression level in macrophage cells (A) schematic representation of recombinant plasmid *pIRES2-EGFP::ptkA* (B) Microscopy of *ptkA* transfected macrophage cells (C) Expression of PtkA in transfected macrophage cells (*lane 1* vector transfectedand *lane 2* is *ptkA* transfected) (D) 2D gel showing protein spots of Galectin 3 (E) Relative density of spots identified in arbitrary units (AU) (F) Expression of Galectin 3 in PtkA in transfected macrophage cells (*lane 1*untransfected/*lane 2* is vector transfected and *lane 3* is *ptkA* transfected) alpha tubulin is used as loading control here. (G) Immunoblotting of Galectin 3 in WT, Δ*ptkA*and *ptkA* complemented strain infected J774 A.1 macrophage cells. (H) Relative density of bands measured by ImageJ and represented in arbitrary units (AU) (I) Transcript level of Galectin 3 in WT, Δ*ptkA*and *ptkA* complemented strain infected J774 A.1 macrophage cells.

3.3.7 Deciphering mechanism of pathology of brain infection caused by non-tuberculous mycobacteria

Mycobacterium fortuitum is capable crossing blood brain barrier and causing neuronal damage by down regulating Parkin via TNFα - NF-κB mediated pathway. *M. fortuitum* are capable of infecting neurons and microglial cells *in-vitro*. *M. fortuitum* is capable of triggering a profound inflammatory response which can lead to irreparable neuronal damage. NTMs could be one of the causative agent responsible for HIV associated neuronal disease/ Parkinsonism

3.3.8 Architecture and molecular mechanisms of BERosomes in DNA Base Excision repair (BER) of Mtb

A multi-molecular complex involving Sliding β-clamp, NAD+-dependent DNA ligase (LigA) and Class-II AP-endonuclease (XthA) along with target DNA is being investigated. We had earlier reported the association and molecular mechanism of the Sliding β-clamp-XthA complex. The Class-II AP-endonuclease (XthA) and NAD^+- dependent DNA ligase (LigA) act during catalyse the initial and terminal stages of DNA Base Excision Repair (BER), respectively, in bacteria. XthA acts on abasic sites of damaged DNA and creates a nick with 3'OH and 5'dRP moieties that is further processed by downstream DNA repair components. Co-immuno precipitation experiments using mycobacterial cell lysate, identified MtbLigA-MtbXthA complex formation. Pull-down experiments using purified domain-deleted mutants of MtbLigA show that LigA binds to XthA through interactions mediated by the BRCT domain of LigA. *In vitro* assays demonstrate that MtbXthA inhibits the ligation activity of MtbLigA by forming a complex. Small-angle X-ray scattering (SAXS) and size-exclusion-chromatography analysis of the complex suggests that MtbXthA engages with the BRCT domain of MtbLigA to form a complex and keeps the latter in a non-productive conformation that disallows encircling of substrate DNA by MtbLigA. Assays involving MtbLigA, MtbXthA and DNA substrate analogs suggest that XthA engages with LigA to counteract 'futile' ligation by preventing the latter from resealing the DNA termini with 3'OH and 5'dRP moieties created by the action of XthA at abasic sites. Overall, our work identifies a novel role for XthA as a regulator of LigA activity in *Mycobacterium tuberculosis*.

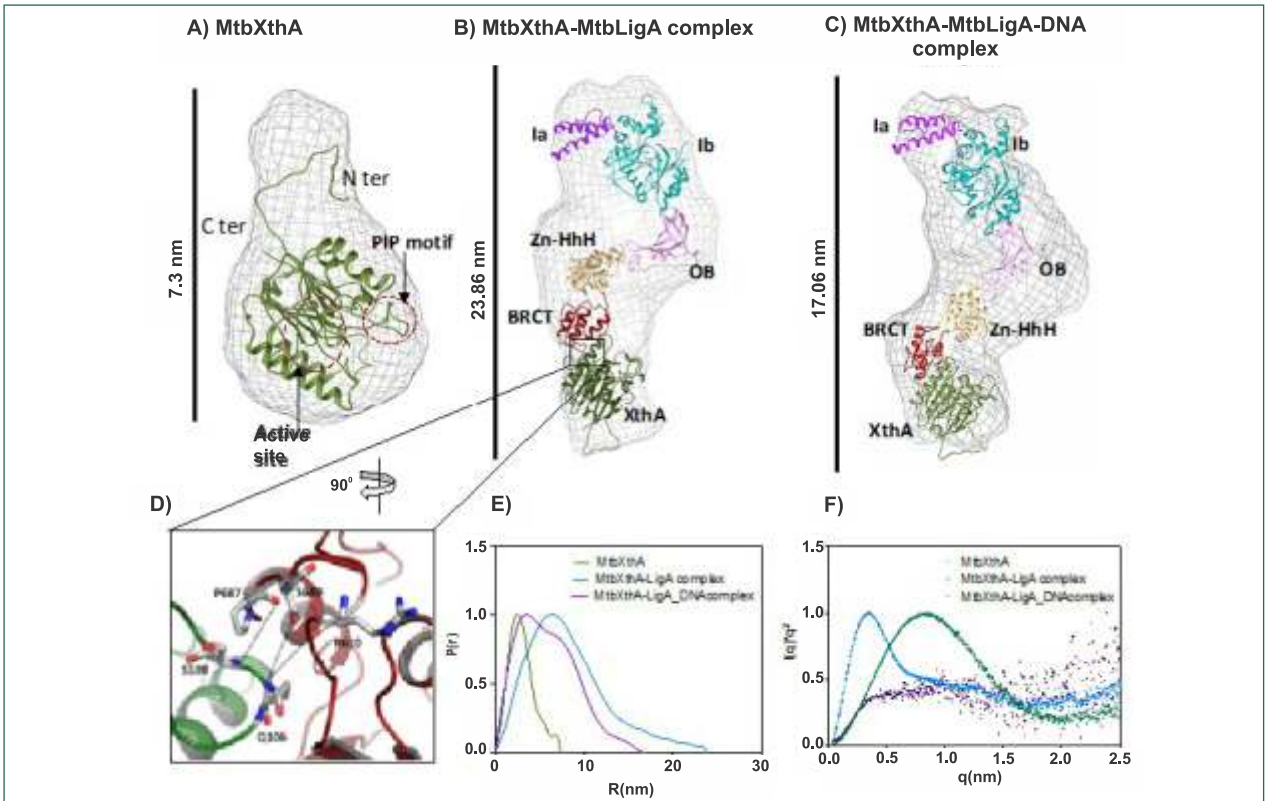


Fig.: MtbXthA forms complex with MtbLigA in solution. Small-angle X-ray scattering studies(SAXS) envelope of **(A)** MtbXthA alone **(B)**MtbXthA-MtbLigA complex in absence **(C)** or presence of nicked DNA substrate fitted with homology model. **(D)** Interaction interface between MtbXthA and BRCT domain of MtbXthA as revealed by XthA-LigA complex in solution. The BRCT domain and MtbXthA is represented in deep red and green respectively. The residues forming contacts at the interface are shown in sticks. The hydrogen bonds are shown as black dotted lines.**(E)** NormalizedPairwise interatomic distance distribution P[r] function of protein and complexes. **(F)** NormalisedKratky plot analysis indicating degree of disorder of protein and complexes.

3.3.9 Structure of BRCT domain of NAD+-dependent DNA ligase (MtbLigA)

The BRCT domain is the C-terminal domain of MtbLigA. Our work has demonstrated that it is involved in protein-protein interactions in bacteria/ Mtb.

Structural analysis of BRCT domain of MtbLigA is completed using NMR approaches. Interaction studies with selected ligands is in progress and subsequent analysis is ongoing. Our work also suggests that deletion of BRCT domain from MtbLigA leads to loss of activity of enzyme and hence it is important in survival of Mtb.

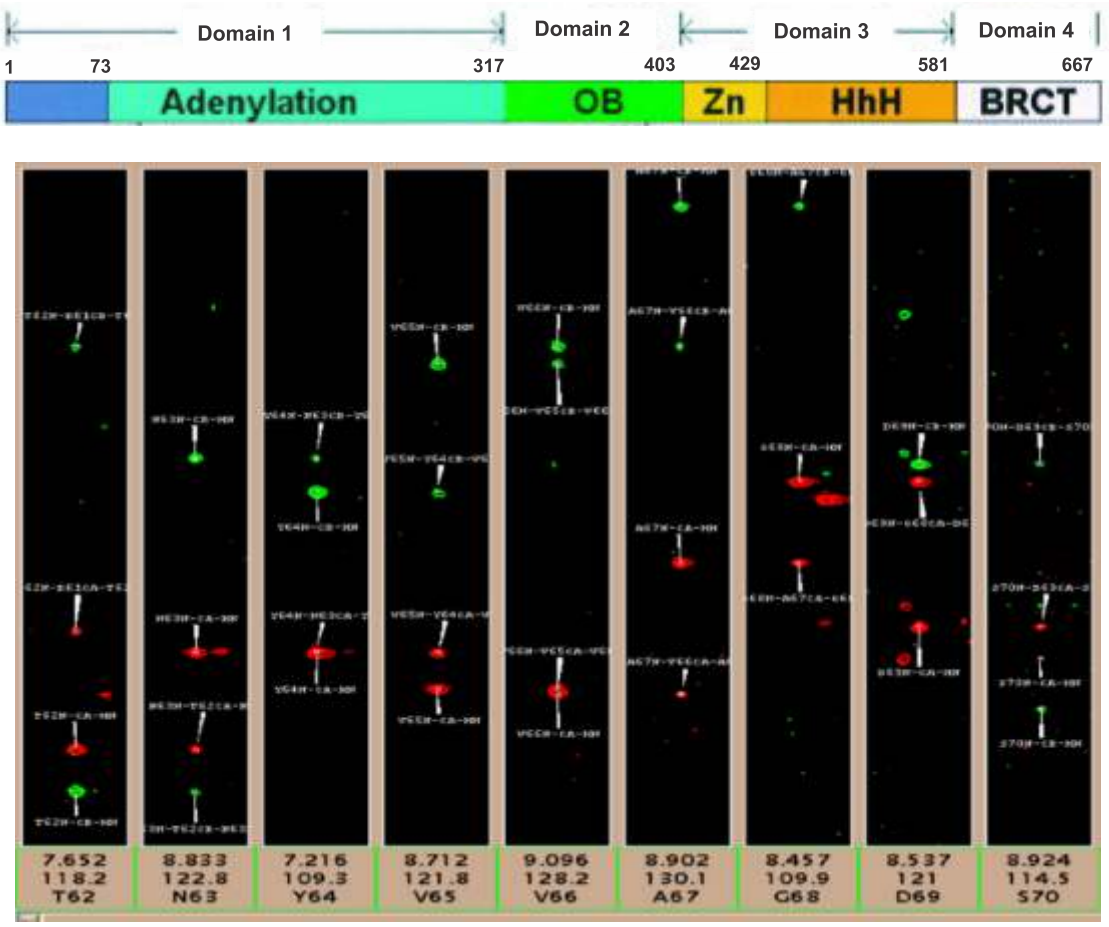


Fig.: Strip plot showing small segment amino acid residues from T62 to S70 of BRCT domain

Fig.:BRCT domain structure showing amino acid residues which interacts with XthA protein. Amino acid which interacts with XthA are T16, V19, S22, T24, D29, K32, K41, A55, G56, Y63 and D64

4 Advancing Knowledge Frontiers in the area of Life Style Diseases and Reproductive Health

Area coordinators:

Dr. W Haq

Dr. Prem N Yadav

Vision and Goal:

- Development of novel therapeutic agents for CVS, CNS and related disorders, cancer, fertility regulation (male/female) and management of endocrine disorders through modern drug design, scientific validation of traditional remedies.
- Carry out excellent basic research to delineate the molecular mechanisms of these pathologies / abnormalities so as to identify suitable targets for drug discovery, as well as to analyze the possible mechanism(s) of action of the candidate drugs.
- Creation of appropriate platform for interdisciplinary collaborative research;

Core Competencies and Activities:

- Development of experimental models of hypertension, dyslipidemia, thrombosis, myocardial ischemia and athero-thrombosis, to identify hypolipidemic, anti-thrombotic and anti-ischemic drugs and identification of the mechanism of action of test substances;
- Design, synthesis and bio-evaluation of novel molecules/isolates from natural sources for new lead generation for:
  - atherosclerosis, dyslipidemia, obesity, hypertension mycordial infarction, major depression, cognitive impairments and aging.
  - Female and male contraceptives,
  - Breast, cervical, oral, prostate and blood cancers
- Scientific validation of traditional remedies for CVS, CNS, cancer and reproductive health disorders;
- Molecular mechanism of action of promising agents;
- New knowledge generation in the area of neurobiology, cardio vascular biology, reproductive endocrinology, fertility regulation, endocrine disorders and Cancer.

Research Team

L to R standing- Dr. Shashi Gupta, Dr. Baisakhi Moharana, Dr. Kashif Hanif, Dr. Rajender Singh, Dr. Sachin Kumar, Dr. Jayanta Sarkar, Dr. Amit Lahiri, Dr. Aamir Nazir, Dr. Rajesh Jha

L to R sitting- Dr. Monika Sachdev, Dr. Manoj K. Barthwal, Dr. Anila Dwivedi, Dr. Gopal Gupta, Dr. Prem N Yadav, Dr. W. Haq, Dr. Anil Gaikwad, Dr. S. K. Rath, Dr. Sarika Singh, Dr. Smrati Bhadauria

4.1 CVS, CNS and Related Disorders

Preclinical drug discovery program in cardiovascular and central nervous system disorders area is focused towards developing novel strategies (NCE, phyto-pharmaceuticals) for Atherosclerosis, Dyslipidemia, Obesity, Hypertension mycordial infarction, Major Depression, Cognitive Impairments and Aging. One of the major focuses of this project to generate new knowledge on disease mechanisms these complex and heterogenic disorders. The research activities include following major objectives:

- Molecular and cellular homeostatic mechanisms of fibrosis in liver, kidney and heart that leads to lifestyle associated major diseases
- To discover novel target and better animal models, push the frontiers of knowledge in CNS and inflammatory disorders
- Discovery and development of target selective novel candidate drugs (NCE based as well as phytopharmaceuticals) for obesity, Dyslipidemia, Neuropathic Pain, Dementia and Major depression.
- Identification of new targets for fertility regulation

4.1.1 Progress in new drug discovery

4.1.1.1 Discovery & development of PCSK9 inhibitors

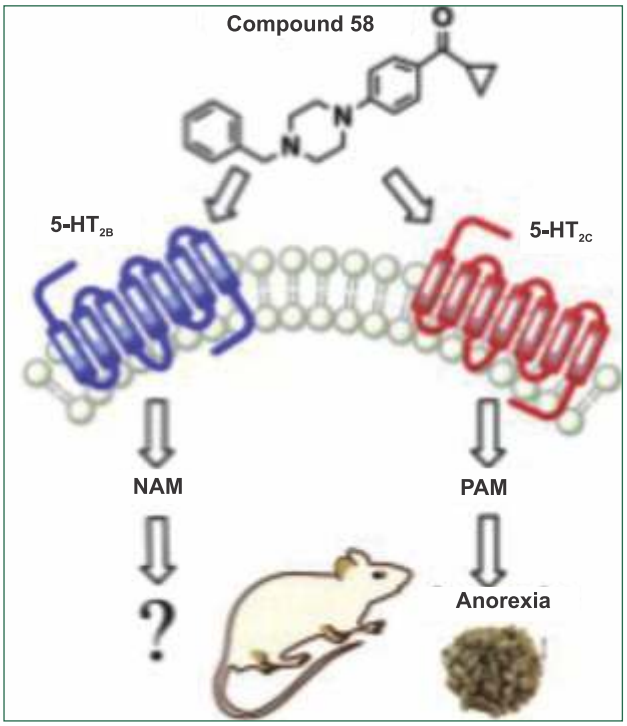
Seventy-one compounds were synthesized and submitted for the evaluation of PCSK9 inhibitory activity. Several interesting hits were obtained.

4.1.1.2 Anti-Inflammatory screening

Five hundred compounds were submitted for the anti-inflammatory screening of compounds under the MoES and CDRI drug development program.The compounds were evaluated at 10μM for the inhibition of LPS induced TNF production in the human monocytic cell line THP-1. Around 9 preliminary hits were obtained which are presently being validated. The compounds significantly inhibited LPS induced TNF production similar to the standard drug Dexamethasone.

4.1.1.3 Development of proof of concept for 5-HT2C receptor positive allosteric modulator for the treatment of obesity

Allosteric modulators of G-protein-coupled receptors have lately gained significant traction in drug discovery. Although5-HT2c serotonin receptor agonist has been approved for the treatment of obesity, desired level of benefit are not being achieved. Emerging evidence, suggest



that positive allosteric modulators (PAM) of this receptor might be more effective in achieving desired (15-20%) weight loss and without severe adverse effect profile such as anxiety associated with selective agonists. Considering these facts, we are actively engaged in discovery of novel PAM of 5-HT2C in a academia-industry partnership program, which has been funded by DPRP program of DST. In campaign of hunting new scaffolds as 5-HT2C PAM, we found an interesting scaffold-piperazine-linked phenyl cyclopropyl methanones that exhibited PAM activity at both 5-HT2C (desired target) as well as 5-HT2B (off target responsible for cardiotoxicity). Further derivatization of this molecule lead us topiperazine linked phenyl cyclopropyl methanones (58) was active as PAM of 5-HT_{2C} (increased the E_{max} of 5-HT to 139%), and as negative allosteric modulator (NAM) of 5-HT_{2B} (decreases EC_{50} of 5-HT 10 times without affecting E_{max}). Similar effect of compound 58 was observed with synthetic orthosteric agonist lorcaserin on 5-HT_{2B}. Molecular docking study revealed that all active compounds were binding to the predicted allosteric site on 5-HT_{2C} and shared a common interacting residues. Finally, compound 58 suppressed food intake in Sprague Dawley rats similar to lorcaserin after i.c.v. administration. Therefore, these results suggest that piperazine moiety is essential for dual activity (PAM & NAM) of compounds 58, and supports the hypothesis of 5-HT_{2C} PAM for the treatment of obesity similar to the full agonist ***(Eur J Med Chem. PMID: 30622024)***.

4.1.2 Advancing knowledge frontiers

4.1.2.1 MicroRNA-99a mimics inhibit M1 macrophage phenotype and adipose tissue inflammation by targeting TNFα

In human adipose tissue and obesity, miR-99a expression is negatively correlated with inflammation. Therefore, the present study investigated the role of miR-99a in macrophage phenotype activation and adipose tissue inflammation. M2 BMDMs showed a significant increase in miR-99a expression when compared to the M0 and M1 phenotypes. Phenotype-switching experiments established an association between upregulated miR-99a expression and the M2 phenotype. Overexpression of miR-99a prevented M1 phenotype activation and attenuated bactericidal activity. Likewise, knockdown of miR-99a abolished M2 phenotype activation. By means of *in silico* target prediction tools and a luciferase reporter assay, TNFα was identified as a direct target of miR-99a. Knockdown of TNFα recapitulated the effect of miR-99a overexpression in M1 BMDMs. In a db/db mice model, miR-99a expression was reduced in eWAT and F4/80+ ATMs. Systemic overexpression of miR-99a in db/db mice attenuated adipocyte hypertrophy with increased CD301 and reduced CD86 immunostaining. Flow cytometry analysis also showed an increased M2 and a reduced M1 macrophage population. Mimics of miR-99a also improved the diabetic dyslipidemia and insulin signaling in eWAT and liver, with an attenuated expression of gluconeogenesis and cholesterol metabolism genes in the liver. Furthermore, adoptive transfer of miR-99a-overexpressing macrophages in the db/db mice recapitulated *in vivo* miR-99a mimic effects with increased M2 and reduced M1 macrophage populations and improved systemic glucose, insulin sensitivity, and insulin signaling in the eWAT and liver. The present study demonstrates that miR-99a mimics can regulate macrophage M1 phenotype activation by targeting TNFα. miR-99a therapeutics in diabetic mice reduces the adipose tissue inflammation and improves insulin sensitivity (***Cell Mol Immunol. PMID: 29849090***).

4.1.2.2 IL-1 β genesis: The art of regulating the regulator

Translating the understanding of murine monocytic IL-1β production to humans may be done with caution since there will be different mechanisms of IL-1β transcription, processing and modification operating in the two species. At

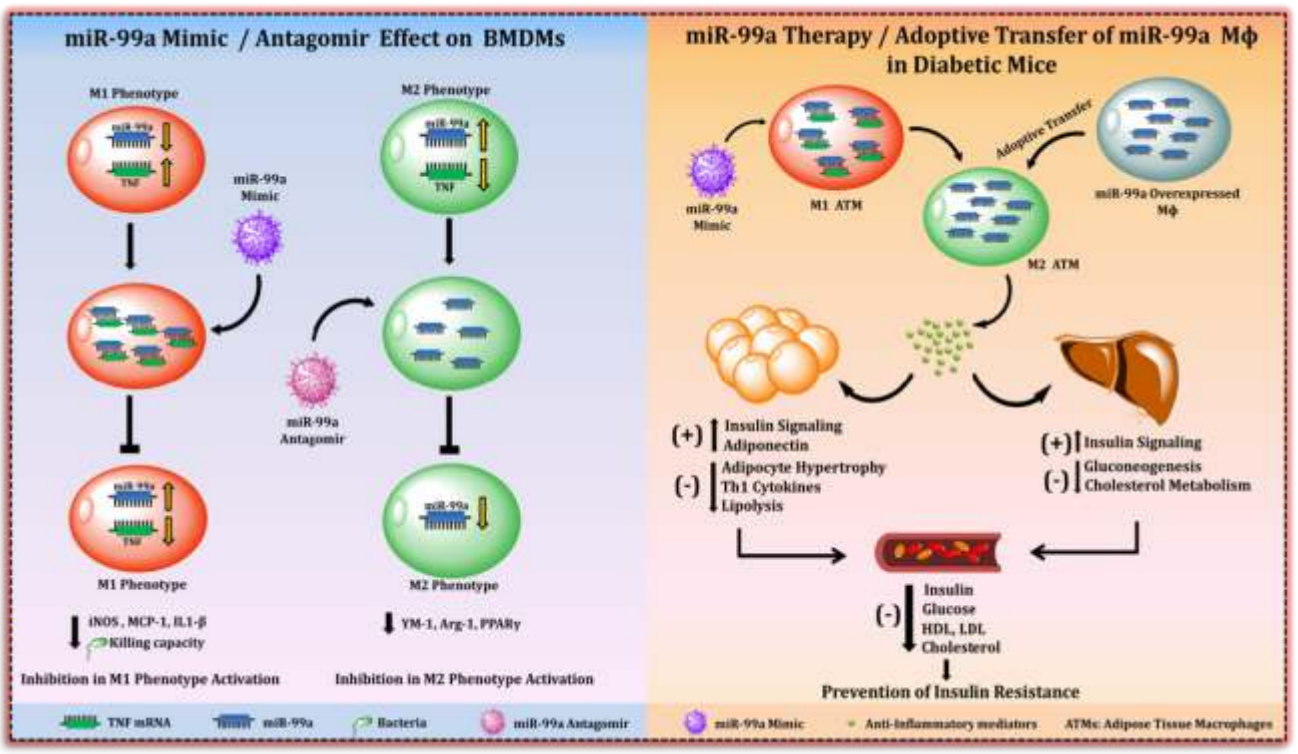


Fig. 2: Graphical illustration demonstrating the effect of miR-99a on macrophage phenotype activation & adipose tissue inflammation & its implication in T2DM.

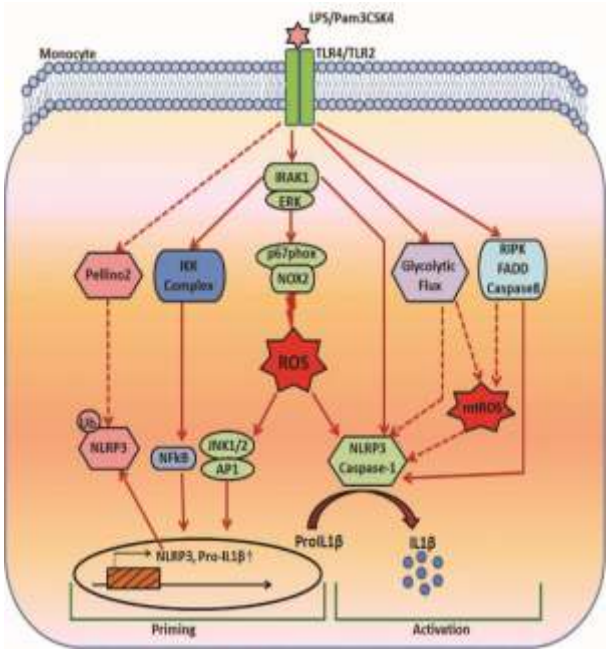


Fig. 3: IL-1β Production in monocytes. Diagram depicting probable mechanisms of IL-1β production in monocytes. Transcription and processing of IL-1β involve steps that promote inflammasome priming and activation respectively. Dotted arrows indicate probable signalling pathways operating in monocytes. mtROS- mitochondrial Reactive oxygen species.

the same time, ROS can be a master regulator of IL-1β production since it may regulate priming and processing of the inflammasome. Controlled ROS production may yield regulated IL-1β production, however high ROS levels can induce pathological levels of IL-1β. Source and location of ROS may also define the aspect of IL-1β production is regulated (Fig.4). Understanding the role of TLR specific metabolic pathways in ROS generation and IL-1β production will help in understanding the fine-tuning of the machinery involved in the IL-1β production. Besides this molecular mechanism of ROS induced IL-1β transcription and processing needs more studies. For secretory IL-1β production, although ROS can regulate both IL-1β transcription and processing, it may also require support from other pathways. This assumption comes from the fact that some inducers like TNF, which do generate ROS, do not affect inflammasome and IL-1β production ***(Cell Mol Immunol. PMID : 29921967).***

4.1.2.3 Cilostazol ameliorates heart failure with preserved ejection fraction and diastolic dysfunction in obese and non-obese hypertensive mice

Cilostazol (Ciloz) a potent Type III phosphodiesterase inhibitor is effective against inflammation, insulin resistance and cardiomyopathy. However, the effect of Ciloz on obesity-associated left ventricular diastolic dysfunction has not been explored yet. Hence, we examined the effect of Ciloz on cardiac remodelling and dysfunction in non-obese and obese-insulin resistant mice infused with AngiotensinII (AngII). Male C57BL/6J mice were initially subjected to 19 weeks of chow or high fat diet (HFD) regimen and thereafter animals were randomised for AngII (1500ng/kg/min, s.c) infusion or saline and Ciloz (50mg/kg, p.o) for another 1 week. Obese and non-obese mice were infused with AngII exhibited significant diastolic dysfunction and features of heart failure with preserved ejection fraction (HFpEF) since a decrease in fractional shortening and no change in ejection fraction were observed when compared with respective controls. Administration of AngII and Ciloz in HFD fed mice significantly improved the left ventricular function compared with AngII infused HFD mice as evinced from the echocardiographic data. Further, Ciloz treatment significantly reduced cardiomyocyte area, interstitial and perivascular fibrosis; and collagen deposition. Moreover, Ciloz reduced the inflammatory milieu in the heart as evinced by decreased F4/80+ and CD68+ cells; IL-1β and IL-6 gene transcripts. Quantitative assessment of the expression levels revealed substantial upregulation of MMP-9 (pro- and mature-forms) and α-SMA in the left ventricle of AngII infused HFD-fed mice, which was considerably suppressed by Ciloz regimen. The beneficial effect of Ciloz was associated with the normalization in gene expression of hypertrophic and fibrotic markers. Likewise, Ciloz administration markedly reduced the AngII and HFD induced TGF-β1/SMAD3 and Akt/mTOR signalling. Additionally, AngII administered and HFD-fed mice showed increased glycolytic flux, which was considerably diminished by Ciloz treatment as indicated from suppressed PKM2, HK-2, PDK-2, HIF-1α mRNA and GLUT-1 protein expression. Taken together, Ciloz might be therapeutically exploited against AngII and obesity-associated diastolic dysfunction thereby preventing overt heart failure (***J Mol Cell Cardiol. PMID: 30138626***).

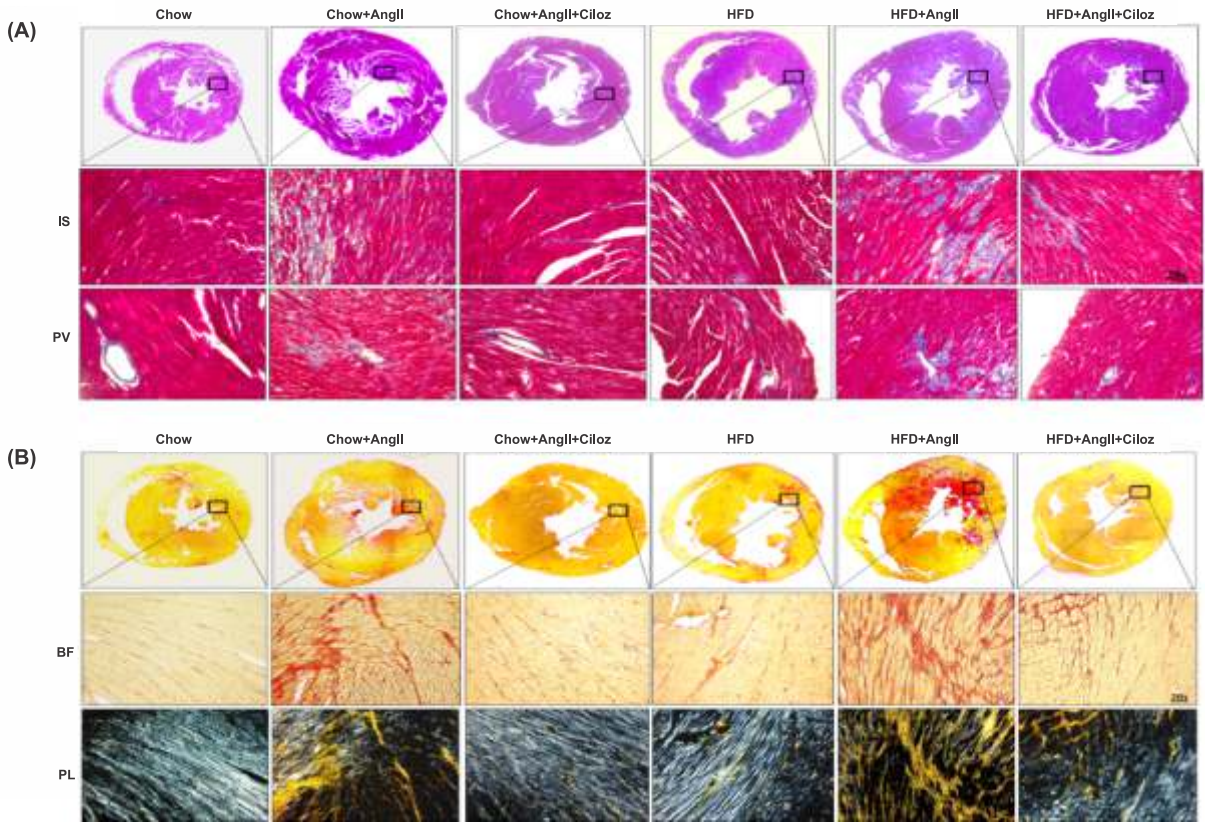


Fig. 4: Cilostazol reduces cardiac interstitial and perivascular fibrosis in HFD-fed animals infused with AngII. (A) Representative gross image of heart transverse sections with insets showing collagen deposition in interstitial (IS) and perivascular (PV) area stained by Masson trichrome staining. (B) Representative photomicrograph of Picro Sirius red stained sections in hearts of different groups after 20 weeks HFD with 7 days of saline or AngII infusion on light microscopy (Bright Field, BF) and polarized light microscopy (PL) with insets showing collagen deposition and its type.

4.1.2.4 Chronic histamine 3 receptor antagonism alleviates depression like conditions in mice via modulation of brain-derived neurotrophic factor and hypothalamus-pituitary adrenal axis

The last two decades of research has established histamine (HA) as a neurotransmitter. Since H3R antagonists are known to modulate several neurotransmitters besides HA, H3R antagonists have shown potential for the treatment of different central nervous system disorders, including depression. However, molecular mechanisms underlying the beneficial effects of H3R antagonism in depression are not clear, yet. In the present study, we investigated the antidepressant potential of ciproxifan, a selective H3R antagonist, in chronic unpredictable stress (CUS) model of depression in C57BL/6 J mice. We observed that chronic treatment of CUS mice with ciproxifan (3mg/kg i.p.; for three weeks) alleviates depression-like symptoms such as helplessness measured by forced swim and tail suspension test (FST and TST), anhedonia measured by sucrose preference test (SPT) and social deficit measured in social behavior test. Chronic ciproxifan treatment restored CUS induced BDNF expression in the prefrontal cortex (PFC) and hippocampus. We also observed that ciproxifan modulates CUS induced NUCB2/nesfatin-1 and CRH expression in the hypothalamus and plasma corticosterone. We also determined the direct effect of HA on BDNF expression in neurons by western blotting and immunocytochemistry, and found that HA significantly induced BDNF expression, which was blocked by the H4R selective antagonist, but not by other HA receptor selective antagonists. Furthermore, ciproxifan significantly modulated NMDA glutamate receptor subunits NR2B and NR2A. Thus, these results suggest that increased HA signaling in the brain produces antidepressant-like effects in mice and modulates BDNF expression and HPA-axis (***Psychoneuroendocrinology. PMID: 30458370***)

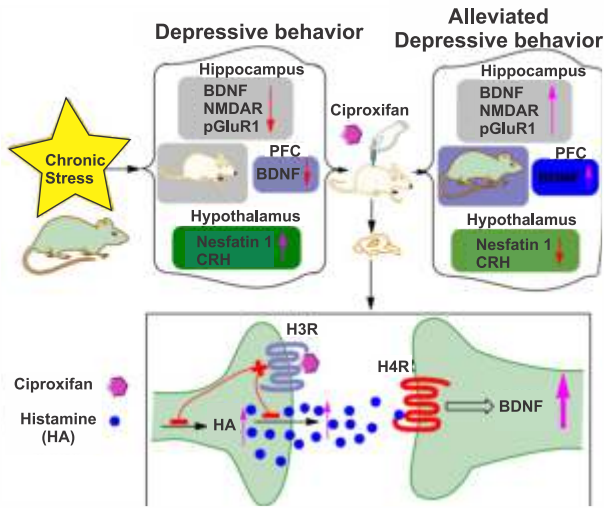


Fig.5:Schematic illustration: molecular mechanism of antidepressant action ofH3R. H3R antagonist alleviates CUS induced depressive behaviour (i.e., immobility, associability, and anhedonia) and modulates the molecular correlates of depression such as BDNF expression in PFC and hippocampus, and restores the overactive HPA-axis to the normal level.

4.1.2.5 miR-876-3p regulates glucose homeostasis and insulin sensitivity by targeting adiponectin

miRNA has been known to regulate various cellular and molecular functions. In the previous study, we have reported that adipocytes differentiated from human mesenchymal stem cells (hMSC) on 72-h chronic insulin (CI) treatment exhibit insulin resistance (IR). Present study has further explored above model to investigate the role of early expressed miRNAs within human adipocytes to modulate differential adipokine expression as observed during IR. Our results highlight that miR-876-3p regulate glucose homeostasis and its dysregulation leads to IR. We found that miR-876-3p level is a critical determinant of adiponectin expression by virtue of its target within adiponectin 3′UTR. Regulatory effect of miR-876-3p impacts crosstalk between adiponectin and insulin signaling. Rosiglitazone treatment in CI-induced IR adipocytes drastically reduced miR-876-3p expression and increased adiponectin level. In line with this, lentiviral-mediated inhibition of miR-876-3p expression ameliorated CI and high-fat diet (HFD)-induced IR in adipocytes differentiated from hMSC and C57BL/6J mice, respectively. Our findings thus suggest that modulating miR-876-3p expression could provide novel opportunities for therapeutic intervention of obesity-associated metabolic syndrome ***(J Endocrinol.2018, PMID: 30307150)***.

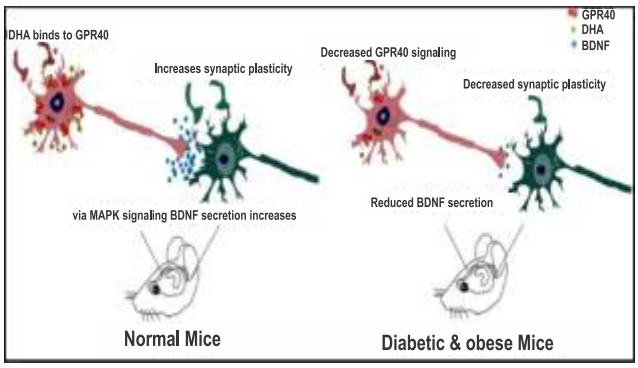
4.1.2.6 Chronic hyperinsulinemia induced miR-27b is linked to adipocyte insulin resistance by targeting insulin receptor

Defect in insulin signaling leads to the development of insulin resistance followed by type 2 diabetes. Exploiting our previously developed physiological chronic hyperinsulinemia (CI)-mediated insulin resistance (IR) model, we wanted to understand how miRNAs contribute to the development of IR. Amongst the identified and validate miRNAs, the expression of miR-27b was found to be highly upregulated during CI-induced IR in 3T3-L1 adipocytes. We also validated the expression of miR-27b in CI induced IR in human mesenchymal stem cell (hMSC)-derived adipocytes and *in vivo* high fat diet (HFD)-induced IR mice model. Bioinformatics target prediction softwares and luciferase reporter assay identified insulin receptor (INSR) as one of a prime target of miR-27b. Lentiviral mediated over expression of miR-27b impairs insulin signaling by modulating INSR expression that in turn led to decreased glucose uptake in both 3T3-L1 and hMSC-derived adipocytes. Conversely, inhibition of miR- 27b reversed CI-mediated suppression of target protein INSR and improved phosphorylation of Akt, a nodal protein of insulin signaling that is impaired by CI treatment. Lentiviral mediated overexpression of miR-27b in *in vivo* C57BL/6J mice impaired whole body glucose tolerance and adipose tissue insulin sensitivity. Furthermore, inhibition of miR-27b in HFD-induced insulin resistance mice model improved glucose tolerance and adipose tissue insulin sensitivity by increasing the expression of its target gene INSR in eWAT. Thus, our results indicate that miR-27b functions as a prime modulator of CI-induced IR via regulating the expression of INSR ***(J Mol Med (Berl). PMID-29455245)***

4.1.2.7 Docosahexaenoic acid modulates brain-derived neurotrophic factor via GPR40 in the brain and alleviates diabesity-associated learning and memory deficits in mice

GPR40 (Free fatty acid receptor 1) has emerged as an important therapeutic target for diabetes. Several studies have demonstrated the association of comorbid psychiatric conditions with decreased n-3 polyunsaturated fatty acids, which may act as an agonist for GPR40. In this study, we for the first time provide evidence of reduced GPR40 signaling in the hippocampus and cortex which may be a critical underlying mechanism mediating cognitive deficits in diabesity (diabetes and obesity together). Specifically, we showed decreased GPR40 and brain-derived neurotrophic factor (BDNF) expression in the brain

regions of high-fat-diet-induced obese and db/db mice. Next, we demonstrated that chronic treatment with docosahexaenoic acid (DHA) or the synthetic GPR40 agonist, GW9508, significantly alleviates cognitive functions in mice, which correlates with increased BDNF expression in the hippocampus. This supports the hypothesis that DHA improves cognitive function in diabesity via GPR40 agonism. We also showed that DHA specifically activates GPR40 and modulates BDNF expression in primary cortical neurons mediated by the extracellular receptor kinase (ERK) and



P38-mitogen-activated protein kinase (MAPK) pathways. Finally, the central nervous system (CNS)-specific blockade of GPR40 signaling abrogated the memory potentiating effects of DHA, and induction of BDNF expression in the hippocampus. Thus, we provided evidence that DHA stimulation of GPR40 mediate some of DHA's beneficial effects in metabolic syndrome and identify GPR40 as a viable therapeutic target for the treatment of CNS-related comorbidities associated with diabesity (***Neurobiol Dis. PMID: 29981843***).

4.1.2.8 Novel circular RNA molecule, circzip-2 and its synthesizing gene *zip-2* characterized in *C. elegans* model of Parkinson's disease

Circular RNAs (circRNAs), are peculiar non-coding RNA molecules which are known to be present across taxa. Considering the body of evidence that establishes critical functions of noncoding RNA molecules, we endeavored to study circRNAs in the context of Parkinson's disease (PD). Employing transgenic *C. elegans* model of PD, we used RNase R mediated cleavage of linear RNA followed by divergent primer based amplifications towards identifying circzip-2, a novel circRNA molecule. We went on to sequence circzip-2 which is synthesized from functionally important gene *zip-2*. Studying RNAi induced knockdown conditions of *zip-2*, we observed a reduced aggregation of α-synuclein protein along with an enhanced lifespan of the worms. We further carried out transcriptome analysis of *zip-2* silenced worms, which suggested that *zip-2* might be functioning via Daf-16 pathway. Further interaction studies revealed that circzip-2 possibly sponges micro RNA molecule miR-60 towards asserting an important role in various processes associated with PD. (***Mol Neurobiol. PMID: 29363043***)

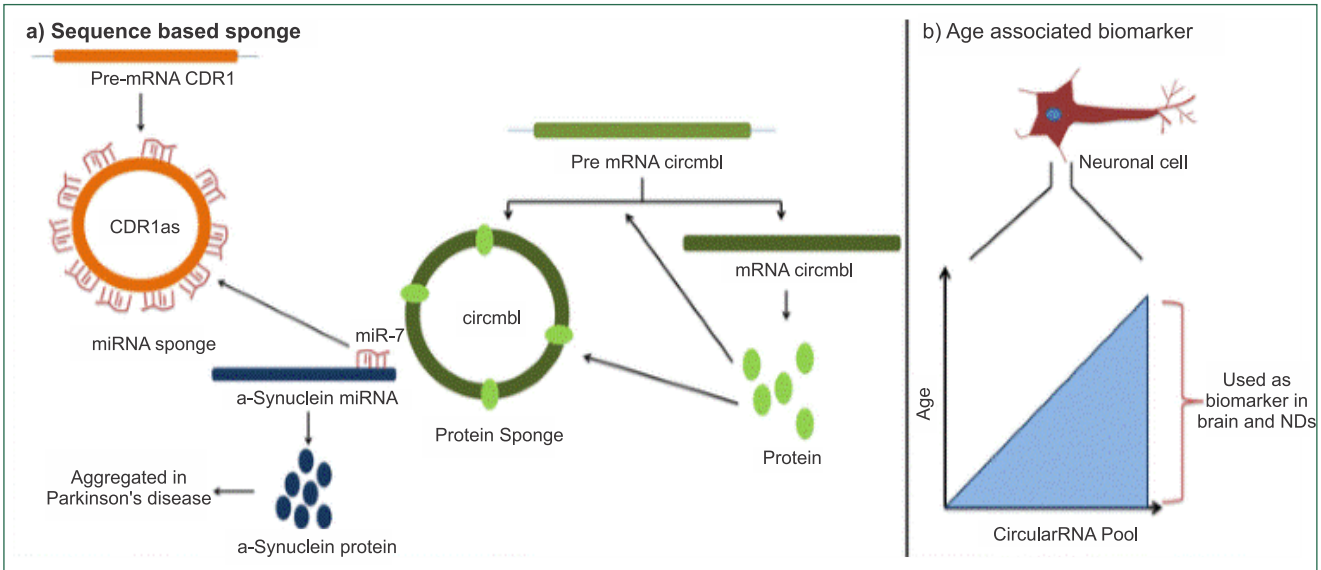


Fig. 6: Function of circRNAs. (a) Circular RNAs play a role in Parkinson's disease through miR-7 sponge that is regulating the expression of α-synuclein protein and regulating the transcription via sponge protein (MBL). (b) With the age progression, the circular RNA pool increases in neuronal cells so circular RNAs can be used as a biomarker for the identification of diseases related to neurons

4.1.2.9 ALCAR promote adult hippocampal neurogenesis by regulating cell-survival and cell death-related signals in rat model of Parkinson's disease like-phenotypes

Formation of newborn neurons in the adult hippocampus is affected by many factors such as anxiety, depression and impairment in learning and memory that are commonly observed nonmotor symptoms in Parkinson's Disease (PD), indicating the role of adult neurogenesis in PD pathophysiology. Acetyl-l-carnitine (ALCAR), regulate mitochondrial metabolism and has been reported to improve cognitive functions in different neurodegenerative disorders through an unknown mechanism. For the first time, we investigated the effect of ALCAR on adult neurogenesis in the 6-hydroxydopamine (6-OHDA) induced rat model of PD-like phenotypes and also explored the possible underlying mechanism of action. A single unilateral administration of 6-OHDA into the medial forebrain bundle reduced neural progenitor cell (NPC) proliferation, long-term survival and neuronal differentiation in the hippocampus. Interestingly, chronic treatment with ALCAR (100 mg/kg/day, i.p) potentially enhanced proliferation, long term survival and neuronal differentiation of NPCs in rat model of PD-like phenotypes. ALCAR treatment stimulates cell survival related signals (AKT and BCL-2) by inhibiting cell death related cues (GSK-3β and BAX) which might be responsible for a neuroprotective effect of ALCAR in rat model of PD-like phenotypes. We conclude that ALCAR exerts neuroprotective effects against 6-OHDA-induced impairment in hippocampal neurogenesis by regulating cell survival and cell death-related signals *(**Neurochem Int. PMID: 28577987**)*.

4.1.2.10 Fatty acid synthase modulates proliferation, metabolic functions and angiogenesis in hypoxic pulmonary artery endothelial cells

Endothelial dysfunction plays an important role in structural remodeling occurring in the pulmonary vasculature during Pulmonary Hypertension (PH). Endothelial injury causes apoptosis and activation of endothelial cells. However, some endothelial cells show apoptosis-resistance and later proliferate extensively leading to vascular oculopathy and formation of plexiform lesions in PH. Studies have shown that rapidly proliferating cells exhibit increased expression of Fatty acid synthase (FAS), a regulatory enzyme responsible for the production of fatty acids. However, the role of FAS in pulmonary artery endothelial cell proliferation and angiogenesis has not been explored. The human pulmonary artery endothelial cells (HPAECs) were exposed to hypoxia and FAS siRNA (60 nM) was used for the FAS inhibition. Increased expression and activity of FAS were observed in hypoxic HPAECs. Inhibition of FAS increased apoptosis and glucose oxidation, but decreased cellular proliferation, markers of autophagy and glycolysis in hypoxic HPAECs. FAS inhibition decreased the angiogenesis as evident by decreased tubule length and VEGF expression in hypoxic HPAECs. Inhibition of FAS also increased expression of endothelial NOS in hypoxic HPAECs, a marker of endothelial function. Our results proved, and further supported previous findings, that inhibition of FAS is beneficial for endothelial function in pulmonary hypertension ***(Eur J Pharmacol. PMID: 28974347).***

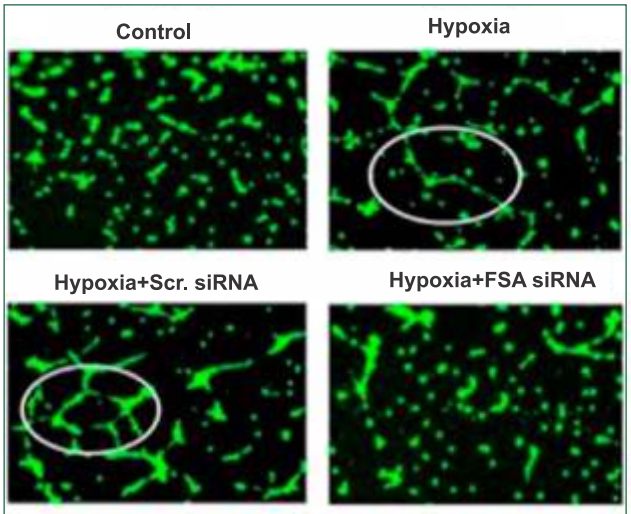


Fig.7: siRNA mediated FAS inhibition reduced angiogenesis by decreasing tubule length

4.1.2.11 A short peptide derived from the collagen domain of adiponectin activates APPL1 and AMPK signaling pathways and improves glucose and fatty acid metabolisms

Adiponectin is a fat tissue–derived adipokine which possesses beneficial effects against diabetes, cardiovascular diseases, and cancer. Accordingly, adiponectin-mimetic molecules have significant pharmacological potential. Oligomeric states of adiponectin appear to determine its biological activity. We identified a highly conserved, 13-residue segment (ADP-1) from adiponectin's collagen domain which comprises GXXG motifs and has one asparagine and two histidine residues that assist in oligomeric protein assembly. We therefore hypothesized that ADP-1 promotes oligomeric assembly and thereby mediates potential metabolic effects. It was observed that ADP-1 is stable in human serum and oligomerizes in aqueous environments. We also found that

ADP-1 activates AMP-activated protein kinase (AMPK) in an adaptor protein, phosphotyrosine interacting with PH domain and leucine zipper 1 (APPL1)-dependent pathway and stimulates glucose uptake in rat skeletal muscle cells (L-6 myotubes). ADP-1–induced glucose transport coincided with ADP-1–induced biosynthesis of glucose transporter 4 and its translocation to the plasma membrane. ADP-1 induced an interaction between APPL1 and the small GTPase Rab5 resulting in AMPK phosphorylation, in turn leading to phosphorylation of p38MAP kinase, acetyl coenzyme-A carboxylase, and peroxisome proliferator–activated receptor alpha. Similar to adiponectin, ADP-1 increased the expression of the adiponectin *receptor 1* gene. Importantly, ADP-1 decreased blood glucose levels and enhanced insulin production in pancreatic β cells in db/db mice. Further, ADP-1 beneficially affected lipid metabolism by enhancing lipid globule formation in mouse 3T3-L1 adipocytes. To our knowledge this is the first report on identification of a short peptide from adiponectin with positive effects on glucose or fatty acid metabolism ***(J Biol Chem., PMID: 29991592)***.

4.1.2.12 Chronic hyperinsulinemia induced miR-27b is linked to adipocyte insulin resistance by targeting insulin receptor

Defect in insulin signaling leads to the development of insulin resistance followed by type 2 diabetes. Exploiting our previously developed physiological chronic hyperinsulinemia (CI)-mediated insulin resistance (IR) model, we wanted to understand how miRNAs contribute to the development of IR. Amongst the identified and validate miRNAs, the expression of miR-27b was found to be highly upregulated during CI-induced IR in 3T3-L1 adipocytes. We also validated the expression of miR-27b in CI induced IR in human mesenchymal stem cell (hMSC)-derived adipocytes and *in vivo* high fat diet (HFD)-induced IR mice model. Bioinformatics target prediction softwares and luciferase reporter assay identified insulin receptor (INSR) as one of a prime target of miR-27b. Lentiviral mediated over expression of miR-27b impairs insulin signaling by modulating INSR expression that in turn led to decreased glucose uptake in both 3T3-L1 and hMSC-derived adipocytes. Conversely, inhibition of miR- 27b reversed CI-mediated suppression of

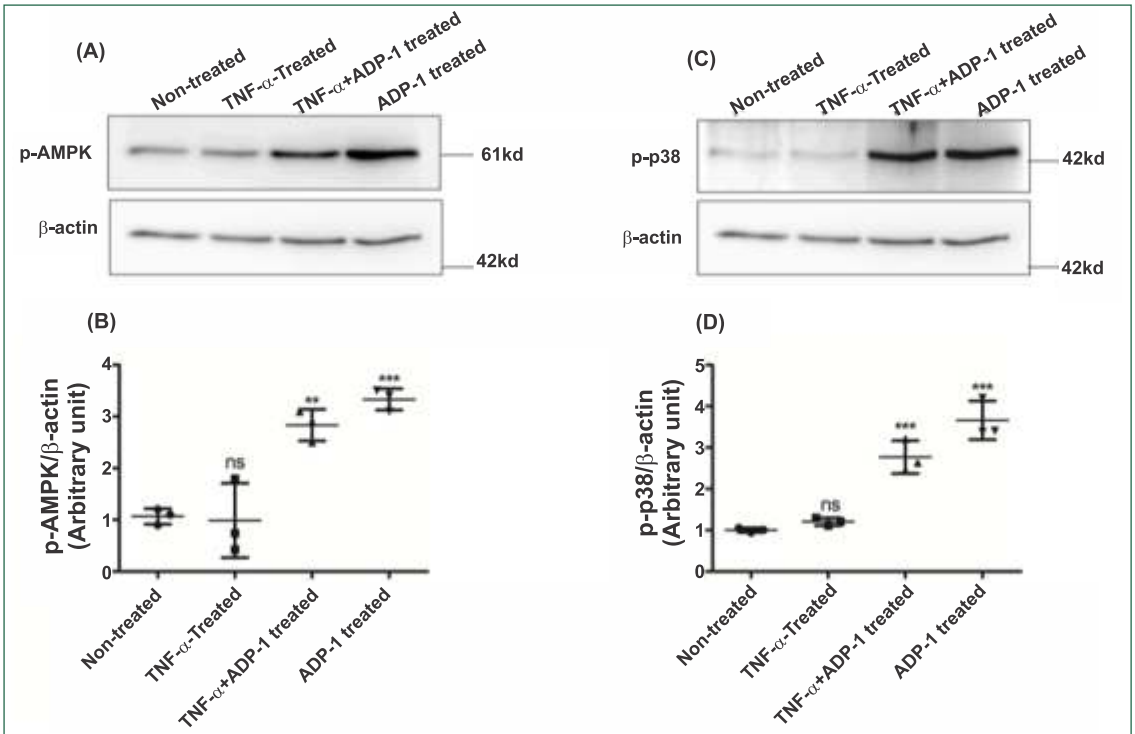


Fig. 8: Restoration of phosphorylations of AMPK and p-38-MAPK in TNF-α treated (10 µg/ml for 24 h) L-6 myotubes by adiponectin-derived peptide, ADP-1 as studied by western blot analyses. Non-treated cells were taken as basal control, followed by only TNF-α Treated cells, TNF-α with ADP-1 (14.3 µg/ml) treated and lastly only ADP-1 treated (14.3 µg/ml for 3 h). **(B)**. Densitometric quantification of phospho- AMPK relative to β-actin. **(C)** Non-treated cells were taken as basal control, followed by only TNF-α Treated cells, TNF-α with ADP-1 (14.3 µg/ml) treated and lastly only ADP-1 treated (14.3 µg/ml for 3 h). **(D)** Densitometric quantification of phospho- p38 MAPK relative to β-actin. Results shown are mean ± SD of three independent experiments significance $p < 0.001$, relative to control.

target protein INSR and improved phosphorylation of Akt, a nodal protein of insulin signaling that is impaired by CI treatment. Lentiviral mediated overexpression of miR-27b in *in vivo* C57BL/6J mice impaired whole body glucose tolerance and adipose tissue insulin sensitivity. Furthermore, inhibition of miR-27b in HFD-induced insulin resistance mice model improved glucose tolerance and adipose tissue insulin sensitivity by increasing the expression of its target gene INSR in eWAT. Thus, our results indicate that miR-27b functions as a prime modulator of CI-induced IR via regulating the expression of INSR ***(J Mol Med (Berl). PMID: 29455245).***

4.1.2.13 Nod1-mediated lipolysis promotes diacylglycerol accumulation and successive inflammation via PKCδ-IRAK axis in adipocytes

Chronic inflammation contributes to obesity mediated metabolic disturbances, including insulin resistance. Obesity is associated with altered microbial load in metabolic tissues that can contribute to metabolic inflammation. Different bacterial components such as, LPS, peptidoglycans have been shown to underpin metabolic disturbances through interaction with host innate immune receptors. Activation of Nucleotide-binding oligomerization domain-containing protein 1 (Nod1) with specific peptidoglycan moieties promotes insulin resistance, inflammation and lipolysis in adipocytes. However, it was not clear how Nod1-mediated lipolysis and inflammation is linked. Here, we tested if Nod1-mediated lipolysis caused accumulation of lipid intermediates and promoted cell autonomous inflammation in adipocytes. We showed that Nod1-mediated lipolysis caused accumulation of diacylglycerol (DAG) and activation of PKCδ in 3T3-L1 adipocytes, which was prevented with a Nod1 inhibitor. Nod1- activated PKCδ caused downstream stimulation of IRAK1/4 and was associated with increased expression of proinflammatory cytokines such as, IL-1β, IL-18, IL-6, TNFα and MCP-1. Pharmacological inhibition or siRNA mediated knockdown of IRAK1/4 attenuated Nod1-mediated activation of NF-κB, JNK, and the expression of proinflammatory cytokines. These results reveal that Nod1-mediated lipolysis promoted accumulation of DAG, which engaged PKCδ and IRAK1/4 to augment inflammation in 3T3-L1 adipocytes (***BBA- Molecular Basis of Disease, PMID: 30391544***).

4.1.2.14 New class of molecules as histamine-3 receptor (H3R) modulators: A new lead for management of obesity

Comprehensive lifestyle management like diet, physical exercise andbehaviour modification are the best ways to treat obesity. An alternative to this is drug-based therapy. Although not preferred or prescribed until lifestyle modifications fails short to achieve the goal, pharmacotherapyprovides an opportunity for the obese population to achieve weight loss and to reduce the incidence of associated health hazards like cardiovascular disease, diabetes, cancer and stroke.Only limited number of drugs are currently available that too with either serious side effect profile or modest efficacyfor the long-term treatment of obesity. Most of the anti-obesity drugs function by altering the appetite or by reducing the fat absorption.Currently, orlistat is the only drug approved by FDA for long term use. Under these circumstances, a novel histamine 3 receptor (H3R) agonist (Figure 10) was identified recently by a drug discovery research group in CSIR-CDRI Lucknow, India, which could lead to new candidate drug for the managementof obesity. A systematic exploration of β-lactams and pyrrolidinone derivatives by utilizing an efficient chemistry could result in exciting findings. Most of the molecules were prepared in single flask chemical transformation often termed as one-pot protocols.

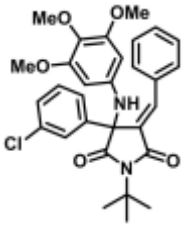


Fig.10. *Most potent compound of the series*

The biological screening of these compounds revealed that they are highly specific to H3R and did not interfere with related isoforms such as H1R, H2R and H4R. A careful investigation of structural features were performed to understand the pharmacophore that is required to design molecules with improved efficacy and safety. In the next stage of our research we evaluated the efficacy of most active molecule in mice. It was also interesting to note that our molecule stimulates hypophagic response in mice reflecting the reduction in food intake. The computational analysis of physicochemical and pharmacokineticproperties of the identified actives suggest that these molecules might possess good bioavailability and permeability, which are important parameters for developing candidate drug. Additionally, we checked the possible covalent interaction of these molecules with other proteins by performing luciferase assay. Further studies to optimize and develop candidate drugs from the identified actives are currently underway. (***European Journal of Medicinal Chemistry, PMID: 29704723).***

4.2 Reproductive Health Research

Preclinical drug discovery program in Reproductive health research area is focused towards developing novel strategies (NCE, phyto-pharmaceuticals) for ovarian disorders, endometrial disorders, infertility management and contraception. The programme also aims to generate new knowledge on male and female reproductive physiology relevant to fertility regulation, reproductive disorders. The research activities include following major objectives:

- Understanding the molecular signaling of endometrial receptivity for blastocyst implantation, endometrial dysfunctions including endometriosis, premature ovarian failure (POF) and polycystic ovary (PCOS) conditions.
- Study of basic mechanisms governing spermatogenesis, sperm energetic, to understand the genetic and epigenetic causes of male infertility.
- Identification of new targets for fertility regulation

4.2.1 The thermo-sensitive gene expression signatures of spermatogenesis

Spermatogenesis in most mammals (including human and rat) occurs at ~3°C lower than body temperature in a scrotum and fails rapidly at normal body temperature. The present study investigated the heat-sensitive transcriptome and miRNAs in the most temperature-sensitive germ cells (primary spermatocytes and round spermatids) that are mainly targeted at elevated temperature in a bid to identify novel targets for contraception and/or infertility treatment. Testes of adult male rats were subjected to surgical cryptorchidism for 0, 24, 72 and 120 h followed by isolation of primary spermatocytes and round spermatids, and their purification to >90% purity. RNA isolated from these cells was sequenced by massive parallel sequencing technique to identify the most-heat sensitive mRNAs and miRNAs. Heat stress altered the expression of a large number of genes by ≥2.0 fold, out of which 594 genes (286↑; 308↓) showed alterations in spermatocytes and 154 genes (105↑; 49↓) showed alterations in spermatids throughout the duration of experiment. 62 heat-sensitive genes were common to both cell types. Similarly, 66 and 60 heat-sensitive miRNAs in spermatocytes and spermatids, respectively, were affected by ≥1.5 fold, out of which 6 were common to both the cell types. The study has identified Acly, selV, SLC16A7(MCT-2), Txnrd1 and Prkar2B as potential heat sensitive targets in male germ cells tightly regulated by the heat sensitive miRNAs rno-miR-22-3P, rno-miR-22-5P, rno-miR-129-5P, rno-miR-3560, rno-miR-3560 and rno-miR-466c-5P. These targets are being explored further for their specific role in male fertility. ***(ReprodBiolEndocrinol, PMID: 29859541)***

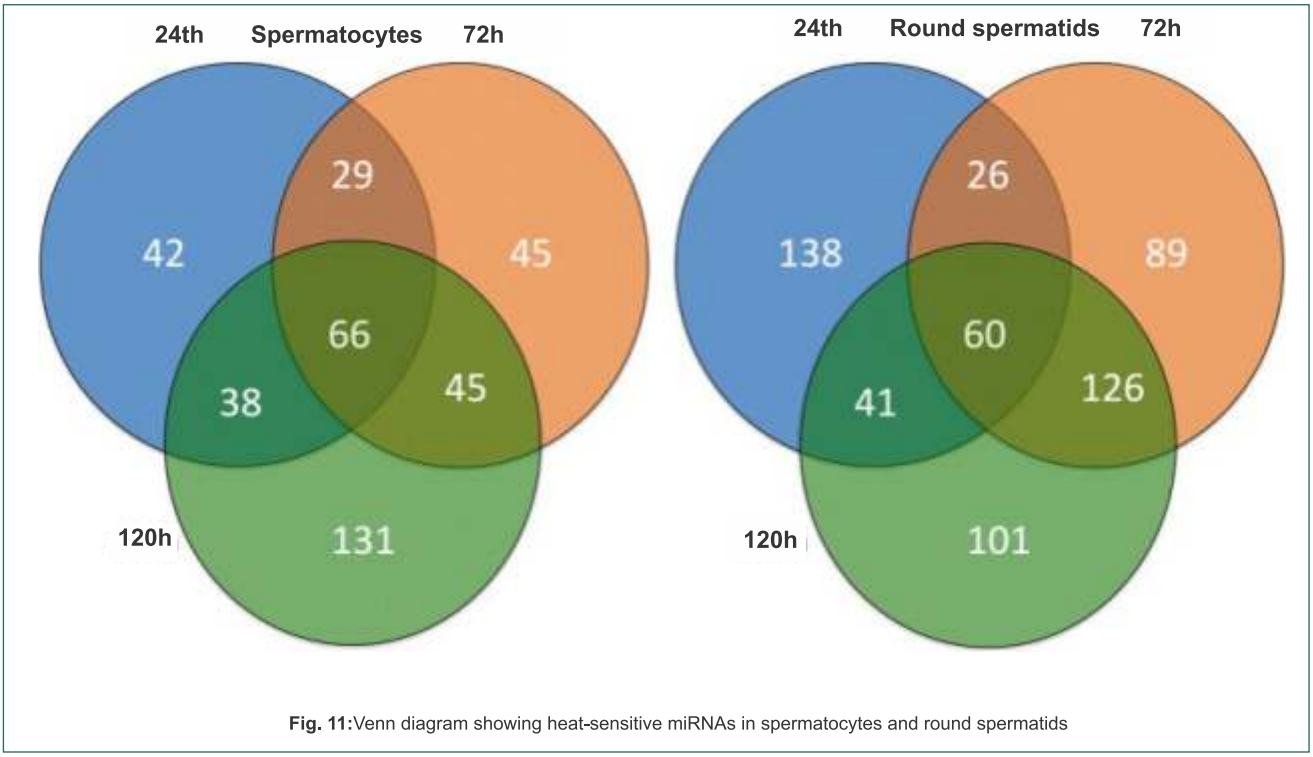


Fig. 11: Venn diagram showing heat-sensitive miRNAs in spermatocytes and round spermatids

4.2.2 Genome-wide differential methylation analyses identifies methylation signatures of male infertility

The specific sperm DNA methylation in mammals is suggested to be essential for spermatogenesis, fertilization and early embryonic development.Methylation changes in a number of genes have been correlated with reduced sperm count and motility. A genome-wide DNA methylation analysis on sperm DNA from infertile individuals was undertaken and compared with fertile controls, then a validation of the differenceswas performed in a larger sample size by employing massive parallel sequencing. The study highlights the association between methylation changes and loss of fertility. Mapping of the DMCs with respective genes showed *HOXB1, EBF3, ANK2, PRDM1, TP73, GATA3, VAX2, MLPH, SMC1B, KCNJ5, ASB4, BCAN, CTNNA3, DLGAP2, MAGI2, SPATA5, SPATA7, SPATA16, SPATA22, TET2, KDM4C, TCERG1L, JMJD1C, HDAC4, SMYD3, HLA-C, HLA-DRB6, HLA-DQA1, CRISPLD1, LPHN3* and *CPEB2* genes to be the top candidates showing alterations. The genes consistent with previous methylation studies include *ANK2, PRDM1, TP73, GATA3, VAX2, MLPH, SMC1B* and *KCNJ5*, which makes them excellent candidates for inclusion in infertility screening panels. Besides the above, this study has identified other differentially-methylated genes, *DLGAP2, HLA-C, HLA-DRB6, HLA-DQA1, CPEB2* and *EBF3*, which need further investigation for their roles in spermatogenesis. The genes showing hypermethylated (*HOXB1, GATA3* and *EBF3)* and hypomethylated CpGs (*BCAN* and *TCERG1L)* in deep sequencing are strong candidates for investigation of their roles in spermatogenesis. In addition to identifying new genes that may play important roles in spermatogenesis, this study has identified methylation markers that can become a part of methylation-based infertility screening panels.(***Human Reprod 33: 2256, 2018***).

4.2.3 Understanding pathophysiological mechanism of endometrial hyperplasia (EH): Sonic hedgehog protects endometrial hyperplasial cells against oxidative stress via suppressing mitochondrial fission protein dynamin-like GTPase (Drp1)

Endometrial hyperplasia (EH) is a precancerous stage characterized by non-invasive proliferation of endometrium and is caused by continuous unopposed exposure of estrogen. With a view to understand the pathophysiological role of Hh signaling in EH, our earlier study showed that Hh/Gli1 cascade as well as Gsk3β-Gli1 crosstalk play crucial role in estrogen-dependent progression of EH. However, the underlying mechanisms involved in progression of disease still remain unclear. The current study was aimed to explore the role of Hh signaling in protection of endometrial hyperplasial cells against oxidative stress and the underlying mechanism involved therein. The exogenous Shh (rShh) exerted cyto-protective effects against oxidative stress in EH cells. Activation of Shh signaling reduced apoptotic events and induced the activity of anti-oxidative defense enzymes i.e., SOD and GPx and diminished the ROS level. In addition, the oxidative stress-mediated up regulation of mitochondrial fission protein Drp1, mitochondrial fragmentation as well as mitochondria-dependent apoptosis were attenuated by exposure to rShh that activated Gli1 and regulated Drp1 in EH cells. Results implicated that Shh signaling modulates antioxidant defense

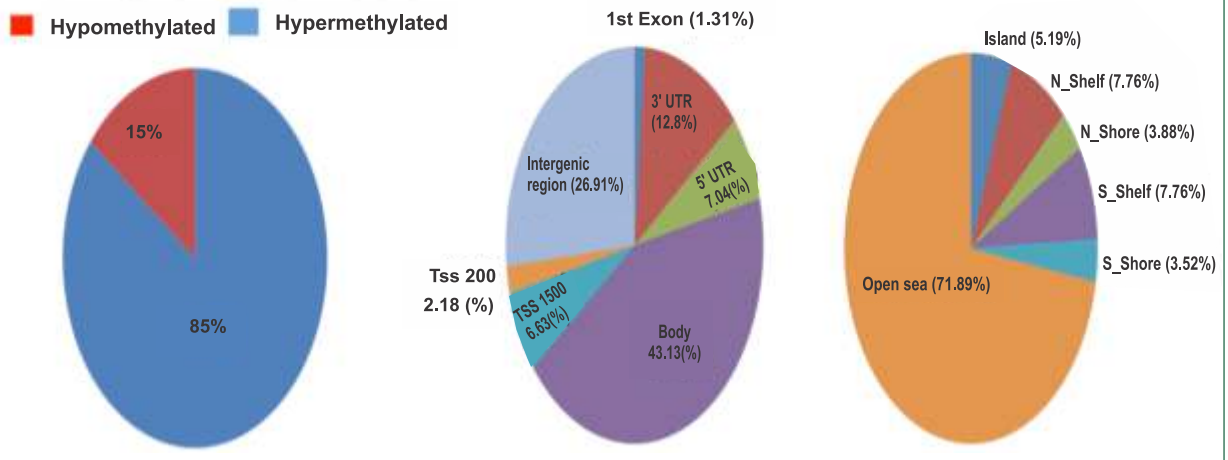
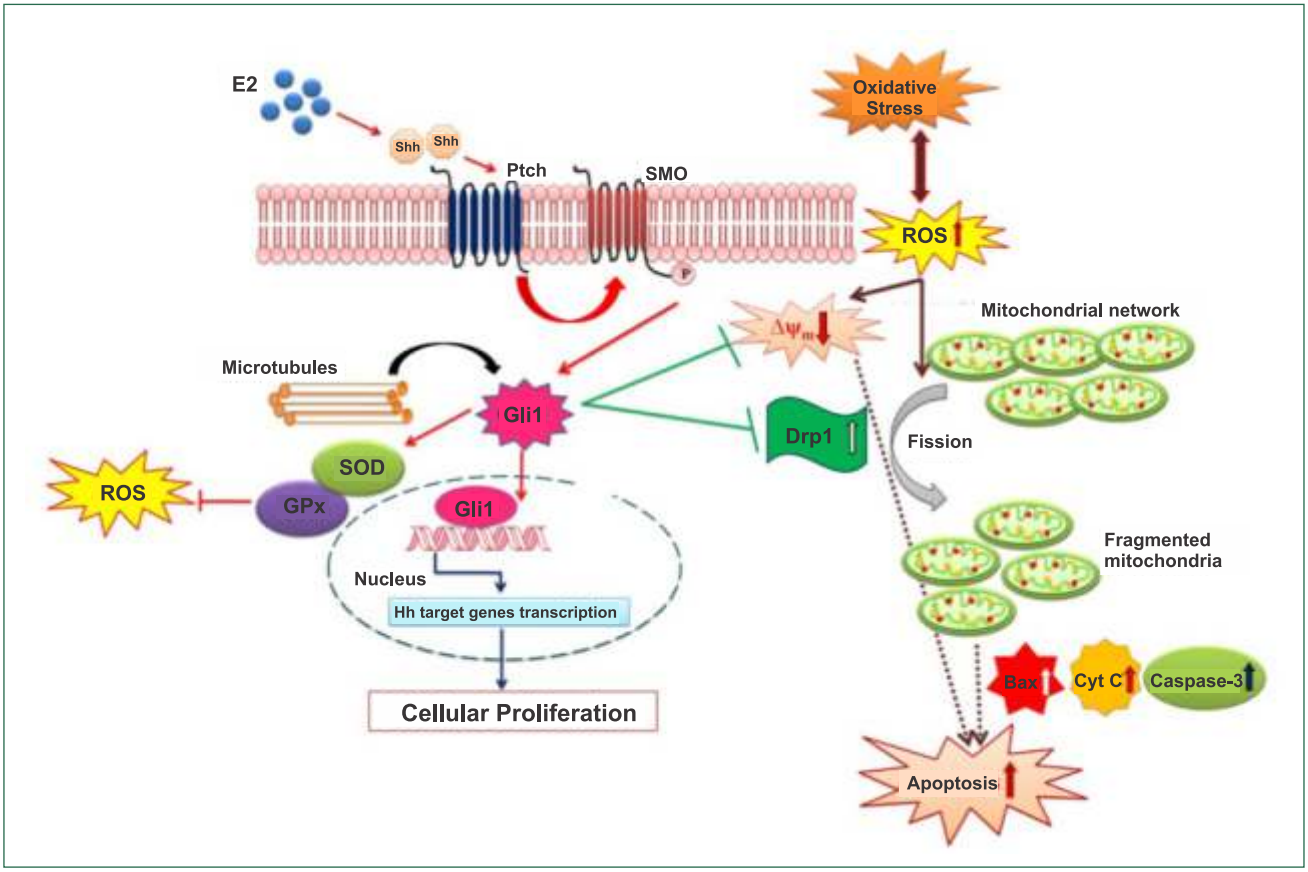


Fig. 12: (**A**) Percentage of DMCs showing hypermethylation and hypomethylation. (B) Distribution of DMCs on the basis of organization of gene transcript structure. (**C**) Distribution of DMCs on the basis of CpG island and neighborhood regions



system and stabilizes mitochondrial dynamics by suppressing Drp1 protein which maintains survival of EH cells against oxidative stress. Hence, Shh signaling plays an important role in pathophysiology of EH, and might be a promising target candidate to be exploited for development of future treatment strategies against endometrial hyperplasia. (***Free Rad Biol Med. PMID: 30347228***)

4.2.4 Uterine receptivity and endometrial proteins: Uterine TPPP3 plays important role in embryo implantation via modulation of β-catenin

Defective endometrial receptivity is considered to be main cause of embryo implantation failure and infertility in women. Tubulin polymerization promoting protein 3 (TPPP3) is known to be expressed in the endometrium in a cyclic manner, however, its functional role in embryo implantation remains unknown. We demonstrate a novel function of TPPP3 during the window of implantation and in the establishment of pregnancy using mouse model. The increased protein expression of TPPP3 and β-catenin during peri-implantation period, i.e. D5 (receptive phase, 0800 h), was observed as compared to that on D1 (non-receptive phase, 0800 h). SiRNATPPP3-mediated knockdown of uterine TPPP3 resulted in implantation failure and inhibited the expression of receptivity markers: LIF, Integrin-β3, IHH, and Wnt4. TPPP3 silencing in mouse endometrial epithelial cells also prevented blastocyst attachment and the adhesion reaction. The increased expression of TPPP3 in E2 + P4-treated Ishikawa cells compared to vehicle or P4 or E2 alone-treated Ishikawa cells also revealed its upregulation by E2. The suppression of β-catenin in uterus under the condition of transient knockdown of TPPP3 and the co-immunoprecipitation experiment revealed that regulation of β-catenin was mediated via TPPP3 during implantation. Also, in order to gain insight into TPPP3 collaborators, we identified TPPP3 interacting proteins by nanoLC-MS analysis in mouse uterus which might be involved during implantation. In conclusion, the study suggests that TPPP3 is important for embryo implantation through modulation of β-catenin. Though the contribution of embryonic TPPP3 in fertility outcome cannot be ruled out, our study contributes to the understanding of the molecular mechanism underlying uterine receptivity and implantation. ***(Biol Reprod., PMID: 29901777)***

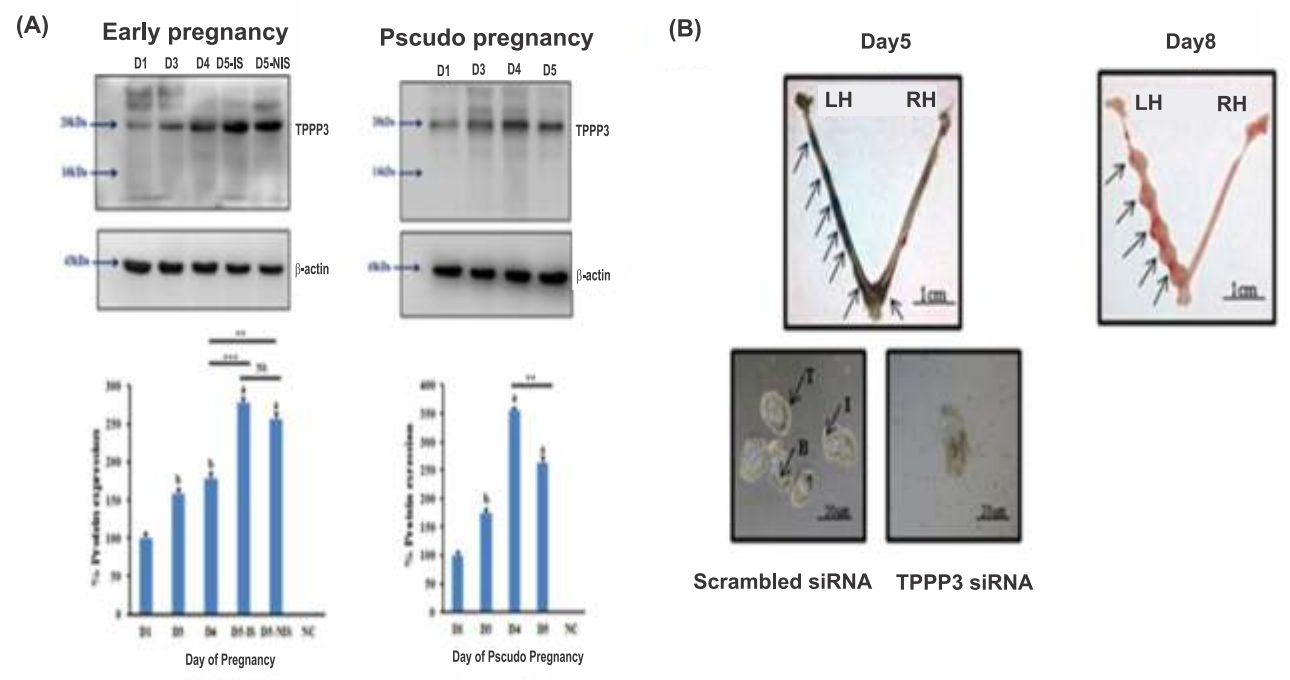
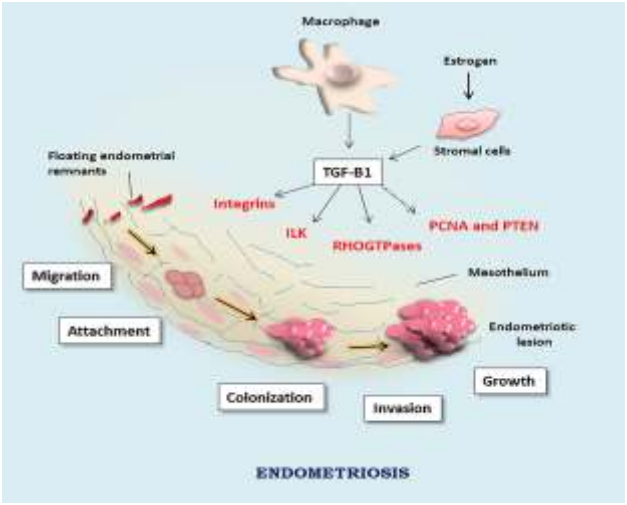


Fig. 14:(A) Representative western blot images showing expression of TPPP3 in pregnant mice and pseudopregnant mice uterine tissue (upper panel) and densitometric analysis (lower panel). IS: implantation sites and NIS: nonimplantation sites. **(B)** Effect of TPPP3 knockdown on the number of implantation sites in mice. Representative images of uteri (D5 and D8) and the collected embryos are shown. The right horn (RH) was transfected with siRNATPPP3 and the left horn (LH) was transfected with scrambled $siRNA_{NC}$. Arrows indicate the fetus. Collected embryos showing—I: Inner cell mass; T: Trophectoderm, B: Blastocoel.

4.2.5 Elevated level of TGF-B1 promotes endometriosis via cell migration, adhesiveness, colonization, and invasiveness

Earlier report has documented increased levels of transforming growth factor-beta1 (TGF-B1) in endometriosis; however, the detail signaling activated by high TGF-B1 in ectopic endometrial tissue remained obscure. We mimicked the human endometriosis condition in mouse model by surgical ectopic endometrium stitching on peritoneum wall and supplementation with TGF-B externally. We observed that externally supplemented TGF-B1 increases the growth of ectopically implanted endometrial tissues in mice, possibly involving SMAD2/3, but suppressing PTEN. We also observed increased adhesion molecules integrins (beta3 and beta8) and FAK in the ectopic endometrial tissue in response to TGF-B1. In mouse model, phosphorylated E-cadherin, N-cadherin, and vimentin were upregulated in the ectopic endometrial tissue in presence of TGF-B1, which is correlated with Epithelial-Mesenchymal Transition (EMT) in ovarian cycstic cells form endometeriosis patients. Furthermore, TGF-B1 favored the expression of RHOGTPases (RAC1, RHOC and RHOG in the human endometriotic cells and tissues from the mouse model of endometriosis (ectopic endometrial tissue). Interestingly, TGF-B1 facilitates the migration, invasive, and colonizing potential of human ovarian cystic cels. Collectively, we conclude that TGF-B1 favors the adhesion of ectopic endometrial cells/tissues by enhancing the integrin-ILK and FAK-signaling axis, and also migration via cadherin-mediated EMT and RHOGTPase-signaling cascades ***(Biol Reprod, PMID: 30423016).***



4.2.6 PKC can activate RAC1 in antral follicle theca and granulosa cells, and is alteredinprematurely failed ovary in SD rat model.

Premature ovarian failure or early menopause (POF) is one of the causes of female infertility that affects women below the age of 40 years. The exact mechanism of premature ovarian failure is still obscure in spite of several investigations. PKC and RHOGTPase has been shown associated with ovarian follicular development and we hypothesized that PKC might be one of the RHOGTPase activator and altered in the POF. Using rodent model of POF, we found augmentedexpression and activity of PKCα during estrus and metestrus stages of the estrous cycle. In theca and granulosa cells of normal antral follicle, PKC controls the expression and activity (RAC1-GTP form) of RAC1. The GTP-bound form of RAC1 was optimal at proestrus stage; however, the total RAC1 was optimal during proestrus and esturs stages, but unaltered at mRNA level. RAC1 activator or guanine exchange fractor, VAV (phosphorylated form) showed an oscillating pattern during estrous cycle. In ovary, under POF condition, the activity of PKC and phosphorylated-RAC1 were altered and cellular distribution of RAC1 and PKCα was seen ubiquitous. We conclude that PKC controls the activity of RAC1 in theca and granulosa cells of an antral follicle and PCK and RAC1 signaling isaltered in the ovary under the POF condition

4.2.7 Targeting germ cell maturation

Infertility is one of the serious adult concerns globally. It affects almost 15% of couples worldwide at reproductive age and out of which about 25% is being diagnosed as idiopathic (unknown origin) infertility. Thus, newer strategies are needed in order to know the reasons behind the idiopathic conditions. Out of many undiagnosed cases of infertility which could be due to gonadal insufficiency, germ cell maturation is a key step. Therefore, characterization of specific targets of germ cell maturation may provide insights into such cases. At the same time these targets can provide an opportunity to develop non-hormonal contraceptive strategies. To implement such experiments and further investigation, we have successfully established rat as well mouse models with dysfunctional gonads for both male and females through chemo-ablation. The authenticity of these animal models has been checked on various parameters that include histology as well as mating trails.

Forthe preliminary screening of oocyte maturation markers; **Trim6, Caspase9, Hmga2, PCNA, Pof1B & Ecat1**were localized in developing stages of follicles aswell as mature oocytes. Hmga2 is a member of the high-mobility group family of proteins, non-histone components of chromatin whose expression is known to be high during embryogenesis. The Hmga2 showed up in all the follicular stages, but mainly localized to the developing oocyte. During the maturation of oocytes, this protein migrated towards the periphery and gets localized in the cortical region of the mature oocyte. Another protein PCNA which is an auxiliary protein for Nucleic Acid synthesis showed lower staining in the developing follicles and localized precisely at the periphery of the mature oocytes. Staining profile of this protein is regularly used as a standard marker in proliferating cells; thus may play a role during subsequent embryonic development (Figure 17).

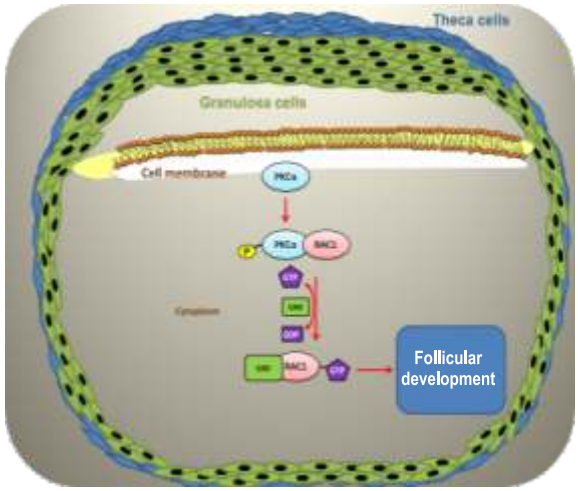


Fig. 17: Localization of Hmga2 & PCNA during mouse oocyte maturation

4.3 Advancing the knowledge frontiers in cancer biology

4.3.1 7-hydroxyfrullanolide, isolated from *Sphaeranthus indicus*, inhibits colorectal cancer cell growth by p53 dependent and independent mechanism

Sphaeranthus indicus Linn. is commonly used in Indian traditional medicine for management of multiple pathological conditions. However, there are limited studies on anti-cancer activity of this plant and its underlying molecular mechanisms. Here, we isolated an active constituent, 7-hydroxyfrullanolide (7-HF), from the flowers of this plant which showed promising chemotherapeutic potential. The compound was more effective in inhibiting *in vitro* proliferation of colon cancers cells through G2/M phase

arrest than other cancer cell lines that were used in the present study. Consistent with *in vitro* data, 7-HF caused substantial regression of tumor volume in a syngenic mouse model of colon cancer. The molecule triggered extrinsic apoptotic pathway which was evident as upregulation of DR4 and DR5 expression as well as induction of their downstream effector molecules (FADD, Caspase-8). Concurrent activation of intrinsic pathway was demonstrated with loss of ΔΨm to release pro-apototic cytochrome c from mitochondria and activation of downstream caspase cascades (Caspase -9, -3). Loss of p53 resulted in decreased sensitivity of cells towards pro-apoptotic effect of 7-HF with increased number of viable cells indicating p53 dependent arrest of cancer cell growth. This notion was further supported with 7-HF mediated elevation of endogenous p53 level, decreased expression of MDM2 and transcriptional up regulation of p53 target genes in apoptotic pathway. However, 7-HF was equally effective in preventing progression of HCT116 $p53^{+/+}$ and $p53^{-/-}$ cell derived xenografts in nude mice which suggests that differences in p53 status may not influence its*in vivo* efficacy. Taken together, our results support 7-HF as a potential chemotherapeutic agent and provided a new mechanistic insight into its anti-cancer activity. ***(Carcinogenesis, PMID: 30535334)***

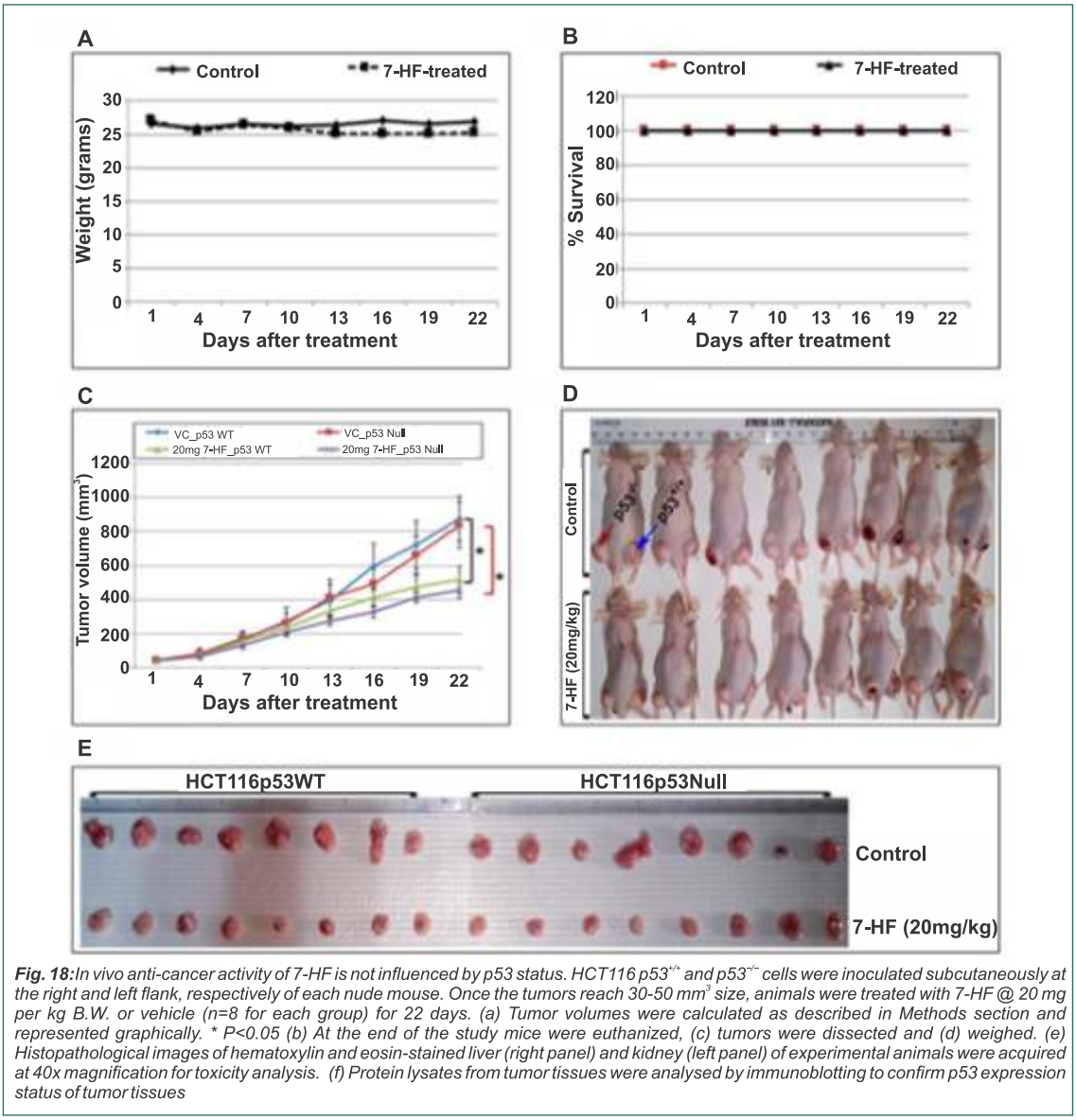


Fig. 18:*In vivo anti-cancer activity of 7-HF is not influenced by p53 status. HCT116 $p53^{+/+}$ and $p53^{-/-}$ cells were inoculated subcutaneously at the right and left flank, respectively of each nude mouse. Once the tumors reach 30-50 mm^3 size, animals were treated with 7-HF @ 20 mg per kg B.W. or vehicle (n=8 for each group) for 22 days. (a) Tumor volumes were calculated as described in Methods section and represented graphically. * P<0.05 (b) At the end of the study mice were euthanized, (c) tumors were dissected and (d) weighed. (e) Histopathological images of hematoxylin and eosin-stained liver (right panel) and kidney (left panel) of experimental animals were acquired at 40x magnification for toxicity analysis. (f) Protein lysates from tumor tissues were analysed by immunoblotting to confirm p53 expression status of tumor tissues*

4.3.2 Identification and characterization of complete BRCA1 C-terminal missense mutations in cancer predisposition

BRCA1 functions as a classical tumor suppressor. Individuals with a BRCA1 mutation have a 50–80% lifetime risk of developing breast cancer and 30–50% risk of developing ovarian and other cancers. The selective missense mutation of BRCA1 has been reported for cancer predisposition and the extensive characterization of such mutation is needed. The one option is to rely on clinical samples, followed by NGS and finding out possible variants on the entire length of BRCA1. The other option is begin with cloning a critical portion such as the BRCT domain (1560-1863) and make a library of complete missense mutation. The respective mutated BRCT domain can further be checked for its biological stability and functional assay in yeast for its cancer predisposition probabilities. We initiated this work and the nucleotide sequence of the BRCT domain was commercially synthesized. We created ten missense mutationsY1863D, H1860E, Q1857R, L1854H, D1851Y, Q1848R, Y1845S,V1842F, L1839M and E1836G)along with the two positive controls (A1708E and M1775R) whose mutations are known to affects the BRCA stability. The expression and purification of the native BRCT domain is optimized to use it as a control for the comparative stability analysis. The expression analysis of other BRCT mutants as well as creation of more such mutations is in progress.

4.3.3 Phosphorylation of Wat1, human Lst8 homolog is critical for the regulation of TORC2 –Gad8 dependent pathway in fission yeast *Schizosacchromyces pombe*

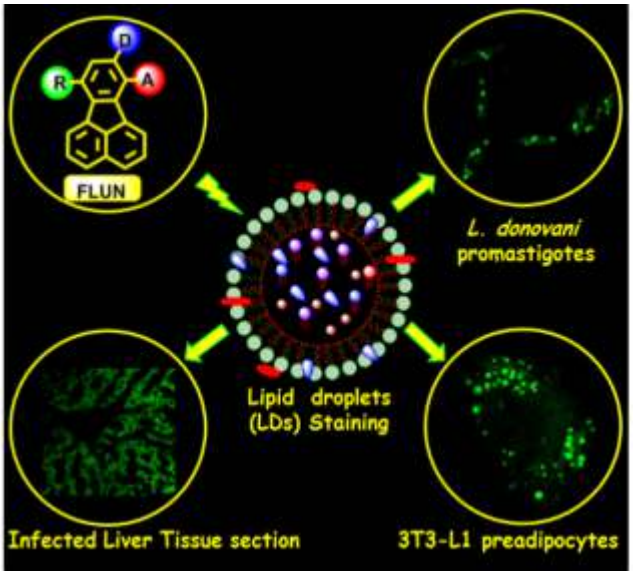
Mammalian Lst8 interacts with the kinase domain of mTOR and stabilizes its interaction with Raptor regulating cell growth through the mTOR-S6K1 signalling pathway. Fission yeast Wat1, an ortholog of mammalian Lst8 is also an essential component of TOR complex 1 (TORC1) and TOR Complex 2 (TORC2) that control protein kinases essential for metabolic pathways. Here, we show that in response to osmotic stress, the Wat1 protein undergoes hyper-phosphorylation at S116 position. Wat1 interacts with the C-terminal region of Tor1 that also contain kinase domain. Co-immunoprecipitation and molecular modelling studies suggest that Wat1-Tor1 interaction is stabilized by FATC domain of Tor1 protein present at the C-terminal region. We have also demonstrated a physical interaction of Wat1 with Gad8, an AGC family protein kinase that is dependent on phosphorylation of Wat1 at S116 residue. Wat1 phosphorylation is required for the maintenance of vacuolar integrity and sexual differentiation. Collectively, our study reveals Wat1 phosphorylation regulates Gad8 function in a manner dependent on Tor1 interaction (***Eur. J. Cell Biol. PMID: 29699848***).

4.3.4 Targeting deregulated protein-degradation machinery in cancer

Aberrant expression of proteins and their hyper activation owing to perturbed protein-degradation pathways is leading cause of cancer pathogenesis. One of the major approaches of our laboratory has been to identify substrate specific E3 ubiquitin ligases that target such proteins for degradation in order to maintain their dynamic steady state levels. We utilize bioinformatics as well as RNAi based approaches to identify E3 ubiquitin ligases and their regulated protein substrates in cancer. Skp1-Cullin-F-box family (SCF) of E3 ubiquitin ligase are one such family that is often deregulated in cancers leading to aberrant steady. We have successfully identified different substrates (G-CSFR and CDX2) and are currently involved in screening of small molecule inhibitors for proteasome pathway using *in vitro* biochemical assay. The compound/fractions submitted are evaluated for Proteasome (chymotrypsin like activity) inhibition. Briefly, synthetic compounds (at 10μM)/ Natural product isolates (at 25-50 μM)/Plant extracts (10μg/ml) are tested for their proteasome inhibitory activity in an assay containing proteasome enriched lysates of Jurkat cells and a fluorogenic substrate. Compounds/extracts showing positive activity (less fluorescence at 380_{exi}-440_{emi} due to non-cleavage of substrate by proteasome inhibition) are then tested for their potential to inhibit proteasomes in a cell-free assay using purified human recombinant 20S fraction of proteasome and the fluorogenic substrate (Suc-LLVY-AMC). MG132/Bortezomib is used as positive control while DMSO/solvent as negative control. Compounds showing IC_{50}< 1μM (Synthetic), <25μM (Natural products), <2.5μg/ml (extracts) are considered active.

4.3.5 Synthesis of yellow fluorescent probes for imaging third stage human cervical cancer tissues and quantification of lipid droplets in *L. donovani*, liver sections of plasmodium infected mice and

Despite of the growing evidence demonstrating deregulated lipid biosynthesis as features of cancer and malaria infection, the mechanism of these metabolic



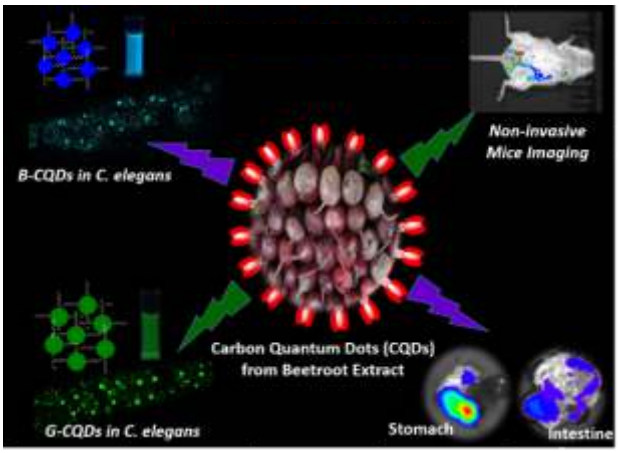
alterations in the development of the disease is not fully understood. Therefore, diagnostic tools for detection, imaging and quantification of lipid droplets in infected/cancerous vs normal tissues are highly desirable for understanding and unravelling the mysteries associated with unregulated lipid biosynthesis and metabolism.

Fluoranthene based yellow fluorescent probes (FLUN-550, FLUN-552, FLUN-547) were designed and synthesized by conjugating ethanolamine head group of the phospholipid phosphatidyl-ethanolamine present in biological membranes. These new probes selectively stained lipid droplets (LDs) in pre-adipocytes and *Leishmania donovani* promastigotes. Furthermore, the probes FLUN-550 and FLUN-552, were successfully applied for lipid droplets staining in the liver sections of Plasmodium yoelii MDR infected mouse and the tissue sections of third stage human cervical cancer patients. The quantification analysis revealed excess accumulation of lipids in Plasmodium infected liver sections (3- to 4-fold) and human cervical cancer tissues (1.5- to 2-fold) compared to normal. To the best of our knowledge, this is the first report of yellow fluorescent probes for quantification of excess accumulation of LDs in malaria-infected liver sections and cervical cancer patient tissues. These yellow fluorescent probes (FLUN-550 and FLUN-552) have opened new avenues as diagnostic tools for detection and quantification of LDs in clinical/pathological biopsy specimens and for understanding the mechanism of abnormal fatty degeneration and its role in pathogenesis of malaria, cancer and metabolic disorders ***(Bioconjugate Chemistry, PMID: 30247899)***

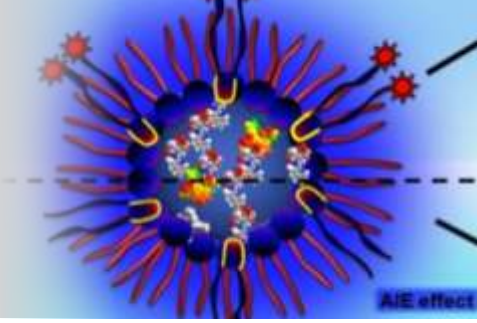
4.3.6 Synthesis of biocompatible fluorescent carbon quantum dots from beetroot extract for *in vivo* live imaging in *C. elegans* and BALB/c Mice

Since the discovery of carbon dots as fluorescent nanomaterials, these nanostructures have shown tremendous potential in modern nanotechnologies and biomedical fields. The preparation of these carbon dots from environmentally benign sources like vegetables and fruits extract is an emerging and fast growing area of research. In order to utilize them for nanotechnological development for in vivo non-invasive live animal imaging, non-toxic carbon nanomaterials, suitable animal models and protocols are urgently required.

We developed one-pot green synthesis of fluorescent carbon quantum dots (CQDs) from beetroot (beta vulgaris) through hydrothermal and mild acid treatment method. The CQDs with carbonyl, hydroxyl and carboxylic acid functionalities at the surface of the quantum dots were investigated for the first time in soil nematodes *Caenorhabditis elegans* (*C. elegans*) model which revealed stable and consistent fluorescence in the body of the worms without exerting any side effects). These encouraging results prompted us to examine them in *in vivo* non-invasive live animal (BALB/c mice) imaging. The tremendous potential shown by these water soluble CQDs in *C. elegans* and mice models opens new avenues for greener CQDs nanomaterials for their applications as diagnostics and theranostics in biomedical and nanotechnological research field for good human health ***(J. Mater. Chem. B, DOI: 10.1039/C8TB00503F).***



5 Pre-clinical Studies in Drug Development and Translation: Development of New Drug Entities, Phytopharmaceuticals and Standardized Extracts in AYUSH Mode



Chairperson

Prof. Tapas K. Kundu

Members

Dr. N. Chattopadhyay

Dr. W Haq

Vision and Goal:

- Pre-clinical and clinical development of drug substances and drug products for diseases of national importance, international relevance and public health needs;
- Provision of services to the pharmaceutical industry, especially micro, small and medium enterprises and public sector manufacturers in areas of clinical trials, regulatory toxicology, safety pharmacology, pharmaceutics and pharmacokinetics;
- Continued engagement with drug regulation and pharmaceutical policymaking in India as well as internationally

Core Competencies and Activities:

- Analytical and bioanalytical method development, quality assurance and stability studies on drug substances and drug products;
- Preclinical pharmacokinetics and metabolism of synthetic compounds and natural products in rodents, small animals and monkeys;
- Bioanalysis and pharmacokinetic modelling for clinical pharmacokinetics and metabolism including bioequivalence and bioavailability studies for generic medicines;
- Pre-formulation, 'Quality by Design' (QbD) formulation and process development for conventional and novel drug substances;
- Safety pharmacology of CSIR-CDRI candidate drugs under certified “good lab practices” (GLP);
- Preclinical toxicology and toxicokinetics of candidate drugs per international guidelines under GLP;
- Preparation of dossiers on new candidate drugs for regulatory filings;
- Protocol design, trial monitoring and coordination for Phase I to Phase IV clinical trials;
- Generation of information on mechanisms of action, toxicity and metabolism of drugs and deployment of alternative model systems for assessing the efficacy of new chemical entities;
- Development of better drug delivery systems for CSIR-CDRI candidate drugs as well as known drugs;

Dr. Sharad Sharma

Dr. SK Rath

Dr. Amit Misra

Dr. Manoj Barthwal

5.1 Pharmaceutics:

5.1.1 Regulatory studies

5.1.1.1 Generation and compilation of data required for regulatory approval

Translation research on drug development requires documentation of the physicochemical properties of drug candidates in a format specified by the Central Drugs Standard and Control Organization (CDSCO). The Drugs Controller General of India, after perusal of results of studies conducted on the active pharmaceutical ingredient (API) and the dosage form (tablet, capsule, injection, etc) grants permissions for clinical testing of safety and efficacy. Regulatory data on specifications of physico-chemical properties (Chemistry, Manufacturing and Controls, CMC) of four CSIR-CDRI candidate drugs: S007-867, S-007-1500 and S-011-1793 were compiled. Investigative New Drug Applications to the Drugs Controller General of India for clinical testing the first of these candidate drugs is ready for submission. The remaining are pending identification of an Industry partner.

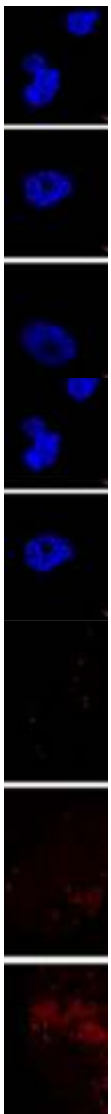
5.1.1.2 Tablet formulation of S007-867

Batches of tablets of the anti-platelet candidate drug S007-867 were prepared by wet granulation and direct compression techniques. The Master Formula was finalized and GMP-compliant process developed for the same. The tablets are under study for real-time and accelerated stability under mandated storage conditions.

Research Team

L to R standing- Dr. Neha Topno, Dr. P.N. Yadav, Dr. Manoj K. Barthwal, Dr. R.K. Tripathi, Dr. J.R. Gayen, Dr. R.S. Bhatta, Dr. Vivek Vidyadhar Bhosale, Dr. Aamir Nazir, Dr. Sripathi Rao Kulkarni, Dr. Smrati Bhadauria, Dr. Madhav Nilakanth Mugale, Dr. Kashif Hanif

L to R sitting- Dr. Prabhat Ranjan Mishra, Dr. Manish Kumar Chourasia, Dr. Sarika Singh, Dr. S.K. Rath, Dr. Sharad Sharma, Dr. W Haq, Dr. Amit Misra, Mr. Naseem Ahmed Siddiqui



5.1.1.1 Development, validation and deployment of methods of pharmaceutical analysis

Analytical methods were developed and validated according to regulatory guidelines for several new as well as known drugs. This year, too, pharmaceutical analysis of 43 different kinds of samples of synthetic compounds, plant products and industrial production batches were analysed, not significantly different from 44 samples analysed in the previous year. Another set of about 2000 samples were analysed for drug content, content uniformity, drug release, stability and impurity profiling in formulation development activities. There are 16 different active projects on pharmaceutical analysis in progress currently. The average time from receipt of sample to filing an analytical report this year was 27.9 days (range: 0 to 92 days), up from 10.3 days in the previous year.

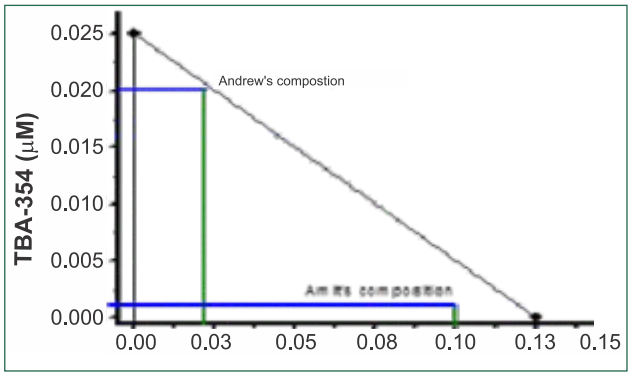
5.1.2 Drug Delivery

5.1.2.1 Inhalable particles containing anti-tuberculosis agents

Additional preclinical experiments suggested by the Indian Council of Medical Research in December 2017 were completed. An Investigator's Brochure and an Investigational New Drug (IND) application for a Phase-1 clinical trial were prepared. A grant application for the trial is under evaluation by ICMR.

5.1.2.2 Inhalable particles containing drugs used in multi-drug resistant (MDR) tuberculosis

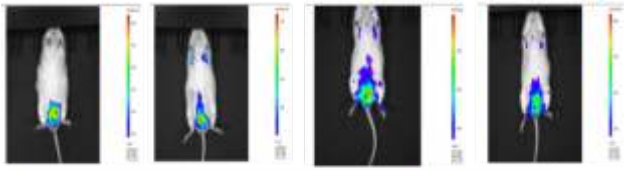
This project is in collaboration with Prof. Gareth Griffiths at the University of Oslo, and will be pursued by an international team including stalwarts such as Prof. David Russell from Cornell University, Prof. Andrew Thompson from The University of Auckland, and young scientists Matthias Barzfrom Mainz, Germany and Bruno de Geest from Ghent, Belgium apart from the CSIR-CDRI group. In the reporting period, personnel from CSIR-CDRI visited Oslo for detailed discussion of data generated in respect of combinations of sutezolid and TBA-354 provided to CSIR-CDRI by Prof. Thompson. An isobologram was generated to guide the proportion of the two drugs in formulations. Nanoparticles and inhalable particles containing these combinations were prepared and evaluated.



The figure shows an isobologram of sutezolid and TBA-354. The triangular area represents compositions that will show synergy. It is planned to compare two combinations in the coming year in terms of efficacy and safety.

5.1.2.3 Inhalable particles for host-directed therapies of tuberculosis—induction of autophagy

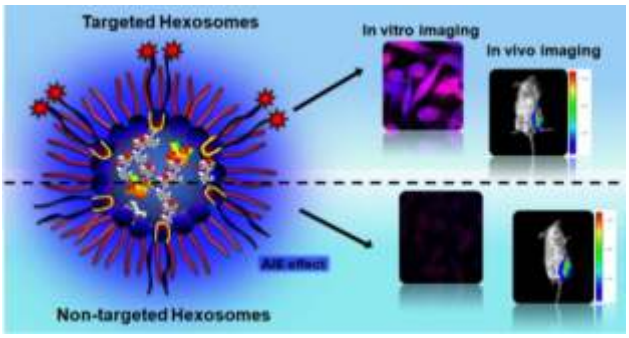
A dry powder inhalable formulation for gene delivery to the airways and deep lungs was prepared by spray-drying and evaluated for aerosol properties and transfection efficiency *in vitro* and in mice. Figure shows the time course of transfection with the reporter gene RFP. It was concluded that transient transfection of the host respiratory tract using inhalable particles is feasible. Inhalable particles containing the gene for gamma interferon are under evaluation of efficacy in a mouse model of TB at our collaborating institution, NJIL&OMD, Agra. *In vivo* imaging at indicated time intervals post inhalation show peak signal at 6h, followed by decline. Background of dietary fluorescence may be seen at all time-points, including untreated control.



5.1.2.4 Anisamide-Anchored lyotropicnano-liquid crystalline particles with aie effect: A smart optical beacon for tumor imaging and therapy

The prospective design of nanocarriers for personalized oncotherapy should be an ensemble of targeting, imaging, and non-invasive therapeutic capabilities. We report the development of inverse hexagonal nano-liquid crystalline (NLC) particles that are able to host formononetin (FMN), a phytoestrogen with known anticancer activity, and tetraphenylethene (TPE), an optical beacon with aggregation-induced emission (AIE) signature, simultaneously. Ordered three-dimensional mesoporous internal structure and high-lipid-volume fraction of NLC nanoparticles (NLC NPs) frame the outer compartment for the better settlement of payloads. Embellishment of these nanoparticles by anisamide (AA), a novel sigma receptor targeting ligand using carbodiimide

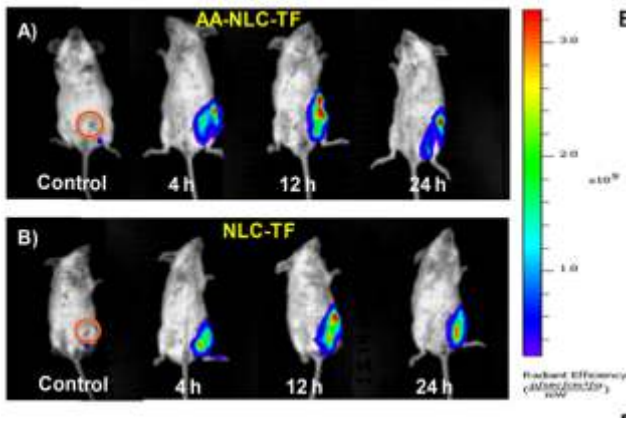
coupling chemistry ensured NLCs as an outstanding vehicle for possible utility in surveillance of tumor location as well as the FMN delivery through active AIE imaging. The size and

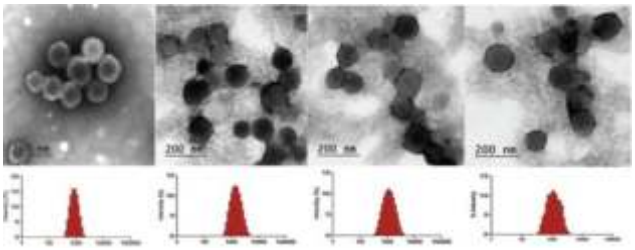


structural integrity of nanoparticles were evaluated by quasi-elastic light scattering, cryo-field emission scanning electron microscopy small-angle X-ray scattering. The existence of AIE effect in the nanoparticles was evidenced through the photo physical studies that advocate the application of NLC NPs in fluorescence-based bioimaging. Moreover, confocal microscopy illustrated the single living cell imaging ability endowed by the NLC NPs. *In vitro* and *in vivo* studies supported the enhanced efficacy of targeted nanoparticles (AA-NLC-TF) in comparison to non-targeted nanoparticles (NLC-TF) and free drug. Apparently, this critically designed multimodal NLC NPs may establish a promising platform for targeted and image-guided chemotherapy for breast cancer (**ACS Applied Mater. & Interfaces, PMID: 29577719**).

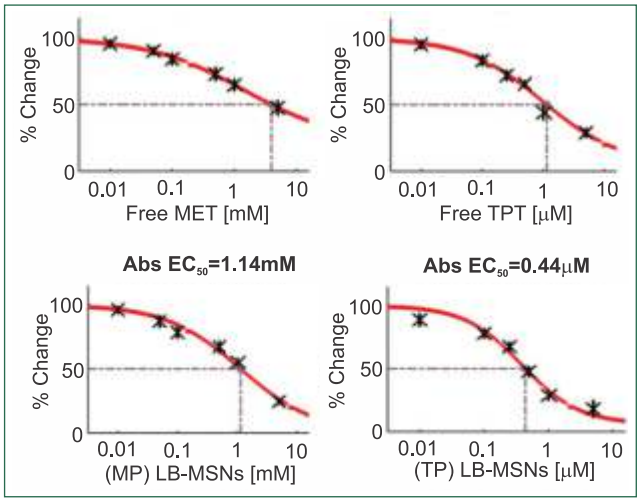
5.1.2.5 Synchronized ratiometric codelivery of Metformin and Topotecan through engineered nanocarrier facilitates *in vivo* synergistic precision levels at tumor site

The combination of metabolic modulators with chemotherapy holds vast promise for effective inhibition of tumor progression and invasion. Herein, a ratiometric





codelivery platform is developed for metformin (MET), a known metabolic modulator and topotecan (TPT), a chemotherapeutic drug, by engineering lipid bilayer–camouflaged mesoporous silica nanoparticles (LB-MSNs). In an attempt to deliver and maintain high tumor site concentrations of MET and TPT, a novel ion pairing–assisted loading procedure is developed using pamoic acid (PA) as an in situ trapping agent. PA, a hydrophobic counter ion, increases the hydrophobicity of MET and TPT and facilitates MSNs with exceptionally high payload capacity (>40 and 32 wt%, respectively) and controlled release profile. Further, the synergy between MET and TPT determined by a modelling approach helps to afford synchronized delivery of both the drugs. Coloaded MET and TPT LB-MSNs present synergistic cytotoxicity against MDA-MB-231/4T1 cells and effectively

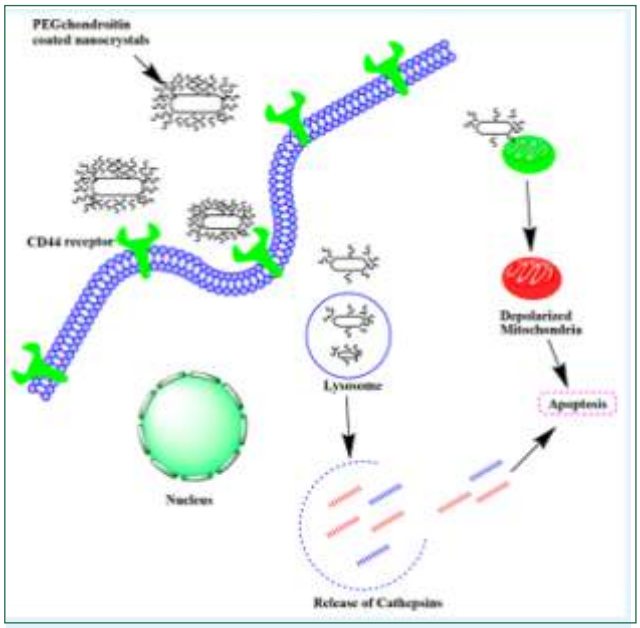


promote apoptosis via mitochondrial membrane depolarization and cell cycle arrest. Extended pharmacokinetic profiles in preclinical models with fourfold to sevenfold longer circulation half-life and 7.5–100 times higher tumor site concentrations correspond to a significant increase in pharmacodynamic efficacy. Taken together, the developed codelivery approach effectively addresses the challenges in the chemotherapeutic efficacy of MET and TPT collectively. In this study, we successfully developed a novel in situ HIP based active loading technique for the efficient loading and controlled release of MET and TPT using

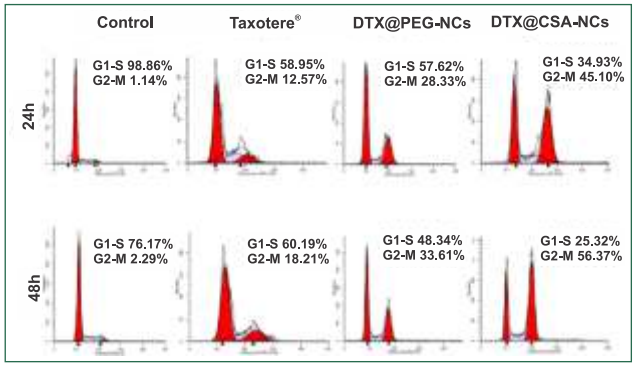
pseudo-cell-like LB-MSNs as templates. The developed delivery system was able to control the release of MET and TPT. This resulted in significantly increased intracellular concentrations of MET which is a major translational concern in the MET therapy in cancer (**Adv Healthcare Mater. PMID: 30102470**).

5.1.2.5 Multifunctional glycoconjugate assisted nanocrystalline drug delivery for tumor targeting and permeabilization of lysosomal mitochondrial membrane

We synthesized a novel polymeric conjugate comprising chondroitin sulfate A and polyethylene glycol using carbodiimide chemistry. We further employed this



glycoconjugate possessing the propensity to provide stability, stealth effects, and tumor targeting via CD44 receptors, all in one, to develop a nanocrystalline system of docetaxel (DTX@CSA-NCs) with size < 200 nm, negative zeta potential, and 98% drug content. Taking advantage of the enhanced permeability and retention effect coupled with receptor mediated endocytosis, the DTX@CSA-NCs cross the peripheral tumor barrier and penetrate deeper into the cells of tumor mass. In MDA-MB-231 cells, this enhanced cellular uptake was observed to exhibit a higher degree of cytotoxicity and arrest in the G2phase in a time dependent fashion. Acting via a mitochondrial-lysosomotropic pathway, DTX@CSA-NCs disrupted the membrane potential and integrity and outperformed the clinically used formulation. Upon intravenous administration, the DTX@CSA-NCs showed better pharmacokinetic profile and excellent 4T1 induced tumor inhibition with significantly less off target toxicity. Thus, this glycoconjugate stabilized nanocrystalline formulation has the potential to take nano-oncology a step forward. On the whole the DTX@CSA-NCs outperformed nontargeted nanocrystals and clinically used formulation in cell line based assays as the results of enhanced cellular uptake via receptor mediated endocytosis. On probing further, it was evident that the nanocrystals acted via mitochondrial (disruption of membrane potential) and lysosomotropic (disruption of membrane integrity) pathways leading to higher cellular toxicity. The results obtained with in

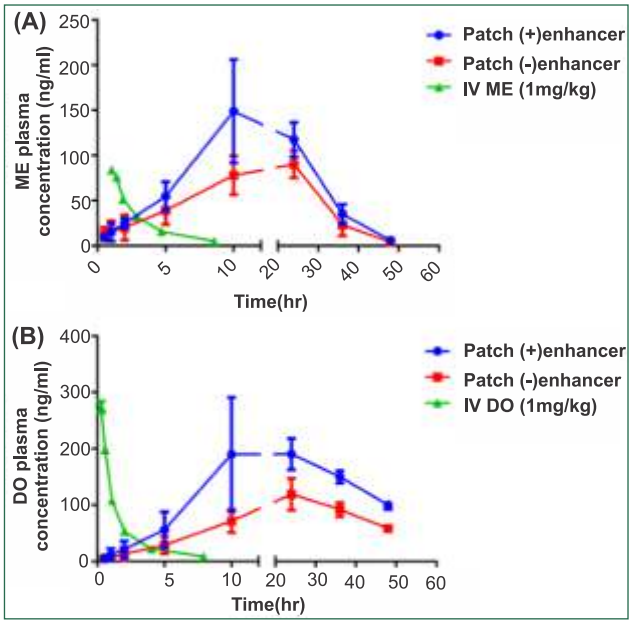


vitro experiments corroborated well with in vivo results where the DTX@CSANCs showed higher plasma concentration and higher tumor regression in 4T1 induced mice tumor model. Hence, it could be conveniently concluded that the developed docetaxel nanocrystalline formulation could be a possible approach for better chemotherapy (**ACS Applied Mater. & Interfaces, PMID: 29726253**).

5.1.2.6 In depth analysis of pressure-sensitive adhesive patch-assisted delivery of memantine and donepezil using physiologically based pharmacokinetic modelling and *in vitro/in vivo* correlations.

The objective of this work was to evaluate the feasibility of transdermal delivery of two widely prescribed dementia drugs for the Alzheimer's disease. In this regard, the drug in adhesive patches of memantine (ME) co-loaded with donepezil (DO) was prepared using an ethylene vinyl acetate polymer and characterized for drug content, the crystallinity of drugs in the polymer matrix, and in vitro permeation. To understand the different physical and chemical processes underlying the percutaneous absorption, it is required to employ a comprehensive model that accounts for the anatomy and physiology of the skin. A transdermal physiologically based pharmacokinetic

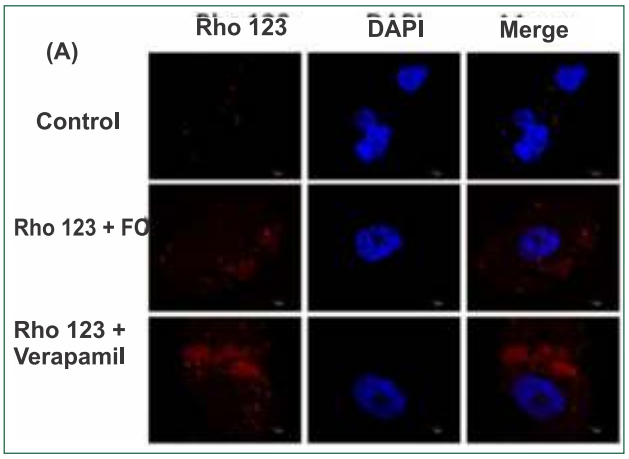
(TPBPK) model was developed and was integrated in a compartmental pharmacokinetic model to predict the plasma drug concentrations in rats. The model predictions



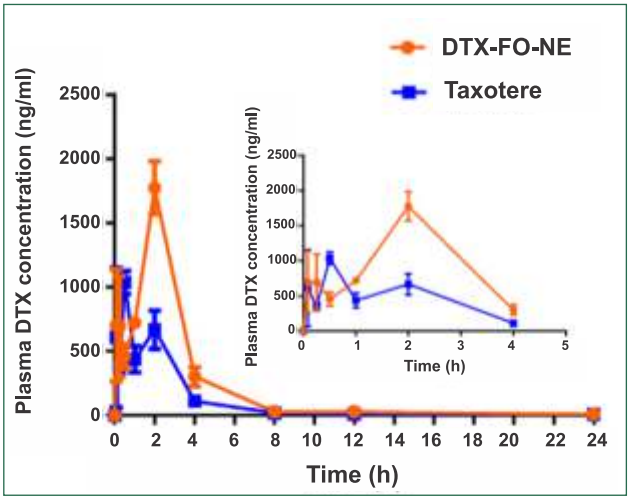
showed a good fit with the experimental data, as evaluated by the prediction error calculated for both drugs. It was evident from the simulations that the drug diffusivity and partition coefficient in the polymer matrix are the critical parameters that affect the drug release from the vehicle and subsequently influence the *in vivo* pharmacokinetic profile. Moreover, a correlation function was built between the *in vitro* permeation data and in vivo absorption for both ME and DO. A good point-to-point *in vitro/in vivo* correlation (IVIVC, Level A correlation) was achieved by predicting the plasma concentrations with convolution for the entire study duration. The results of our study suggested that the implementation of mechanistic modelling along with IVIVC can be a valuable tool to evaluate the relative effects of formulation variables on the bioavailability from transdermal delivery systems (**Mol Pharm, PMID: 29856631**).

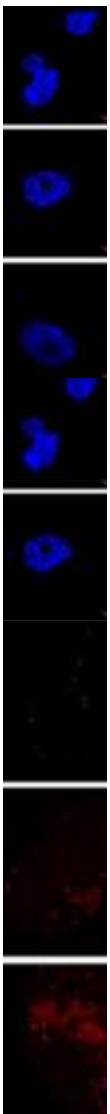
5.1.2.7 P-gp modulatory acetyl-11-keto—boswellic acid based nanoemulsified carrier system for augmented oral chemotherapy of docetaxel

In spite of being a very potent and promising drug against many types of cancer, docetaxel suffers the disadvantage of low solubility and poor bioavailability rendering it unsuitable for oral administration. Also, the available marketed formulation for intravenous administration has its inherent drawbacks owing to the presence of polysorbate 80. Here, we exploited the anticancer and P-gp inhibitory potential of naturally



occurring frankincense oil to fabricate a stable docetaxel loaded nanoemulsified carrier system for oral delivery. The nanoemulsion possessing desirable particle size (122±12nm), polydispersity (0.086±0.007) and zeta potential (−29.8±2.1mV) was stable against all type of physical stresses and simulated physiological conditions tested. The formulation showed higher uptake in Caco-2 cells and inhibited P-gp transporter significantly ($P<0.05$). In MDA-MB-231cells,it showed less IC50, arrested cells in G2-M phase and exhibited higher degree of apoptosis than marketed formulation Taxotere®. The 182.58±4.16% increment in relative oral bioavailability led to higher *in vivo* anti-proliferative activity manifesting 19% more inhibition than Taxotere®. To sum up, DTX nanoemulsion was successfully fabricated with desired quality attributes and performance. The nanoemulsion comprising of an oil, FO, possessing both anti-cancer and P-gp inhibitory properties displayed significantly superior results in terms of cytotoxicity, cell cycle arrest and ultimately apoptosis as compared to marketed formulation Taxotere®. Enhanced cellular internalization and retention was observed in Caco-





2 cells due to inhibition of P-gp, which lead to increased bioavailability and consequently higher tumor regression rate. Thus, the frankincense oil based nanoemulsion could be a promising approach for oral delivery of DTX and other chemotherapeutic drugs with similar properties (**Colloids and Surfaces B: Biointerfaces, PMID: 28437753**).

5.1.2.8 Drug delivery system for docetaxel

Poor bioavailability of Docetaxel (DCT) arising due to its low aqueous solubility and permeability limits its clinical utility. The aim of the present study was to develop DCT loaded self-emulsified drug delivery systems (D-SEDDS) and evaluate its potential ability to improve the oral bioavailability and therapeutic efficacy of DCT. D-SEDDS were characterized for their *in vitro* antitumor activity, *in situ* single pass intestinal perfusion (SPIP), bioavailability, chylomicron flow blocking study and bio-distribution profile. The D-SEDDS were prepared using Capryol 90, Vitamin E TPGS, Gelucire 44/14 and Transcutol HP with a ratio of 32.7/29.4/8.3/29.6 using D-Optimal Mixture Design. The solubility of DCT was improved upto 50 mg/mL. The oral bioavailability of the D-SEDDS in rats (21.84 ± 3.12%) was increased by 3.19 fold than orally administered Taxotere (6.85 ± 1.82%) (Figure). The enhanced bioavailability was probably due to increase in solubility and permeability. In SPIP, effective permeability of D-SEDDS was significantly higher than Taxotere. D-SEDDS showed 25 fold more *in vitro* cytotoxic activity compared to free DCT. Chylomicron flow blocking study and tissue distribution demonstrated the intestinal lymphatic transport of D-SEDDS and higher retention in tumor than Taxotere. The data suggests that D-SEDDS showed desired stability, enhanced oral bioavailability and in vitro antitumor efficacy.

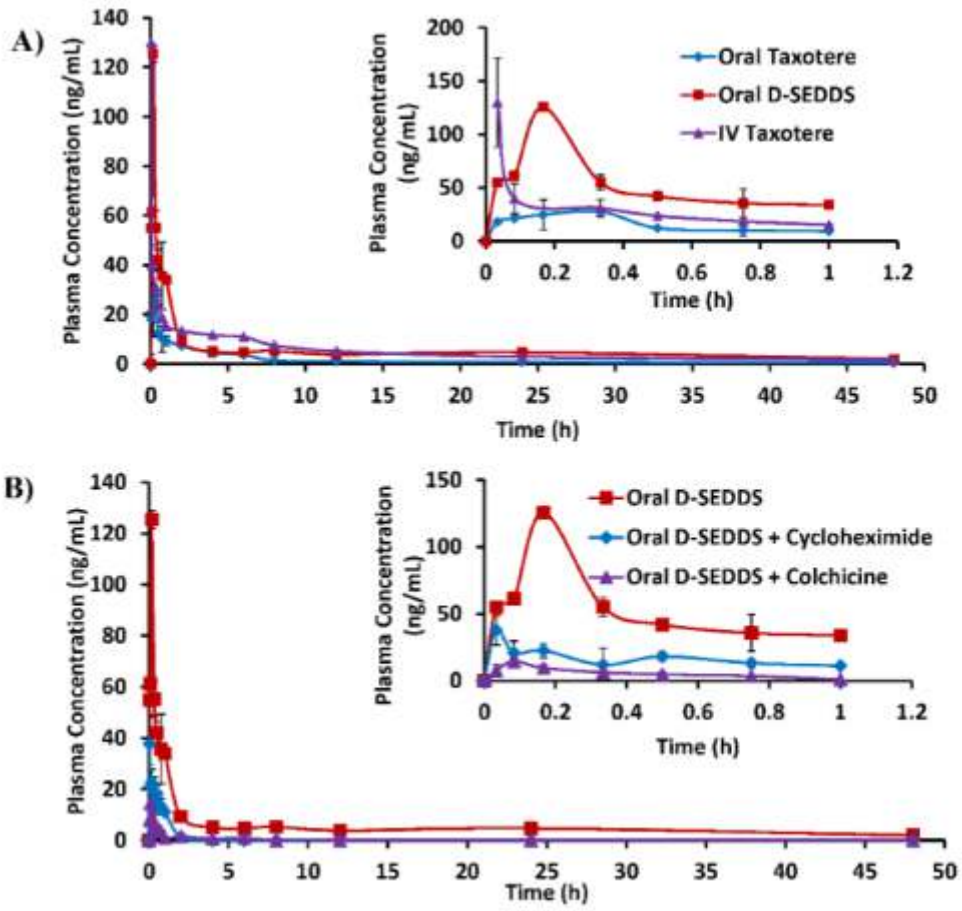


Figure :A) Plasma concentration-time profile of DCT after i.v administration of Taxotere (2 mg/kg, equivalent to free DCT), p.o administration of Taxotere (10 mg/kg, equivalent to free DCT) and D-SEDDS (10 mg/kg, equivalent to free DCT). **B)** Plasma concentration-time profile of DCT after p.o administration of D-SEDDS (10 mg/kg, equivalent to free DCT), Cycloheximide treated D-SEDDS (10 mg/kg, equivalent to free DCT) and Colchicine treated D-SEDDS (10 mg/kg, equivalent to free DCT). Insight shows the expanded plasma concentration profile for 0-1 h duration.

5.2 Pharmacokinetics & Drug Metabolism Studies

5.2.1.1 Pharmacokinetics and bioavailability assessment of Miltefosine

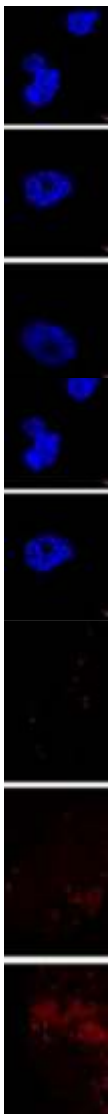
Miltefosine (MFS) is the first effective oral drug for treatment of visceral, mucosal and cutaneous leishmaniasis. In this study, liquid chromatography coupled mass spectrometry (LC–MS/MS) method of MFS was validated in rat plasma and its practical utilization to pharmacokinetic studies in rats for the first time. A rapid, selective and sensitive LC–MS/MS method for MFS in rat plasma was linear over the calibration range of 1–500 ng/mL. MFS and Phenacetin (internal standard) were separated on Phenomenex Luna 3 µ HILIC 200A column under isocratic condition using methanol: 0.1% formic acid in triple distilled water, 90:10 (v/v) mobile phase at a flow rate of 0.8 mL/min. The total chromatographic run time was 4.0 min. The intra- and inter-day assay accuracy was observed between 99.45-102.88% and 99.92-101.58%, respectively. The intra- and inter-day assay precision was observed between 2.68-5.54% and 2.35-5.94%, respectively. The validated assay was practically applied to determine the plasma concentrations after oral and intravenous administration of MFS to rats. After oral administration, MFS showed C_{max} (3200.00 ± 95.39 ng/mL) was observed at 12.00 h (t_{max}) and t1/2 was 102.36 ± 16.65 h. The absolute bioavailability of MFS was 60.33 ± 2.32% (Table).

5.2.1.2 Pharmacokinetics, metabolism, bioavailability, tissue distribution and excretion studies of 4655-K-09

Oral bioavailability, metabolism, tissue disposition and excretion of 4655K-09, a novel HMG-CoA reductase inhibitor in male Sprague Dawley (SD) rats was evaluated at oral 25 mg/kg. *In vitro* metabolism studies were carried out in different rat tissues, S9 fractions to evaluate primary organs responsible for conversion of parent 4655K-09 to its major active metabolite K-9T. The quantification of both parent and metabolite in different biological matrices was performed using LC-MS/MS method. The oral bioavailability of 4655K-09 was found to be 30% in male SD rats. The biodistribution study was illustrated in terms of tissue to plasma area under curve (AUC)0−∞ ratio (Kp) revealed the preferential distribution of 4655K-09 and K-9T to liver. *In vitro* tissue S9 fraction stability assay demonstrated the rapid and extensive metabolic conversion of 4655K-09 to K-9T, primarily through liver and kidney. Very low amount of parent and metabolite were excreted unchanged in urine and faeces.

Table: Pharmacokinetic parameters of MFS following intravenous and oral administration to rats (n=6).

Pharmacokinetic parameters	Intravenous (Mean ± SD)	Oral (Mean ± SD)
Dose (mg/kg)	0.5	5
$t_{1/2}$ (h)	64.13 ± 19.99	102.36 ± 16.65
T_{max}(h)	-	12.00
C_{max}(ng/mL)	2253.33 ± 460.58	3200.00 ± 95.39
AUC_{0-t} (h*ng/mL)	39881.06 ± 4393.34	250780.01 ± 12258.79
$AUC_{0-\infty}$ (h*ng/mL)	42900.11 ± 3835.49	258831.57 ± 9965.36
$MRT_{0-\infty}$ (h)	97.01 ± 9.38	83.78 ± 4.88
CL (mL/h/kg)	11.72 ± 1.08	19.34 ± 0.73
V_d (L/kg)	1.09 ± 0.36	2.86 ± 0.52
Bioavailability (%)	-	60.33 ± 2.32



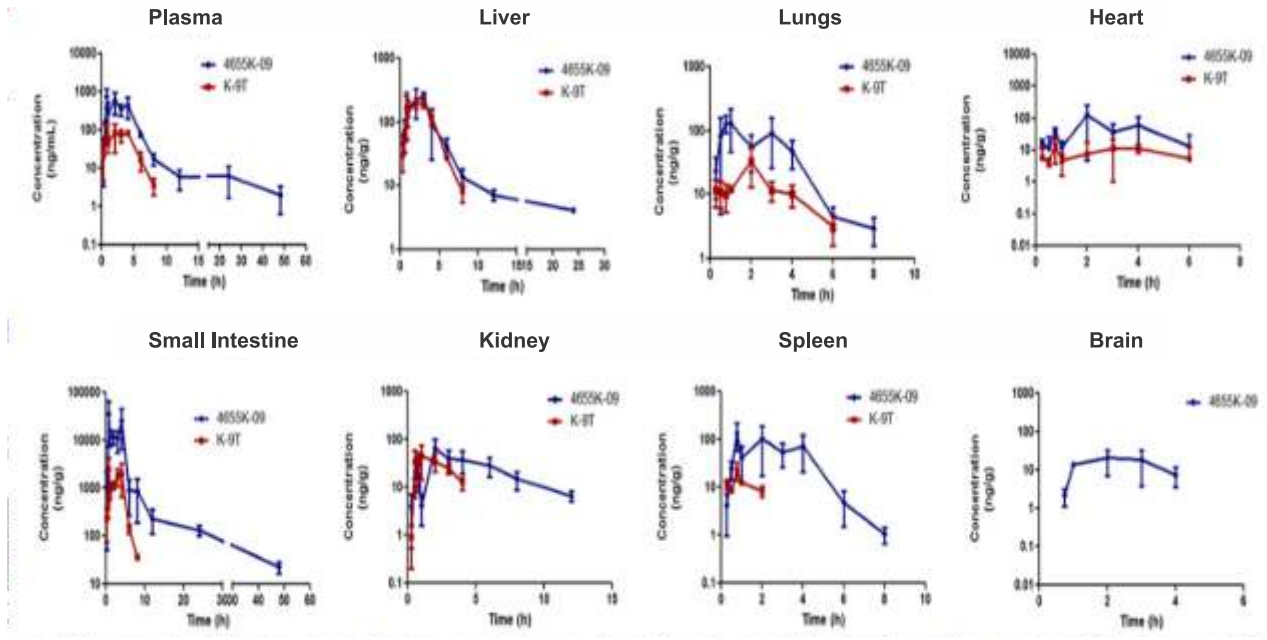


Figure: Tissue concentration-time profile of 4655K-09 and its metabolite K-9T

5.2.1.3 *Invitro* metabolism, CYP profiling and metabolite identification of *E*-and *Z*-guggulsterone

The polyphenol *E*- and *Z*-gugggulsterone (GS) is an antagonist ligand for the Farnesoid X Receptor (FXR) and known to possess potent hypolipidemic properties. GS was found to be an inhibitor of CYP2C19 with an IC50 value of 2.1 μM. GS showed high plasma protein binding (96 %), and low to moderate binding with human serum albumin (~70%). Unbound intrinsic clearances (CLint, *in-vitro*) was determined to be low at 0.029 ± 0.0009 and 0.027 ± 0.008 mL/min/mg protein for E- and Z-isomer, respectively in human liver microsomes. Nineteen phase I and II metabolites were identified and hydroxylation was found to be major metabolic pathway using human liver microsomes and S9 fractions.

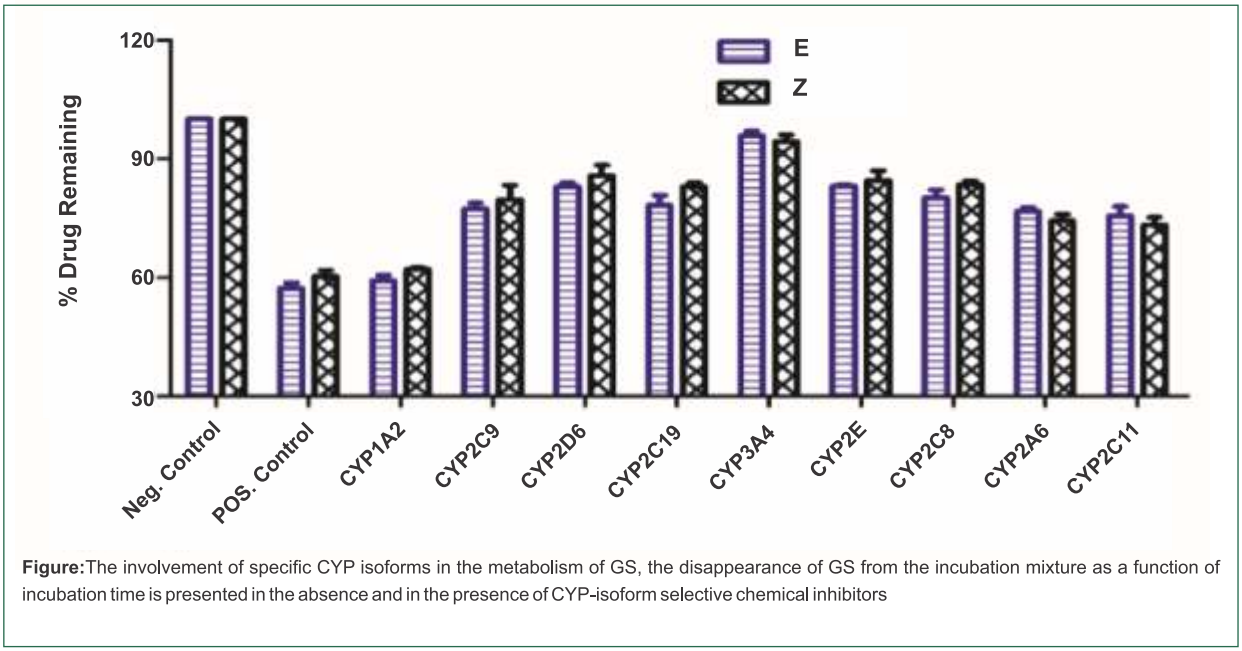


Figure: The involvement of specific CYP isoforms in the metabolism of GS, the disappearance of GS from the incubation mixture as a function of incubation time is presented in the absence and in the presence of CYP-isoform selective chemical inhibitors

5.2.1.4 Simultaneous quantification of luteolin, wedelolactone and apigenin:

Eclipta alba (Bhringraj) in ayurveda has been widely used as a traditional medicine for its multi-therapeutic properties for ages. Luteolin (LTL), wedelolactone (WDL) and apigenin (APG) are the three main bioactive phytochemicals present in *Eclipta alba* extract. However, there was a lack of sensitive bioanalytical method for the pharmacokinetics of these free compounds in plasma which majorly contributes for their activities after oral administration of *Eclipta alba*. The present study aims to develop a sensitive, rapid and reliable liquid chromatography tandem mass spectrometry (LC-MS/MS) method for the simultaneous estimation of mice plasma concentrations of LTL, WDL and APG using quercetin as an internal standard for the pharmacokinetic analysis. Analytes were separated on Phenomenex Luna C18 column with mobile phase containing methanol: acetonitrile (90: 10, v/v) and 0.1% formic acid in 10mM ammonium formate buffer in the ratio of 70: 30 (v/v) in isocratic mode. Liquid-liquid extraction was optimized using Hansen solubility parameters and diethyl ether finalized as an extraction solvent for the recovery ranging from 61 to 76% for all analytes in mice plasma. The validated method has an accuracy and precision over the linearity range of 0.1–200 ng/mL with a correlation coefficient (r2) of ≥0.997. The intra and inter-day assay accuracy was between 98.17 and 107% and 95.83–107.89% respectively and the intra and inter day assay precision ranged from 0.37–6.05% and 1.85–10.76%, respectively for all the analytes. Pharmacokinetic parameters of LTL, WDL and APG in mice after oral dose of *Eclipta alba* chloroform extract 50 mg/kg using Non compartmental model analysis of Winnonlin Version 5.1 (Table). This validated method can be used for future clinical investigation studies of *Eclipta alba* extracts.

5.3 Regulatory Toxicology and Pharmacology studies

During this period the following molecules were evaluated for further development

5.3.1 CDRI219-C003

(Glucocorticoid induced osteoporosis)

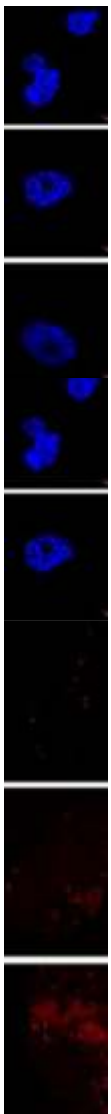
CDRI 219-C003 was tested in the doses of 250, 625, 1250 and 2500 mg /kg and frequency, tidal volume, inspiratory time, expiratory time, Peak inspiratory flow (PIF), Peak expiratory flow (PEF), Enhanced pause (Penh), Minute volume and airway resistance was studied. The oxygen Saturation studies in conscious rats were also undertaken. The compound was found safe.

Telemetric studies on 219-C003 compound on QT interval elongation using live conscious rats are also completed. These studies indicate the coronary artery vasocontraction. The compound was found safe.

The effect of the compound was also studied on gross behavioral changes by manual observation and grading using Irwin's Protocol. The locomotor activity, neuromuscular coordination, nociception responses and body temperature was monitored and found unaltered.

Table: Pharmacokinetic parameters of LTL, WDL and APG in mice after oral dose of *Eclipta alba* chloroform extract 50 mg/kg using Non compartmental model analysis of Winnonlin Version 5.1. Values are in Mean ± S.D.

PK Parameter (Units)	LTL	WDL	APG
AUC_{0-t} (ng*h/mL)	7.74 ± 0.09	27.45 ± 0.81	3.82 ± 1.39
$AUC_{0-\alpha}$ (ng*h/mL)	8.17 ± 0.18	30.07 ± 0.84	3.84 ± 1.39
C_{max} (ng/mL)	2.69 ± 0.54	4.32 ± 1.50	1.07 ± 0.73
T_{max} (h)	1.40 ± 0.50	1	1
K_{el} (h^{-1})	0.14 ± 0.04	0.12 ± 0.01	0.61 ± 0.03
$t_{1/2}$ (h)	5.25 ± 1.28	5.81 ± 0.81	1.14 ± 0.07
$V_{z\text{-}obs}$ (L/kg)	92881.20 ± 23170	27862.40 ± 3527	47290.80 ± 19120
$CL_{z\text{-}obs}$ (L/h/kg)	12246.10 ± 273	3326.60 ±93	28337.20 ± 9843
MRT (h)	5.05 ± 0.32	8.43 ± 0.56	5.01 ± 0.56



Bacterial reverse mutation assay was completed with219-C003 in 4 *Salmonella* tester strains TA 97a, TA 98, TA 100 and TA 102. With 10, 33, 100, 333 and 1000µg/plate and was found non mutagenic.

Micronucleus test in swiss mice was conducted by treating219-C003 by oral route at the doses of 0.625g, 1.25g and 2.5g/ kg and was found to be non clastogenic and non aneugenic

Similarly, Chromosomal aberration test in Swiss mice was conducted in mice by treating219-C003ract) at the doses of 0.625g, 1.25g and 2.5g/ kg orally and was found to be non clastogenic.

The acute toxicity studies of 219-C003 was carried in rats and mice upto a dose of 2.5g/kg and found to be tolerated well.

5.3.2 S007-1500 (Fracture healing)

Based on the study of repeat dose toxicity data on rodents we initiated a repeat dose toxicity study in dogs.

5.3.3 96/261 (Antileishmanial)

The acute toxicity studies in mice and rats were initiated following which 28days repeat dose toxicity studies will be planned.

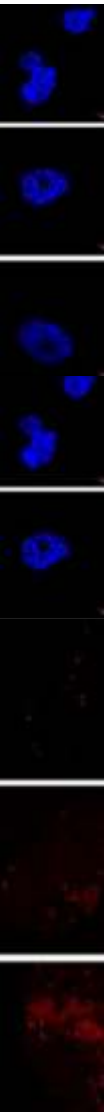
5.3.4 S001-1793 (Antimalarial)

The repeat dose toxicity studies in rodents were completed and the histological examinations of different tissues are in process.

5.4 Clinical studies

5.4.1 S007-867 (Anti-thrombotic)

The data generated in different laboratories compiled, prepared IND document & filed.



Section II
Scientific & Technical Services

GLP Test Facility for Pharmaceuticals

The following studies are conducted under certificate of GLP compliance for various sponsors to meet the regulatory requirements:

- Acute toxicity study
- Oxygen Saturation study
- Respiratory Safety study
- CNS Safety Pharmacology
- CVS Safety Pharmacology

Types of Chemicals/Materials for Toxicity Studies:

- New chemical entities (NCE)
- Pharmaceuticals (Small molecules, Bio-similars, Bio-therapeutics, Vaccines, etc.)
- Veterinary drugs
- Nutraceuticals
- Phytopharmaceuticals
- Plant extracts in Ayush mode

Test Systems for the Studies:

- Rat (Wistar, SD, CF)
- Mouse (Swiss albino; C57Bl/6; Balb/C)
- Rabbit (New Zealand White, Belgium)

Studies under GLP Compliant Conditions:

- AMES assay
- *In vivo* micronucleus assay
- *In vitro* micronucleus assay
- *In vivo* chromosomal aberration assay
- *In vitro* chromosomal assay
- Repeat dose toxicity studies in rodents (28, 90 and 180 days)
- Repeat dose toxicity study in non-human primates
- Male fertility study
- Female fertility study
- Teratogenicity study
- One generation reproductive toxicity
- Two generation reproductive toxicity

Test Systems for the Studies:

- Rat (Wistar, SD, CF)
- Mouse (Swiss albino; C57Bl/6; Balb/c)
- Rabbit (New Zealand White, Belgium)
- Monkeys (*Macaca mulata*)
- Guinea Pig (Hartley)

Scientific & Technical Services

1. Business Development & Intellectual Property

1.1 Business development activities

The Institute sustained to explore the business development opportunities by establishing liaison with national and international organizations and industries in order to have more public–private partnership at early stage of the development and to have collaborations for new leads. The major new contracts/assignments signed/undertaken by the Institute during reporting period are as follows:

L to R : Mr. Naseem Ahmed Siddiqui & Dr. Sripathi Rao Kulkarni

Sl. No.	Title	Client / Collaborator	Signing Date
Demonstration of Technology (Know-how)			
1.	Demonstration of Know-how on process technology for the preparation of the compound S008-399 on lab scale	Ortho Regenics, Hyderabad	26-09-2018
License Agreement			
1.	CSIR-CDRI bioactive extract and formulation of 219-C002	Pharmanza Herbal Pvt. Ltd., Dharmaj, Gujarat	17-02-2018
Sponsored Agreement			
1.	Assessment of a product on systemic calcium and skeletal parameters in estrogen deficient (OVX) rats	Tata Chemicals Limited, Mumbai	05-10-2018
Testing Services			
1.	*In vivo* testing of topical formulation for wound healing	ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly	31-12-2018
2.	To study the therapeutic effect of a sample against ageing in experimental animals	Periyar Maniammai Institute of Sciences and Technology, Thanjavur, Tamilnadu	26-10-2018
3.	X-ray diffraction studies of samples	Cadila Healthcare Ltd, Ahmedabad.	13-07-2018
4.	Bone PD parameters	Eurofins Advinus Ltd., Bengaluru	24-09-2018
5.	Determination of absolute stereochemistry of single crystal X-ray analysis	Sun Pharmaceutical Industries Ltd., Gurugram	22-06-2018
6.	Raising antiserum against purified antigens in rabbits	ABio Laboratories, Gonda	21-05-2018
Secrecy Agreements			
1.	Information disclosed by CSIR-CDRI for development of their hit/lead/candidate drugs/molecules	Adamya Herbal Care Pvt. Ltd., Lucknow	27-12-2018
2.	Outsourcing the synthesis of 3 kg material of S007-867 prepared under GMP accredited facility	GVK Biosciences Pvt. Ltd., Hyderabad	27-12-2018
3.	Information disclosed by CSIR-CDRI for development of their hit / lead / candidate drugs / molecules and utilizing the R&D facilities	Dr. Reddy's Laboratories Ltd., Hyderabad	29-11-2018
4.	CSIR-CDRI standardized fraction 4655/K09 for hypertriglyceridemia	Himalaya Drug Company, Bengaluru	25-10-2018
5.	Outsourcing the synthesis of 3 kg material of S007-867 prepared under GMP accredited facility	Jubilant Chemsys Ltd., Noida, UP	11-10-2018
6.	Novel cancer biomarker for the early detection of cervical cancer	DNA Lifesciences Pvt. Ltd., Bhubaneswar	07-10-2018

7.	CSIR-CDRI developed a novel orally active fracture healing synthetic molecule S007-1500	PS3 Laboratories LLP, Hyderabad	28-08-2018
8.	CSIR-CDRI plant product N-012-0001 for the early management of Benign Prostatic Hyperplasia (BPH)	Lumen Marketing Company, Chennai	10-08-2018
9.	Manufacturing of CDRI compound S007-1500 for research work	GVK Biosciences Pvt. Ltd., Hyderabad	11-04-2018
10.	Information disclosed by CSIR-CDRI for development of hit / lead / candidate drugs / molecules	Femera Life Sciences & Healthcare Pvt. Ltd., Pune	12-04-2018
11.	Cost effective non-infringing synthetic routes.	Dr. KPC Life Sciences Pvt. Ltd, 24 Parganas (South), W.B.	05-04-2018
12.	Indo German Science and Technology Centre 2+2 call 2017 for submitting the joint project on CDRI compound S-008-399 under the thematic area Advanced Manufacturing and New Materials.	Orthoregenics, Hyderabad, Eberhard Larls Universitat Tubingen, Germany and Curasan AG, Germany13-02-2018	
13.	cGMP manufacturing and formulation of CDRI compounds 97/78, 99/373 for human clinical trials	Gennova Biopharmaceuticals Ltd., Pune	07-02-2018
14.	A non-steroidal oral contraceptive pill designated as Centchroman and other products	CIPLA Ltd., Mumbai	29-01-2018
15.	Information disclosed by CSIR-CDRI for development of hit / lead / candidate drugs/molecules	Aurbindo Pharma Ltd., Hyderabad	08-12-2017
Memorandum of Agreements			
1.	Determination and structure elucidation of bioactive compounds from the selected traditional medicinal plants of Mizoram with a focus on anticancer compounds	DBT, New Delhi	20-12-2018
2.	*In silico* design, synthesis, bioassay and elucidation of novel analogues of vasicine and other quinazolinone compounds as potent antimycobacterial agents	DBT, New Delhi	04-10-2018
3.	Design and synthesis of hybrid molecules for multi-drug-resistant tuberculosis	DBT, New Delhi	07-08-2018
4.	Characterization of *L. donovani* S-adenosyl Methionine Decarboxylase: Spermidine Synthase Interactions	DBT, New Delhi	16-07-2018
5.	Small molecule inducers of redox stress targeting antibiotic resistance	DBT, New Delhi	29-06-2018
6.	Identification of the role of Serine7 phosphorylation of RNA polymerase II CTD in the mRNA transcription	DBT, New Delhi	24-05-2018
7.	Evaluation of TGF-β mediated signaling mechanism in the endometriosis using mouse model	DBT, New Delhi	24-04-2018
8.	Regulation of pancreastatin to control the energy homeostatis in diabetes	DBT, New Delhi	21-02-2018
9.	Understanding the role of RBR-E3 Ubiqutin ligase in *P. falciparum* and exploring its potential for pharmacological intervention	DBT, New Delhi	01-02-2018
10.	Synthesis and anti-parasitic activities of quinoline-tetrahydropyrimidine hybrids with special reference to anti-malarial, anti-leishmanial and anti-filarial activities	DBT, New Delhi	15-01-2018
Memorandum of Understanding for Joint R&D			
1.	To promote institutional linkage between CSIR-CDRI and IIT, Mumbai and to explore other avenues for possible collaborative research programs in specific fields of interest	IIT, Mumbai	01-01-2019

2.	To promote institutional linkage between CSIR-CDRI and JNCASR and to explore other avenues for possible collaborative research programs in specific fields of interest	Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru	20-12-2018
3.	To promote institutional linkage between CSIR-CDRI and IIT, Guwahati and to explore other avenues for possible collaborative research programs in specific fields of interest	IIT, Guwahati	24-09-2018
Material Transfer Agreements			
1.	THP-1 cell line (ATCC-TIB-202)	ATCC, USA	03-01-2019
2.	Plasmids 73080-pEGFP-hGal3, 62734-mAG-GAL3 & 38086-pFRT/To/his/Flagiha-Prdx1	Addgene, USA	03-10-2018
3.	pCDH-CB1-HIF2a-GFP-T2A-Puro pcDNA3-EGFP-C4-Nrf2	Addgene, USA	10-09-2018
4.	Recombinant plasmids cloned HA/FLAG tagged HPV16 E5 gene (plasmid#37874) and luciferase reporter plasmid (plasmid#48688) for expression in mammalian cells.	Addgene, USA	29-08-2018
5.	Provide 2-arylbenzothiazole (thioflavin) derivatives for beta-amyloid plaque binding for R&D use	SGPGIMS, Lucknow	20-07-2018
6.	MOLM-13-GFP Luc cells	CTL, Cornell University, New York, USA	18-05-2018
7.	piRFP670-N1 (Plasmid#45457)	Arbert Einstein College of Medicine, USA	11-05-2018
8.	Plasmid pSTMT3-M	Addgene, USA	11-04-2018
9.	Recombinant plasmids clones pU6-(Bbsl) CBh-Cas9-T2A-mCherry-H1 (BamH), plasmid#64217, 83306, 71783, 72835, 17603, 17605, 17604, 17606 & 17608	Addgene, USA	04-04-2018
10.	Cell line THESCs; Enndometrium; Human 1 ml	ATCC, USA	25-01-2018
11.	Expression clone and recombinant purified protein of Trypanothione reductase of *Leishmania donovani*	National Institute of Pharmaceutical Education & Research, Kolkata	03-01-2018
Other Collaborative Research Agreements			
1.	Drugs from sea- Marine natural product inspired drugs leads (Drugs from sea)	MoES, Govt. of India, New Delhi & CSIR-IICT, Hyderabad	26-11-2018
2.	Development of preclinical formulation of radioprotective RK-IP-006 and its pharmacokinetic evaluation as per regulatory guidelines	Institute of Nuclear Medicine & Allied Sciences, Defence Research & Development Organization (DRDO), Delhi	25-10-2018
3.	Combination formulation of *Spinacea oleracea* and *Boswellia serrata* for synergistic efficacy for the treatment of osteoarthritis / joint related disorders	Pharmanza Herbal Pvt. Ltd., Dharmaj, Gujarat	08-08-2018
4.	A Global Network for Neglected Tropical Diseases	University of Durham, The Palatine Centre Stockton Road, DH1 3LE, UK	6-07-2018
5.	Synthesis and bioevaluation of chemical libraries of carboling-based mimics of marine natural products	MoES, New Delhi	19-06-2018

1.2 Intellectual property management activities

Implementation of Intellectual Property Management Policy to ensure timely completion of procedures for filing and grant of patents for the institute and their maintenance. List of patents filed and granted during the year are detailed in the Research Output section of this report. The assignments undertaken during the reporting period are as follows.

- Protection of innovations arising from the institute's pursuits
- Coordination for filing and grant of Indian and foreign applications/patents with CSIR-IPU, CSIR-URDIP, Collaborative partners (Industry & Academia) and IP Law attorneys in respect of various jurisdictions
- Maintenance of Patents and Management of patent portfolio
- Recommendations for renewal of patents/ commercialization status
- Maintenance of information on IP system/ surveillance
- Respond to queries on IP related issues
- Training and dissemination of IP in the region

2. Sophisticated Analytical Instrument Facility

Sophisticated Analytical Instrument facility at CSIR Central Drug Research Institute, Lucknow is more than 40 years old and is one of the first four such facilities set up by the Department of Science & Technology (DST), Government of India for fulfilling the following objectives:

- Provide facilities of Sophisticated Analytical Instruments to CSIR-CDRI scientists and other users from academic institutes, R&D laboratories and industries to enable them to carry out measurements for R&D work.

L to R- Dr. Sanjeev Kanojiya, Dr. Ravi Sankar Ampapathi, Dr. Brijesh Kumar, Dr. Sanjeev Kumar Shukla

- Acquire and develop capability for preventive maintenance and repair of sophisticated instruments and organize short-term courses/workshops on the use and application of various instruments and analytical techniques.
- Development of new measurement/analytical techniques: Apart from providing routine analytical techniques/methods of analysis available on the instruments, efforts are made by the SAIF to develop new techniques/methods of analysis to put the instruments to their full use and offer them to the scientists for exploring new dimensions in research in various areas of science and technology.
- Train technicians for maintenance and operation of sophisticated instruments
- Organize training programs and workshops for internal and external candidates.
- Organize Skill Development programs for external candidates
- Apart from providing analytical services, SAIF is involved in R & D activity of the institute with several ongoing projects and a large number of Ph.D. students.

Workshops & Training Programs Organized

- HPLC Basics and Method Development Workshop from 18th-20th June18 followed by one day seminar on Applications of HPLC and LC-MS/MS in drug research on 20th June2018 and three day workshop from 21-23th June18 were organized to increase awareness of using LC-MS and HRMS instruments for natural product chemists.
- National Workshop on “Small Molecule Analysis by NMR Spectroscopy & Mass Spectrometry” during 12th-14th December, 2018

Skill Development Program

- Under the CSIR Skill Development Initiatives; in the first batch April to June-2018, 3 aspirants were trained. In the SDP-Batch-3 Aug to Nov-2018, 27 Students were trained.

Digital library of Indian medicinal plants and their metabolites: *a bioinformatics tool/product*

Institute has developed a prototype of bioinformatics product to explore chemical diversity of Indian medicinal plant. The present creation provides mass spectrometry

Table : Analytical Services provided by the SAIF facility during 2018 are as follows:

Facilities	No of External samples analysed	No of Internal samples analysed	Total
Mass Spectrometry	2140	21053	23193
NMR Spectroscopy	2284	22296	24580
IR & UV-Vis	383	878	1261
Flow Cytometry	156	10065	10221
HPLC & OR	70	2823	2893
Micro Analysis	306	330	636
Electron Microscopy	199	2187	2386
Total	5538	59632	65170

based methodologies to explore the chemistry of medicinal plants. It has targeted applications for medicinal plants chemistry.

1) Identification and authentication of plant species based on their Mass Spectrum/HPLC/LC-MS Fingerprints.
2) Discovery of known bioactive compounds from previously unknown sources (*inverse search*).
3) Distribution of known compounds in different biological source (Plants/herbs).
4) Identification of known/unknown derivatives of bioactive compounds in different biological source (Plants/herbs) using LC-MS/MS data.

Currently, 316 medicinal plant species has been incorporated into Digital library from 101 families with more than 740 chemical /Mass spectrum fingerprints.

3. National Laboratory Animal Centre

The Division of Laboratory Animals, CSIR-Central Drug Research Institute, Lucknow which is also recognized as the National Laboratory Animal Center (NLAC), is a CPCSEA-registered (Reg. no. 34/GO/Re-SL/BiS/99/CPCSEA), Institutional Animal Ethics Committee (IAEC) monitored and GLP certified (No.: GLP/C-108/2017, DOI: 18.10.2017) R&D support facility of the institute engaged in breeding and production of small laboratory animal species like rodents and rabbits required for biomedical research and experimentation programmes. The facility also serves as national resource center for supply of healthy animals to other CPCSEA registered research and academic institutions across the country. The Center possesses approximately 20 thousand laboratory animals of about 9 species with their more than 25 inbred and out bred strains which is unique in terms of having disease specific, transgenic specialized research animal models for more precise studies on human diseases.

The major objectives of the center are as follows:

- Breeding, production and supply of standard quality laboratory animals for IAEC approved in-house studies and research
- Supply of healthy lab animals to other CPCSEA-approved private/government research and academic organizations.
- Monitoring and maintaining animal health and quality through genetic, microbial, viral, pathological, and parasitological screening of animals.
- Acting as Referral Center for scientific and technical advisory/consultancy on development of research animal facility in accordance with guidelines of the CPCSEA
- Conducting human resource development programmes including organizing symposium/workshop/seminar on various aspects of laboratory animal science and on-hand fresher/advanced practical training in care, breeding and management of laboratory animals
- Publication and dissemination of scientific literature on contemporary issues of laboratory animal science and animal experimentation
- Generation of ECF through animal sales and supplies

L to R- Mr. S. Raja Kumar, Dr. H.K. Bora, Dr. D.S. Upadhyay, Dr. Shishir Kumar Gupta, Dr. Rajdeep Guha, Dr. Dhananjoy Hansda

Animal species available

Sl No	Species	Strains	Genotype	Opening stock (as on 01.01.18)	Closing stock (as on 17.12.18)
1	Mice	Out bred: Swiss	Out bred	1406	1097
		Inbred: C57BL/6, CBA , BALB/c, DBA1J, DBA2J, db/db	In bred	6184	8004
		Transgenic: NOS1,NOS2,ApoE,	Inbred	766	1050
2	Rat	Outbred: SD, CF, DR,	Out bred	2342	2760
		Inbred: Wister, Lew, SHR	Inbred	940	1675
3	Hamster	Syrian golden	Out bred	648	1167
		Syrian/golden	Inbred	396	423
4	Gerbil	Mongolian	Out bred	502	482
5	Mastomys	Coucha	Out bred	532	545
6	Guinea pig	Duncan Hartley	Out bred	267	544
7	Rabbit	NZW & Belgian	Out bred	439	508
8	Monkey	Rhesus	Out bred	47	44
9	Sheep	Marino	Out bred	1	1
			TOTAL	14470	18300

New animal strains procured

Species	Strains	Source
Mice	C57BL/6J (6 nos)	National Institute of Immunology, New Delhi
Mice	Balb /c J	
Mice	FasKO	Jackson laboratory, USA
Mice	NuJ	

Experimental animal supplied for research purpose:

Number of experimental Animals supplied for research purpose			
Animal Species	**In-house supply**	**Supplied to other organizations**	**Total Supply**
Mouse	11864	2289	14153
Rat	5793	1264	7057
Hamster	1374	204	1578
Mastomys	130	0	130
Gerbil	137	0	137
Guinea pig	20	141	161
Rabbit	163	440	603
Total	**19481**	**4338**	**23819**

3.1 Experimentation on Non-Human Primates

Nonhuman primate facility of LAF is also approved by the CPCSEA for experimentation on monkeys for the studies and experiments in the area of regulatory toxicology, anti-malarial and anti-leishmanial screening of novel compounds and vaccines. Eco-friendly NHP rehabilitation unit has been developed according to the norms of the CPCSEA to rehabilitate the surviving monkeys after termination of the experiment. Proper management and due veterinary care is extended to these animals round the clock by the expert veterinarians.

Two numbers of CPCSEA approved research projects on Rhesus monkeys were performed during this period as per details given below:

1. *"S007-867:28 days Toxicity study in rhesus monkey by oral route"*
2. *"Preclinical efficacy evaluation of potential anti-malarial compound triphasphate salt of CDRI S0011-1793"*

Nonhuman primates maintained in the units were periodically examined physically and clinically for their physical and physiological wellbeing. Screening of fifty fecal samples was made through microscopic examination for presence of endo-parasites state, while skin scrapping samples were examined for presence of ecto-parasites especially the mange mites and lice. Tuberculin testing and chest radiography were done for screening of tuberculosis. Post mortem examinations were carried out for the animals sacrificed /died in during the course of experimentation as well as rehabilitation.

Status of animals in NHP facility:

Species maintained	Brought forward	Animals under experiment	Animals procured	Animals in rehabilitation unit	Animals euthanized as per protocol	Current stock position
Rhesus monkey	47	31	0	13	3	44

3.2 Parasitological monitoring of animals:

- In rodents, for detection of ectoparasites, like mites, lice etc living in the skin, samples of the piece of the hair or deep skin scrappingwere collected and examined microscopically.
- Faecal samples were collected for detection of endo-parasites or their eggs/ova by means of microscopic examination. Direct smear technique was performed to detect the infection.
- Total 1170 samples were screened, out of which 940 samples were collected from rodent colonies (mouse, rat, hamster, mastomys and gerbil), guinea pigs (120 nos) and rabbits (110 nos).
- Observation showed occasional presence of cestode (*H. nana*) infection in rodents, nematode (*Syphacia spp)* and mite infestation. There was rare incidence of pinworm infection in rabbit colony.
- After parasitological monitoring, periodic prophylactic treatment was provided using anthelmintics like albendazole, praziquantal or ivermectin to keep the animal colony healthy.

3.3 Microbial monitoring of animals

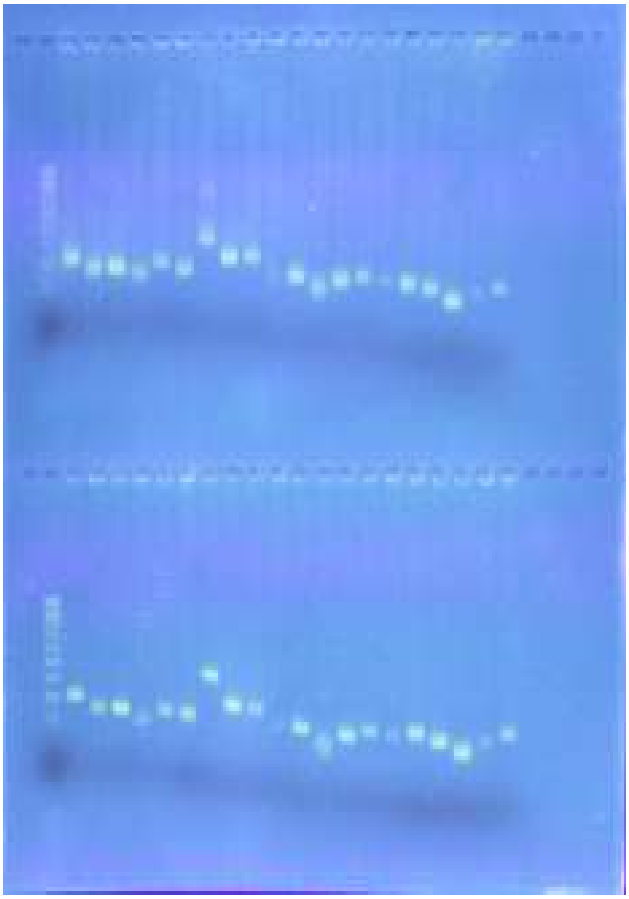
Rodent and non-rodent animal colonies were observed for potential infections that affect biomedical research outcome and can have adverse effects on health of the animals. Most of the animal colonies were observed to be free from any clinical infections and no outbreak of any disease was reported during the Agarose gel electrophoresis of 20 microsatellite panel of Balb/c male & female miceperiod. Hygienic conditions were periodically reviewed and improved to keep the animals healthy.

3.4 Pathological monitoring of animals:

Diseased or moribund animals from the breeding colonies showing clinical symptoms were subjected to necropsy and their gross pathologies were recorded. Representative tissue samples were also collected and preserved for further confirmative histopathological diagnosis as per details given below:

3.2 Genetic monitoring of animals

A panel of twenty SSLP markers (D1Mit17, D1Mit77, D1Mit171, D2Mit75, D3Mit54, D3Mit200, and D4Mit15, D4Mit53, D5Mit10, D6Mit39, D6Mit102, D7Mit25, D7Mit222, D9Mit172, D16Mit5, D17Mit24, D17Mit28, D18Mit14, D18Mit49, D18Mit87) was used as primary genetic screen to genetically monitor the common inbred mice strains (Balb/c, C57BL/6J), and six markers (D5RAT48, D8RAT55, D14MIT9, D11RAT11, D18RAT61, D20MGH1) were analyzed for Rats (Wistar, SD, CF and SHR). Genetic profiling of the animals examined confirmed the homozygous state of the inbred strains of the animals being bred and maintained in the animal facility of the institute.



Agarose gel electrophoresis of 20 microsatellite panel of Balb/c male & female mice

Species	No of animals examined	Gross pathologies observed	Remarks
• Rat (SD and Wistar) • Mice (Swiss, Balb/c, C57Bl/6) • Guinea pig • NHP	27 09 10 01	Generalized congestion and hemorrhages, gastro-enteritis, bacterial abscess, External injuries, ecto-parasitic infestation, wet tail disease	No occurrence of any outbreak of disease in any animal colony

3.6 Training programmes organized

- Certificate course under Skill India Initiative on "Care and management of laboratory animals and experimental techniques" conducted from 7th May to 15th June 2018 and 12th Nov to 21 Dec. 2018.
- "Scientific and Technical Awareness Training Program in Animal Ethics & Experimentation" for 51 research scholars under AcSIR PhD course was conducted in three batches from August 06-31, 2018.

3.7 Ethics in animal experimentation programmes of the institute

Depending upon requirement the IAEC meetings were convened periodically during the year. More than 150 fresh and ongoing animal research proposals including in-house, collaborative and sponsored/extramurally funded were reviewed and granted approvals. With recommendation of the IAEC, one proposal requiring rhesus monkeys has been approved by the CPCSEA, to use rhesus monkeys for malaria study.

4. Human Resource Development Unit

4.1 Skill Development Program

Skill development program under the aegis of CSIR Integrated Skill Initiative, is being coordinated by the HRD unit. This program is an initiative launched to empower the youth of our country with skill sets which make them more employable and more productive in their work environment. We offer four certificate courses of level IV to VII under the CSIR-CDRI, Skill Development Program. The courses will meet the aspirations of students, young researchers and industry sponsored personnel looking for training. These courses will provide an opportunity for skill development and hands-on experience in the chosen area. Courses conducted during the reporting period are detailed in the Research Output section.

4.2 Post-graduate Training Program

This unit also coordinates the Post-graduate training program under which Post graduate students from Universities and affiliated colleges across the India are trained for 4-6 months in different aspects of biomedical research. Number of trainees during the reporting period are detailed in the Research Output section.

L to R - Mr. Vinay Tripathi, Mr. Prem Prakash

4.3 JIGYASA – Quest for Curiosity

JIGYASA, a student- scientist connect programme, which was initiated, by Council of Scientific and Industrial Research (CSIR) and Kendriya Vidyalaya Sangathan (KVS) last year. The objective of the programme is to engage students in practical activities to get a flavor of research in CSIR-CDRI by extending classroom learning to research and laboratory-based learning at early age. Details of visits by KVS schools are given in events & activities section.

The program will promote Science education among children and the expected outcome will be:

- Developing conceptual clarity amongst children
- Establishing linkage between classroom and real life experience.
- Interaction with scientists and research scholars will motivate students for careers in science.
- Promote Science education by nurturing potential talent of students;
- Creation of scientific temper amongst students and teachers by "doing science".
- Students will be encouraged towards experimentation and innovativeness to create positive perceptions towards science
- Create a positive image of scientists by showcasing the pride for the passion.
- Enhancing the scientific approach of children by explaining simple science concepts around them
- Play a key role in the emergence of new student entrepreneurs.
- Awareness on emerging global/country issues
- Training and development of teachers is important and will be improved.
- Science model exhibition and quiz competitions

4.4 Dissemination of Technical Information

- Maintaining and updating the CSIR-CDRI Social Media (Facebook & Twitter)
- Biological screening services for external users
- Respond to queries from individuals, Govt./non-Govt. agencies etc.
- Print and Electronic Media management
- Communication within and outside the institute
- Management of database on projects, staff, budget, ECF, awards, research fellow's conferences / symposia / seminar / workshop etc.

4.5 ISTAG

- Processed 14 (Fourteen) no of foreign deputation proposals of scientists and other technical staff visiting abroad to attend conferences, meetings, fellowships, bilateral exchange programme and instruments trainings etc.
- Providing foreign deputation reports to the Head, ISTAD, CSIR regarding scientists visited abroad

- Arranging training programs for foreign candidates coordination of distinguished foreign visitors/ delegation at CSIR-CDRI
- International collaborative projects, bilateral International cooperation programs

4.6 Institutional Publications

- CSIR-CDRI Annual Report 2017-18 (Hindi)
- CSIR-CDRI Annual Report 2017-18 (English)
- CSIR-CDRI Advertisements
- Inputs for CSIR News and CSIR Annual Report

4.7 ERPS

- Co-ordinate and facilitated various groups for integration of the ERPS implementation at CSIR-CDRI

4.8 RTI

Implementation of Right to Information Act-2005 in the institute for Scientific & Technical matters to promote transparency and accountability in the working of every public authority in India

4.9 Societal Activities under the aegis of Scientific Social Responsibilities (SSR) of Institute

4.9.1 Health Awareness and Outreach Program at villages

CSIR-CDRI, regularly do awareness programme in villages on different disease areas related to health as per its mandate. To fulfil its scientific social responsibilities, CSIR-CDRI, Lucknow, stepped-out for organizing three Health Awareness and outreach programs in villages. Detailed report is given in Events & Activities section.

4.9.2 Students Motivation Programs for various Schools & Colleges

To initiate and promote experimentation and innovativeness in education and bringing confidence to society about relevance of Institute in terms of Social Impact various motivation program were organized in the reporting period. Detailed report is given in Events & Activities section.

5 Scientific Directorate

The Scientific Directorate is looking after three major portfolios viz. Director Secretariat, PME, and Technical Information, apart from Coordination with agencies, and other miscellaneous activities. Significant work carried out during the year are as follows:

Dr. Anand P. Kulkarni

5.1 PME

- Revised budget estimates 2018-19 and Budget estimates 2019-20
- Vetting of project proposals and processing for approval of the competent authorities monitoring of funds and day to day clearance of indent through the Real Time Budget
- Monitoring Tool raised by the scientists & other staff members in various projects.
- Incorporation of newly joined staff and new sanctioned projects in SnP software
- Co-ordination with Finance & Accounts and Stores & Purchase
- Maintenance of all kind of project folders and record keeping at central place
- Vetting of expenditure statements, utilization certificates and processing for approval of the competent authorities.
- Digitized information management
- Coordination with Audit for performance audits
- Management of R&D Portal of the ERPS
- Research Council Meeting coordination, preparation of Executive Summary and Presentation.
- Project Monitoring Meetings

5.2 Director Secretariat

- Support in overall R&D planning activity with inputs from concerned stake holders
- Implementation & follow up reports on policy decisions taken by the Director from time to time
- Preparation of background papers/documents and policy drafts
- Collation and analysis of information pool for informed decisions
- Preparation of reports/documents sought by the CSIR from time to time
- Periodic performance mapping and reports to the Director
- Monthly Reports
- Processing of scientific matters & budgetary requests for Director approval
- Any other activity as assigned by the Director from time to time
- Background work for recruitment of Technical & Scientific Staff
- Nominations for training programs
- Processing of staff nominations for honours & awards and fellowships
- Instrumental support in organization of Institutional events
- Instrumental support in organizing visits of important delegations, VIPs, Industry personnel, etc
- Popular Health Talk and Nobel Symposium organization

5.3 Dissemination of Technical Information

- Respond to queries from various corners (Govt./ non-Govt. agencies)
- Parliament Queries coordination
- Communication within and outside the institute
- Management of database on projects, staff, budget, ECF, Awards, etc.
- Preparation of publicity material.

6 Academic Affairs Unit

The unit serves as a centre for the management of academic activity of research scholars (JRFs/SRFs) working in different divisions of the institute. The academic activities carried out during the period include the following:

- Completion of Pre-Ph.D. course work of 73 students (I and II semester) under AcSIR PhD Program for the session January –December 2018.
- Total 76 JRF/SRFs got registered under AcSIR for their PhD program through interview for the batches commencing August 2018 and January 2019.
- Conducted 54 viva voce exams: 32 students registered with CSIR-CDRI-JNU PhD Program and 22 students registered with CSIR-CDRI-AcSIR PhD Program.
- Seventy-Six (76) students submitted their Ph.D. thesis in this session for the award of Ph.D. degree.
- Comprehensive exams of 44 AcSIR students were conducted during the reporting period.
- Screening and endorsement of Post-Doctoral Fellow (03) and SRF (15) application forms were done from candidates outside CSIR-CDRI to various Indian funding agencies.
- Scrutiny committee meeting of CSIR-CDRI-JNU PhD Program was organized on 18 January 2019 at CSIR-CDRI.
- Meetings of CSIR-CDRI Academic Council were organized to prepare guidelines for carrying out academic activities in the institute.
- Under the aegis of Social Scientific Responsibility (SSR) of Institute, 25 societal projects were coordinated for AcSIR-800 course work of research scholars.

(L to R): Dr. SK Rath, Dr. Saman Habib & Dr. Sanjeev Yadav

7 Information Technology Services

7.1 Software Development/Maintenance

Computer Center has developed, implemented and maintained the following software systems during the reporting period:

- Software enhancement, maintenance and support for old and new SnP Software.
- Compound Submission and Bio-Assay Reporting (CBRS) System and its enhancement for natural compounds.
- CDRI internet and intranet website.
- Requisition for bio-evaluation of compounds from CDRI Repository
- Online request / reporting for small molecule X-ray diffraction facility
- Website for recruitment of project assistants etc.
- Online sample submission/analysis and equipment booking software for SAIF
- Biometric based attendance system for contractual staff of old campus, new campus (Engineering Section, Animal house)
- Biometric based attendance system for student's/Project staff/Trainee
- Enhancement of AEBAS Record Management System(AEBAS+) for regular staff
- MIS application for AEBAS Record Management System for regular employees
- Maintenance of MoES database Application
- Feature enhancements in HRMS system for students
- Enhancement of Software for online Digital Herbarium
- Online Electrical/Civil/Refrigeration/Other Lab Services Job cards
- Software for dispensary automation (under-implementation)
- Instrument online pre-booking system
- Subject expert database, Alumni database, online registration for seminars etc.
- Android mobile application for IT helpdesk
- Implementation of latest DSPACE software
- SMS (Through GSM Modem) and Landline/Mobile Call based monitoring/alert system for Server room temperature monitoring.
- Customization of Desktop Biometric devices for attendance of regular staff.

L to R- Mr. Santosh Shukla, Mr. Kural

- Animal Issue Software
- Co-operative Society Database
- Database for GPF Statement
- Online Budget Monitoring System
- Online Guest House Booking System (under-implementation)
- Visitor Management System
- Vendor Registration Software for CSIR-HQ
- Online Skill Development Program (SDP) registration for CSIR-CDRI Courses
- Online Gate Pass application for visitors
- Management & hosting of *plantmetabolome.cdri.res.in* Plant Metabolites database and Tendem Mass Spectrum Database.
- Vehicle Booking System
- Software for automating Foreign deputation processes
- Website for CTDDR-2019 registration
- Student ID card data collection
- Software for Wireless Controller log

7.2 ICT Infrastructure Management and Services

- Operation and Management of LAN/WAN System comprising of 1500 wired nodes and campus-wide Wireless network and NKN link of 1 Gbps bandwidth.
- Operation and Management of servers and SAN systems
- Comprehensive IT support to institute wide users comprising of approximately 1000 clients.
- Web hosting services for several publicly accessible websites including institute's internet website (www.cdri.res.in)
- Support provided for implementation of e-procurement System
- Provisioning for NIC e-mail services
- Maintenance of PCs as per Standard Operation Procedure(SOP) for Protection and validation of Hardware and Software under GLP
- Hosting of CDRI tenders on website Portal
- Helpdesk for ERP & AEBAS user support
- Skype & Videoconferencing facility
- Operation and Management of CCTV and access control systems
- ICT support to administration for conducting CBT test for recruitment
- ICT support for Audiovisual arrangements
- Bulk procurement of ICT items (Desktop, Laptops, Printers etc.) for institute wide users
- ICT support for implementation of Account-manager
- ICT support for adoption of GeM software
- Procurement and Support for setting up of ICT infrastructure for AMRIT Incubation Center
- Procurement and Installation of Large Sized Digital Signage

8 S&T Knowledge Resource Centre


Shri Suman Mallik

During the year, the KRC has served the purpose and mission of the institute by subscribing and making available the scientific resources to the researchers including students of CSIR-CDRI. Knowledge Resource Centre of CSIR- CDRI also provides information on Biomedical Research in general and drugs and pharmaceutical in particular, to users all across India in academia, drug industry and research institutions. Apart from that large number of students and faculty visited the library during 2018- 2019 as well as about 1134 walk in users from universities and other academic institutions. Present collection of books and bound volumes of journals has reached to 22968 and 73969 respectively including hindi books. Apart from regular journals subscription, SciFinder, Web of Science, Grammarly and other databases were added this year along with resources like Current Protocols in Molecular Biology, Current Protocols in Pharmacology, Annual Reviews, and Methods in Enzymology. The centre also manages, maintains and updates the institute's web OPAC based on KOHA and institutional repository which is available online.

In addition, centre provides services to the scientists of the institute and other scientific organizations in photography, power point presentations, exhibitions, display panels, posters, designing of covers and layouts for institutional publications.

9 Other Lab Services

9.1 Support to Good Laboratory Practice (GLP) Facility

OLS Division maintaining the Institutional GLP Facility as per the OECD Guidelines to comply the statutory requirements of NGCMA, New Delhi.

- Preparation and revision of SOP and other controlled documents in compliances with NGCMA requirements.
- Technical specification verification, procurement, installation and commissioning of GLP equipment.
- Calibration/validation of GLP equipment as per OECD guidelines.
- Troubleshooting/repair of sophisticated GLP equipment.
- Performance check/preventive maintenance of GLP equipment.
- Monitoring and controlling the standard micro environmental conditions in experimental rooms and other GLP labs.

9.2 Audio-Visual Unit

Audio Visual Unit under OLS division looks after the audio visual requirements for institutional scientific lectures, conferences, seminars, workshops, project meetings, selection committee meetings, RC meetings and other general events.

- Operation & maintenance of high end audio and visual systems to ensure smooth functioning during events.
- Preventive maintenance of amplifiers, switchers,

L to R: Er. NK Agarwal, Dr. W Haq, Er. Manoj Rawat, Dr. Ranveer Singh

feedback suppresser, microphones, portable sound systems, speakers and projection systems.

- Up-gradation of audio and visual system to make it compatible with available latest technology.
- Operation & management of Information display system in Auditorium Complex for event information.
- Operation and management of Live broadcast systems.
- Operation & Management of information kiosk installed at auditorium complex.

9.3 Instrumentation

Instrumentation Centre provided efficient and economical repair, maintenance and upkeep of different sophisticated analytical, biomedical, electronics and laboratory equipment in CSIR-CDRI and CDRI-SAIF. Due to non-availability of imported components/spares, equivalent indigenous substitute were used to ensure the smooth functioning of equipment. Tracing of part of circuit were carried out whenever circuit diagram/service manual was not available. Technical specification verification was carried out for the procurement of state of the art new equipment. Division helped the user Scientists to prepare broad based technical specification and to choose right equipment to suit their application.

9.4 Centralized Gas supply & Utility Generation services

Centralized Gas supply and utility services under other lab services at CSIR-CDRI provide crucial technical services in terms of operation and maintaining various centralized Services. Presently following services are effectively functional and maintained under OLS Division at CSIR-CDRI, Lucknow

- Onsite generation of Liquid Nitrogen (LN_2).
- Operation & maintenance of nitrogen gas generation and onsite supply in approx. 500 distribution points in 120 labs.
- Onsite supply and maintenance of LPG gas at work bench.
- Operation & maintenance of vacuum generation services, air compressor and onsite supply at work bench at approx. 500 distribution points.
- In House operation and maintenance of Glass Blowing Unit to manufacture glass capillaries repair of glassware equipment's etc.
- Operation & Maintenance of pharmaceutical grade (ASTM D1193 Grade-III) specification De-ionized water supply at work bench.
- In House Operation & maintenance of Sewage Treatment Plant (STP) & Effluent Treatment Plant (ETP), Biomedical waste disposal through Incineration unit with following up statuary compliances of UPPCB and Ministry of Environment & Forest.
- Operation, up keeping of fire alarm, fire-fighting, fire hydrant system, public announcement (PA) system, fire pumps and Safety stations as per statuary compliances of Department of Fire services, Uttar Pradesh Government.
- Maintaining of various housekeeping services i.e. Pest & rodent control, termite control, fogging, specialized cleaning in Animal care lab, Horticulture services etc. Environmental & Waste management as per statuary /Good Laboratory Practices (GLP) guidelines.

10 Grievance Redressal Cell

During the year, two grievances were received by Grievance Redressal Cell and were addressed as per rule.

11 Laboratory Engineering Services

The Lab Engineering Services Division (ESD) continued to provide Engineering Services to the Institute to maintain the existing infrastructure & services for R & D works and create new infrastructure. The major works carried out during reporting period are as follows:

11.1 Completed works

- Miscellaneous type of up -gradation works for creation of Lab 'AMRIT', i.e. Advanced Platform for Research, Innovation and Translation.
- Construction of fountain at Entrance plaza.
- Development of Sports Complex by creating cricket stadium, toilet facility and covered shed etc.

L to R- Er. Kamal Jain, Er. Parvez Mahmood

- Development of Volleyball court in residential area
- Development of indoor badminton court
- Development of covered parking for Two & Four wheelers
- Provision of tube well at CSIR Scientist Apartment, Sector K, Aliganj, Lucknow.
- Provision of false ceiling in auditorium complex
- Renovation of 11 KV Sub Station, LV Distribution cubicles etc.

11.2 Ongoing works:

- Renovation of Non-human primate facility at First Floor of Primate House, Old Campus, CDRI Lucknow.
- Construction of Radio Isotope Laboratory
- Upkeep of GLP facility of the Institute
- Upkeep of Power supply of the Institute
- Upkeep of Water supply of the Institute
- Upkeep of HVAC system of the Institute

12. Tissue & Cell Culture Laboratory

Dr. Neena Goyal

The Tissue & Cell Culture Laboratory is engaged in maintaining and providing cell cultures to the user scientists within and outside institute. Provision of cell cultures to various research/academic organizations is made available on payment basis. The laboratory at thepresent has 42 different types of mammalian cell lines in its repository out of which some of them are actively being maintained and propagated for our scientist for their various research projects and rest of them are maintained in frozen state.

Task carried out/service rendered during reporting period:

- Provision of 144 cell culture flasks of different cell lines to user scientist under various research projects.
- 32 various cell lines supplied on payment basis to the several academic/research institutions including Jiwaji University, Gwalior; MNNIT, Allahabad; CSIR-NBRI, Lucknow; IIT Madras, Chennai; Integral University, Lucknow;KGMU, Lucknow, Central University of Kerala, Kasargod, Kerala; Ch. Charan Singh University, Meerut etc.
- Training in Cell & Tissue Culture Techniques provided to the people from different academic/research organizations.

Notes

Section III
Research Output

Mitochondria meet from Nov 28

PIONEER NEWS SERVICE :: LUCKNOW

The 7th International Conference of the Society for Mitochondria Research and Medicine is being organised from November 28 to 30 in CSIR-CDRI. The purpose of Mitoconf-2018 is to foster research on basic science of mitochondria, mitochondrial pathogenesis, prevention, diagnosis and treatment.

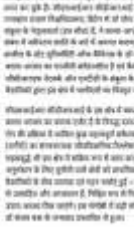
"Mitochondrial diseases result from failures of the mitochondria; specialized compartments present in every cell of the body. Mitochondria are responsible for creating more than 90 per cent of the energy needed by the body to sustain life and support organ function. When they fail, less and less energy is generated within the cell. Cell injury and even cell death follow. If this process is repeated throughout the body, whole organ systems begin to fail. The parts of the body, such as the heart, brain, muscles and lungs, requiring the greatest amounts of energy are the most affected," a CDRI scientist said.

He said that Mitochondrial disease was difficult to diagnose, because it affected each individual differently. "Symptoms can include seizures, strokes, severe developmental delays, inability to walk, talk, see, and digest food combined with a host of other complications. If three or more organ systems are involved, mitochondrial disease should be suspected. Mitoconf-2018 will address "Emerging concepts in Mitochondrial Biology", "Mitochondrial medicine: Current status and future prospects", "Mitochondria: A therapeutic target disease," he said.

The three-day event will include plenary and invited lectures, flash talks and posters by number of International, national scientists featuring investigational biology, clinical aspects and translational biomedical research. Mitoconf-2018 will provide a common platform for assessment of the challenges associated with drug design and development in these areas.

'eed collective efforts to make India TB-free'

'वह बोले बारिश आने दो सब गड्ढे भर जाएंगे'



1 Publications

2017

(Not included in the previous year Annual Report due to late reporting)

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2. Ajay S, Saidhareddy P and Shaw AK. A substrate-directed diastereoselective synthesis of vicinal diamines using an A(3)-coupling strategy: An application to the total synthesis of (+)- and (-)-Epiquinamides. **Asian Journal of Organic Chemistry 6(5), 503-506**
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6. Mishra T, Shukla S, Meena S, Singh R, Pal M, Upreti DK and Datta D. Isolation and identification of cytotoxic compounds from a fruticose lichen *Roccella montagnei*, and it's *in silico* docking study against CDK-10. **Brazilian Journal of Pharmacognosy 27(6), 724-728**
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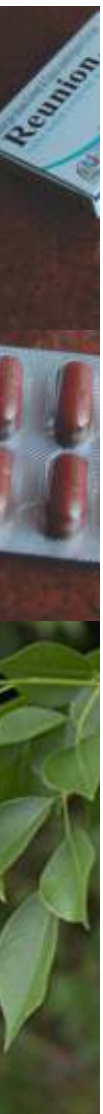

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Book Chapters

1. Das S, Garg T, Chopra S and Dasgupta. A nontuberculous Mycobacteria: An update on infections caused, Laboratory Identification and their Treatment In. **Singh P. (eds) Infectious Diseases and Your Health. Springer, Singapore**

2. M Shukla, I Soni, A Dasgupta and S Chopra. Drugs under preclinical and clinical testing for the treatment of infections caused due to *Staphylococcus aureus*: An update. **In: Singh P. (eds) Infectious Diseases and Your Health. Springer, Singapore**

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2 Patents

2.1 Patents Filed in India

Patent Application No.: 201817035274 **Date of Filing:** 19-09-2018
Title: Substituted methanopyrido [2, 1-a] isoindolones as mAChR modulators for treating various associated pathophysiological conditions and process for preparation thereof
Inventors: Ganesh Pandey, Rajesh Varkhedkar, Divya Tiwari, Prem Narayan Yadav, Shalini Dogra & Yusuf Hussain

Patent Application No.: 201811021504 **Date of Filing**: 08-06-2018
Title: Bioactive extract, fraction and formulation of *Cassia occidentalis* for bone regeneration and the prevention or treatment of Glucocorticoid induced osteoporosis and muscular atrophy
Inventors: Naibedya Chattopadhyay, Subhasish Pal, Sudhir Kumar, Ramakrishna Eppalapally, Padam Kumar, Sapana, Gayen Jiaur Rahaman, Riyazuddin Mohammed, Sabyasachi Sanyal, Anagha Gurjar, Prabhat Ranjan Mishra, Naresh Mittapelly, Kamal Ram Arya, Brijesh Kumar, Srikanta Rath, Arun Kumar Trivedi & Rakesh Maurya,
Supporting Staff: Satish Chandra Tiwari, Athar Husain

2.2 Patents Granted in India

Patent No.: 302104 **Date of Grant:** 10-10-2018
Title: A process for the isolation of standardised antidiarrhoeal fraction and its active compounds from the fruit seed coat of *Xylocarpus granatum* KOEN. and its use thereof
Inventors: Vijai Lakshmi, Ajet Saxena, Ram Raghubir, Mahendra Nath Srivastava, Sudhir Srivastava, Satyawan Singh & Raghwendra Pal
Support staff: Naveen Prakash Misra, Hriday Ram Misra, Suresh Chandra, Tarun Lata, Gupta R.R, Tika Ram

Patent No.: 295689 **Date of Grant:** 11-04-2018
Title: Novel coumarin-chalcone hybrids as anticancer agents
Inventors: Koneni Venkata Sashidhara, Abdhesh Kumar, Manoj Kumar, Jayanta Sarkar & Sudhir Kumar Sinha
Support staff: Sanjeev Meena

Patent No.: 294724 **Date of Grant:** 21-03-2018
Title: Substituted 4-arylthiazole-2-hydrazone derivative for the treatment of tuberculosis
Inventors: Supriya Singh, Kuldeep Kumar Roy, Sandeep Kumar Sharma, Ranjana Srivastava, Vinita Chaturvedi & Anil Kumar Saxena
Support staff: Zahid Ali, Arimardan Singh Kushwaha

Patent No.: 294354 **Date of Grant:** 15-03-2018
Title: Novel dispiro cycloalkanones as inhibitors of NAD+ - dependent DNA Ligase and antitubercular agents
Inventors: Rama Pati Tripathi, Jyoti Pandey, Nimisha Singh, Divya Dubey, Vandana Kukshal, Shalini Bhatnagar, Sudhir Sinha, Vinita Chaturvedi & Ravishankar Ramchandran

Patent No.: 294021 **Date of Grant:** 09-03-2018
Title: Substituted benzfurochromenes and related compounds for the prevention and treatment of bone related disorders
Inventors: Atul Goel, Amit Kumar, Sumit Chaurasia, Divya Singh, Abnish Kumar Gautam, Rashmi Pandey, Ritu Trivedi, Man Mohan Singh, Naibedya Chattopadhyay, Lakshmi Manickavasagam, Girish Kumar Jain & Anil Kumar Dwivedi
Support staff: Abdul Malik & Avinash Kumar

Patent No.: 293872 **Date of Grant:** 06-03-2018
Title: Novel 3, 3-spiroanellated 5, 6-disubstituted -1, 2, 4-trioxanes as antimalarial agents and a process for the preparation thereof
Inventors: Prem Prakash Yadav, Sunil Kumar Puri, Ranjani Maurya & Awakash Soni

Patent No.: 293425 **Date of Grant:** 26-02-2018
Title: An antitubercular formulation of 4-Alkoxy phenyl cyclopropyl alkanols
Inventors: Rama Pati Tripathi, Prabhat Ranjan Mishra, Girish Kumar Gupta, Surendra Singh Bisht, Jyoti Pandey, Vinita Chaturvedi, Sudhir Sinha, Varsha Gupta & Anil Kumar Dwivedi
Support staff: Vinod Kumar Maurya, Hori Lal, A.S.Verma & Chandra Mool

Patent No.: 290171 **Date of Grant:** 30-11-2017
Title: Novel furano- and pyranoflavonoids as antidiabetic agents
Inventors: Rakesh Maurya, Atul Goel, Tadigoppula Narender, Arvind Kumar Srivastava, Anil Kumar Rastogi, Suresh Chandra Agarwal, S.M.

Rajendran, Chandishwar Nath, Ram Raghubir, Mukesh Srivastava, Prem Prakash Yadav, Shweta, Manish Dixit, Preeti Tiwari & Brajendra Kumar
Support staff: S.C. Tiwari, Suresh Yadav, H.C. Verma, G.P.Singh & J.K.Joshi

Patent No.: 290121 **Date of Grant:** 30-11-2017
Title: A pharmaceutical composition for the prevention/treatment of bone disorders and a process for the preparation thereof
Inventors: Rakesh Maurya, Geetu Singh, Pandruvada Subramanyam Narayana Murthy, Sandhya Mehrotra, Divya Singh, Biju B & Man Mohan Singh
Support staff: J.K. Joshi

Patent No.: 289774 **Date of Grant:** 21-11-2017
Title: Novel substituted spiro [indoline-heterocycle]-carboxylic acid derivatives as antidiabetic and metabolic disorder treating agents
Inventors: Atul Kumar, Ram Awatar Maurya, Arvind Kumar Srivastava, Amar Bahadur Singh & Akhilesh Kumar Tamrakar
Support staff: Tahseen Akhtar Ansari

Patent No.: 285622 **Date of Grant:** 25-07-2017
Title: Novel substituted pyrimidin -2-amines, derivatives and salts thereof and process for preparation thereof
Inventors: Shivaji Narayanrao Suryavanshi, Suman Gupta & Susmita Pandey
Support staff: Manju & Shive Ram

2.3 Patents Filed Abroad

United States Patent Application No.: 16/117156 **Date of Filing:** 30-Aug-18
Title: Combination of Clofazimine and Imatinib for effective therapy of drug-resistant myeloid leukemia
Inventors: Sabyasachi Sanyal, Harish Kumar, Naibedya Chattopadhyay, Ravishankar Ramachandran, Arun Kumar Trivedi, Sonal Shree, Anagha Ashok Gurjar, Sourav Chattopadhyay, Sapana Kushwaha, Abhishek Kumar Singh, Shikha Dubey, Kiran Lata, Riyazuddin Mohammed, Jiaur Rahaman Gayen & Anil Kumar Tripathi
Support staff: Achche Lal Vishwakarma

PCT Patent Application No.: PCT/IN2018/050317 **Date of Filing:** 18-May-18
Title: Substituted methanopyrido [2, 1-a] isoindolones as mAChR modulators for treating various associated pathophysiological conditions and process for preparation thereof
Inventors: Ganesh Pandey, Rajesh Varkhedkar, Divya Tiwari, Prem Narayan Yadav, Shalini Dogra & Yusuf Hussain

2.4 Patents Granted Abroad

China Patent No.: ZL201480019885.8 **Date of Grant**: 14-08-2018
Title: Carbodithioates and process for preparation thereof
Inventors: Vishanu Lal Sharma, Nand Lal, Amit Sarswat, Santosh Jangir, Veenu Bala, Lalit Kumar, Tara Rawat, Ashish Jain, Lokesh Kumar, Jagdamba Prasad Maikhuri & Gopal Gupta

United States Patent No.: 9994515 **Date of Grant**: 12-06-2018
Title: Novel Aryl Naphthyl methanone oxime derivatives for the treatment of haematological malignancies and solid tumors
Inventors: Sabyasachi Sanyal, Atul Kumar, Naibedya Chattopadhyay, Jawahar Lal, Arun Kumar Trivedi, Dipak Datta, Srikanta Kumar Rath, Tahseen Akhtar, Shailendra Kumar Dhar Dwivedi, Manisha Yadav, Bandana Chakravarti, Abhishek Kumar Singh, Jay Sharan Mishra, Nidhi Singh & Anil Kumar Tripathi

United States Patent No.: 9820968 **Date of Grant**: 21-11-2017
Title: An antileukemic agent useful for inducing differentiation in myeloid leukemia cells
Inventors: Pooja Pal, Savita Lochab, Jitendra Kumar Kanaujia, Sabyasachi Sanyal & Arun Kumar Trivedi

3 Papers Presented in Scientific Conventions

Medicinal Chemistry Conference (MedChem-2017), Indian Institute of Technology Madras, Chennai (27-28 November 2017)

- Design, synthesis, *in vitro* evaluation and docking studies of novel 1,3-disubstituted pyrazole-2,4-disubstituted thiazole hybrids embedding benzothiazole and coumarin moieties as antibacterial, anticandidal and anti-biofilm agents, Gondru R, Sirisha K, Raj S, Kumar S.G, Pasupuleti M, Bavantula R

24th ISCB International Conference 2018 - Frontier Research in Chemistry & Biology Interface, Indian Society of Chemists & Biologists, Manipal University, Jaipur (11-13 January 2018)

- Identification of lead fragments for designing anticancer compounds based on the energetics of largazole sub-structures in HDAC8 co-crystals: Molecular dynamics approach, V. Dewaker and Y.S. Prabhakar
- Pyranone derived Donor-Acceptor based fluorescent dyes for live cell imaging applications, Jagriti Singh, Ashutosh Raghuvanshi, Ashutosh Sharma, Shahida Umar, Ajay Kumar Jha, Aamir Nazir, Kalyan Mitra and Atul Goel
- Design and synthesis of π-congugated fluorescent arenes and heteroarenes for chemosensing application, Neeraj Mohan Gupta, Shahida Umar, Ajay Kumar Jha, Deepak Purohit, Rakesh Kumar Arya, Deepak Dutta, and Atul Goel
- Some efforts to combat the problems in TB, Vinita Chaturvedi

Emerging Trends in Drug Discovery and Development, Indian Institute of Technology (BHU), Varanasi (18-20 January 2018)

- S-enantiomer of the anti-tubercular compound S006-830 complements activity of frontline drugs against tuberculosis and targets biogenesis of *Mycobacterium tuberculosis* cell envelope, Padam Singh, Shashikant Kumar, Vineet Maurya, Basant Kumar Mehta, Hafsa Ahmad, Anil K Dwivedi, Vinita Chaturvedi, Tejendra S Thakur, Sudhir Sinha
- Challenges of drug discovery and development for unmet medical needs in commercially unprofitable market segments, Amit Misra

International Congress of Cell Biology 2018: The Dynamic Cell – From Molecules and Networks to Form and Function, Hyderabad, India (27-31 January 2018)

- Isolation and functional characterization of a promising chemotherapeutic agent from *Sphaeranthus indicus*, Kuldeep Choyal, Praveen Pandey, Mohammad Hasanain, Mayank Maheshwari & Jayanta Sarkar.
- Coumarin-chalcone hybrid instigates DNA damage by minor groove binding and stabilizes p53 through post-translational modifications, Raghib Ashraf, Mohammad Hasanain, Praveen Pandey, Mayank Maheshwari, Koneni V. Sashidhara & Jayanta Sarkar
- PST inhibitors ameliorate dexamethasone induced diabetic complications in rodent model, Anand P. Gupta, Guru R. Valicherla, Mohammed Riyazuddin, Pragati Singh, Jiaur R. Gayen
- Investigating extra-ribosomal functions of ribosomal proteins in mycobacteria, Chetan Prakash, Manitosh Pandey, Amit Kumar Pandey, Niti Kumar
- The shikimate pathway enzyme that generates chorismate is not required for the development of Plasmodium in mammalian host and mosquito vector, Choudhary HH, Srivastava PN, Singh S, Kumar KA, Mishra S.
- *Plasmodium berghei* Stearoyl-CoA delta 9 desaturase is essential for liver stage maturation, Narwal SK, Choudhary HH, Ghosh A, Mishra S.
- HIV-1 Nef CAWLEAQ motif: a regulator of monocytes invasion through ENO1 modulation", Reshu Saxena, Umesh Kumar, Pradeep Kumar, Amit Kumar, J. K Ghosh and Raj Kamal Tripathi

18th All India Congress of Cytology and Genetics and the International Symposium on Translating Genes and Genomes, Kolkata, India (29-31 January 2018)

- Ammonium trichloro [1,2-ethanediolato-O,O']-tellurate cures experimental visceral leishmaniasis by redox modulation of *Leishmania donovani* trypanothione reductase and inhibiting host integrin linked PI3K/Akt pathway, Vishwakarma P, Parmar N, Chandrakar P, Sharma T, Kathuria M, Agnihotri PK, Siddiqi MI, Mitra K, Kar S.

10th Edition of Yeast Meeting, School of Life Sciences, Jawaharlal Nehru University, New Delhi, (8-11 February 2018)

- Understanding the role of Wat1, a WD repeat containing protein during the cell cycle checkpoint and TOR1 dependent stress response pathway in fission yeast *S. pombe*, Shakil Ahmed

International Conference on Cell Death in Cancer and Toxicology, CSIR - Indian Institute of Toxicology Research, Lucknow, India (20-22 February 2018)

- mTOR signaling complex 2 (mTORC2): Role in cancer progression and response to therapy, Smrati Bhadauria
- Competitive binding of peptide out of Ras binding domain RBD down regulate mTORC2activation, Showkat Ahmed Malik
- Upstream regulation of mTORC2: a study to unravel the role of superoxide anion O2-, Mohammad Asif
- Synergistic inhibition of human breast cancer cells by combination of Salinomycin and 2- Methoxyestradiol *in vitro*. J. Dewangan, S. Srivastava, P. K. Pandey, S. Mishra, A. Divakar& S. K. Rath
- Assessment of the cytotoxicity of diethylene glycol monoethyl ether on a neuroblastoma cell line via *in vitro*

assays, S. Srivastava, S. Mishra, J. Dewangan, A. Divakar, P. K. Pandey & S. K. Rath

- Toxic effects of chronic nandrolone- decanoate administration on the biomarkers of hepatotoxicity and oxidative stress in Swiss Mice, P. K. Pandey, J. Dewangan, S. Mishra, S. Srivastava, A. Divakar& S. K. Rath

2nd National Symposium on Metabolism and Molecular Medicine in General Practice, MMRS, Jaipur (9-12 March 2018)

- Biomarkers of adipose tissue dysfunction & diabetes, Anil Gaikwad

51st Conference of Indian College of Allergy, Asthma and Applied Immunology, King George's Medical University Lucknow (16-18 March 2018)

- Bystander activation of complement cascade potentiates lung inflammation during Tropical Pulmonary Eosinophilia, Laxmi Ganga, Neha Satoeya, Ruchi Jha, Pankaj Sharma and Mrigank Srivastava

Silver Jubilee AGM meeting of CPWA and Symposium on Clean Environment and Health, CSIR-NBRI Lucknow, India (17-18 March 2018)

- CSIR-CDRI S007-1500 and S008-399: New cost effective drug candidates for rapid healing of bone fractures, Pallavi Awasthi, Amit Kumar, Divya Singh, Wahajuddin, AK Dwivedi, Sharad Sharma, SK Rath, Manoj Bhartwal, PN Yadav, Atul Goel.
- Saroglitazar improves memoryin rat model of dementia by enhancing adult neurogenesis via up regulation of Wnt/β-catenin signaling, Sandeep Mishra, Akanksha Mishra, Shubha Shukla and Rakesh Shukla
- Stressful life event with high- fat food consumption triggered pathogenesis of metabolic disorder, Parul, Seema Singh, Sonu Singh, Akanksha Mishra and Shubha Shukla
- Methoxyestradiol potentiates the antineoplastic action of ionophore in breast cancer cells, Jayant Dewangan, Sonal Srivastava, Prabhash Kumar Pandey, Sakshi Mishra, Aman Divakar & Srikanta Kumar Rath

10th NIPER (R) Symposium on Nano Based Therapy for Neurodegenerative Diseases, NIPER, Raebareli (27-28 March 2018)

- Nano based therapy for neurodegenerative diseases, P N Yadav.

International Conference on Microscopy and XXXIX meeting of Electron Microscope Society of India, Bhubaneshwar (18-20 July 2018)

- Molecular and ultrastructural studies on the mode of cell death induced by Gedunin in ovarian cancer cells, Rohit Sahai, Arindam Bhattacharjee, P Sukanya, Sabbu Satish, T Narender, Jayanta Sarkar, Kalyan Mitra
- Studies on antiproliferative and ultrastructural effects induced by by a plant derived hydroxynaphthoquinone in *Leishmania donovani*, Swetapadma Majhi, Bhanu Priya Awasthi, Kalyan Mitra

International Conference on Movement & Cognition, Harvard Medical School, Boston, Massachusetts, USA (27-29 July 2018)

- Axin-2 knockdown promote mitochondrial biogenesis ando paminergic neurogenesis by regulating Wnt/ß-catenin signaling in rat model of Parkinson's disease, Akanksha Mishra, Sonu Singh and Shubha Shukla.

8th Annual Uppsala Pharmacometrics Summer School, Uppsala, Sweden, (13-24 August2018)

- PK-PD modeling of the antihyperglycemic interaction between PSTi8 and Metformin in diabetic rat model, Mohammed Riyazuddin, Pragati Singh, Athar Husain, Roshan Katekar, Saurabh Verma and Jiaur R. Gayen.

Annual Molecular Parasitology Meeting XXIX, Marine Biological Laboratory Woods Hole, MA, USA (9-13 September 2018)

- The proteome of malaria parasite merosomes and liver stage merozoites. Shears MJ, Nirujogi R, Swearingen K, Renuse S, Mishra S, Moritz R, Pandey A, Sinnis P.

Oral presentation in International Conference on Nutraceuticals and Chronic Diseases, Swami Rama Himalayan Institute, Dehradun, India and University of Tennessee, U.S at Dehradun, India (14-16 September 2018)

- HIV-1 Nef regulates differential expression of RabGTPases: The analysis of host protein trafficking pathways, Sushila Kumari, Tripti Kumari, JimutKanti Ghosh Raj Kamal Tripathi

10th Microencapsulation Training School, Trondheim, Norway. (18-21 September 2018)

- Assessment of anti-TB drugs encapsulated in inhalable particles as DPI, Ashish Srivastava, Amit Misra

2nd National Postdoc Symposium, Hyderabad (3-5 October 2018)

- TN-16 inhibits growth of breast cancer cells by impairing autophagic fluxand inducing apoptosis, Mohammand Hasanain, Deepa Gandhi, Praveen Pandey, Mayank Maheshwari, Kuldeep Choyal, Jayanta Sarkar

Targeted Bioconjugates for Drug Delivery to Cancer Cells, Surat, (5-6 October 2018)

- Targeting particles to erythrocytes infected with *Plasmodium falciparum*, Hasham Shafi, Heikham Kajal Devi, D V Siva Reddy, Tabassum Khan, Rajeev Ranjan, Ashish Srivastava, Suniti Vaishya, Tanuj Sharma, Mohammad Imran Siddiqui, Saman Habib, Amit Misra

1st National Biomedical Research Competition (NBRCom), Rishikesh (15 October 2018)

- Deciphering the role of p21 (Cip 1/Waf 1) in regulation of autophagy, Mayank Maheshwari, Praveen Pandey, Mohammad Hasanain, Kuldeep Choyal, Jayanta Sarkar

International Symposium on Malaria Biology and 29th National Congress of Parasitology on Basic & Applied Aspects, University of Hyderabad, Hyderabad (1-3 November 2018)

- Negative regulatory protein of toll-like receptor signaling pathway facilitates in the establishment of malaria infection in Balb/c mouse model, Rahul Shivahare, Kanchan Yadav, Anamika Sharma, Salique Hassan Shaham, Renu Tripathi

- Antiplasmodial potential of purine based C-nucleoside analogues against falciparum malaria, Prince Joshi, Kartikey Singh, Rama Pati Tripathi and Renu Tripathi
- Cloning, overexpression and purification of plasmodial chaperone in multi drug resistant rodent malaria parasite, Anamika Sharma, Kanchan Yadav, Bhavana Singh Chauhan and Renu Tripathi.
- Aminopropanol derivatives based treatment of experimental malaria against asexual stage of *Plasmodium falciparum*, Kanchan Yadav , Shint U Methew, Kishore Mohanan and Renu Tripathi.
- Anticancer medicine (ROS inducer) and Artemisinin derivative: A partnership for the treatment of experimental blood-stage malaria parasite, *Plasmodium falciparum*, Kanchan Yadav, Prince Joshi, Sarika Gunjan and Renu Tripathi.
- A novel glideosome-associated protein coordinates motility and invasion of plasmodium sporozoites, Ghosh A, Narwal SK, Gupta R, Gaurav S, Choudhary HH, Ahmed S, Mishra S
- Design of plasmodium liver arresting mutants by targeting sporozoite specific genes: Implications for developing a whole organism vaccine, Al-Nihmi F, Togiri J, Reddy SR, Jalapali R, Kolli SK, Mastan BS, Mulaka M, Singh D, Dey S, Gupta R, Ghosh A, ChoudharyHH, Narwal SK, Sijwali PS, Mishra S, Kota KA

45th Annual Meeting of Indian Immunology Society, IMMUNOCON 2018, THSTI, Faridabad (1-3 November 2018)

- Role of Anaphylatoxins in immunomodulating the lung microenvironment during Tropical Pulmonary Eosinophilia, Laxmi Ganga, Neha Satoeya, Ruchi Jha and Mrigank Srivastava
- Effect of the infective larvae of filarial nematode *Brugia malayi* on regulatory dendritic cells at the earliest host parasite interface, Neha Satoeya, Laxmi Ganga, Ruchi Jha and Mrigank Srivastava
- Trehalose-6-phosphate phosphatase and heavy chain myosin of the filarial parasite *Brugia malayi* shows cross reactivity with humans infected with *Wuchereria bancrofti*, Ruchi Jha, Laxmi Ganga, Neha Satoeya, Shailja Bhattacharya, Mrigank Srivastava.

New Trends in Multimodal Molecular Imaging and Pharmacokinetics, Guwahati, India (20-21November 2018)

- Role of echocardiography in drug discovery, Himalay Singh.
- Role of ultrasound in drug discovery, Abhinav Singh.

National Conference on Alternatives to Animal Experiments, Jamia Hamdard, New Delhi (27 November 2018)

- The micro RNA molecules and genes associated with protein quality control machinery, modulate clearance of aggregated proteins in *C. elegans* models of neurodegenerative diseases, Arunabh Sarkar, Rohil Hameed, Shamsuzzma, Lalit Kumar, Aamir Nazir
- Glial cells and neurodegenerative diseases: Deciphering the functional cues employing genetic model system *Caenorhabditis elegans*, Rohil Hameed, Arunabh Sarkar and Aamir Nazir

87th Annual Meeting of Society of Biological Chemists (India): Genome Biology in Health and Disease, Manipal Academy of Higher Education, Manipal, India (25-27 November 2018)

- Preliminary characterization of a cupin protein of *Mycobacterium tuberculosis*, Suman Bharti, Rahul Kumar Maurya, V Umamageswaran, Manju Y Krishnan.
- Role of triglyceride synthesis in *Mycobacterium tuberculosis*, Rahul Kumar Maurya, Shivangi Rastogi, Manju Y Krishnan.

International Conference on Innovation for the Elimination and Control Visceral Leishmaniasis (IEC-VL), Jamia Hamdard Institute of Molecular Medicine, New Delhi, India (28-30 November2018)

- Hybrid approach and assessment of biological activity of isoxazole derivatives with bezylamine and quinoline as novel antileishmanial age, Karthik Ramalingam, Sushobhan Mukhopadhyay, Sanjay Batra, Neena Goyal.
- Identification of MAPK1 regulated proteins of *Leishmania donovani* by comparative proteome analysis, Pavneet Kaur, Neena Goyal
- TCP1 gamma subunit is associated with growth and infectivity of *Leishmania donovani*, Shailendra Yadav and Neena Goyal.

4th International Plant Physiology Congress (IPPC-2018) , CSIR-National Botanical Research Institute, Lucknow, U.P. (2-5 December 2018)

- Biosynthesis and enrichment of cardiac glycosides within *in vitro* grown *Calotropis gigantea* plant, Pankaj Singh, Amar Jeet, Renu Nimoriya, Sanjeev Kanojiya, Vineeta Tripathi and Dipak Kumar Mishra

Drug Delivery to the Lungs-2018, Edinburgh, UK (12-14 December 2018)

- Dry powder inhalation of Glucagon-like Peptide-1 for management of Type-2 Diabetes Mellitus, Sanket kumar Pandya, Durgesh Kumar, Swati Gupta, Kalyan Mitra, Anil N Gaikwad, Amit Misra.

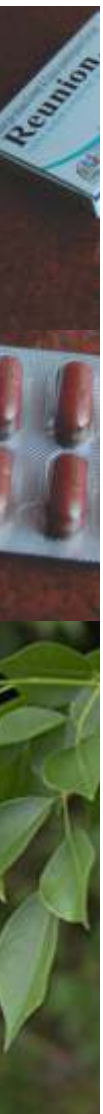
38th Annual Conference of Society of Toxicology India, STOX Conference 2018, Sri Balaji Vidyapeeth Puducherry (12-14 December 2018)

- A selective COX-2 inhibitor decreases Deoxynivalenol induced proliferation, inflammation and protein kinase C translocation via modulating downstream targets in mouse skin, Sakshi Mishra, S. Srivastava, J. Dewangan A. Divakar, S.K. Rath

International Symposium on Molecular Medicine 2018, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow (14-16 December 2018)

- HIV-Nef regulates differential expression of RabGTPases: The analysis of host protein trafficking pathways, Sushila Kumari, Raj Kamal Tripathi

International Conference on Functional Biology and Molecular Interactions, University of Lucknow, Lucknow (20-22 December 2018)



- HIV-1 Nef-GCC85 interaction regulates cellular protein complexes at TGN: Revisiting the MHC-1 down regulation pathways, Sushila Kumari, Manjeet Kumar, Richa Verma, Jimut Kanti Ghosh and Rajkamal Tripathi

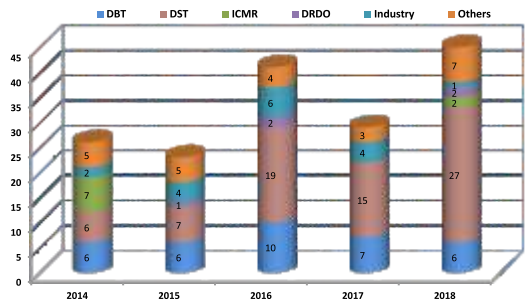
XLII All India Cell Biology Conference & 2nd International Conference on Trends in Cell and Molecular Biology, BITS Pilani K K Birla Goa campus (21-23 December 2018)

- Inhibition of *Mycobacterium tuberculosis* by polycationic phosphorus dendrimers and their mode of action, Dheerj Soam, Vishwadeepak Tripathi, Dinesh K Tripathi, Serge Mignani, Anne-Marie Caminade, Jean-Pierre Majoral and Kishore K Srivastav
- Protein Tyrosine Phosphatase -B plays diverse roles in determining intracellular survival and infection of *Mycobacterium tuberculosis*, Ekta Dhamija, Shivraj Yabaji, Aditi Chatterjee, Alok Mishra, Rikesh K Dube, Apoorva Narain and Kishore K Srivastava.
- Delineation of the function of a mitochondrial translocated hypothetical protein of Mycobacteria, which regulates oxidative phosphorylation of infected macrophage, Rikesh K Dubey, Dheeraj Sonam, Ekta Dhamija, Shivraj M Yabaji, Alok K Mishra, Kanchan Srivastava and Kishore K Srivastava.
- Mycobacterial Tyrosine Kinase: An Enzyme with Unusual Functions, Swati Jaiswal and Kishore K Srivastava.
- Fungicidal activities of IgG1 monoclonal antibody directed against cell surface catalase of A. fumigates, Ravindra Kumar Yadav and P.K. Shukla.
- Nod1-mediated lipolysis promotes diacylglycerol accumulation and successive inflammation in adipocytes, Aditya Sharma, Chandan K. Maurya, Amit K. Rai, Sushmita Singh, Akhilesh K. Tamrakar
- Sweet is no more sweet: Fructose exposure induces skeletal muscle AGEs accumulation and glucose intolerance in rat, Amit K. Rai, Aditya Sharma, Ishbal Ahmad, Akhilesh K. Tamrakar
- cAMP-dependent protein kinase catalytic subunit mediated signaling is essential for erythrocytic stages but not required for pre-erythrocytic stages of *Plasmodium berghei*, Choudhary HH, Gupta R, Mishra S

International Conference on Frontiers at The Chemistry - Allied Sciences Interface-2018, University of Rajasthan, Jaipur, 21-22 December 2018)

- Development of short and scalable post-Ugi modifications towards privileged scaffolds, Anirban Ghoshal, Shashank Tripathi, D. Yugandhar and Ajay K. Srivastava

4 Networks & Inter Agency Linkages



1. CSIR Mission / Thematic / In-house Projects (Duration up to 31 March 2020)

Nature	Project Title	PI
CSIR Mission	CSIR Phytopharmaceuticals Mission	Dr. Naibedya Chattopadhyay
CSIR Mission	Mission Nutraceuticals and Nutritionals	Dr. Naibedya Chattopadhyay
CSIR - FTT	Validation of potential biomolecules against Parkinson's disease: A Preclinical study"	Dr. Aamir Nazir
CSIR - FTT	Development of male infertility diagnostic kits (DeMID)'	Dr. Rajender Singh
CSIR - FTT	Development of a small molecule inhibitor of PCSK9	Dr. Manoj Kumar Barthwal
CSIR - FTT	Clinical development of antiplatelet compound S007-867 for treatment of cardiovascular diseases	Dr. Vivek Vidyadhar Bhosale
CSIR - NCP	Non- alcoholic steatohepatitis (NASH)	Dr. Durga Prasad Mishra
CSIR - NCP	Chronic respiratory disease innovation and solution program (CRISP)"	Dr. Kashif Hanif
CSIR - FBR	Investigating chemical therapeutic space and determinates of survival and virulence in malaria [ParaDlgM]	Dr. Saman Habib
CSIR - FBR	Development of identified lead molecule as novel anti-leishmanial therapeutic agent	Dr. Neena Goyal
CSIR - FBR	Development of therapeutic against skeletal targets to improve bone health	Dr. Naibedya Chattopadhyay
CSIR - FBR	Dissecting the architecture and molecular mechanism of multi protein complexes (BERosomes) involved in DNA Base Excision Repair (BER) and Transcription coupled DNA repair (TCR) pathways from *M. tuberculosis*	Dr. Ravishankar R
Facility Creation	Up-gradation of existing non-human primate experimentation facility	Dr. DS Upadhyay
Facility Creation	Clinical Pharmacology and Pharmacokinetics Facility at CSIR-CDRI	Dr. Amit Misra
Major Lab Project	Addressing biological processes for designing new strategies of intervention in parasitic diseases and anti-parasitic drug discovery	Dr. Saman Habib
Major Lab Project	AMR: Drug resistant-mycobacterial infections & ESKAPE pathogens	Dr. Ravishankar R
Major Lab Project	Research on anabolic skeletal targets in health and illness: Bone health and metabolic bone diseases	Dr. Naibedya Chattopadhyay
Major Lab Project	Pre-clinical studies in drug development and translation: Development of new drug entities, phytopharmaceuticals and standardized extracts in AYUSH mode	Dr. Srikanta Kumar Rath
Other Lab Project	Advancing knowledge frontiers in the area of Life style diseases and reproductive health	Dr. W Haq

2. Grant in Aid Projects

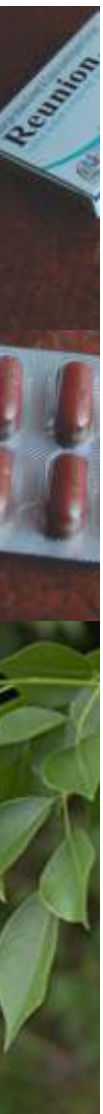
Title of the Project	PI	Project Start	Completion Date
CSIR - New Millennium Indian Technology Leadership Initiative Project			
Novel DPP IV Inhibitor - phase I/II Study: A safety , pharmacokinetic and pharmacodynamic study of CPL - 2009-0031 in healthy volunteers and patients with type 2 diabetes mellitus(T2DM)	Dr. Srikanta Kumar Rath	01-04-2016	31-03-2019
CSIR Young Scientist Award			
Elucidation of functional inactivation of cdx2 expression in colon cancer cells: possible role of E3 ubiquitin ligases in regulating steady state levels of cdx2 protein expression via ubiquitination.	Dr. Arun Kumar Trivedi	01-04-2014	31-03-2019
CSIR-Emeritus Scientist			
Standardized phytopharmaceuticals for the prevention and treatment of bone related disorders and cardiovascular health: End to end pre-clinical development	Dr. Rakesh Maurya	06-01-2017	30-06-2019

Department of Scientific & Industrial Research and Council of Scientific & Industrial Research			
Creation of DSIR – Common Research and Technology Development Hub (CRTDH) in the area of Affordable Health under DSIR-CRTDH Programme	Dr. Amit Misra	01-01-2019	13-12-2023
Department of Biotechnology, Ministry of Science & Technology, India			
Genetic manipulation and drug targeting approaches against *Plasmodium berghei* sporozoite specific proteins S14, Serine Threonine Protein Kinase-9 and liver stage specific Acyl-CoA synthase	Dr. Satish Mishra	10-10-2013	09-01-2019
Investigating the extra-ribosomal functions of ribosomal proteins during Stress and Infection	Dr. Niti Kumar	13-11-2013	12-11-2018
Assembly of Iron-Sulphur [Fe-S] cluster on critical proteins of the Plasmodium apicoplast	Dr. Saman Habib	11-10-2013	10-10-2019
Exploration of Interleukin 1 Receptor Associated Kinase(IRAK) family of kinases during macrophage foam cell formation and inflammation	Dr. Manoj Kumar Barthwal	22-10-2014	21-04-2018
Molecular and biochemical characterization of Chaperonin class of heat shock proteins of *Leishmania donovani*, their exploration as drug target	Dr. Neena Goyal	19-02-2015	30-06-2018
Quest for corannulene based polyfunctional molecules in nanobiotechnology and nanomedicine: Transporting and translocating properties of corannulene derived carrier systems	Dr. Gautam Panda	24-03-2015	23-07-2018
Profiling and characterization of early phase differential mi-RNA(s) responsible for downstream development of Insulin resistance in hMSC derived adipocytes	Dr. Anil Nilkanth Gaikwad	28-04-2015	27-04-2018
Tissue specific transcript and cardiac glycoside profiling of *Calotropis* plant after different biotic and abiotic elicitor	Dr. Vineeta Tripathi	20-04-2015	19-04-2018
Mechanistic studies on napthaquinone based anticancer agents in cancer	Dr. Durga Prasad Mishra	29-07-2015	27-05-2019
Design, development and performance evaluation of hybrid systems comprising novel cationic lipids intended to deliver therapeutic siRNA to solid tumors	Dr. Manish Kumar Chourasia	15-02-2016	14-02-2019
Induction of autophagy as a strategy for treatment of tuberculosis	Dr. Amit Misra	01-06-2016	31-05-2019
Deciphering the roles of secreted proteases in host-*Mycobacterium tuberculosis* interaction: Implications for novel drug discovery and vaccine development	Dr. Arunava Dasgupta	13-07-2016	12-07-2020
Induction of mitochondrial cell death and reversal of anti-cancer drug resistance via multifunctional immunotherapeutic nanoemulsion	Dr. Manish Kumar Chourasia	03-10-2016	02-04-2018
Understanding the role of RBR-E3 Ubiquitin ligase in *P. falciparum* and exploring its potential for pharmacological intervention	Dr. Niti Kumar	08-11-2016	07-11-2019
Evaluation of TGF-β mediated signaling mechanism in the endometriosis using mouse model	Dr. Rajesh Kumar Jha	08-11-2016	07-11-2019
Synthesis and anti-parasitic activities of quinoline-tetrahydropyrimidine hybrids with special reference to anti-malarial, anti-leishmanial and anti-filarial activities	Dr. Renu Tripathi	13-10-2016	12-10-2019
Study to establish infection of *L. donovani* through intradermal route in hamsters and its pathological validation	Dr. Amogh Anant Sahasrabuddhe	31-03-2017	30-03-2019
Characterization of *L. donovani* S-Adenosyl methionine decarboxylase: Spermidine synthase interactions	Dr. J. Venkatesh Pratap	25-06-2017	24-06-2020
Small molecule inducers of Redox stress targeting antibiotic resistance	Dr. Sidharth Chopra	05-07-2017	04-07-2020
Functional characterization and validation of drug target potential of a unique triacyl glycerol synthase of *Mycobacterium tuberculosis*	Dr. Manju Y Krishnan	17-07-2017	16-07-2020
Exploring the role of Nucleotide binding Oligomerization Domain proteins (NODs)-mediated inflammation in diet-induced insulin resistance	Dr. Akhilesh Kumar Tamrakar	25-07-2017	24-07-2020
Deciphering organellar genome maintenance in the Malaria parasite	Dr. Saman Habib	25-09-2017	24-09-2020
Regulation of pancreastatin to control the energy homeostasis in diabetes	Dr. Jiaur Rahaman Gayen	30-12-2017	29-12-2020

Development of small molecule inhibitor of PCSK-9, a new target for LDL receptor and atherosclerotic cardiovascular disease	Dr. Manoj Kumar Barthwal	26-02-2018	25-08-2019
Identification of the role of Serine 7 phosphorylation of RNA polymerase II CTD in the mRNA transcription	Dr. Sohail Akhtar	26-03-2018	25-03-2021
Design and synthesis of hybrid molecules for multi-drug resistant Tuberculosis	Dr. Arunava Das Gupta	02-08-2018	01-08-2021
Novel rationally designed DNA gyrase inhibitors as antibacterials	Dr. Sidharth Chopra	31-07-2018	30-07-2021
Determination and structural elucidation of bioactive compounds from the selected traditional medicinal plants of Mizoram with a focus on anticancer compounds	Dr. Brijesh Kumar	29-09-2018	28-09-2021
In silico design, synthesis, bioassay and elucidation of novel analogues of vasicine and other quinazolinone compounds as potent anti mycobacterial agents	Dr. Vinita Chaturvedi	13-09-2018	12-09-2021
Screen for identification of small molecule orally active glucagon-like peptide-1 receptor agonist	Dr. Sabyasachi Sanyal	07-02-2018	07-01-2019
Ramalingaswami Fellowship, Department of Biotechnology, Ministry of Science & Technology, India			
Discovery of novel cell-autonomous host pathways and the counteracting immune evasion strategies employed by vacuolar pathogens-an approach to identify new antimicrobial host-factors and novel microbial targets	Dr. Arun Kumar Haldar	09-08-2017	08-08-2022
RhoA GTPase in neutrophil chemotaxis and functions during inflammation	Dr. Sachin Kumar	31-05-2016	30-05-2021
Woman Scientist Scheme, Department of Biotechnology, Ministry of Science & Technology, India			
miRNA in the regulation of Sclerostin, A therapeutic approach for osteoporosis	Dr. Sharmistha Bhattacharya	26-09-2014	18-03-2018
Science & Engineering Research Board, Department of Science and Technology, India			
Sophisticated Analytical Instrument Facility	Dr. Brijesh Kumar	01-04-1975	Long term
Deciphering the role of Ccr4-Not complex in human malaria parasite *Plasmodium falciparum*	Dr. Manish Goyal	10-06-2013	09-06-2018
Molecular and functional characterization of MAP Kinase1 homologue of *Leishmania donovani*	Dr. Neena Goyel	01-01-2015	30-06-2018
Development of sugar amino acid derived peptides self-assembling selectively on bacterial membranes, forming ion pores and killing bacteria including MTB	Dr. Ravi Sankar Ampapathi & Dr. Vinita Chaturvedi	20-05-2015	19-05-2018
Skeletal effect of stimulation of receptor activator of NF-kB Ligand (RANKL) from osteoblast by theophylline and the mechanism of action of the drug	Dr. Naibedya Chattopadhyay	03-06-2015	02-06-2018
E3 Ubiquitin ligases in breast cancer: Identification of novel interacting proteins of E3 ubiquitin ligase E6AP from breast cancer cells	Dr. Arun Kumar Trivedi	03-06-2015	02-06-2018
Design & development of plants secondary metabolite LC-MS/MS library to explore the chemistry of medicinal plants	Dr. Sanjeev Kanojiya	14-12-2015	15-12-2018
Original biocompatible phosphorus dendrimers as a new strategy to tackle pulmonary tuberculosis	Dr. Kishore Kumar Srivastava	16-09-2015	15.09.2019
In vivo studies of GIT enzyme resistance insulin compound	Dr. Jiaur R Gayen	04-01-2016	04-01-2018
Design and synthesis of natural, un-natural analogues of Calothrixins A, B and evaluation of antimalarial and anticancer activity	Dr. Niti Kumar	12-01-2016	11-01-2019
Do transmembrane protein kinase PERK, IRE1 and activation transcription factor 4 and 6 (ATF4 & 6) are involved in neuronal death?	Dr. Sarika Singh	07-04-2016	06-04-2019
Activity guided isolation of anticancer agents from Indian medicinal plants and synthetic modifications of major bioactive constituents	Dr. Rashmi Gaur	01-02-2016	31-01-2018
Enantioselective organocatalysis: A novel approach to use acetal as pro-nucleophile and hydroxylactam as pro-electrophile via co-operative catalysis	Dr. Dipankar Koley	27-09-2016	26-09-2019
Targeting the DnaG-DnaB interaction in *Mycobacterium tuberculosis* to identify and validate suitable small molecule inhibitors	Dr. Manju Y Krishnan	28-09-2016	27-09-2019

Dissecting the role of Drp1, a Rint1 family protein during DNA damage response and its implication on cell cycle checkpoint pathway in fission yeast *S. pombe*	Dr. Shakil Ahmed	30-09-2016	29-09-2019
Adipocyte biology and insulin resistance: Metabolic homeostasis using naturally occurring bio -active/dietary lipids	Dr. Anil Nilkanth Gaikwad	27-09-2016	26-09-2019
Synthesis and characterization of hydroxyapatite nano drug vehicles for effective drug delivery and their *in-vitro / in-vivo* studies in bone	Dr. Vijay Kumar Mishra	14-07-2016	13-07-2018
Quest for druggable targets against Filarial manifestation of Tropical Pulmonary Eosinophilia (TPE): A mass spectrometry based global proteome analysis of Eosinophilis	Dr. Mrigank Srivastava	30-12-2016	29-12-2019
Decarboxylative cross couplings en route to the synthesis of heterocycles *Dalbergia sissoo*	Dr. Sanjay Batra	04-01-2017	03-01-2020
NMR based metabolic profiling of osteogenic phytoconstituents in	Dr. Sanjeev Kumar Shukla	21-02-2017	20-02-2020
Understanding the role of CTD phosphorylation of RNA polymerase II for the transcription during mitosis	Dr. Sohail Akhtar	22-03-2017	21-03-2020
Novel small molecules as selective and Positive Allosteric Modulators (PAM) of 5 HT2c receptor: Discovery and development of potential anti-obesity agents	Dr. Prem Narayan Yadav	27-06-2017	26-06-2020
Application Motivated Organic Synthesis (AMOS): En route to New Chemical Entities (NCEs) through chemical genetics approach	Dr. Ajay Kumar Srivastava	01-08-2015	23-11-2018
Synthesis and therapeutic evaluation of new LpxC inhibitors as potent anti-bacterial agents	Dr. Sidharth Chopra	19-07-2017	18-07-2020
Applications of experimental charge density and crystal structure prediction approaches in multi- component crystal development and for studying intermolecular interactions in protein-ligand complexes	Dr. Tajender Singh Thakur	17-08-2017	16-08-2020
Synthesis of privileged heterocycles via visible light photoredox catalyzed cascade reactions	Dr. Namrata Rastogi	04-09-2017	03-09-2020
In vitro biosynthesis and enrichment of indole alkaloids from *Alstonia scholaris* and elucidation of their metabolic pathway	Dr. Dipak Kumar Mishra	28-09-2017	27-09-2020
Role of autophagy in vascular smooth muscle cell remodelling and phenotype	Dr. Manoj Kumar Barthwal	28-09-2017	27-09-2020
Development of small molecular inhibitor specifically targeting mTORC2 for cancer therapeutics: Development of targeted anti-cancer strategy	Dr. Smrati Bhadauria	17-03-2018	16-03-2021
Plasmodium SCOT1 mutant as experimental malaria vaccine: Implications for inducing pre-erythrocytic and cross-stage immunity	Dr. Satish Mishra	17-03-2018	16-03-2021
Genetic validation of actin as a drug target in Leishmania and development of drug screening assay system	Dr. Amogh Anant Sahasrabuddhe	22-03-2018	21-03-2021
Biochemical, biophysical and structural analysis of NhaA antiporter: A structure based study	Dr. Manish Dwivedi	05-12-2017	17-07-2018
Structural and functional characterization of PadR-like transcriptional regulatory proteins from *Mycobacterium tuberculosis* H37Rv	Dr. Ashish Arora	09-07-2018	08-07-2021
A systematic screen of functional genomics and epigenetic interventions towards identification of novel genetic modulators of Amyloid Beta effects in a transgenic *C. elegans* models of Alzheimer's disease	Dr. Aamir Nazir	10-07-2018	09-07-2021
Modulation of host endocytosis during Plasmodium liver stage development	Dr. Satish Mishra	17-07-2018	16-07-2021
Redox regulation of immune cells, neutrophils in insulin resistance and type 2 diabetes	Dr. Sachin Kumar	27-07-2018	26-07-2021
Targeting Triple Negative Breast Cancer (TNBC) by a plant derived small molecule: An *in vitro* and *in vivo* approach	Dr. Dipak Datta	30-07-2018	29-07-2021
To decipher the role of RHOG in the endometrial receptivity for blastocyst adhesion and invasion process	Dr. Rajesh Kumar Jha	10-06-2018	10-05-2021
Therapeutic evaluation of organometallic compounds as potent antibacterial agents	Dr. Sidharth Chopra	12-10-2018	11-10-2021
Identifying critical hotspots in macromolecular complexes involved in bacterial BER	Dr. Ravishankar Ramachandran	26-10-2018	25-10-2021

Studies to delineate the immunoregulatory role of PD -L 1 /PD-1 pathway and exploring it as a potential tool for vaccination strategies against Visceral Leishmaniasis	Dr. Amogh Anant Sahasrabuddhe	09-05-2018	09-04-2021
Branch chain amino acid biosynthesis in *Mycobacterium tuberculosis* and relevance of ketol– acid reductoisomerase for antimycobacterial drug discovery	Dr. Sudheer Kumar Singh	02-11-2018	01-11-2021
Trifluorodiazoethane as a precursor for the rapid synthesis of Trifluoromethylated building blocks	Dr. Kishor Mohanan	12-10-2018	11-10-2021
Neuroprotective and neuritogenic effects of a cell-permeable bacterial histone-mimic protein: Therapeutic implications for neurodegenerative pathologies	Dr. Shubha Shukla	15-11-2018	14-11-2021
Targeting DNA repair proteins to overcome topoisomerase drug resistance	Dr. Dibyendu Banarjee	05-11-2018	04-11-2021
Investigating the role of the NLRP3 inflammasome in fractose-included peripheral Insulin resistance	Dr. Akhilesh Kumar Tamrakar	06-11-2018	05-11-2021
To elucidate the role of MAPKAPK2 (MK2) in inflammation mediated lymphangiogenesis during myocardial infarction	Dr. Kumaravelu Jagavelu	06-11-2018	05-11-2021
Identification and characterization of microRNAs controlled by mutations in Phex gene, a regulator of X-linked hypophosphatemic rickets, an intrinsic bone mineralization defect	Dr. Divya Singh	06-11-2018	05-11-2021
Cooperative catalysis through dual activation for stereoselective synthesis of glycosides	Dr. Pintu Kumar Mandal	28-11-2018	27-11-2021
Investigation of the role of small RNAs in genomic imprinting	Dr. Rajender Singh	04-12-2018	03-12-2021
National Post-Doctoral Fellowship, SERB, DST, India			
Assessment of the toxicity potential of anabolic-androgenic steroids: A proteomic and toxicogenomic approach	Dr. Prabhash Kumar Pandey	18-04-2016	17-04-2018
Functional evaluation of miRNA regulators during early embryonic development of mice	Dr. Amar Nath	01-04-2016	31-03-2018
Investigation of uptake and efflux transporters role in first line prescription medicines and CDRI candidate drug disposition, potential drug combination and pharmacological effects by experimental therapeutic studies	Dr. Sadaf Jahan	15-03-2016	14-03-2018
Modulation of systemic immune response and pathology in DBA-1 mouse model of rheumatoid arthritis by *Fasciola gigantica*-derived immunomodulatory proteins (IMP)	Dr. Yasir Khan	16-03-2016	15-03-2018
Applications of common vegetables derived fluorescent carbon nanoparticles in *in vivo* multianalyte sensing	Dr. Vikram Singh	11-08-2016	10-08-2018
Isolation, characterization of novel antimalarial compounds from potent Indian medicinal plants which being practised by various Indian tribes against malaria and evaluating the efficacy of their combination against drug resistant *Plasmodium falciparum* as an excellent alternative drug	Dr. M. Nagarajan	01-09-2016	31-08-2018
Role of antidepressants in the regulation of bone morphogenesis	Dr. Shailendra Kumar Maurya	31-03-2017	30-03-2019
Evaluation of stress dependent functional responses and gene expression in ras1Δ and allied mutants of *Schizosaccharomyces pombe* cells as a functional study for targeting Ras-Redox pathway in cancer therapy	Dr. Noosrat Masood	07-04-2017	06-04-2019
Deciphering the role of negative regulators of TLR-mediated signaling in parasite survival during experimental malaria	Dr. Rahul Shivahare	10-04-2017	09-04-2019
Targeting epigenetic alterations in regulating Aldehyde Dehydrogenase (ALDH) expression in Triple Negative Breast Cancer (TNBC) *in-vitro* and *in-vivo*	Dr. Akhilesh Singh	07-04-2017	06-04-2019
Understanding protein quality control system and exploring its pharmacological potential in mesenchymal stem cells	Dr. Bhagyashri Gupta	01-05-2017	30-04-2019
Exploring the role of Notch/Nrf-2 signalling in amelioration by flavonoids in endometriosis	Dr. Radhika Kapoor	03-04-2017	02-04-2019



Identification and characterization of complete BRCA1 C-terminal missense mutations in cancer predisposition using heterologous yeast model	Dr. Islam Husain	27-06-2017	26-06-2019
Targeted co-delivery of gemcitabine and betulinic acid using hyaluronic acid functionalized amphiphilic PLGA-PEG copolymer nanoparticles for the treatment of pancreatic cancer	Dr. Md. Noor Alam	08-06-2017	07-06-2019
Structural and functional characterization of oxidative stress proteins from *Mycobacterium tuberculosis* as potential drug target against tuberculosis: A cross-talk with Fenton reaction	Dr. Radhey Shyam Kaushal	12-06-2017	11-06-2019
Targeted co-delivery of micro-RNA and chemotherapeutic agent in bio inspired nano carriers by hormone refractory cancers	Dr. Monika Dwivedi	01-06-2017	31-05-2019
Role of estrogen subtype estrone and estriol on Hematopoietic Stem Cells (HSCs) and bone marrow regeneration	Dr. Rupali Saini Kumar	02-04-2018	01-04-2021
Investigation of effect of CDRI08 (keenmind)on Parkinson's disease pathology	Dr. Arun Kumar Yadawa	02-04-2018	01-04-2020
Elucidating the effect of resveratrol on Nrf2 Mediated signalling and unfolded protein responses during Parkinson's disease pathology	Dr. Ashish Singh	02-04-2018	01-04-2020
Investigating the role of high risk human papilloma virus E5 protein in regulation of crosstalk of apoptosis signals between mitochondria and endoplasmic reticulum	Dr. Deepa Gandhi	02-04-2018	01-04-2020
Ramanujan Fellowship, SERB, DST, India			
Aptamer anchored smart multifunctional dendrimer-BSA nano-architectures for the effective treatment of drug resistant non-small cell lung cancer	Dr. Prashant Kesharwani	20-04-2017	19-04-2022
JC Bose National Fellowship, SERB, DST, India			
Vaccine development against Visceral leishmaniasis	Dr. Anuradha Dube	09-08-2016	08-05-2019
Woman Scientist Scheme-A, DST, India			
Protective effect of topical application of Celecoxib and/or N-Acetylcysteine on Deoxynivalenol: A mycotoxin induced skin inflammation, genotoxicity and tumorigenecity in mice	Dr. Sakshi Mishra	01-07-2016	30-06-2019
Identification of shikimate kinase as a drug target against *Mycobacterium tuberculosis*	Dr. Sapna Pandey	16-01-2017	15-01-2020
Unveiling the role of host BTF3 protein in immune regulation against intracellular bacterial infections: A CRISPR/Cas 9 system directed study	Ms. Kavita Rawat	23-10-2017	22-10-2020
Profiling nanoprarticle-protein corona and investigation the role of specific proteins in NP uptake	Dr. Vani Mishra	12-01-2018	11-01-2021
Young Scientists and Technologists Scheme, DST, India			
Receptor mediated Co-delivery of anticancer drug and siRNA to overcome multidrug resistance in breast cancer	Dr. Lipika Ray	02-06-2014	01-06-2018
RNAi mediated functional analysis of biomarkers for endometrial receptivity	Dr. Rohit Kumar	06-04-2015	05-04-2018
Inspire Fellowship, DST, India			
New approaches to the fluorinated N-heterocycles via A+C109mine radical cation pathway	Dr. Sushobhan Chowdhury	08-09-2017	07-09-2022
Indian Council of Medical Research (ICMR), India			
Cytokines and xenobiotics metabolizing enzymes gene polymorphisms in acquired aplastic anaemia	Dr. Raj Kamal Tripathi	01-03-2015	28-02-2018
Drug targeting for improved treatment of multi-drug resistant tuberculosis (MDR TB)	Dr. Amit Misra	01-08-2018	31-07-2021
Do Endoplasmic Reticulum stress mediated death signalling pathways	Dr. Sarika Singh	15-10-2018	14-10-2019
Indian Council of Medical Research (ICMR) Emeritus Scientist Scheme			
Design, synthesis and biological evaluation of ATP synthase inhibitors as potential antitubercular agents	Dr. Anil Kumar Saxena	17-07-2017	16-07-2019
DRDO - Institute of Nuclear Medicine & Allied Sciences			
Development of preclinical and clinical radioprotective formulation prepared by combining Podophyllotoxin and Rutin	Dr. Rabi Sankar Bhatta	03-06-2016	02-03-2018

Development of preclinical formulation of radioprotective RK-IP-006 and its pharmacokinetic evaluation as per regulatory guidelines	Dr. Rabi Sankar Bhatta	28-09-2018	27-12-2019
Indian National Science Academy			
Understanding the role of Heat Shock Proteins (HSPs) in *Plasmodium falciparum* survival in stress conditions	Dr. Niti Kumar	01-01-2015	30-06-2018
Deciphering the role of SOCS proteins in regulating pro/anti-inflammatory response during experimental visceral leishmaniasis	Dr. Susanta Kar	01-03-2016	28-02-2019
Immunobiology of Visceral Leishmaniasis	Dr. Anuradha Dube	01-04-2016	31-03-2021
Ministry of Earth Science (MoES)			
Synthesis and bioevaluation of chemical libraries of B- Carboline based mimics of marine natural products	Dr. Sanjay Batra	20-04-2015	31-12-2018
Ligand and structure based screening of designed and synthesized chemical library around Psammaplin A against DNA methyltransferase I (DNMTI) and diversity oriented synthesis of Pachastrissamine as anticancer agents	Dr. Gautam Panda	01-02-2016	31-01-2019
Biological evaluations, discovery of novel bioactive compounds & coordination of the program "Drug From Sea"	Dr. Manoj Kumar Barthwal	06-03-2018	05-03-2021
A high-throughput screening for modulators/inhibitors of quorum sensing, class b-β-Lactamase inhibitor, biofilm and efflux pump	Dr. Mukesh Pasupuleti	21-05-2018	20-05-2021
Third party verification and outsourcing of activities Related to Lead compound GS/IICT5/6 showing anti-angiogenic activity	Director	27-11-2018	31-03-2020
AYUSH			
Exploration, identification and isolation of bone fracture healing agents from Indian folk traditional plants *Pholidota articulate* and *Coelogyn cristata* (Orchidaceae)	Dr. Brijesh Kumar	09-01-2018	08-01-2021
BIRAC, SRISTI Ahmedabad NPDF			
RGB emitting Carbon quantum dots from vegetables/ fruits extract and their applications	Dr. Vikram Singh	06-07-2017	05-07-2019
Department of Atomic Energy (DAE)			
Design and synthesis of donor-acceptor based new organic fluorescent dyes and their applications	Dr. Atul Goel	06-01-2016	05-01-2021
Amino acids derived steroidal and non-steroidal ligands as inhibitors of steroid 5-α-reductase in cancer	Dr. Gautam Panda	18-06-2018	17-06-2021
Indian Council of Agricultural Research (ICAR-NASF)			
Study the effect of mesenchymal stem cell transplantation on ovarian function and fecundity in Goats	Dr. Monika Sachdev	01-02-2017	31-01-2020
Lady Tata Memorial Trust, Mumbai			
Elucidating mechanisms underlying breast cancer invasion and metastatis: Role of E3 ubiquitin ligase Fbw7 in suppressing breast tumorigenesis	Dr. Arun Kumar Trivedi	06-07-2017	05-07-2020
Council of Science & Technology, Uttar Pradesh			
To evaluate anti-metastatic potential of diminished cardiotoxic tumor targeted liposomal formulation of Etoricoxib	Dr. Smrati Bhadauria	01-06-2018	31-05-2021
Global Challenges Research Fund - Network for Neglected Tropical Diseases			
Structural studies of the GTP binding proteins Rab7 from *Leishmania donovani*	Dr. Ashish Arora	01-10-2018	30-09-2019
Sponsored Projects			
Anti-malarial activity of one of Evolva ingredients Nootkatone	Dr. Renu Tripathi	17-07-2017	16-07-2019
Estimation of biomarkers of serum Homocystiene (Hcyt) and Methyl Malonic Acid (MMA) for Iron deficiency anemia	Dr. Rabi Sankar Bhatta	30-08-2017	29-08-2018
DNA Bar- coding & LC-MS fingerprinting of the herbal Product	Dr. Sanjeev Kanojiya	22-09-2017	21-09-2018
Assessment of a TCL product on systemic calcium and skeletal parameters in estrogen deficient(OVX) rats	Dr. Naibedya Chattopadhyay	14-11-2018	13-11-2019

5 Human Resource Development

1. Ph.D. Thesis Submitted

Sl. No.	Name of Student	Title	Name of Supervisor
		Jawaharlal Nehru University, New Delhi	
1.	Harish Kumar	Repositioning of FDA approved drugs for anti-cancer activity	Dr. Sabyasachi Sanyal
2.	Sulekha Adhikary	Mechanisms involved in secondary osteoporosis induced bone loss affecting muscle before and after anabolic therapy	Dr. Ritu Trivedi
3.	Shagun Krishna	Identification and prioritization of potential anti-cancer agents targeting proteins with relevance in cancer epigenetics using *in silico* approaches	Dr. M I Siddiqi
4.	Vikas Dwivedi	Novel strategies involving activation of alkynes towards conjugated molecules and heterocycles	Dr. Mukesh Pasupuleti
5.	Munesh Kumar Harioudh	Investigation on the biological activities of naturally occurring antimicrobial peptides, their analogs and designed novel peptides	Dr. Jimut Kanti Ghosh
6.	Tanuj Sharma	Computational studies on protein targets involved in central nervous disorders and *in silico* identification of potential therapeutic agents	Dr. M.I. Siddiqi
7.	Mohd. Sayeed	Identification of fragments derived from proteins related to metabolic disorders and innate immunity and characterization of their anti-diabetic or anti-inflammatory effects	Dr. Jimut Kanti Ghosh
8.	Vandana Singh	Generation and characterization of a mycobacterial fadR (a transcriptional regulator of fatty acid metabolism) knock-out mutant strain	Dr. Bhupendra N Singh
9.	Keerti	Therapeutic potential of Th1 stimulatory recombinant proteins against experimental visceral leishmaniasis	Dr. Amogh A Sahasrabudhe
10.	Jayant Dewangan	Mechanistic studies on the effect of polyether ionophores on angiogenesis and cancer	Dr. S.K. Rath
11.	Pradeep Kuamr	Identification and characterization of HIV-1 Nef interacting partner and its implication in Nef pathogenesis	Dr. Raj Kamal Tripathi
12.	Pooja Purohit	Synthesis and bio-evaluation of Nitrogen heterocycles using Ugi and other methodologies	Dr. PMS Chauhan
13.	Lalit Kumar	Validation and functional characterization of circular RNAs in context of age associated neurodegenerative diseases: Studies employing transgenic *Caenorhabditis elegans*	Dr. Aamir Nazir
14.	Neha Sahu	Exploration and evaluation of some selected Indian folklore medicinal plants for their anti-cancer and anti-diabetic activities and *in vitro* biosynthesis of their secondary metabolites	Dr. K.R. Arya
15.	Shachi Mishra	Synthesis of donor/acceptor–based heterocyclic compounds of biological importance	Dr. Atul Goel
16.	Sheela Nagarkoti	Involvement of nitric oxide and redox modulators in regulating neutrophil superoxide radical formation: Implications in microbial killing and inflammation	Dr. Madhu Dikshit
17.	Jaya Gopal Meher	Novel self-emulsifying drug delivery system(s) bearing hydrophobic drug(s) for improved chemotherapy	Dr. Manish K. Chourasia
18.	Akanchha Shukla	Studies on molecular regulation of tumor angiogenesis	Dr. D.P. Mishra
19.	Manohar Singh	Studies on differential regulation of cell death pathways in leukemia cells	Dr. D.P. Mishra
20.	Aastha Pandey	The molecular basis of thermal regulation of testicular function	Dr. Gopal Gupta
21.	Richa Sharma	Understanding heat shock response in transformed and non-transformed cell line	Dr. Niti Kumar
22.	Subhashis Pal	Investigation of phosphodiesterase inhibitors as pharmacological target for bone anabolic therapy	Dr. N. Chattopadhyay
23.	Sujit Kumar Mohanty	Genome wide DNA methylation analysis for identification of the differentially methylated regions that affect sperm count	Dr. Rajender Singh

24.	Narendra Kumar Yadav	Evaluation of Th17 pathway in conjunction to Th1/Th2 paradigm in experimental visceral leishmaniasis	Dr. Amogh A Saharabudhe
25.	Shahebraj Khan	Identification and biological characterization of anti-tubercular agents targeting mycobacterial ATP synthesis	Dr. Y.K. Manju
26.	Pragati Kushwaha	Design and synthesis of novel Benzofuran and Thiazole derivatives as potential chemotherapeutic agents	Dr. K.V. Sashidhara
27.	Anirudha S Karvande	Elucidation of the potential role of miR-451 targeting vitamin D binding protein during osteogenesis: Comparison with anabolic and resorptive therapies	Dr. Ritu Trivedi
28.	Byanju Rai	Design and synthesis of small *N*-heterocyclic molecules as Anticancer and Antiproliferative agents	Dr. Atul Kumar
29.	Swati Jaiswal	Exploration of the molecular mechanism on the interplay between protein tyrosine kinase and the substrate(s), and its consequences on intracellular survival of Mycobacteria	Dr. Kishore K Srivastava
30.	Akanksha Upadhyay	Design, synthesis and biological evaluation of novel Imidazopyridine and Quinoline derivatives	Dr. K.V. Sashidhara
31.	Rahul Kuamr Maurya	Synthesis of functionalized indazoles & related N-heterocyles as biodynamic Agents	Dr. Prem P. Yadav
32.	Srinivas Lavanya Kumar M	Amino acids derived benzofused architectures as possible anticancer agents	Dr. Gautam Panda
33.	Tripti Joshi	Analysis of naturally occurring carbazole alkaloids and flavonoids using ultra performance liquid chromatography - mass spectrometry and their chemical transformations	Dr. Sanjeev Kanaujia
34.	Veena Devi	Synthesis of annulated β-carbolines as possible anti-cancer agents	Dr. Sanjay Batra
35.	Pradeep Singh Chouhan	Diversity oriented synthesis of novel heterocyclic molecules as anti-parasitic agents *via* isocyanide based multi component reactions	Dr. PMS Chauhan
36.	Deepti Singh	Diverse synthesis of bioactive heterocycles as antileishmanial and antimalarial agents *via* novel chemical transformations	Dr. PMS Chauhan
37.	Alok Kumar Mishra	Deciphering the role(s)of two component system*prrA-prrB*by molecular and functional genomics, and addressing its importance in intracellular survival of mycobacteria	Dr. Kishore K. Srivastava
38.	Roshni Gupta	Understanding the role of ARK3 and SPATR in *Plasmodium berghei*: A reverse genetics approach	Dr. Satish Mishra
39.	Aizaz Ahmed John	Identification and characterization of novel microrna(s) regulating osteoblast functions and their contribution in pathogenesis of osteoporosis	Dr. Divya Singh
40.	Ankit Kumar Agrawal	Study the effect of antispermatogenic agent – chebulinic acid on male reproductive system Benign Prostate Hyperplasia (BPH)	Dr. Monika Sachdeva
41.	Anant Jaiswal	Novel signaling mechanisms regulating macrophage function, heterogeneity and resolution of inflammation: Implications in metabolic disorders	Dr. Manoj K. Barthwal
42.	Sampa Gupta	Design, synthesis and bioevaluation of Pyrazole and Pyran derivatives as possible biodynamic agents	Dr. K.V. Sashidhara
43.	Ankita Jain	Characterization of a novel cancer testis antigen CABYR as a potential biomarker for squamous cell carcinoma	Dr. Monika Sachdev
44.	Ahamdullha Ansari	Structural and functional studies of proteins involved in post translational modification of *V. cholerae* and actin interacting proteins from *L. donovani*	Dr. J.V. Pratap
45.	Ritesh Pramodrao Thakare	Identification and characterization of antimicrobial activity of aryl sulfide derivatives against *Staphylococcus aureus*	Dr. Sidharth Chopra
46.	Vijay Kumar Sirohi	Identification of novel miRNA(s) playing role in endometrial receptivity and embryo implantation	Dr. Anila Dwivedi
47.	Vikas Chandra Tripathi	Marine bacterial derived antioxidant & anti-quorum sensing molecule: Discovery, characterization and biological activities	Dr. Mukesh Pasupuleti
48.	Ajeet Kumar	*Functional selectivity at histamine receptors in neurotrophins signaling in brain cells*	Dr. Prem N. Yadav
49.	H Soyar	Investigations on host-defence peptides and its biological functions	Dr. Mukesh Pasupuleti

50.	Praveen Pandey	Understanding molecular mechanism of lead anticancer molecule(s) from *Sphaeranthus indicus*	Dr. Jayanta Sarkar
		AcSIR – Academy of Scientific & Innovative Research	
51.	Bhavana Singh Chauhan	Study of malaria parasite/toxin induced pathogenesis & its reversal	Dr. Renu Tripathi
52.	Aditya Gandhidas Lavekar	Development of green synthetic methodologies for C-C and C-X (X = N, S) bonds formation and their application in the synthesis of bioactive small molecules	Dr. Arun K. Sinha
53.	Deepti Tripati	Functional analysis of MAPKAPK2 (MK2) in endothelial microparticles	Dr. Kumaravelu J
54.	Meera Kumari	Structural and functional characterization of the transcriptional regulator Rv3488 of *Mycobacterium tuberculosis* H37Rv	Dr. Ashish Arora
55.	Priyanka Shukla	To study the role of IL-12 family cytokine(s) on post-menopausal osteoporosis	Dr. Divya Singh
56.	Shakir Ahmad	Domino reactions employing diazo compounds: Efficient access to novel N-heterocycles	Dr. Kishor Mohanan
57.	Chandan Sona	Elucidating the role of GPR40 in diabesity associated abnormalities on mood and cognition	Dr. Prem N. Yadav
58.	Durgesh Kumar	Holy Grail of adipose tissue insulin resistance: Immunometabolic alterations and potential therapeutic interventions	Dr. Anil N. Gaikwad
59.	Yabbaji Shivaji Mohanrao	Elucidating the macrophage proteins modulated through early secretory antigenic target protein of mycobacteria in intracellular persistence	Dr. Kishore K. Srivastava
60.	Sanket Kumar M Pandya	Novel delivery systems containing Glucogon-Like Peptide-1 (GLP-1) fragment for management of Type 2 *Diabetes mellitus*	Dr. Amit Misra
61.	Rajeev Ranjan	Inhalation formulation of second-line drugs for the treatment of drug-resistant tuberculosis	Dr. Amit Misra
62.	Akansha Pandey	Metabolites and transcripts profiling of *Calotropis procera* for elucidation of cardiac glycoside biosynthetic pathway	Dr. Vineeta Tripathi
63.	Vinay Shankar Tiwari	Synthesis, structural and biological studies of novel amino acids and amino acid conjugates	Dr. W. Haq
64.	Gitu Pandey	Surface engineered smart nanocarriers bearing Docetaxel for improved chemotherapy against cancer	Dr. P.R. Mishra
65.	Tulsankar Sachin Laxma	Preclinical ADME, human pharmacokinetic prediction and PK-PD studies of 4655K-09: A novel HMGCoA reductase inhibitor	Dr. Rabi S Bhatta
66.	Naresh Mittapelly	Delivery of Mimantine and Donepezil using novel drug delivery system for the better management of Alzheimer's disease	Dr. P.R. Mishra
67.	Santhosh Kumar Putrevu	Pharmacokinetic - Pharmacodynamic studies of anti-endotoxin peptide S016-1271 and ADME assessment of a novel anti-leishmanial agents 96-261	Dr. Rabi S Bhatta
68.	Jyotsana Pandey	Identification and evaluation of phytoestrogens for the management of peripheral insulin resistance	Dr. Akhilesh K Tamrakar
69.	Moon Jain	A study on autophagy in hypertension associated vascular dysfunction	Dr. Kashif Hanif
70.	Soobiya Fatima	Studies on molecules of Protein Tyrosine Phosphatase family and their association with neurodegenerative diseases employing *Caenorhabditis elegans*	Dr. Aamir Nazir
71.	Bhanu Priya Awasthi	Evaluation of anti-leishmanial activity and understanding the mechanism of action of promising leishmanicidal agent	Dr. Kalyan Mitra
72.	Ashis Kumar Gupta	Novel strategies for the synthesis of spiro heterocycles employing α-diazo-β-ketophosphonate	Dr. Kishor Mohanan
73.	Pragya Chandrakar	Decoding the mechanism of Intracellular signalling between immune cells and the role of regulatory elements in modulating cellular crosstalk during experimental Visceral leishmaniasis	Dr. Susanta Kar
74.	Atul Kumar Chaturvedi	Novel annulation reaction for the synthesis of carbocyclic/heterocyclic Scaffolds	Dr. Namrata Rastogi
75.	Ravindra Kumar Yadav	Generation and characterization of monoclonal antibodies against cell surface proteins of *Aspergillus fumigatus* for diagnostic and therapeutic use	Dr. P.K. Shukla
76.	Kemant	Design and synthesis of novel five – membered N – Heterocycles as potential anti-cancer agents	Dr. Atul Kumar
77.	Jyoti Bala Kaushal	Investigation of the molecular and signaling mechanism implicated in pathogenesis of endometrial dysfunction(s)	Dr. Anila Dwivedi

2. Skill Development Program

Skill development program, under the aegis of CSIR Integrated Skill Initiative, is being coordinated by the HRD unit. This program is an initiative launched to empower the youth of our country with skill sets which make them more employable and more productive in their work environment. Institute offers four certificate courses of level IV to VII under the CSIR-CDRI, Skill Development Program. The courses will meet the aspirations of students, young researchers and industry sponsored personnel looking for training. These courses will provide an opportunity for skill development and hands-on experience in the chosen area. Courses conducted and number of candidates trained during the reporting period are as follows:

Course	Batch – I (2017-18)	Batch - II (2017-18)	Batch - I(2018-19)
AST - Certificate course on Skill Development in Advanced Spectroscopic (NMR,HPLC, LC- MS, UV/IR) techniques	10	4	27
MFC - Certificate course on Skill Development in Microscopy (Electron Microscopy, Confocal and Intra vital Microscopy) and Flow Cytometry (Old course)	1	0	3
CADDD - Certificate course on Skill Development in Computational Approaches to Drug Design and Development	4	4	0
LAE - Certificate course on skill development in Care, Management of Laboratory Animals & Experimental Techniques	0	0	10
Total	**15**	**8**	**40**

3 Training to Post Graduate Students

During the calendar year, a total of 143 Post-graduate students from 50 Colleges/Universities and their affiliated colleges from all over the country were selected on merit basis and were imparted training in various disciplines of drugs and pharmaceutical research for 4-10 months duration.

As a mentor institute for the NIPER Raebareli, imparted one year project training in biomedical research to 30 M.S. (Pharm) Pharmaceutics & Medicinal Chemistry specialization students.

4 Training under cooperation with INSA & NASI

Under the programme, **08** INSA & NASI fellows from different institutes were provided training in different aspects of biomedical research.

5 National Workshop Series on GLP Sensitisation for Faculty & Scientist at CSIR-IITR on Dec 07, 2018

Following staff attended the training program

Aamir Nazir	Deepmala Umrao	Rabi Sankar Bhatta
Amit Lahiri	Dhananjoy Nil Hansda	Rajdeep Guha
Anil Kumar Meena	Himangsu Kousik	Sachi Bharti
Anil Nilkanth Gaikwad	Jiaur Rahaman Gayen	Sachin Kumar
Anupama	Kashif Hanif	Sheeba Saji Samuel
Anurag Kumar Srivastava	Kumaravelu Jagavelu	Shrikant Ramesh Mulay
Baisakhi Moharana	Manoj Kumar Barthwal	Shubha Shukla
Bharti Bhushan	Navodayam Kalleti	Smrati Bhadauria
Chandra Prakash Pandey	Pankaj Shukla	Sudhaker Yadav
Chandra Shekhar Yadav	Pradeep Kumar	V. Sarvana Kumar
Daya Shankar Upadhyay	Prem Narayan Yadav	Vivek Vidyadhar Bhosale
Deepak	Promod Kumar Agnihotri	

6 Honours & Awards

Prof. Tapas K Kundu

- DSc Degree conferred by Uttar Banga Krish Vishwavidyalaya, Pundibari, Cooch Behar

Dr. Ritu Trivedi

- Fellow of the National Academy of Sciences (FNASc), National Academy of Sciences, Allahabad

Dr. Anuradha Dube

- Dr. BN Singh Memorial Oration Award for contribution in the field of Parasitology

Dr. Kashif Hanif

- Dr. DN Prasad Memorial Oration Award for year 2017, ICMR

Dr. Namrata Rastogi

- ISCB Distinguished Women Scientist Award-2019 in the area of Chemical Sciences, Indian Society of Chemists & Biologists (ISCB)

Dr. Renu Tripathi

- Elected Fellow of International Society of Environmental Botanist (FISEB), 2017 by International Society of Environmental Botanist (FISEB), India

Dr. Dibyendu Banerjee

- ICMR International Fellowship for Young Bio-medical Scientists-2018-19

Dr. Wahajuddin

- Alexander von Humboldt Fellowship
- Elected as a member of Indian National Young Academy of Sciences, INSA
- Selected Member, Global Young Academy, GNAS, Germany.

Dr. Sripathi Rao Kulkarni

- Best Individual Contributor Award for Group Presentation: International Training Programme on STI Policy and Management for Developing Countries (ITPS), Kuala Lumpur, Malaysia, 6 - 10 August, 2018.
- Recognized as one among the Top 100 IP Leaders of India by World IP Forum (March 2018)

Ms. Suman Bharti

(Student of Dr. YK Manju)

- Young Researcher Award 2018, Society of Young Biomedical Scientists, All India Institute of Medical Sciences, Rishikesh, India

Mr. Sanketkumar Pandya

(Student of Dr. Amit Misra)

- Pat Burnell Award, The Aerosol Society/ Drug Delivery to the Lungs, Edinburgh 2018

Ms. Jyoti Bala Kaushal

(Student of Dr. Anila Dwivedi)

- Dr. (Mrs) Mridula Kamboj Young Scientist Award (ISSRF-2018), Indian Society for the Study of Reproduction and Fertility (ISSRF)
- Outstanding Paper Presentation Award (ESICON-2018), Endocrine Society of India (ESI)

Ms. Kavita Rawat

(Student of Dr R.K. Tripathi)

- Young Scientist Award, Swami Rama Himalayan Institute, Dehradun, India and University of Tennessee, U.S at Dehradun, India

Ms. Pooja Maurya

(Student of Dibyendu Banerjee)

- Young Scientist Award, International Conference on Emerging Research in Bioscience (ICERB-2018), Guru Ghasidas Vishwavidyalaya Bilaspur

Ms. Akanksha Mishra
(Student of Dr Shubha Shukla)

- Best Poster presentation Award in International Conference on Movement and Cognition (Movementis 2018) held at Harvard Medical School, Boston, Massachusetts, USA

Aijaz A John
(Student of Dr. Divya Singh)

- Best Scientific Presentation Award in oral category, International Conference on Trends in Biochemical and Biomedical Research: Advances and Challenges (TBBR- 2018) Banaras Hindu University, Varanasi, 13-15 Feb, 2018

Ms. Laxmi Ganga
(Student of Dr. Mrigank Srivastava)

- First Prize in Poster Presentation, ICAAICON 2017, 51 Conference of Indian College of Allergy, Asthma and Applied Immunology held at KGMU, Lucknow

Ms. Anupama Tiwari
(Student of Dr. Saman Habib)

- Asian Pacific Organization of Cell Biology Award for Best Poster presentation at International Congress of Cell Biology 2018, at CSIR-CCMB Hyderabad

Mr. Sandeep Urandur
(Student of Dr. Prabhat Mishra)

- Best poster presentation (Third Prize), Awarding organisation: International conference on cell death in cancer and toxicology (CDCT-2018)

Ms. Ayushi Verma
(Student of Dr. Dipak Datta)

- Best Oral Presentation Award, International Conference on Cell Death in Cancer and Toxicology 2018 at IITR Lucknow

Mr. Shivraj M Yabaji
(Student of Dr. Kishore K Srivastava)

- Best paper presentation, Indian Society of Cell Biology 2018, CSIR-CCMB Hyderabad

Mr. Vinay Shukla
(Student of Dr. Anila Dwivedi)

- APA Best Poster Award-2018, Animal Physiologists Association, First Annual Conference of APA (APACON-2018) at Indian Veterinary Research Institute, Izatnagar.

Ankita Jain
(Student of Dr. Monika Sachdev)

- Certificate of Excellence Third Best Poster Presentation Award, World Congress on Cancer 2018 at Jaipur India

Mr. Arunabh Sarkar
(Student of Dr Aamir Nazir)

- Best poster award, Society for Alternatives to Animal Experiments

Dr. Sakshi Mishra
(Laboratory of Dr. SK Rath)

- 2nd Best Oral Presentation, Society of Toxicology

Mr. Rohit Sahai
(Student of Dr. Kalyan Mitra)

- First Prize in Photomicrography Contest (SEM Category), at International Conference on Microscopy- EMSI 2018
- First Prize at IITR-ZEISS Workshop on Confocal and Super-Resolution Microscopy, CSIR-IITR and CARL ZEISS

Akansha Pandey
(Student of Dr. Vineeta tripathi)

- Best poster Award at International conference on Biotechnological Research and Innovation for sustainable Development (BioSD-2018) organized by CSIR-IICT

Mr. Pankaj Kumar Shukla

- KN Bhal Nomination Award, for his Poetry Book on Atomic energy, awarded by Uttar Pradesh Hindi Sansthan

Section IV
Events & Activities Organized

GBP team interacts with CDRI scientists

A four-member delegation from Guwahati Biotech Park (GBP), Assam, led by ... Choudhary and ... visited Central Drug Research Institute (CDRI) on Monday. The objective of the visit and interaction with the scientists was to seek collaboration for the betterment of science and technology entrepreneurship related with healthcare and pharmaceuticals in north-eastern India.

Introducing GBP, Choudhary said it was a ... project launched by an autonomous society under the Assam government. "The founders of GBP hope to change the economic condition of the region and the state, thereby increasing the opportunities for the citizens of north-eastern and eastern India. GBP aims to be a place where education, researchers and business ... come together as collaborative partners for the betterment of science and technology entrepreneurship in northeastern India," she said.

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सीडीआरआइ ने लॉन्च किया न्यूट्रास्यूटिकल

लखनऊ : सीडीआरआइ के निदेशक, प्रोफेसर आलोक धावन ने ऑस्टियोआर्थराइटिस में राहत देने के लिए न्यूट्रास्यूटिकल लॉन्च किया। यह पालक के विशेष आहार घटक से युक्त है। नैनो फॉर्मूलेशन फार्मान्जा हर्बल प्राइवेट लिमिटेड को 31 जुलाई 2017 को लाइसेंस किया गया था। इसकी मार्केटिंग सहयोगी कंपनी एरन लैब इंडिया प्राइवेट लिमिटेड करेगी। लॉन्चिंग के अवसर एरन लैब के कार्यकारी निदेशक डॉ संजीव अग्रवाल और शोधकर्ताओं की टीम मौजूद थी। यह उत्पाद अब बाजार में ज्वाइंट फ्रेश के नाम से उपलब्ध होगा। वि.

http://epaper.jagran.com/ePaperArticle/14-mar-2018-edition-Lucknow-page_23-15604-6205-11.html

जासं, लखनऊ : हृदय संबंधी रोगों के लिए लोग स्वयं जिम्मेदार हैं। ... सुधार कर इन बीमारियों को आसानी से नियंत्रित किया जा सकता है। ... सीडीआरआइ में गुरुवार को शुरू हुई लोकप्रिय स्वास्थ्य व्याख्यान श्रृंखला ...

पूर्वोत्तर भारत में विज्ञान और प्रौद्योगिकी उद्यमिता के उत्थान के लिए सहयोग की तलाश

मिलेगी राहत | सीडीआरआई ने लॉन्च

गठिया के मरीजों को अब दर्द से छुटकारा दिलाएगी 'पालक'

अमर उजाला ब्यूरो

गठिया के मरीजों के लिए दवा 'ज्वॉइंट फ्रेश' को सीडीआरआई के निदेशक ने मंगलवार को लॉन्च किया।

गठिया के इलाज की पहली दवा

न्यूट्रास्यूटिकल को जानें

बड़ी राहत देगा न्यूट्रास्यूटिकल

106 रुपये में एक दिन की खुराक

एक पैकेट मतलब एक किलो पालक

इस टीम ने बनाई दवा

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नवभारत टाइम्स

'विज्ञान और प्रौद्योगिकी से स्वास्थ्य क्षेत्र का होगा उत्थान'

विज्ञान महोत्सव की तैयारियों का लिया जायजा

'विज्ञान और प्रौद्योगिकी से स्वास्थ्य क्षेत्र का होगा उत्थान'

पूर्वोत्तर भारत में विज्ञान और प्रौद्योगिकी उद्यमिता के उत्थान के लिए सहयोग की तलाश

...रआइ सेहत व औषधि... ता विकास में करेगा ...

सीडीआरआइ में आयोजित बैठक में शामिल गुवाहाटी बायोटेक पार्क के प्रतिनिधि

जासं, लखनऊ : पूर्वोत्तर भारत में पारंपरिक उपचार की मदद से लोगों को सेहतमंद करने की कोशिश में अब केंद्रीय औषधि अनुसंधान संस्थान (सीडीआरआइ) गुवाहाटी बायोटेक पार्क (जीबीपी) की मदद करेगा।

जीबीपी की डॉ.बुला चौधरी और डॉ. एमजी बारठाकुर के नेतृत्व में चार सदस्यीय प्रतिनिधिमंडल ने सीडीआरआइ का दौरा किया। उन्होंने कहा कि पार्क अपनी सुविधाओं के माध्यम से पूर्वोत्तर भारत में स्वास्थ्य देखभाल और फार्मास्यूटिकल्स सेक्टर को बढ़ावा देना चाहता है। इसका मुख्य फोकस पूर्वोत्तर भारत के प्राकृतिक संसाधनों की खोज पर जोर देना है जिससे वहां के निवासियों को अधिकतम लाभ मिले और उनकी आर्थिक एवं सामाजिक उन्नति को गति मिल सके। साथ ही पारंपरिक चिकित्सा पद्धतियों के ज्ञान को खोजना है जो आयुर्वेद का हिस्सा है। जड़ी-बूटियों का वैज्ञानिक सत्यापन कर, क्लीनिकल डेटाबेस के साथ जोड़ते हुए उसे वैज्ञानिक रूप से बढ़ाना देना है। इसके अलावा विभिन्न रोगों के लिए प्राकृतिक उत्पादों की नवीन रासायनिक इकाइयों ... बढ़ावा भी देना है।

सीएसआइआर-सीडीआरआइ से डॉ.श्रीकांत कुमार रथ ने संस्था... लिए सुलभ स्वास्थ्य देखभाल (... हेल्थकेयर फॉर ऑल) और ... से संबंधित उपलब्धियों और ... प्रस्तुतीकरण दिया। उन्होंने विभि... कार्यक्रमों, कौशल विकास ... बायोलॉजिकल स्क्रीनिंग फैसि... बाबत जानकारी दी। डॉ.वहा... विभिन्न अवसरों के बारे में जान... बताया कि पूर्वोत्तर भारत में स्वा... और फार्मास्यूटिकल से संबंधित ... प्रौद्योगिकी उद्यमशीलता के सु... जीबीपी और सीडीआरआइ दोनों ... सहयोग कर सकते हैं इस पर वि... की। डॉ. संजीव यादव ने प्रति... संस्थान के जीएलपी, अमृत ... विश्लेषणात्मक उपकरण सुविधा ... सुविधाओं के बारे में विस्तृत जान...

... में उद्यमिता विकास में करेगा ...

संक्रामक बीमारियों प... फरवरी में होगी संगोष्ठी

लखनऊ : औषधि खोज एवं अनु... मौजूदा रुझानों पर अंतरराष्ट्रीय ... (सीटीडीडीआर) का आयोजन 2... 23 फरवरी के बीच होगा। संगोष्ठी ... तीसरे वर्ष आयोजित की जाती है ... दुनिया भर के विशेषज्ञ भाग लेते ... गोष्ठी संक्रामक बीमारियों जैसे म... लीशमानिया और माइक्रोबियल ... जीवन शैली संबंधी विकारों पर वि... होगी। (जासं.)

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1 Events & Activities

Institutional Events

67th Annual Day Celebrations and 43rd Sir Edward Mellanby Memorial Oration

CSIR-CDRI, a constituent laboratory of Council of Scientific & Industrial Research (CSIR), New Delhi was formally dedicated to the nation on February 17, 1951. Since inception, Institute is striving relentlessly in the pursuit of providing affordable drugs and health care to the entire populace of the country. Sir Edward Mellanby was the founder Director of CSIR-Central Drug Research Institute (1950-51). As a tribute to the contributions of Sir Mellanby, the Institute, during its Silver Jubilee Year in 1976 started "Sir Edward Mellanby Oration series. An eminent Scientist delivers this Oration every year in the Institute.

67th Annual Day of this premier drug research institute was celebrated on 17 February 2018. Dr. Rajiv I. Modi, Chairman and Managing Director, Cadila Pharmaceuticals Limited, graced the Annual Day celebrations as Chief Guest. Dr. Girish Sahni, Secretary, DSIR and Director General, CSIR presided over the function. Dr. Anil Koul, Director, CSIR-IMTech delivered 43rd Sir Edward Mellanby Memorial Oration. Title of his oration was 'Discovery and development of Bedaquiline – A new drug for drug-resistant tuberculosis – harnessing value of Innovation'. The day began with the felicitation ceremony of Annual Day Sports winners and concluded with colourful cultural event followed by Dinner for entire CSIR-CDRI family.

National Science Day 2018

National Science Day was celebrated on 28th February 2018 to commemorate discovery of the 'Raman Effect', which led to Sir C.V. Raman winning the Noble Prize. The theme of NSD-2018 was “Science and Technology for a Sustainable Future”. Professor P.K. Seth, Ex-Director, CSIR-IITR graced the occasion as Chief Guest and delivered National Science Day lecture on “Science and Technology for a sustainable future”.

During the day, 82 students from 6 blocks of Bahraich districts visited our institute along with 14 teachers. The visit was organized under TRL programme by 'Care India' and was sponsored by ORACLE. On the occasion Science Quiz, Games, Puzzles etc. were organized. Students appraised with the accomplishments and ongoing programs of CSIR-CDRI.

National Technology Day 2018

Institute celebrated National Technology Day on 11th May 2018 –a day to commemorate the technological achievements & advancements. Dr Jitendra N. Verma, Founder Director, Lifecare Innovations graced the occasion as Chief Guest. Dr Nitya Anand, Ex-Director, CSIR-CDRI presided over the function. Theme of this year's National Technology Day celebrations was “Science and Technology for a Sustainable Future”.

Later in the program, Dr Mridula Kamboj Innovation Award-2017 orations were delivered by the awardees, Dr Atul Goel and Dr Divya Singh. Their oration lecture focussed on their new innovative dual bone anabolic and anti-resorptive agent, to accelerate bone fracture healing. Dr V.P Kamboj, Ex-Director, CSIR-CDRI, presided over the innovation award oration function.

76th CSIR Foundation Day Celebrations and CSIR-CDRI Award Orations

The Council of Scientific & Industrial Research (CSIR), known for its cutting edge R&D knowledgebase in diverse S&T areas, is a contemporary R&D organization. Having a Pan-India presence, CSIR has a dynamic network of 38 national laboratories, 39 Outreach Centres, 3 Innovation Complexes and 5 units.

Established on 26 September 1942, nearly 5 years before independence of the Nation, Today, CSIR India is amongst the largest scientific organizations in the world and oldest in India. CSIR played pivotal role in partnering & strengthening Indian industry in Aerospace, Agrochemicals, Petroleum and Petrochemicals, Chemical Intermediates, Polymers, Glass and Ceramics, Minerals and Metals, Coal, Building Materials, Surface Engineering, Food Processing, Aromatic Plants and Healthcare Products.

To commemorate the Foundation Day, Institute celebrated 76th CSIR Foundation Day on 26 September 2018. On this occasion, Prof. Satyanarayana Rao, Former President, JNCASR, Bengaluru graced the occasion as chief guest. He delivered a talk on, "Epigenomics and Human Biology". On foundation day, besides other regular programs, Institute also felicitated the recipients of prestigious 'CDRI Awards for Excellence in Drug Research'. Awardees for the year 2018 ~~are~~, Dr. P. Srihari, IICT, Hyderabad (Chemical Sciences) and Dr. Arun Shukla, IIT Kanpur and Dr. Amit Joharapurkar, Zydus Cadila Ahmedabad (Life Sciences) delivered award orations.

During the day, an Outreach Program was organized, as part of the IISF-2018. More than15000 students and faculties from various schools/institutions participated in this event & interacted with the scientists and visited the labs.

India International Science Festival (IISF) 2018, Lucknow.

India International Science Festival was organized at Lucknow with huge participation of scientists, students and experts from across the country and abroad. This event was organized by Ministry of Science and Technology, Ministry of Earth Sciences in association with Vijnana Bharati at Indira Gandhi Pratishthan, Lucknow during 5-8 October, 2018. Union Minister of Science &Technology, Dr. Harsh Vardhan inaugurated few of the major events at the four-day science festival in Lucknow including Young Scientists' Conference, Global Indian Science & Technology Stakeholders' Meet (GIST) and the Mega Science, Technology & Industry Expo. IISF-2018 with its focal theme **"Science for Transformation"** was having 23 special events in its 4th edition.

With an aim to give a special exposure to selected students of India's North East Region, North East Students Conclave was organized. In this conclave, North East students visited CSIR-CDRI and got the opportunity to interact with Scientists and to appraise themselves with the ongoing research activities of the Institute and contributions of CSIR-CDRI to the Nation.

During IISF-2018, Team-CSIR, showcased CSIR technologies and products, which are niche creating on one hand and are in connect with the masses on the other, bringing thus the much needed S&T interventions. CSIR pavilion was organized under the themes namely, Aerospace, Electronics and Instrumentation & Strategic Sector; Civil Infrastructure and Engineering; Mining, Minerals, Metals and Materials; Chemicals (including leather) and Petrochemicals; Energy (Conventional and Non-conventional) and Energy Devices; Ecology, Environment, Earth Sciences and Water; Agri, Nutrition & Biotechnology (Farmer Centric); Healthcare; and Nurturing Human Resource + Jigyasa.

Team-CSIR received first prize from Dr. Harsh Vardhan, Hon'ble Union Minister for Science & Technology and Earth Sciences for this expo.

72nd Independence Day Celebrations

Institute celebrated the 72nd Independence Day Celebrations with great zeal and gusto. The official celebrations took place in front of the Administrative block. Prof. Tapas K. Kundu, Director, CSIR-CDRI hoisted the tricolour flag followed by national anthem by CSIR-CDRI staff and their family. During the occasion, Director reminded us about our valiant freedom fighters who fought selflessly and even sacrificed their lives for our country to attain freedom from the colonial rule. He appreciated the contributions of CSIR-CDRI in technological independence in the area of Pharmaceuticals and encouraged everyone to contribute more while aligning with the expectations of new India and future challenges. As a part of 72nd Independence Day Celebrations, Staff Club of the Institute organized Blood Donation Camp on 13 August 2018.

70th Republic Day Celebrations

Institute celebrated 70th Republic Day on 26 January 2019, honouring the date on which the Constitution of India came into effect replacing the Government of India Act (1935). Prof. Tapas K Kundu, Director, CSIR-CDRI hoisted the National Flag and addressed all the staff members and students of the Institute.

Prof. Tapas K. Kundu takes over the charge as Director, CSIR-CDRI

Prof. Tapas K. Kundu, Professor, Molecular Biology & Genetics Unit, JNCASR, Bengaluru took over the charge as Director, CSIR-CDRI on 9 August 2018. Prof. Kundu had joined Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru as assistant Professor in 1999 and served as a Professor until 2018. Prof. Kundu has made significant contributions in the area of regulation of gene expression and its link to disease and therapeutics. He is not only elucidating the mechanisms of transcription regulation through the epigenetic modifications, but also targeting them to design new generation diagnostics, as well as therapeutics. Over the years, he has published several research papers in many international journals. Several patent applications from the laboratory have been granted and some are under process, which includes several academically important research reagents with potential commercial values, some of which have already been commercialized by renowned companies. He is the recipient of several awards, noteworthy among which are: the Shanti Swarup Bhatnagar prize from CSIR Government of India (2005), the National Academy of Science, India- Reliance Industries Platinum Jubilee Award (2008), the Sir JC Bose National Fellowship from DST Government of India (2010), the GD Birla award for scientific research (2011), The Ranbaxy Research Award 2011 in the field of Medical Sciences – Basic Research and India Innovation Award 2012 given by Merck Millipore 2012 (First place). He is the fellow of three major national academies of India and served as an editorial board member of the *Journal of Biological Chemistry (JBC) from 2011-2016*. He was instrumental to establish the *Asian Forum for Chromatin and Chromosome Biology* and *Chemical Biology Society, India*. Besides fundamental research, Prof. Kundu is also involved in teaching and organizing science outreach programs.

During a formal welcome program, organized by CSIR-CDRI staff club, he expressed his delight and said that it is an honour for being selected to the position of the Director of CSIR-CDRI, a premier drug research institute of India which has made remarkable contributions towards technological independence of the Nation in health and pharma sector. He looked forward for the support from all staff and students of the Institute to take the Institute towards newer heights in the service of nation. Prof. Kundu, on behalf of CSIR-CDRI family, expressed gratitude to Prof. Alok Dhawan for his service to the Institute as Director on Additional Charge for the last 8 months.

Study-Visit of the Departmental-related Parliamentary Standing Committee on Science & Technology, Environment & Forests

Departmental-related Parliamentary Standing Committee on Science & Technology, Environment & Forests visited CSIR – Central Drug Research Institute, Lucknow on 03-12-2018. Shri Prasanna Acharya chaired the committee. Committee comprised of Shri S.R. Balasubramoniyan, Shri E.T. Mohammed Basheer, Shrimati Vasanthi M., Shri Daddan Mishra, Shri Vikram Usendi and officials from Rajya Sabha Secretariat and DSIR.

Committee, accompanied with Director, and senior scientists of CSIR-CDRI, visited National Repository of Organic Compounds, Herbarium of Medicinal Plants, Natural Product Process Chemistry laboratory, X-Ray Crystallography Facility, Electron and Confocal Microscopy Facility and NMR Facility. During the meeting with the Committee, Director, CSIR-CDRI presented achievements of the Institute, future roadmap and challenges faced and way forward. Committee largely appreciated the facilities and contributions of CSIR-CDRI to the Nation and encouraged Institute scientists to reach greater heights in the service of the nation.

Committee desired that Institute shall take up research activities in the area of viral diseases as nation is frequently facing the viral epidemics. We are happy to report that Institute has already taken up the initiative to venture into newer and most relevant disease areas including viral infections, ageing biology and neurobiology envisioning the healthcare challenges for India 20 years from now. Institute also envisages setting up of super specialty hospital to give impetus to biomedical research activities of the Institute.

Seminars & Symposium

Mini Symposium of the Global Challenges Research Fund Network for Neglected Tropical Diseases

CSIR-CDRI in association with the Global Challenges Research Fund Network for Neglected Tropical Diseases organized a mini symposium on neglected tropical diseases on 4 May 2018. During the symposium, Dr. Nahid Ali, CSIR-IICB gave an overview of the program and proposed contribution. Dr. Paul Denny, Department of Biosciences, Durham University, UK delivered lecture on Targets to Drug Discovery, and back again. Dr. Adriano C Coelho, Institute of Biology, State University of Campinas, Brazil delivered lecture on Susceptibility and resistance to drugs in leishmaniasis Dr. Ehmke Pohl, Biophysical Sciences Institute at Durham University, UK delivered lecture on Structure-based design of Tuberculosis booster drugs Dr. Neena Goyal, CSIR-CDRI delivered lecture on Leishmaniasis: An Overview. Dr. Anuradha Dube, CSIR-CDRI discussed about the Vaccine against Leishmaniasis. Dr. Susanta Kar, CSIR-CDRI gave a lecture on Host-pathogen interaction in VL: A signaling point of view Dr. Ashish Arora gave a lecture on Structural studies on Leishmania Rab proteins.

One-day Seminar on Applications of HPLC and LC-MS/MS in Drug Research

One-day seminar on Applications of HPLC and LC-MS/MS in drug research was organized on 20 June 2018 to increase awareness of using LC-MS and HRMS instruments for natural product chemists. More than 54 participants, from different parts of India and Nepal, participated in this seminar. The outcome of this workshop benefited in improved understanding of participants towards the techniques and their applications in research activity. This also helped them to assess their molecules for the right type of analysis and systematic interpretation of data to know their compounds. All the participants were able to see the HPLC/UPLC-HRMS, MS/MS and MS^n experiments on the instrument and interpretation of data by expert.

One Day Symposium on Past, Present and Future of Drug Discovery and Development in India

As a part of the 76th CSIR Foundation Day Celebrations, Institute organized a One-day Symposium on Past, Present and Future of Drug Discovery and Development in India followed by a panel discussion exclusively by the former Directors of CSIR-CDRI to enlighten the Institute scientists with their experienced views and provide futuristic direction to lead the drug development program of CSIR-CDRI. During the symposium, Dr. Nitya Anand shared his experiences from the inception of this institute to till date. He shared how this institute helped in development of Pharma sector in India after independence and Research on National Development Programmes, Basic research in cognate area & Applied Research/Process Development. Dr. VP Kamboj shared his outlook towards the drug development in India and contribution of CSIR-CDRI in this context. Dr. CM Gupta discussed the pace of drug discovery during the early days and also shed light on contribution of CDRI from 1980-2000 CDRI. He opined that upgradation of skills in molecular and computational sciences, medicinal chemistry and pharmacology is the need of hour. Dr T K Chakraborty added that Interdisciplinary approach to understand the drug development is important. Dr. Madhu Dikshit opined that we have to cope with the competitiveness in global scenario.

Panel discussion concluded that there is a need to change our approach towards collaboration with industries and academia to compete with global scenario. CSIR-CDRI should put more emphasis on disease markers and diagnosis along with its new drug developmental research program. More collaborative projects can be initiated for this. New start up can be initiated and supported for filling the gap with industry. Institute needs to venture into newer areas like ageing biology, neurobiology and viral infections to meet the future challenges of the nation.

CSIR-CDRI Nobel Symposium 2018

Research scholars of CSIR-CDRI, under the mentorship of Prof. Tapas K. Kundu, Director, CSIR-CDRI, initiated Nobel Symposium Series in the Institute. Objectives of this symposium is to provide a platform to discuss and share the excitement of events which led to World's highest scientific award during the year. First in the series, CSIR-CDRI Nobel Symposium 2018 was organized on 10 December 2018. It covered the Nobel prizes in Chemistry and Physiology or Medicine. CSIR-CDRI research scholars, Mr. Dinesh Barak, Ms. Jyoti Shukla, and Ms. Pallavi Awasthi covered topics related to Nobel Prize in Chemistry 2018 and delivered talks covering the theme "Revolution based on evolution". Ms. Anupama Tiwari, Mr. Mushtaq Ahmad, Dr. Nabanita Das and Mr. Pratik Narain Srivastava covered Nobel prize in Physiology or Medicine 2018 and delivered talk around the theme Immunotherapeutics: A new beginning. This symposium invigorated new scientific discussions based on Nobel Prize winning work.

CSIR – CDRI Scientific Lecture Series

During the year, CSIR-CDRI Scientific Lecture Series were initiated with an aim to create an interacting platform among the scientists of the institute and eminent contributors in the field of drug discovery and development / disease biology / other related field. In this series monthly series of lectures, researchers from India and abroad, who have made pioneer contribution in the field of biomedical research towards unmet medical needs, will be delivering a scientific lecture covering their contribution in advancing the knowledge frontiers.

The inaugural lecture in this series was delivered by Dr. Praveen Kumar Vemula, Institute of Stem Cell Biology and Regenerative Medicine (inStem), GKVK Campus, Bengaluru on 22 January 2019. Dr. Vemula has made outstanding contributions towards design of therapeutic and prophylactic biomaterials for biomedical applications. Lecture was presided by Prof. Tapas K Kundu, Director, CSIR-CDRI.

7th Annual Conference of the Society for Mitochondrial Research and Medicine on Targeting Mitochondria for Health and Disease

The 7th International Conference of the Society for Mitochondria Research and Medicine, India titled "Targeting Mitochondria in Health and disease" 'Mitoconf-2018' was organized on 28-30 November, 2018 in CSIR-CDRI, Lucknow. The purpose of Mitoconf-2018 was to foster research on basic science of mitochondria, mitochondrial pathogenesis, prevention, diagnosis and treatment. Mitoconf-2018 addressed cutting- edge advances Emerging Concepts in Mitochondrial Biology, Mitochondrial Medicine: Current Status and Future Prospects, Mitochondria: A Therapeutic Target Disease Biology, Mitochondria and Drug Discovery: The Road ahead. The three-day event included plenary and invited lectures, flash talks and posters by a number of international/ national scientists featuring investigational biology, clinical aspects, and translational biomedical research. A total of 18 eminent scientists from India and abroad (USA, Norway, Denmark and Taiwan) have come together in discussing about the recent developments in the field of mitochondrial research and medicine. Mitoconf-2018 provided a common platform for assessment of the challenges associated with drug design and development in these areas.

During the conference, the first Dr Lalji Singh Memorial Lecture Award was conferred to Dr Anurag Agarwal, Director, CSIR-IGIB, New Delhi. In His award oration he talked about the critical role of mitochondria in pathogenesis of respiratory diseases and the ability of mesenchymal stem cells to act as mitochondrial donors, reversing lung injury and inflammation.

Popular Health Talk & CDRI Lecture Series

Over the last more than six decades, CSIR – Central Drug Research Institute has significantly contributed to the growth of Pharmaceutical industry in India through new drugs of national importance, economic process technologies, national level policies and globally competitive human resource. During this period, several eminent clinicians immensely contributed to the growth & development of drug discovery programs of CSIR-CDRI. In order to enlighten the scientists by the real field clinical practices, Institute designed the popular health talk series, where the renowned physicians from all over the country will bring the realistic view of up-to-date therapeutic practices and future need of the nation.

Inaugural lecture in this series, was delivered by eminent clinician, Dr. Nagaraj Desai, Cardiologist, Director, Namana Medical Centre, Bengaluru, India on 1 November 2018. Title of the talk was Atherosclerosis / Atherothrombosis: An exciting future awaits.

Second lecture in the series was delivered by Prof. K.S. Gopinath, Prof. of Surgery & Oncology, Sri Devraj Urs Medical College, Tamaka, Kolar, Karnataka on 19 -11-2018. Title of his talk was “Clinician Perspectives of Personalized Cancer Medicine: Hope – Hurdle – Hype !!!

Exhibitions and Expo

During the year, Institute showcased R&D activities, products and its accomplishments in various exhibitions and mela's across India. Some prominent programs include: (i) Grand State Mela exhibition from 15th to 17th Dec. 2017 at Simauni, Baberu, Banda; (ii) Exhibition of CSIR Technologies/products for rural India at Kisan Mela of CSIR-CIMAP on 31st Jan. 2018; (iii) Healthcare Pavilion of CSIR in 105th Indian Science Congress (ISC-2018) at Manipur University, Imphal during March 16-20th, 2018; (iv) 8th Science Expo at Regional Science Centre, Lucknow during March.26-28, 2018; (v) Generics and Healthcare Pavilion of CSIR at NER Railway Ground at Gomti Nagar, Lucknow during India International Science Festival (IISF-2018) during Oct. 5-8, 2018.

Awareness Programs / Thematic Celebrations

Workshop on Gender Sensitization and Sexual Harassment of Women at Workplace

The CSIR-CDRI strongly encourages gender parity and is constantly working towards providing a conducive environment for efficient and effective communications between the employees and students. With the support from CSIR - Human Resource Development Centre, Ghaziabad, Institute organized a workshop on Gender Sensitization and Sexual Harassment of Women at Workplace: Prevention, Prohibition and Redressal. Workshop was held on 22 March 2018. The objective of the workshop was to sensitize the participants on gender issues, to help them be aware of gender biases, to help them resolve interpersonal conflicts arising from gender issues and to enable them to act assertively and respond to challenges in workplace. The Workshop was held with the intention to create awareness about gender issues and Sexual Harassment at Workplace Act, 2013.

During the workshop, Dr. Sunita H. Khurana, Director, Institute of Secretariat Training and Management talked about Need for gender sensitization, understanding what constitutes sexual harassment, An overview of the Sexual harassment of women at workplace (prevention, prohibition and redressal) act and Constitution and functions of ICC, Role of ICC and Duty of the employer. Staff and students participated in this workshop.

Vigilance Awareness Week – 2018

In pursuance of Central Vigilance Commission directives, vigilance awareness week was observed at CSIR-CDRI during 29 October to 3 November 2018. This week, through its various outreach activities, it seeks to motivate stakeholders to collectively participate in the fight against corruption and also aims at raising public awareness regarding the detrimental consequences of corruption. This year, theme of the week was “Eradicate Corruption-Build a New India” During the week, various activities were conducted including taking of the Integrity Pledge by all the employees, Poster on preventive vigilance, sensitization workshop, Essay, Debate and Quiz competition, and lecture by Shri Sulkhan Singh, Ex-Director General of Police, Uttar Pradesh. Winners of the various competitions were given Certificates during the concluding ceremony.

Kavi Sammelan

Kavi Sammelan was organized on 25 April 2018 by the hindi language section of CSIR-CDRI, with the aim of spreading the official language. The Kavi Sammelan was attended by a number of National level poets, including Dr. Surya Kumar Pandey, Sh. Wahid Ali, Dr. Nirmal Darshan, Sh. Rajendra Pandit, Sh. Abhay Singh Nirbheek, Dr. Manasi Dwivedi, and Sh Pankaj Prasun. All the scientists and research students enjoyed a lot and appreciated the poetry.

Hindi Saptah

Hindi Saptah is an annual celebration starting on September 14. On this day in 1949, Hindi written in Devanagari script became the official language of India under the Article 343. As per the practice in the past, Institute observed Hindi Saptah from 14-24 September 2018. During entire week hindi promotional activities and competitions including Hindi translation, writing, quiz, essay, debate, etc were organized. Staff and students actively participated in the programs. Cash prize and certificates given to winners of the competitions

Hindi Karyashala

A Hindi Karyashala was organized on 27 September 2018, which was actively participated by staff and students of CSIR-CDRI. In this karyashala, Hindi voice typing training was given to the staff members with an aim to address the issues in preparing the official communications/documents in Hindi.

Workshop & Trainings

Scientific Workshop on Antibiotics & Human Health

To improve the interest of science in today's youth and increase the scientific thinking and experience of the students, CSIR-CDRI has organized a Scientific Workshop on Antibiotics & Human Health (in Hindi medium) on 25 January, 2019 for the high school and intermediate students. This workshop provided the students an opportunity to understand scientific aspects of antibiotics and human health. In this workshop, renowned clinicians and researchers from different scientific organizations, including KGMU, Lucknow, IVRI, Rae barely and JNCASR, Bengaluru gave a detailed update in Antibiotics and human health. More than 150 high school students and faculty from 11 schools in the city participated in the workshop. During the day, for the development of competitive intellectual skills and ideological creativity, a Poster session on Antibiotics was organized. A committee of eminent scientists evaluated the posters and conferred Best Poster Awards to selected group of students.

Scientific and Technical Awareness Training Program in Animal Ethics & Experimentation

National Laboratory Animal Facility of CSIR-CDRI organized Scientific and Technical Awareness Training Program in Animal Ethics & Experimentation during 06-31 August 2018. About 51 research scholars under AcSIR PhD program of CSIR-CDRI participated in this training program.

3rd Next Generation Sequencing workshop

The third NGS Workshop was conducted during first week of January 2019 to provide training in the most advanced methods of genome sequencing. A total of 20 participants from different institutes all over India participated in the workshop. Laboratory hands on demonstrations for library preparation, targeted sequencing, exome sequencing, bioinformatics analysis of data handling, transcriptome sequencing, small RNA sequencing, ChiP sequencing and metagenome were conducted. The participants benefitted by learning the contemporary sequencing techniques, which would help them in implementing these techniques in their research. The possibility of collaboration between CDRI and other institutes for research projects involving next generation sequencing methods was also discussed.

National Workshop on "Small Molecule Analysis by NMR Spectroscopy & Mass Spectrometry"

SAIF, CSIR-CDRI has organized a National Workshop on "Small Molecule Analysis by NMR Spectroscopy & Mass Spectrometry" during 12-14 December, 2018. The workshop has provided an opportunity to experience the state-of-the-art NMR, LC-MS and LC-MS/MS techniques and initiate lively discussion among research scientists, academicians and young researchers to share their knowledge in the frontier areas of chemical sciences. The beginners have get a chance to familiarize themselves with NMR and LC-MS techniques and gain confidence by observing their applications and data interpretation as done in real situation. This Workshop was focused on the structure characterization of small molecules using NMR, LC-MS and MS/MS techniques. Total 24 participants (research scholars, faculty and industry participants) from different part of country have attended the workshop.

National Workshops on HPLC Basics and Method Development

With the sponsorship of DST, Government of India, Sophisticated Analytical Instrument Facility of CSIR-CDRI organized National workshops on HPLC Basics and Method Development during 18-19 April and again on 18-19 June 2018. These workshops aimed to cover basics of high performance liquid chromatography (HPLC) to enable users to separate, identify and quantify chemicals as well as molecules in a mixture (crude extract). The participants benefitted from this workshop and improved their understanding of the techniques and its applications in research activity. All the participants were able to watch the HPLC experiments and method development. Instrument handling was allowed in groups. The workshop included both lectures (30% time) and laboratory sessions (70% time). Topics covered (i) HPLC Basics and Instrumentation; (ii) Method Development strategies and Applications, (iii) On-site Training and (iv) Lab Visit.

2nd National Workshop on Applications of Transmission Electron Microscopy and Scanning Electron Microscopy in Life Sciences

Institute organized 2nd National Workshop on Applications of Transmission Electron Microscopy and Scanning Electron Microscopy in Life Sciences during 6 – 8 March 2018. This workshop was sponsored by CSIR, Jeol and Gatan. With 12 participants from across the country, this three-day workshop was aimed at enhancing the knowledge and skill-set of students, research fellows, faculty and staff working in the area of life sciences and included both theory and practical sessions. The focus was on various techniques, applications and their sample preparation methods with intensive practical sessions including hands-on sessions. Latest developments especially in the area of Cryo-EM. Course also covered basic TEM/SEM operation and maintenance / troubleshooting issues. Participants appreciated the basics of TEM/SEM along with the ability to integrate EM tools/experiments in the workflow of their research projects by selecting the appropriate technique from a variety of available techniques and then optimizing it for obtaining the best solution for their research problems.

National Workshop on Small Molecule Analysis by API-Mass Spectrometry & NMR Spectroscopy.

With the support of DST, Government of India, Institute organized a National Workshop on Small Molecule Analysis by API-Mass Spectrometry & NMR Spectroscopy during 21 – 23 February, 2018. This workshop provided an opportunity to experience the state-of-the-art LC-MS, LC-MS/MS and NMR techniques and initiated lively discussion among research scientists, academicians and young researchers to share their knowledge in the frontier areas of chemical sciences. The beginners got a chance to familiarize themselves with LC-MS and NMR techniques and gain confidence by observing their applications and data interpretation as done in real situation. This Workshop focussed on the structure characterization of small molecules using LC-MS, MS/MS and NMR techniques. Topics of the workshop were Basics of Mass Spectrometry and NMR Spectroscopy, Basic Instrumentation of LC-MS and NMR Applications of LC-MS, LC-MS/MS, 1D and 2D NMR techniques and their data interpretation, and Demonstration on instrument (Lab. session) followed by discussion

Scientific Social Responsibility Programs

JIGYASA – Quest for Curiosity

The Jigyasa programme is inspired by Prime Minister Narendra Modi's vision of a new India and Scientific Social Responsibility (SSR) of Scientific Community and Institutions. Jigyasa, a student - scientist connect programme was launched by the government in New Delhi. The Council of Scientific and Industrial Research (CSIR) is implementing the programme in collaboration with Kendriya Vidyalaya Sangathan (KVS). JIGYASA- the objective of the programme is to engage students in practical activities to get a flavor of research by extending classroom learning to research and laboratory-based learning at an early age. 'JIGYASA' would inculcate the culture of inquisitiveness on one hand and scientific temper on the other, amongst the school students and their teachers. During the year, as a part of JIGYASA, students and teachers from following Kendriya Vidyalayas visited CSIR-CDRI.

S.No.	Date	College	Students	Faculty
1.	10.05.2018	Kendriya Vidyalaya, Rail Parisar, Gonda	50	5
2.	22.06.2018	Kendriya Vidyalaya, AFS, Gorakhpur	25	2
3.	27.06.2018	Kendriya Vidyalaya, FCI, Gorakhpur	16	2
4.	29.06.2018	Kendriya Vidyalaya IFFCO, Phulpur, Allahabad	29	4
5.	13.07.2018	Kendriya Vidyalaya, AFS, Bamrauli, Allahabad	45	4
6.	20.07.2018	Kendriya Vidyalaya, IIM, Lucknow	32	2
7.	25.07.2018	Kendriya Vidyalaya, Mau	56	3
8.	26.07.2018	Kendriya Vidyalaya, ITI,Mankapur, Gonda	55	5
9.	27.07.2018	Kendriya Vidyalaya, Basti	24	2
10.	02.08.2018	Kendriya Vidyalaya, BKT, AFS, Lucknow	20	2
11.	16.08.2018	Kendriya Vidyalaya RDSO, Lucknow	44	2
12.	24.08.2018	Kendriya Vidyalaya, Chero, Salempur, Deoria	25	2
13	18.09.2018	Kendriya Vidyalaya, Ballia	20	2
14	20.09.2018	Kendriya Vidyalaya, Memaura, Lucknow	50	5
15	27.09.2018	Kendriya Vidyalaya, CRPF, Kanpur	42	4
16	27.09.2018	Kendriya Vidyalaya, BKT, AFS, Lucknow	8	2
17	29.10.2018	Kendriya Vidyalaya, Cantt., Lucknow	47	5
18	30.10.2018	Kendriya Vidyalaya, AMC, Lucknow	44	4
Total			541	48

Health Awareness and Outreach Program at villages

As a part of CSIR's Scientific Social Responsibility, CSIR-CDRI conducts awareness programme in villages on different disease areas related to health as per its mandate. During the year, Institute scientists stepped-out for villages and organized following Health Awareness and outreach programs:

- On the occasion of World Health Day with slogan # Health For All under this year's theme "Universal health coverage: everyone, everywhere", CSIR-CDRI organized a two days Health Awareness and outreach programs in village Parenda, Block Miyanganj, Distt. Unnao from 6-7 April 2018.
- Under the aegis of Aspirational Districts Programme, CSIR-CDRI selected Baharich district and organized Health Awareness Program and free health check-up camp was organized at village Begampur, Block Chittora, Distt. Bahraich on 6th July 2018.
- To mark the World Diabetes Day on 14th November 2018 a Health Awareness Program and free health check-up camp was organized at village Gajadharpur, Block Fakarpur, Distt. Bahraich in association with CARE India to sensitize the villagers for health, education and cleanliness during this program.

Students Motivation Programs for various Schools & Colleges

As a part of CSIR's Scientific Social Responsibility, with an aim to promote experimentation and innovativeness in education and bringing confidence to society about relevance of Institute in terms of Social Impact, various motivation programs were organized during the year. Under this program, Institute invites Schools and colleges across India to visit CSIR-CDRI. The major objective of the program is to motivate the young students for pursuing their career in Science and explore the knowledge of drug Discovery and Research. During the visit, students and faculties are appraised with the Institutes accomplishments in the service of nation, ongoing R&D programs and visits to important facilities and R&D laboratories.

S. N.	Date	School / College	Students	Faculty
1.	06.02.2018	R.J. College, Ghatkopar, Mumbai	35	03
2.	20.02.2018	SAAII College, Kanpur	28	1
3.	23.02.2018	Sir Madan Lal Group of Institutions, Almapur Hauz, Etawah, UP	44	5
4.	23.02.2018	D. B. PG College, Bachhrawan, Rae Bareli	17	2
5.	28.02.2018	Kasturba Gandhi Balika Vidyalaya, Bahraich	85	11
6.	09.5.2018.	Loreto Convent Intermediate College, Lucknow	100	04
7.	05.06.2018	10 selected Peer Ambassadors from UP	10	04
8.	14.08.2018	K.K. Academy, Lucknow	23	04
9.	28.08.2018	MG Institute of Management and Technology, Lucknow	46	5
10.	11.09.2018	Vivek College of Technical Education, Bijnor	27	5
11.	26.09.2018	Open Day for visit by Schools & Colleges of Lucknow	1187	20
12.	07.10.2018	North East Student Conclave, IISF-2018	238	18
13.	11.10.2018	Deen Dayal Snatkottar Mahavidylaya, Sitapur	20	2
14.	26.10.2018	Pt. Khushilal Sharma Government Ayurveda College & Institute, Bhopal	55	04
15.	26.10.2018	Darrang College, Tezpur, Assam	10	02
16.	16.11.2018	Naraina Group of Institutions, Kanpur	27	03
17.	27.11.2018	Dept. of Zoology, University of North Bengal, Siliguri	60	02
18.	07.12.2018	D.B.S. College, Kanpur	37	03
19.	18.12.2018	Department of Pharmaceutics & AKS Satna	37	04
20.	20.12.2018	Department of Physiology, Raja N. L. Khan Women's College, Midnapore, West Bengal	34	05
		Total	**2120**	**107**

Sports & Recreational Activities

Golden Jubilee Shanti Swarup Bhatnagar Memorial Tournament-2018

Sports are a universal form of recreation. They are also one of the great expressions of the aspirations of man to excel and instil the spirit of discipline and team-work. In CSIR, sports activities are being promoted through an official platform 'CSIR Sports Control Board' (SPB). The Shanti Swarup Bhatnagar Memorial Tournament, sponsored by CSIR-SPB, is a novel way of paying tribute to the one of the great scientists of India and also a forum for bringing together staff members of CSIR irrespective of discipline and organizational leads. This year, CSIR celebrated the Golden Jubilee Shanti Swarup Bhatnagar Memorial Tournaments across the CSIR labs. Zonal-II (indoor & Outdoor) tournament was organized at CSIR-CDRI, during 26-29 Nov, 2018. Teams from the 10 CSIR labs, including, CSIO, NPL, NISTADS, IGIB, CSIR Hq, CMERI, NEERI, NGRI, IHBT, and IIIM participated in this event. Sports included Cricket, Volleyball, Badminton, Table Tennis, Chess, Bridge, Carom. Shri Gulab Chand, former International Athlete (Arjun Awardee) was guest of honour for the Inaugural function held on 25-11-2018. Shri Mahendra Modi, IP (DG-SIT, UP) was Chief Guest.

68th CSIR-CDRI Annual Day Sports Events

As a part of the 68th CSIR-CDRI Annual Day, Staff Club of the Institute organized various Indoor and Outdoor sports activities, including Badminton, Bridge, Campus Run, Carom, Chess, Cricket, Football, Kabaddi, Table Tennis, Volleyball for the staff and students of the Institute. Activities like field events and painting competition was organized for the children of CSIR-CDRI staff and scholars.

2 Distinguished Visitors and Lectures

Distinguished Visitor	Title of Lecture	Date
Prof. Subhash C. Pandey Director Center for Alcohol Research in Epigenetics University of Illinois at Chiacago & Jesse Brown VA Medical Center Chicago, IL60612, USA	Adolescent alcohol exposure and brain: Epigenetic reprogramming and adult psychopathology	08.01.2018
Dr. Harshad Rami EDL – Project Director ADD- UK; Glaxo SmithKline, UK	Introduction to DDW and GSK607- a human microdose study	11.01.2018
Dr. Ashok Singh Wisconsin Institute of Medical Research Medison, WI, USA	Inhibition of UVR- induced carcinogenesis in an experimental Model	12.03.2018
Dr. Vivek Garg Lucknow Cancer Institute, Lucknow	Breast cancer: Myths and facts	08.03.2018
Dr. Ganesh Nagaraju Department of Biochemistry IISc, Bengaluru	Trans-dichlorooxovanadium (IV) complex as a novel photoindcble DNA interstrand crosslinker for cancer therapy	13.04.2018
Dr. Sunita H Khurana Director, Institute of Secretariat Training & Management New Delhi	Gender sensitization and sexual harassment of women at workplace: Prevention, prohibition and redressal	22.03.2018
Prof. Leon Ghosez, Emeritus Professor UCL, Visiting Scientist IECB	Design and synthesis of privileged scaffolds derived from natural products: An invaluable source of molecules of therapeutics import	14.08.2018
Prof. Anne-Marie Caminade Principal Investigator (French Side) Laboratoire de Chimie de Coordination du CNRS Délégation Midi-Pyrenees, Toulouse	Anti-inflammatory and related properties of phosphorus dendrimers	06.09.2018
Prof. Serge Mignani Universite Paris Descartes, Pres Sorbonne Paris Cite France	From phosphorus metallo-dendrimers to polycationic dendrimers and dendrons as original nanoplatforms to treat cancers	07.09.2018
Dr. Vikas Singh Rawat Assistant Scientific Editor Science of Synthesis, Thieme	Science of synthesis	25.09.2018
Dr. Matthias Kiesselbach, Director German Research Foundation (DFG)	Funding opportunities for prospective post-doctoral researchers and faculties	05.10.2018
Prof. Madhu Dikshit THSTI National Chair, NCR Biotech Science Cluster, Faridabad, Haryana	Prof N R Dhar Memorial Award Oration “Neutrophils: prominent soldiers of innate immunity”	29.10.2018
James P Clement Chelliah PhD. Assistant Professor (Faculty Fellow) JNCASR, Bengaluru, India	Overview of intellectual disability using *Synap1* heterozygous mutation as a model	20.11.2018

3 Invited Lectures Delivered by Institute Scientists

Dr. A.K. Sinha

- Natural product inspired green chemistry approach for the synthesis of small molecules of biological and industrial relevance, in International seminar and 55th Convention of Chemists, 2018 (RACS2A-2018), G. B. College, Naughachia, Bhagalpur, 28-30 December 2018
- Natural-product-inspired pot-economy synthesis of diverse polyphenolic-based molecules of biological and industrial relevance, in MRSI-North East Chapter Conference on The Frontiers in Chemical Biology, CSIR-NEIST, Jorhat, 25-28 June 2018.
- Green and step-economical strategy for synthesis of natural and unnatural polyphenolic compounds and their biological evaluation, in Seminar on Role of Chemistry & Biology Interface in Drug Discovery, Indian Society of Chemists & Biologists (ISCB), Lucknow, 23 June 2018.
- Natural and unnatural phenolic based small molecules: Green chemical synthesis and their biological evaluation, in 24th ISCB International Conference, Manipal University, Jaipur, 11-13 January 2018.

Dr. Y. S. Prabhakar

- Histone Deacetylases (HDACs)-ligands co-crystal structures' analysis: Identification of ligand/inhibitors requirements for binding, at Chemistry Department, Sri Y N College, Narsapur, Andhra Pradesh, 21 June 2018.

Dr. Brijesh Kumar

- Phytochemical investigations using MS and LC-MS/MS tools, at Indira Gandhi National Tribal University, Amarkantak, 31 August 2018.
- Phytochemical investigations using MS and LC-MS/MS instruments, at Mizorum University, Tanharil, Aizawl, 12 May 2018.

Dr. Anila Dwivedi

- Microtubule depolymerization attenuates WNT4/CaMKIIα signaling in mouse uterus and leads to implantation failure, in Animal Physiologists Association conference (APACON) 2018, ICAR-IVRI, Izatnagar, 23 December 2018.

Dr. K.K. Srivastava

- Biological activities of phosphorous dendrimers against infectious diseases and cancer, at LCC-CNRS Toulouse France, 27 June – 10 July, 2018.

Dr. Neena Goyal

- Drug discovery to combat VL in India, at JH-Institute of Molecular Medicine, Jamia Hamdard, New Delhi, 29 November 2018.

Dr. Sharad Sharma

- GLP in animal research: Current indian scenario, in LASAI, Lucknow, 29 April 2018.
- Role of QA in auditing test and reference items and role of QA in review of SOP's, in Training Course for QA Personnel of GLP Test Facilities, in NGCMA, New Delhi, 23-24 August 2018
- Resources and documentation in GLP environment, and quality assurance unit: Role and responsibilities, in National Workshop in GLP for sensitization of Faculty & Scientists of Delhi, THSTI NCR Biotech Science Cluster, 3rd Milestone, Faridabad, 24-09-2018 and National Workshop in GLP, IITR Lucknow, 7 December 2018.

Dr. Saman Habib

- Assembly proteins in biogenesis of reduced organellar ribosomes of the malaria parasite, in Symposium on Genome Biology 2018: Mechanisms in Health and Disease, Department of Biochemistry, Indian Institute of Science, Bengaluru, 13-14 July 2018

Dr. Ravishankar R.

- Architecture and molecular mechanism of multi-protein complexes (BERosomes) involved in DNA Base Excision Repair (BER), National Seminar on Crystallography (NSC46), NIMHANS, Bengaluru, 29 June 2018

Dr. Sanjay Batra

- Developing complementary synthesis via common reagents, National Symposium on Emerging Trends in Chemical Sciences, Banaras Hindu University, Varanasi, 17-18 November 2018
- Antileishmanial chemotherapy: Update, pitfalls and advances, in Indo-Australian workshop on rational drug design, CSIR-IICB, Kolkata, 4 April 2018
- Sodium Nitrite-mediated Domino reactions in organic synthesis, in Emerging Trends in Chemical Sciences, Deen Dayal Upadhyay Gorakhpur University, 24-25 February 2018
- Sodium Nitrite for cascade reactions in organic synthesis, in Org. Chem. Symposium, IIT Kanpur, Kanpur, 18-20 January 2018
- Chemistry of β-Carbolines: Synthesis of natural product mimics and annulated systems, in International Conference on Chemistry for Human Development, Kolkata University, Kolkata, 8-10 January 2018

Dr. Vinita Chaturvedi

- Anti-TB treatment: Some facts and prospects, in Symposium on Medical and Health Sciences, Amity University, Lucknow, 10 October 2018

Dr. S.K. Rath

- Drug discovery and development from a Regulator's point of view, in International Conference on Emerging Research in Biosciences, Guru Ghasidas Viswavidyalaya, Bilaspur, 30 0ctober 2018
- Ethics in genomics, in International Workshop on "Current Trends in Genomics and Molecular Medicine, KGMU, Lucknow, 21 November 2018
- Can Ionophores control cancer?, at Biotechnology Department, Utkal University, Vanivihar, 15 December 2018
- Biology in 21st century, Zoology Department, Christian College, Lucknow, 25 September 2018

Dr. Amit Misra

- Pharmacokinetics-inspired drug delivery systems and devices, at Indian Institute of Technology, Guwahati, 12 November 2018
- Pharmaceutical formulation and MDR Mtb, at University of Oslo / Indian-Norwegian Joint Network on MDR *M. tuberculosis*, Oslo, 16 October 2018
- Inhalable particles targeting lung macrophages, at University of Oslo/ Indian-Norwegian Joint Network on MDR *M. tuberculosis*, Oslo, 17 October 2018
- Experience of public funded R&D initiatives: Contrasting perspectives of public-funded and private entity researchers, Vivanta, (Pharmexcil and CSIR), in Conference on Biomedical R&D for Public Health in India, New Delhi, 13 August 2018
- Biosimiliraity: Sequence, structure or function? South Centre, in Expert Meeting on Access to Generic Bio-Therapeutic Products, South Centre, Geneva, 21 March 2018

Dr. Gautam Panda

- Amino acids towards bioactive alkaloids and steroidomimetics: Rays of Hope? at IIT Kanpur, 23 July 2018
- Amino acids derived alkaloids as anticancer agents, at IIT, BHU, Varanasi, 19 August 2018

Dr. Atul Goel

- Pyranone derived donor-acceptor fluorescent molecules for organic electronics and biomedical applications, in XIX NOST-Organic Chemistry Conference, Goa, 6-9 September 2018

Dr. P.R. Mishra

- Meeting challenges through rationalized nano-medicines, at Amity University, 30 August 2018
- Is it feasible to meet challenges through Nano-medicines? at Pandit Ravishankar Shukla University, Raipur, 08 September 2018
- Are the nanoparticles the distant high-tech future? Lab experiences with special emphasis on drug delivery, at Dr. NGP Arts and Science College, Coimbatore, 05 December 2018

Dr. B.N. Singh

- Microbial genomics & drug discovery: Genomics driven approach to Tuberculosis drug development, in First Indo-UK Training Workshop on "Current Trends in Genomic and Molecular Medicine", CFAR-KGMU, 19-21 November 2018

Dr. T. Narender

- Drug discovery program at CDRI on Indian medicinal plants, in National Seminar on Indian Tribal Medicinal Plants Research: Challenges & Prospects, Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh, 28 April 2018
- Role of phytochemicals in drug discovery and development, in National Workshop on "Best Practices and Compliance of Indian Pharmacopoeia Standards for Herbal Drugs and Phytopharmaceuticals", Indian Pharmacopeia Commission, Ghaziabad, 18 September 2018
- Aegeline inspired synthesis of novel β3-AR agonists for insulin resistance and amino alcohol and thiazolidinedione hybrids for antiadipogenic activity, in 6th Biennial 'International Conference on New Developments in Drug Discovery from Natural Products and Traditional Medicines, NIPER, Mohali, 16 November 2018

Dr. R.K. Tripathi

- Identification of HIV-1Nef-Host protein interaction(s) as novel target for developing anti-Nef Therapeutics: An alternate therapy against viral infection, at Swami Rama Himalayan Institute, Dehradun, India and University of Tennessee, U.S at Dehradun, India, 14-16 September 2018

Dr. Anil Gaikwad

- Biomarkers of adipose tissue dysfunction and diabetes; in Continual Medical Education Lecture, Guwahati by Assam Endocrine Society, Guwahati. 28 April 2018

Dr. Ravi Sankar Ampapathi

- Course on Nuclear Magnetic Resonance, in Faculty Development Program (Training the trainers), Amity University, Lucknow, 13 June, 2018

Dr. P.N. Yadav

- Kappa Opioid Receptor (KOR): Molecular target for depression and pain, in 11th Symposium on-Frontiers in

Biomedical Research, Dr. B. R. Ambedkar Centre for Biomedical Research, University of Delhi, 19-21 February 2018

- DHA modulates BDNF via GPR40 in the brain and alleviates diabesity-associated cognitive deficits, in 10th NIPER (R) Symposium on Nano Based Therapy for Neurodegenerative Diseases, NIPER, Raebareli, 27-28 March 2018
- Two facets of Kappa opioid receptor: Implications in depression and pain, in Neuroscience Educational Week, Era Medical University, Lucknow, 1-3 November, 2018

Dr. Ajay Kumar Srivastava

- Development of post-IMCR modifications en route to new chemical entities for drug discovery research, in Contemporary Facets in Organic Synthesis 2017 (CFOS-2017), Indian Institute of Technology Roorkee, 24 December 2017

Dr. Y.K. Manju

- Unravelling the secret lives of the TB bacterium: A molecular microbiology approach, in Young Scientists Meet-2018, Department of Biotechnology, Calicut University, Kerala, 22 February 2018

Dr. Monika Sachdev

- Restoration of dysfunctional gonads through mesenchymal stem cells, in National Symposium on New Paradigm in Veterinary Medical Research at Animal Husbandry Directorate, Lucknow, 29 April 2018
- Dysfunctional gonads can be restored through stem cell therapy, at Department of Zoology, School of Studies in Life Sciences; Guru Ghasidas University (GGU), Bilaspur, Chhattisgarh, 29 October 2018
- Novel Cancer Biomarkers (NCB) for early prognosis & diagnosis of cervical cancer, in International Symposium on Molecular Medicine at the Department of Molecular Medicine & Biotechnology, SGPGIMS, Raebareli Road, Lucknow, 16 December 2018

Dr. Aamir Nazir

- Functional genomics and epigenetics studies employing *C. elegans* models of neurodegenerative diseases: Implications for mechanistic understanding and drug discovery efforts, in National Conference on Alternatives to Animal Experiments, Jamia Hamdard, New Delhi, 27 November 2018

Dr. Sanjeev Kanojiya

- Digital library of Indian medicinal plants & their metabolites: A mass spectrometry-based Bioinformatics Tool, in MS-INDUSCON-2018, Gomti Nagar, Lucknow, 30 November 2018

Dr. Kumaravelu Jagavelu

- Circulating endothelial microparticles: Implications on heart, at PGIMER Chandigarh, 16-18 February 2018
- Cardiovascular diseases: Cure from medicinal plants, at Bharathidasan University, 1 March 2018

Dr. Rabi S. Bhatta

- Computer-aided biopharmaceutical characterization: PBPK modelling, in Training the Trainers (PCI Sponsored), AMITY University, Lucknow, 31 August 2018

Dr. Kalyan Mitra

- Applying high resolution imaging tools for investigating mechanisms of cell death, in International Conference on Microscope & XXXIX Annual Meeting of Electron Microscope Society of India, Mayfair Convention Center, Bhubaneswar, 19 July 2018

Dr. Sanjeev K. Shukla

- Applications of NMR Spectroscopy, at Shri Ramswaroop Memorial University, Lucknow, 20 September 2018

Dr. Kashif Hanif

- Study on the involvement of MAP kinase-activated protein kinase 2 in pulmonary hypertension' at 'Respiration under hypobaric hypoxia: Clinical and molecular portrayal, Gangtok, Sikkim, India, 15-19 November 2018

Dr. Mukesh Pasupuleti

- "ABC" of biologics discovery and preclinical development", at Manipal Academy of Higher Education (MAHE), MANIPAL 21-25 September 2018.
- Opportunity and avenues for a nanotechnology in drug development from discovery to delivery, in International Conference on Environmental and Biomedical Nanotechnology (ICEBN 2018), School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India, 14-15 September 2018

Dr. Satish Mishra

- A novel glideosome-associated protein coordinates motility and invasion of *Plasmodium* sporozoites, in International symposium and 29th National congress of parasitology on basic and applied aspects, University of Hyderabad, Hyderabad, India 2 November 2018
- Modern molecular genetic approaches in malaria, in CRISPR/Cas workshop, Shiv Nadar University, 27 May 2018
- Engineering of genetically attenuated parasites for a safe and effective malaria vaccine. Bombay College of Pharmacy, Mumbai, India, April 2018

- Genetically attenuated malaria parasites as a vaccine, Recent Trends in Biotechnology: Technology to Skill development, Shri Ramswaroop Memorial University, Lucknow, India, March 24, 2018

Dr. Sripathi Rao Kulkarni

- Protection of inventions, in a Six-day Continuing Medical Education Programme for Teachers, Department of Saidla, Faculty of Unani Medicine, Aligarh Muslim University, Aligarh, 22 - 27 October 2018
- Importance of IPRs in academic set up, Workshop on Intellectual Property Rights Awareness, Kalam- Centre for Innovation and Incubation of start-up (K-CIIS), Dr. A.P.J. Abdul Kalam Technical University, Lucknow, 08 September 2018

Dr. Namrata Rastogi

- Silyl diazoenolates as nucleophiles in visible-light photoredox catalyzed mannich reaction, in Indian Society of Chemists & Biologists Conference (ISCBC), Manipal University, Jaipur, 12 January 2018
- Diazonium salts & diazo enolates in visible light photoredox catalyzed transformations, in International Conference on Emerging Trends in Chemical Sciences (ICETCS), D.D.U. Gorakhpur University, Gorakhpur, 25 February 2018
- Intramolecular rearrangement/trapping of ammonium ylides *en route* to aza-heterocycles, in Frontiers at the Chemistry - Allied Sciences (FCASI) at University of Rajasthan, Jaipur, 21December 2018
- Evolution & interweaving of diazo group chemistry with visible light catalysis, in Indian Society of Chemists & Biologists Conference (ISCBC), Lucknow, 13 January 2019

Dr. Rajesh Kumar Jha

- RHOGTPase signaling in ovary and implications in the ovarian pathophysiology, in International conference on Emerging Researches in Bioscience' (ICERB-2018), Central University Guru Ghasidas Vishwavidyalaya, Bilaspur, 28-30 October 2018

Dr. Niti Kumar

- Understanding organellar protein folding capacities and assessing their pharmacological modulation by small molecules. NCCS, Pune, 18 July 2018
- Understanding the role of non-canonical nucleic acid structures in human malaria parasite and exploring their pharmacological targeting. IIT-B, Mumbai, 20 July 2018

4 Visits & Deputations Abroad

	Name of Scientist	Country of Visit	Purpose of visit	Period of Deputation
1.	Dr. Saman Habib,	France	To attend the Fellowship Review Committee Meeting of the International Human Frontier Science Organisation (HFSP) held at Strasbourg France.	22-24 January 2018
2.	Dr. Wahajuddin	Germany	To avail Alexander von Humboldt Foundation Research Fellowship	05 March 2018 - 04 March 2020
3.	Dr. Shakil Ahmed	Japan	To attend the 5 th HiHA International Symposium on Healthy Ageing	12 March 2018
4.	Mr. S.K. Mallik	Singapore	To attend the Wiley Asia-Pacific Library Advisory Board meeting	12-13 March 2018
5.	Dr. Amit Misra	Geneva	To attend the Expert Meeting on Access to Generic Bio-Therapeutic Products	21-22 March 2018
6.	Dr. Aamir Nazir	Hungary	For collaborative research work at University of Budapest	19-27 March 2018
7.	Dr. Amit Misra	Norway	To attend the Meeting for Indo-Norway Bilateral Project "Drug Targeting for Improved Treatment of Multi-Drug Resistant Tuberculosis (MDR TB)"	16-18 April 2018
8.	Dr. Kishore K. Srivastava	France	To work in the Laboratories of French collaborators at CNRS-LCC Toulouse	27 June - 10 July 2018
9.	Dr. Sripathi Rao Kulkarni	Malaysia	To attend International Training Programme on Science, Technology and Innovation (STI) Policy and Management for Developing Countries	6-10 August 2018
10.	Dr. Mohammad Imran Siddiqi	Turkey	Invited as a Visiting Researcher at Department of Pharmaceutical Chemistry, Faculty of Pharmacy, Ankara University	17 September - 16 October 2018
11.	Dr. Dibyendu Banerjee	USA	To avail ICMR International Fellowship for Young Bio-medical Scientists-2018-19 at Department of Radiation Oncology and Neurosciences, Houston Methodist Research Institute.	15 October 2018 - 14 April 2019
12.	Dr. Amit Misra	Norway	To attend the Meeting for Indo-Norway Bilateral Project "Drug Targeting for Improved Treatment of Multi-Drug Resistant Tuberculosis (MDR TB)"	15-17 October 2018
13.	Dr. Brijesh Kumar	Nepal	To participate in 23 rd Conference of International Academy of Physical Science under CSIR-NAST Exchange Program	16-18 November 2018
14.	Dr. Jiaur Rahaman Gayen	Australia	To attend the O2K-Workshop on High-Resolution FluoRespirometry (HRFR) held at Melbourne, Australia	27-28 November 2018

5 Membership of Distinguished Committees / Boards / Societies

Prof. Tapas K. Kundu

- Life Member, Society of Biological Chemists, India.
- Member, Executive Committee, Society of Biological Chemists, India
- Nominated Member, American Chemical Society
- Fellow, International Union Against Cancer
- Nominated Member, American Society for Biochemistry and Molecular Biology
- Elected Member, Guha Research Conference (GRC).
- Member, American Society for Microbiology (ASM)
- Invited (by Editor-in-Chief) member of "Nature" reader panel
- Founder Member, Chemical Biology Society, India
- Secretary, Chemical Biology Society, India
- Member, Indian Society of Cell Biology.
- Member, Steering Committee, Ministry of Earth Sciences, Drug from Sea Program.
- President, Chemical Biology Society, India
- Member, Drug Technical Advisory Board, Directorate General of Health Services, DCGI, India
- Member, Advisory-cum-Monitoring Committee of Biotech Park, Lucknow

Dr. Arun K Sinha

- Member, University Court, North-Eastern Hill University, Shillong (Meghalaya)

Dr. Anila Dwivedi

- Member, Society for Study of Reproduction, USA

Dr. Renu Tripathi

- Elected Joint Secretary, Indian Society of Parasitology (2018)

Dr. Sharad Sharma

- Life Member, Society of Toxicology, India
- Life Member, Laboratory Animal Science Association of India
- Life Member, Indian Medical Association
- Life Member, Indian Association of Pathologist and Microbiologists
- Life Member, Indian Society of Cell Biology

Dr. Saman Habib

- Member, Review Committee for Long-term and Cross-disciplinary Fellowships of the Human Frontier Science Program Organisation (HFSP), France (2015-18).
- Member, DBT Task Force on 'Basic Research in Modern Biology' (2017-).
- Member, Selection Committee for Nehru Post-Doctoral Fellowships in Biological Sciences, CSIR
- Member, CSIR SRF/RA Selection Committee Meeting in the area of General Biology (GENBIO/13), HRDG, CSIR
- Member, Society of Biological Chemists, India
- Member, Editorial Board, Current Science.

Dr. Gopal Gupta

- Member, Society for the Study of Reproduction, USA

Dr. Vinita Chaturvedi

- Life Member, Indian Immunology Society

Dr. S.K. Rath

- External expert in DRC, Amity Institute of Biotechnology, Lucknow
- External expert of DRC, KGMU, Lucknow
- Member, RCGM. Department of Biotechnology, Government of India
- Member, Expert committee for evaluation of phytopharmaceuticals, DCGI, Government of India
- Member, Academic Editor, PLOS one
- Life Member, Indian Society of Cell Biology
- Life Member, Genome foundation, India
- Life Member, Laboratory Animal Science Association of India
- Life Member, Society of Toxicology.

Dr. Amit Misra

- Life Member, Indian Pharmaceutical Association
- Vice-President (India), Asian Federation for Pharmaceutical Sciences
- Member, South Centre (Geneva) and Third World Network (Kuala Lumpur) Consultative Groups on Biologicals and Biosimilars
- Member, Subject Expert Committee (Antimicrobial, Antiparasitic, Antifungal, Antiviral), CDSCO advising DCGI for New Drug approvals
- Member, Medical Biotechnology and Medical Nanotechnology Sectional Committee, Bureau of Indian Standards, Government of India
- Member, Board of Studies, Jamia Hamdard, New Delhi

Dr. Sanjay Batra,

- Co-opted Member, SERB committee for Chemical Sciences (ECRA and nPDF)
- Co-opted Member, SERB committee for Chemical Sciences (EMR projects)
- Member, American Chemical Society
- Member, Royal Society of Chemistry

Dr. Atul Goel

- Life Member, Society of Biological Chemists, India
- Regional Editor, Indian Journal of Heterocyclic Chemistry

Dr. Gautam Panda

- Member, MEXT fellowships supported by Govt. of Japan

Dr. T. Narender

- Member, Expert committee to evaluate the New Phytopharmaceutical Drugs proposal for Regulatory Approvals, Central Drug Standard Control Organisation (CDSCO), Directorate General Health Services, MoHFW, New Delhi.

Dr. Prabhat Ranjan Mishra

- Member, Medical Biotechnology and Medical Nanotechnology Sectional Committee, Bureau of Indian Standards, Government of India
- Life Member, Indian Pharmaceutical Association
- Life Member, Indian Society of Cell Biology
- Expert Member, Project Monitoring Committee, BIRAC, Department of Biotechnology, Govt. of India
- Member, Advisory Board of PhD student at Nirma University, Ahmedabad
- Member, Board of Studies, Jamia Hamdard, New Delhi

Dr. Divya Singh

- Member, American Society of Bone and Mineral Research

Dr. Y K. Manju

- Member, Society of Biological Chemists, India

Dr. Akhilesh K. Tamrakar

- Life Member, Society of Biological Chemists, India

Dr. Sanjeev Kanojiya

- Member, National Sectional Committee (Organic Chemicals, Alcohols & Allied Products), Bureau of Indian Standards (BIS) Govt. of India.
- Member, Facility Management Committee of SAIF-Shibpu, W.B. from Department of Science & Technology (DST), New Delhi.
- Member, Technical expert committee (Analytical Instruments), Madhya Pradesh Council of Science & Technology, Bhopal (M.P.).

Dr. Aamir Nazir

- Fellow, Society of Applied Biotechnology, India.
- Academic Editor, PLOS One.
- Life Member, Indian Society of Cell Biology
- Life Member, Laboratory Animal Science Association of India.

Dr. Monika Sachdev

- Member, Indian Society of Cell Biology, India
- Member, Society for Frontiers in Reproduction, USA
- Member, Society for study of Reproduction, USA
- Member, Indian Society for the Study of Reproduction and Fertility
- Member, International Society of Transgenic Technology
- Member, Society for Mitochondrial Research & Medicine
- Member, Laboratory Animal Science Association of India (LASAI)

Dr. Sarika

- Life Member, Laboratory Animal Science Association of India.

Dr. Rabi S Bhatta

- Editorial Board Member, Journal of Drug Formulation and Production
- Member, International Society for Study of Xenobiotics (ISSX), USA

Dr. Pintu K. Mandal

- Member, Association of Carbohydrate Chemists and Technologists, India

Dr. Satish Mishra

- Elected member, The National Academy of Sciences, India
- Life member, National Academy of Biological Sciences, India.
- Life member, Indian Science Congress Association, India.
- Life member, Society of Biological Chemists, India.
- Life Member, Indian Society of Parasitology.

Dr. Jiaur R. Gayen

- Life-Member, Association of Biotechnology and Pharmacy, India
- Life-Member, Indian Society for Mass Spectrometry
- Life-Member, Indian Pharmacological Society
- Life-Member, Society of Biological Chemists, India
- Life-Member, Indian Science Congress Association
- Life-Member, Laboratory Animal Science Association of India
- Life-Member, Society of Applied Biotechnology, India

Dr. Rajesh Kumar Jha

- Member, Society for the study of Reproduction (SSR), USA.
- Life Time Member, Indian Society for the Study of Reproduction and Fertility (ISSRF)
- Life Time Member, Laboratory Animal Science Association of India
- Life Time Member, National Population Stabilization Fund (Janasankhya Sthirata Kosh), MoH&FW, New Delhi.

Dr. Rajdeep Guha

- Life Member, Laboratory Animal Science Association of India (LASAI)
- Life Member, Indian Society of Animal Genetics and Breeding (ISAGB)

Dr. Susanta Kar

- Life Member, Indian Society for Parasitology
- Life Member, Indian Immunology Society

Dr. Mrigank Srivastava

- Life Member, Indian Society of Parasitology
- Life Member, Indian Immunology Society
- Life Member, Indian Society of Cell Biology
- Member, Executive Committee, Indian Society of Parasitology

The Staff

DIRECTOR

Prof. Tapas K. Kundu, PhD, DSc,
FNASc., FASc., FNA, Sir J. C. Bose National Fellow

R&D DIVISIONS / UNITS

BIOCHEMISTRY

Senior Principal Scientist
Neena Goyal, M.Sc., Ph.D. *In Charge*
Neeloo Singh, M.Sc., Ph.D.
Vinita Chaturvedi, M.Sc., Ph.D.

Principal Scientist
Sabyasachi Sanyal, M.Sc., Ph.D. FNASc

Senior Scientist
A.K. Tamrakar, M.Sc., Ph.D.
Arun Kumar Trivedi, M.Sc., Ph.D.
Dipak Datta, M.Sc., Ph.D.
Jayant Sarkar, M.Sc., Ph.D.

Principal Technical Officer
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Sr. Technical Officer (2)
Hori Lal (Retired on 31.7.18)

Sr. Technical Officer (1)
Ajay Singh Verma, M.Sc.
Ishbal Ahmad, M.Sc.

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Shyam Singh, M.Sc.
Priyanka Trivedi, M.Sc.
Karthik R. M.Sc., Dip. in DCLM

ENDOCRINOLOGY

Senior Principal Scientist
Anila Dwivedi, M.Sc., Ph.D., *In-Charge*
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Naibedya Chattopadhyay, M.Sc., Ph.D., *In-Charge, Ethnobotany*

Principal Scientist
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Durga Prasad Mishra, M.Sc., Ph.D.
Divya Singh, M.Sc., Ph.D.

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Rajesh Kumar Jha, M.Sc., Ph.D.

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Balvir Singh, M.Sc.
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Jaspreet Kaur, M.Sc.
Amar Deep Lakra, M.Sc

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Harish K. Checker (Jr. Steno.)

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Mahesh Chandra Tewari, BSc

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Ram Karan, Intermediate

ETHNOBOTANY

Senior Scientist
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Scientist
Vineeta Tripathi, M.Sc., Ph.D.

Lab. Assistant
Satya Narayan *(Horticulture work)*

Lab Attendant (2)
R.C. Maurya
N.K. Khanduri, Intermediate
Ashok Kumar *(Horticulture work)*

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Arun K Sinha, M.Sc., Ph.D. FNASc, *Supervising Scientist-in-Charge, SAIF*
P.M.S. Chauhan, M.Sc., Ph.D. (Retired on 30.06.18)
Y.S. Prabhakar, M.Sc., Ph.D.

Senior Principal Scientist
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Atul Goel, M.Sc., Ph.D.

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Ashok Kumar Sharma, B.Sc., D.Ch.E., A.M.I.E.
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Manju, B.Sc.
Ram Lakhan Intermediate

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N.P. Misra, M.Sc.
Krishna Kumar, B.Sc.

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Avadhesh Kumar, B.A.

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Y. K. Manju, M.Sc., Ph.D
Sidharth Chopra, M.Sc., Ph.D.
Mukesh Pasupuleti, M.Sc, Ph.D

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Sr. Technical Officer (1)
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Umamageswaran V., M.Sc.

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Ram Prakash, B.A.
Shyam Sunder Yadav, B.A.

MOLECULAR & STRUCTURAL BIOLOGY

Senior Principal Scientist
Ravishankar Ramachandran, M.Sc., Ph.D. *In-Charge*
Jimut Kanti Ghosh, M.Sc., Ph.D., FNASc
Saman Habib, M.Sc., Ph.D., FASc, FNASc, *In-Charge, Academic Affairs Unit*

Principal Scientist
J. Venkatesh Pratap, M.Sc., Ph.D.
Mohammad Imran Siddiqi, M.Sc., Ph.D.
Amogh Anant Sahasrabuddhe, M.Sc., Ph.D.
Mohammad Sohail Akhtar, M.Sc., Ph.D.

Senior Scientist
Ashish Arora, M.Sc., Ph.D.
Shakil Ahmed, M.Sc., Ph.D.

Scientist
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Tejender S. Thakur, M.Sc., Ph.D.

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J.P. Srivastava, B.Sc., LL.B.
R.K. Srivastava, B.Sc.

Sr. Technical Officer (1)
Ruchir Kant, M.Sc. Ph. D, PGDCA
Anupam Jain, M.Sc.
Rima Ray Sarkar, M.Sc

Technical Officer
Sarita Tripathi, M.Sc.

Sr. Technician (2)
Ram Radhey Shyam, Intermediate

PARASITOLOGY

Senior Principal Scientist
Renu Tripathi, M.Sc., Ph.D., FNASc *In-Charge*

Senior Scientist
Satish Mishra, M.Sc, Ph.D

Scientist
Mrigank Srivastava, M.Sc., Ph.D.
Susanta Kar, M.Sc., Ph.D.

Niti Kumar, M.Sc., Ph.D.
Bidyut Pukrait, M.Sc., Ph.D.

Technical Officer
Shikha Mishra, M.Sc.
Ashan Manhas, B.Sc., M.L.T
Sr. Technician (2)
K.K. Singh, M.Sc.

Lab. Attendant (2)
Prem Babu, Intermediate
Ram Das

Lab. Attendant (1)
Om Prakash, Intermediate

PHARMACEUTICS & PHARMACOKINETICS

Senior Principal Scientist
Amit Misra, M.Pharm., Ph.D., *In-Charge*

Principal Scientist
Prabhat Ranjan Mishra, M.Pharm., Ph.D.
Manish Kumar Chourasia, M.Pharm., Ph.D.

Senior Scientist
R.S. Bhatta, M.Pharm., Ph.D.
Jiaur Rahaman Gayen, M.Pharm., Ph.D.
Wahajuddin, M.S. Pharm., Ph.D

Technical Officer
V. Saravanakumar, M.Sc., M.Phil., PGDCA, DIS
Deepak, M.Sc.,

Sr. Technician (3)
S.K. Bhatnagar, B.Sc.

Sr. Technician (2)
Narendra Kumar, B.Sc

Technician (2)
Akhilesh Kumar, Intermediate

Lab. Assistant
Shiv Lal

Lab. Attendants (2)
Ram Bhajan Shukla, Intermediate
Ram Kumar
Ram Sunder Lal, B.A.
Chandramani

PHARMACOLOGY

Principal Scientist
Manoj K. Barthwal, M.Sc., Ph.D., In-charge
Anil Gaikwad, MS (Pharma), Ph.D.

Senior Scientist
Prem N Yadav, M.Sc., Ph.D.
Kumaravelu Jagavelu, M.Sc., Ph.D.
Kashif Hanif, M.Sc., Ph.D.
Sachin Kumar, M.Sc., Ph.D.
Amit Lahiri, M.Sc., Ph.D.

Scientist
Shubha Shukla, M.Sc., Ph.D.
Baisakhi Mohapatra, M.Sc., Ph.D.
Srikant Mulay, M.Sc., Ph.D.
Shashi Gupta, M.Sc., Ph.D.

Principal Technical Officer
V.S. Nigam, B.Sc.

Sr. Technical Officer (3)
C.P. Pandey, M.Sc.

Sr. Technical Officer (1)
Sheeba Saji Samuel, M.Sc.

Technical Officer
Sachi Bharti, M.Sc.
Smriti, M.Sc.
Pankaj Kumar Shukla, B.Sc., P.G.D.B.T.
Divya Mohan, M.Sc. (Transferred to CSIR-NIIST)
Deep Mala, M.Sc

Sr. Technician (3)
Bharti Bhushan, B.Sc.

Sr. Technician (2)
H.C. Verma (Retired on 31.07.18)
Anil Kumar Verma, B.Sc.
Ramesh Chandra, M.Sc.

Technician (2)
Surendra Singh, M.Sc., Ph.D

Sr. Steno
Renuka Mushran, B.A.

Lab. Assistant
Shiv Lal (Retired on 31.12.18)

Lab. Attendent (1)
Pankaj Sengupta

TOXICOLOGY & EXPERIMENTAL MEDICINE

Senior Principal Scientist
Sharad Sharma, M.B.B.S., M.D., *In-Charge*
S.K. Rath, M.Sc., Ph.D.

Principal Scientist
R.K. Tripathi, M.Sc., Ph.D.

Senior Scientist
Aamir Nazir, M.Sc., Ph.D.
Smrati Bhadauria, M.Sc., Ph.D.
Sarika Singh, M.Sc., Ph.D.
Madhav Nilakanth Mugale, M.V.Sc., Ph.D.

Scientist
Vivek Vidyadhar Bhosale, M.B.B.S., M.D.

Principal Technical Officer
Mukesh Srivastava, M.Sc., Ph.D. (Biometry & Statistics)
P.K. Agnihotri, M.Sc., Ph.D.
Sadan Kumar, M.Sc

Technical Officer
Anurag Kumar Srivastava, B.Sc.
Shail Singh, M.Sc., Ph.D.
Anil Kumar Meena, M.Sc., B.Ed.
Navodayam Kalleti, M.Sc.
Sudhakar Yadav, M.Sc., M.L.T.

Sr. Technician (3)
M.P.S. Negi, B.Sc., PGDC (Biometry & Statistics)

Sr. Technician (2)
Anupma, B.Sc.

Sr. Steno
Mohd. Sufiyan, B.Com.

Lab. Assistant
Umesh Kumar
Savitri Devi

Lab. Attendant (2)
Ram Kumar
Nand Pal Yadav, Intermediate

CLINICAL PHARMACOLOGY UNIT (CDRI), SETH G.S. MEDICAL COLLEGE, MUMBAI

Sr. Technician (2)
P.S. Acharya (Retired on 30.6.18)

Lab. Assistant
R.B. Pawar

TECHNICAL INFRASTRUCTURE DIVISIONS / UNITS

ACADEMIC AFFAIRS UNIT

Principal Scientist
Anju Puri, M.Sc., Ph.D. (Retired on 31.8.18)

Scientist
Sanjeev Yadav, M.Sc., Ph.D.

Sr. Technician (2)
A.K. Pandey, B.Sc.

BUSINESS DEVELOPMENT& INTELLECTUAL PROPERTY UNIT

Senior Scientist
Naseem Ahmed Siddiqui., B. Pharma (Hons), M.B.A., Head, BD
Sripathi Rao Kulkarni, M.Sc., Ph.D., P.G. Dip. In Patents Law

Sr. Technical Officer (3)
A.S. Kushwaha, B.Sc.

Technical Officer
Neelima Srivastava, M.C.A

Technician (2)
Preeti Agarwal, M.C.A.

COMPUTER CENTRE

Sr. Principal Scientist
Kural, B.E., *Centre In-Charge*

Scientist
Santhosh Shukla, B.Tech.

Technical Officer
Ajay Kumar Maurya, M.C.A.

HUMAN RESOURCE DEVELOPMENT

Chief Scientist
Vinay Tripathi, M.Sc., M.B.A., P.G. Dip., *Unit In-Charge*

Sr. Principal Scientist
D.N. Upadhyay, M.Sc., Ph.D. (Retired on 31.12.2018)

Principal Scientist
Prem Prakash, M.Pharm.

Sr. Technical Officer (3)
Ravindranath S. Londhe, GD Art (Comm.), Art Teachers Dip.

Sr. Technical Officer (1)
Savita Tripathi, M.Sc., B.Ed.

Sr. Technician (2)
Chandrika Singh, B.Sc., LL.B

Technician (2)
Susheel Kumar, Intermediate

Sr. Steno.
Surendra Kumar, B.Com.

Lab. Attendant (1)
Pradeep Kumar Srivastava, B.Sc.

KNOWLEDGE RESOURCE CENTRE

Chief Scientist
S.K. Mallik, M.A., M.L.I.Sc., *In-Charge*

Principal Technical Officer
Sanjay Kumar, M.L.I.Sc
G.C. Gupta, B.Sc. *(Retired on 31.12.2018)*

Sr. Technical Officer (1)
Ramesh Chandra Gupta, M.L.I.Sc.

Technical Officer
Pankaj Upreti, M.L.I.Sc

Sr. Steno
Himanshu Upadhyay, B.A

Lab. Attendants
Chakar Sen Singh (Retired on 30.6.18)

LABORATORY ANIMALS FACILITY

Chief Scientist
D.S. Upadhyay, M.V.Sc., Ph.D., *In-Charge*

Principal Scientist
S. Raja Kumar, M.Sc
Dhananjoy Hansda, M.V.Sc.

Senior Scientist
Rajdeep Guha, M.V.Sc., Ph.D

Scientist
H.K. Bora, M.V.Sc
Shishir Kumar Gupta, M.V.Sc., Ph.D

Principal Technical Officer
Karunesh Rai, M.Sc.

Technical Officer
Chandra Shekhar Yadav, M.Sc., PGDCA

Sr. Technician (3)
Ravinder Singh, M.Sc., Ph.D.

Sr. Technician (2)
A.K. Dubey (Retired on 31.12.18)

Sanjeev Kumar Saxena, B.Sc.
Ravi Kumar Shukla
Narendra Kumar, B.A.
Dinesh Kumar, B.A.
Pradeep Tirkey, Intermediate

Technician (2)
Arun Sharma, B.Sc.

Sr. Steno (H)
Raj Kumar, B.A.

Lab. Assistant
V.B.L. Srivastava
S.K. Verma
Shiv Pal Singh (Retired on 30.9.18)
P.B. Thapa (Retired on 30.06.18)
O.P. Verma, B.A.
Mohad. Saleem (Retired on 31.03.18)

Lab. Attendants (2)
Jameel Beg
Najbullah

Lab. Attendants (1)
Changa Lal

OTHER LAB SERVICES

Senior Principal Scientist
N.K. Agarwal, M.Sc.

Sr. Scientist
Manoj Kumar Rawat, M. Tech.

Sr. Technical Officer (2)
Ram Karan Harijan, AMIE

Sr. Technical Officer (1)
Sanjay Kumar, B.Tech (Civil Engg.)

Technical Officer
Arbind Kumar, B.C.A, PGDAM

Sr. Technician (3)
J.K. Joshi, B.Sc.

Sr. Technician (2)
V.K. Mishra, Diploma
Kamal Kishore Verma, ITI (Retired on 30.11.18)
Kamal Singh, ITI
Laxmi Narain, ITI
Shailendra Mohan, M.Sc., PGDCA
K.M. Shukla, B.Sc.
Suresh S. Bhakuni

Technician (1)
Sumit Khichi , Intermediate, ITI Jodhpur
Kul Bahadur Thapa, Intermediate ITI Trade Electronics

Lab. Assistant
Mohd. Islam

SCIENTIFIC DIRECTORATE

Senior Scientist
Anand P. Kulkarni, M.Sc., Ph.D., Head, PME

Technical Officer
Farha khan, M.C.A

Technical Assistant
Ashok Kumar, Diploma (Mechanical)

SOPHISTICATED ANALYTICAL INSTRUMENT FACILITY

Chief Scientist
Brijesh Kumar, M.Sc., Ph.D. *Mass Unit In-charge, and Overall Facility In-charge*

Principal Scientist
Ravi Sankar Ampapathi, M.Sc., Ph.D. *NMR Unit In-charge*

Senior Scientist
Sanjeev Kumar Shukla, M.Sc., Ph.D.
Sanjeev Kanojiya, M.Sc., Ph.D.
Kalyan Mitra, M.Sc., Ph.D. *Electron Microscopy Unit In-charge,*

Principal Technical Officer
H.M. Gauniyal, M.Sc. Ph.D
A.K. Mandwal, M.Sc., Ph.D.

Sr. Technical Officer (3)
Sunil Kumar, B.Sc.
Pramod Kumar, M.Sc.

Sr. Technical Officer (2)
R.K. Purshottam, B.Sc.

Sr. Technical Officer (1)
Kavita Singh, M.Sc. Ph.D.

Technical Officer
Binod Kumar Saw, M.Sc.
Garima Pant, M.Sc.
Pooja Soni, Diploma
Tofan Kumar Rout, M.Sc. Ph.D.
S. Mehazabeen, M.Sc., Dip. In Software Engineering
Amit Kumar, M.Tech

Sr. Technician (3)
Ashok Pandey, B.Sc.
Sandeep Sengupta, B.Sc.
Madhu Chaturvedi, Diploma

Sr. Technician (2)
V.K. Maurya, ITI
Radhey Krishna (Retired on 31.7.18)
Akhilesh Kumar Srivastava, B.Sc.
Madhuli Srivastava, B.A.
O.P. Gupta, B.Sc.
S.A. Singh, B.Sc., PGDCA
D.N. Vishwakarma

LABORATORY ENGINEERING SERVICES

Senior Superintending Engineer
Parvez Mahmood, B.Sc., Engineering(Civil), *In-Charge*
Kamal Jain, B.E., (Electrical)

Assistant Executive Engineer
Mohit Kumar Shukla, A.M.I.C.E (Civil)
Jai Prakash, Diploma in Mech. Engg.
Sidho Hembrom, Diploma in Mech. Engg.
D.K. Vishwakarma, Diploma in Civil Engg.
Brahma Singh, Diploma in Electrical Engg.

Assistant Engineer
Madhukar Saroj, Diploma, BTech (Civil)
Ajay Kumar, Diploma in Electronic Engg.

Sr. Steno (H)
Raj Kumar, B.A.

Sr. Technician (2)
B. D. Pradhan (Retired on 28.2.18)
B.P. Sunwar (Retired on 28.2.18)
Z.U. Beg (Retired on 31.07.18)
Radhey Lal (Retired on 31.07.18)
Kamal Kishore Verma (Retired on 30.11.18)
M.S. Verma, BA, ITI
Harish Kumar, Intermediate
Vijay Kumar
Swapan Karmi
Ramesh Kunwar
Arun Kumar Srivastava, ITI

Technician (2)
R.A. Prajapati, MA

Lab. Assistants
Popinder Singh
S.K. Bhattacharya
S.K. Yadav
Bishan Singh Negi
A.K. Misra
Shankar Roy

Lab Attendant (2)
Sandeep Roy
Dhirendra Misra, Intermediate
Mohd. Irfan, Intermediate
Raju Vishwakarma
Ram Autar
Hari Om Garg
Satyajeet Roy
Ram Samujh, Intermediate
Bindeswari Prasad
Suresh Kumar
Gaya Prasad
Ram Asrey

Lab. Attendant (1)
Darshan Lal

GENERAL ADMINISTRATION AND FACILITIES

ADMINISTRATION

COA OFFICE

Controller of Administration
CP Arunan, BA

Asstt. (G) Grade I ASO
Kamla Kandpal, M.A

Jr. steno
Kshama Bajpai,B.A.

Multi Tasking Staff
Saurav Sarkar, Intermediate

DIRECTOR'S OFFICE

Private Secretary
Sumit Srivastava, B.Com.

V.P. Singh, B.A.
Sunita Chopra, B.A.

Sr. Technician (2) (Driver)
Shakeel Ahmad Khan

Lab. Attendant (2)
Nand Kishore

Trainee
Rajesh

ESTABLISHMENT I

Section Officer (G)
Krishna Raj Singh, B.Sc, MSW

Assistant Section Officer (G)
Vibhash Kumar, B.A (Hons), CIC
Jagdish Prasad, B.Sc., MPA
Saju P. Nair
Reena Bisaria, B.A
Riti Chaudhary, B.A

Junior Secretariat Assistant (G)
Deepak Gupta, MCom
Anjali Singh, BA

Sr. Steno
Deepak Dhawan, BA

Lab. Assistant
Vinod Kumar

Group-"C" of "D"
Manju Yadav

ESTABLISHMENT II

Section Officer (G)
Ishwar Nath Jha, B.A., MBA

Assistant Section Officer (G)
Vivek Bajpai, M.A.
Rashmi Srivastava, B.A, B.Ed
Dilip Kumar Sen, B.Com
Gangadin Yadav, B.A
Neena Raizada, B.A
Aparna Bajpai, B.A
Kailash Chandra, Intermediate
Ajay Shukla, M.Com

Junior Secretariat Assistant (G)
Kumar Saurabh, B.Com

Sr. Steno
Vinod Kumar Yadav, B.A

Lab. Assistant
Bhagwanti Devi (Retired on 31.10.18)

MTS
Ram Kumar, B.Com

GENERAL SECTION

Section Officer (G)
Anil Kumar, B.Sc.

Assistant Section Officer (G)
Rajendra Prasad, B.A
Rani
Mohd. Irfan

Junior Secretariat Assistant (G)
Anup Thakur, B.Tech.
Rishi Kant, M.Sc.

Sr. Steno
Seema Srivastava, M.A

Sr. Technician (2) (Driver)
K.K. Kashyap
Prem Chand (Retired on 31.03.2018)

Drivers
Daya Shankar Singh

MTS
Kalpanath Sharma
Mohd. Saleem

BILL SECTION

Section Officer (G)
Nitu Kumari, B.Sc., M.A

Assistant Section Officer (G)
H.K. Johar, B.A
Dilip Kumar (Cash), B.A, LLB

Junior Secretariat Assistant (G)
Nida Parveen, B.Com
Vinay Singh, BCA
Indra Prakash Singh, BA

Sr. Steno
Vineet Pandey, B.A., P.G. Comp.

Jr. Steno
Lalit Kumar, BA

Lab. Attendant (2)
Vinod Kumar Sharma

Lab Assistant
VP Mishra

Trainee
Faizi

VIGILANCE

Assistant Section Officer (G)
Ajay Kumar, B.A., LLB

Junior Secretariat Assistant (G)
Jaya Singh

RECORDS

Assistant Section Officer (G)
Md. Irfan

Lab. Attendant
K.P. Mishra

HINDI SECTION

Hindi Officer
Neelam Srivastava (Retired on 30.4.18)
Sr. Steno (Hindi)
Anil Kumar, B.Com

SECURITY

Security Officer
Anil Kumar Upadhyay, M.A.

FINANCE & ACCOUNTS

Controller of Finance & Accounts
Baljeet Singh, B.Com, LLB

Finance & Accounts Officer
I.B. Dixit, M.Sc., M.B.A

Section Officer (F&A)
R.P. Tripathi, M.Com, LL.B

Assistant Section Officer (F&A)
Shiv Lal Gupta (Retired on 31.8.18)
Mahesh Babu, B.A
Sasidharan Radha
U.K. Tewari, B.Sc
Ajay Kumar, B.A

Senior Secretariat Assistant (F&A)
D.K. Khare, B.Com
Mahender Kumar, B.Com
Sanjay Kumar, B.A
Tahseen Tilat, B.A
S.A. Siddiqui, B.A
Chandrashekhar, Intermediate

Sr. Steno
Jitendra Patel, M.A

Junior Secretariat Assistant (F&A)
Abhishek Kumar, Intermediate
Mamata Chourasia, M.A.

Lab. Attendants (2)
Vikramaditya

Lab. Attendants (1)
Angad Prasad

MTS
Mohd. Firoz, B.A
Shekhar Singh

STORES & PURCHASE

Stores & Purchase Officer
MP Singh, M.A., PGDBA, MBA
Prasenjeet Mitra, BSc

Section Officer
Amit Kumar, M.A.

Assistant Section Officer (S&P)
P.S. Chauhan, B.Sc
Arun Wadhera, Intermediate
H.B. Neolia, M.A

R.C. Dwivedi, B.Com
Md. Rijwan, B.Tech, MPA
Mahesh Kumar, B.A.

Senior Secretariat Assistant (S&P)
M.C. Verma, B.Com
Srikant Mishra, B.A
Kanchan Bala, B.A

Junior Secretariat Assistant (S&P)
Vandana Parwani, B.A
G.P. Tripathi, Intermediate
Anil Kumar, BA

Sr. Technician (3)
Ram Pal, B.Sc., LLB

Sr. Technician (2)
Nuzhat Kamal (Retired on 30.11.18)
Ravi Kumar Mehra, B.A.

Attendant
Hardwari

MTS
Sudhir Kumar Yadav, Intermediate

CSIR DISPENSARY

Medical Officer Group III (5)
N.K. Srivastava, M.B.B.S., In-charge

Medical Officer Group III (3)
Kunal Gupta, M.B.B.S.
Shalini Gupta, M.B.B.S., PGDHHM

Technician (2)
Shraddha, M.A., Diploma in Nursing
Shabana, B.A., Diploma in Pharmacy

Technician (1)
Shahjada Jalal (Pharmacist)
Shimpi Gupta (Pharmacist)

Lab. Assistant
S.K. Paswan

Lab. Attendant (2)
Lalji Prasad

Lab Attendant
Shubhendra Kumar

CANTEEN

Manager Gr. II (ACP)
J.P. Satti, B.A

Assistant Manager Cum store Keeper
R. S. Tiwari (Retired on 30.9.18)

Count Clerk (ACP)
Ram Jiyawan Tewari (Coupon clerk)
Y.K. Singh, B.A

Asstt. Halwai
Uma Shanker Tewari

Bearer
Ganga Ram
Rajender
Sukhdev Prasad

S/Man
Raj Kumar

Wash Boys
Ram Murat
Dinesh Pal Singh, Intermediate

www.cdri.res.in

CSIR-Central Drug Research Institute

Vision *A multidisciplinary hub for drug discovery and development to serve humanity*

Charter

- To develop new drugs for controlling diseases of national relevance
- To systematically explore the Indian flora & fauna for therapeutic potential
- To serve as a national nodal centre to convert 'hits' into 'new drug candidates'
- To provide co-working platform, process technologies and consultancy to pharma industry
- To conduct cutting-edge research in disease biology and to translate the results into biotherapeutics to face challenges of the future
- To develop human resource specializing in diverse areas of drug discovery and development

Priority Areas of Research

- Parasitic diseases (Malaria & Leishmaniasis)
- AMR (MDR Mycobacteria & ESKAPE pathogens)
- Bone health

Business Opportunities

- Joint R&D
- Contract R&D
- Licensing of IPR
- Licensing of knowledge base
- Consultancy Services;
- Technical services
- Incubator and Innovation Centre

Human Resource Development

- Ph.D. & Post-Doctoral Research
- Post Graduate Training
- Project Fellowships
- Skill Development for Bio-Pharma Sector
- Sponsored Training for Industry Personnel
- International Training under Bilateral Cooperation
- Hands on Training Courses in Specialized Techniques

Major Facilities & Services

- New Drug Discovery Facilities – Bioinformatics, Medicinal & Process Chemistry, Biological Screening
- GLP Certified Test Facility for Safety Pharmacology and Acute Toxicity
- Sophisticated Analytical Instrument Facility
- National Repository of Organic Compounds
- National Laboratory Animal Centre
- Knowledge Resource Centre
- Clinical Trial Centers

सीएसआईआर-केन्द्रीय औषधि अनुसंधान संस्थान
CSIR-Central Drug Research Institute
सेक्टर 10, जानकीपुरम विस्तार, सीतापुर रोड, लखनऊ–226031, भारत
Sector 10, Jankipuram Extension, Sitapur Road, Lucknow-226031, India
Phone: + 91-522-2772450 Fax: +91-522-2771941

CSIR-Central Drug Research Institute

सीएसआईआर-केन्द्रीय औषधि अनुसंधान संस्थान
CSIR-CENTRAL DRUG RESEARCH INSTITUTE

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Sector 10, Jankipuram Extension Sitapur Road, Lucknow-226031, India

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