ANNUAL REPORT 2024-25

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RGCB
DISCOVERIES FOR A BETTER TOMORROW

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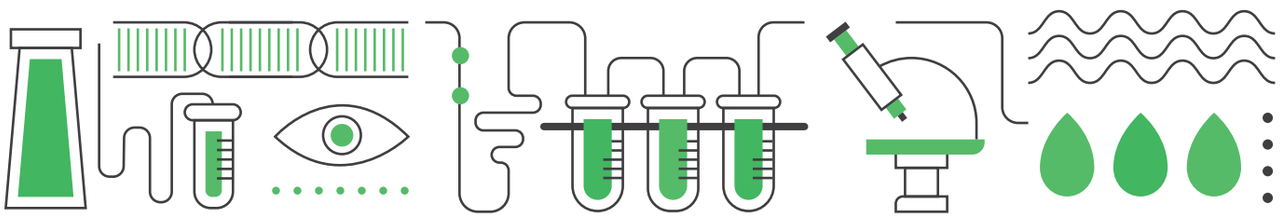

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BRIC
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RGCB
DISCOVERIES FOR A
BETTER TOMORROW

BRIC-RGCB AT A GLANCE 2025

RESEARCH PROGRAMS

- Cancer Research
- Cardiovascular Diseases & Diabetes Biology
- Neurobiology
- Pathogen Biology
- Plant Biotechnology & Disease Biology
- Regenerative Biology
- Transdisciplinary Biology

CORE RESEARCH FACILITIES

- Animal Research Facility
- Bio-Imaging Facility
- Biosafety Level-3 (BSL-3) Facility
- Central Clean Room Facility
- Central Histology Core Facility
- Central Instrumentation Microinjection Facility
- Central Protein Facility
- Genomics Facility
- Mass Spectrometry Facility
- Raman Confocal Facility
- Transmission Electron Microscope (TEM)

PUBLIC SERVICES & TRAINING FACILITIES

- Bioinformatics Facility
- Laboratory Medicine & Molecular Diagnostics
- Medical Laboratory Services
- Molecular Forensics & DNA Technologies
- Research Consultancy Services & Molecular Platforms

TRANSLATIONAL BIOTECHNOLOGY

- Development of Natural Products as Therapeutics
- Product & Process Development
- Repositioning of Therapeutics
- Target Identification
- Vaccine Efficacy, Pre-Clinical Testing & Clinical Trials

SCIENTIST DETAILS

- Core Faculty Scientists : 38
- Faculty Fellows (Ramalingaswami or Ramanujam or INSPIRE Fellows) : 01
- Program/ Project Scientists : 01

STUDENT DETAILS

Ph.D. Students

- Total Ph.D. Students: 156
  Total Female: 122
  Total Male: 34
- Total Ph.D. Students Admitted: 40
  Total Female: 30
  Total Male: 10
- Total Ph.D. Students Awarded : 24
  Total Female: 19
  Total Male: 05

M.Sc Students

- M.Sc 2022-2024 batch Students: 19 (Female: 10, Male: 9)
- M.Sc 2023-2025 batch Students: 19 (Female: 10, Male: 9)
- M.Sc 2024-2026 batch Students: 20 (Female: 12, Male: 8)

M.Sc Students admitted in 01/04/2024 to 31/03/2025

- M.Sc 2024-2026 batch: 20

STAFF DETAILS

- Administration Staff: 25
- Technical Staff: 66

BIONEST INCUBATION CENTER DETAILS

- Startups Incubated: 25
- Virtual Startups: 04
- Ongoing Startups: 15
- Matured Incubatees: 10

BRIC-RGCB PUBLICATION, CITATION, GRANTS & PATENTS

APRIL 1, 2024 TO MARCH 31, 2025

- Number of Publication: 108
- Number of Citation: 5260
- Number of Extra Mural Research Grants: 69
  - National: 66
  - International: 03
- No of Patents Submitted: 01
- No of Patents Granted: 01

DIRECTOR'S MESSAGE

The BRIC-Rajiv Gandhi Centre for Biotechnology (BRIC-RGCB) has experienced a landmark year in 2024-25, marked by significant breakthroughs in molecular biology, biotechnology, and disease biology. Our institute has made seminal contributions in various domains of disease biology. We have explored the non-canonical functions of a protein Star-PAP in governing the expression of cancer-causing genes thereby offering potential avenues for the development of innovative treatment strategies to curb breast cancer. Another finding was a combination approach involving the ASAH1 inhibitor and anti-PD-1 antibody demonstrates potential for sensitizing resistant tumors and enhancing the immune response within the tumor microenvironment. This approach may offer a promising avenue for overcoming resistance to tumor-targeted and immune-targeted therapies. We have also developed a cell resource system capable of high-throughput, and this can be used for the screening of compounds that cause caspase activation, autophagy, or both, demonstrating the potential utility of the sensor probe for diverse biological applications. Membrane pores are exploited for the stochastic sensing of various analytes, and a seminal finding indicates that the competitive binding of different PEGylated peptides with the same pore produced specific blockage signals reflecting their identity, size, and conformation, suggesting that this pore can find applications in proteomics. We also reported that the absence of TLX3, a gene crucial for cerebellar development, exhibits behavioral patterns reminiscent of autism spectrum disorders, and understanding how TLX3 variants may affect human populations can pave the way for deeper investigations into therapeutic strategies.These advancements reaffirm BRIC-RGCB's leadership in precision medicine and biomedical innovation.

In the realm of infectious disease research, BRIC-RGCB has actively addressed global health challenges by focusing on SARS-CoV-2 genomics, microbial pathogenicity, and antimicrobial resistance. We have developed bacterial toxin models and exosome-based dissemination mechanisms that uncover critical immune evasion strategies. Furthermore, high-resolution cryo-electron microscopy analyses of key proteins, such as nucleoplasmin, have provided valuable insights for tackling infectious diseases and enhancing drug development. These initiatives solidify BRIC-RGCB's pivotal role in combating emerging pathogens and refining vaccine design.

Our commitment to public health and societal welfare has also seen significant contributions. Collaborative research with governmental and private sectors has advanced traditional medicine, promoted sustainable agriculture through microbiome-based crop resilience, and developed bioinformatics platforms for diagnostics. These initiatives have effectively bridged scientific research with societal needs, setting a benchmark in translational science. Notably, BRIC-RGCB empowered 416 tribal families by promoting enterprises that utilize local bioresources, thereby enhancing sustainable development and preserving tribal heritage in Kerala.

In the academic sphere, BRIC-RGCB offers MSc and PhD programs in biotechnology that emphasize hands-on training and research excellence. During the 2024-25 academic year, we achieved significant milestones with 23 PhD students successfully defended their theses. Our students have excelled in various national and international conferences, earning multiple awards. We provided robust training and internship opportunities, benefiting over 200 postgraduate students.

To promote the translational research, BRIC-RGCB agreed on an MoU with Cochin Cancer Research Centre (CCRC), Kochi. The MoU is quite important and as a part of the agreement, BRIC-RGCB will provide scientific mentoring and overall technical management of the R&D facility at CCRC and also provide structured training to its research staff and clinicians.

Moreover, in 2024-25, BRIC-RGCB significantly enhanced its research infrastructure by establishing state-of-the-art facilities for microinjection, recombinant protein purification and clean room facility, a Transmission Electron Microscopy facility, and a Mass Spectrometry-based Proteomics facility. Noteworthy developments at the Akkulam campus included the completion of a Research Block and the construction of an Animal Research Facility. These advancements, coupled with sustainable initiatives and community spaces, have fostered a vibrant academic environment, reinforcing BRIC-RGCB's status as a leader in biotechnology and research.

Haritha Kerala Mission, Government of Kerala, certified BRIC-RGCB, campus 2 at Akkulam as a green institution for imparting the culture of environmental conservation to society. The campus has secured an A+ grade in demonstrating exemplary and efficient practices adhering to green protocol in the fields of waste management, water security, energy, and biodiversity conservation, and is a remarkable achievement supporting BRIC-RGCB's initiative to conservation and sustainable development.

In summary, BRIC-RGCB's holistic approach—integrating fundamental research, technological advancements, and societal impact—has defined the 2024-25 period as transformative. By pioneering discoveries in molecular biology and diagnostics, fostering strategic collaborations, and leading impactful health campaigns, BRIC-RGCB has cemented its reputation as a premier biotechnology institute with a profound influence on research and public health.

We are very much grateful to the Secretary, Department of Biotechnology for the sustained support both for the newer initiatives and also for the ongoing research programmes.

JAI HIND

Professor Chandrabhas Narayana, FASc, FRSC, FNASc
DIRECTOR, BRIC-RGCB

FACULTY PROFILE

Abdul Jaleel K. A, PhD

Scientist G & Associate Dean (Research Administration & Faculty Affairs)
Cardiovascular Diseases & Diabetes Biology

BRIEF THEME OF LABORATORY

Investigating the metabolic adaptations or alterations responsible for the onset of type 2 diabetes is the main theme of our laboratory. We study normal healthy young people, both men and women, who are having risks for diabetes, such as overweight, family history of diabetes investigating if they already have any metabolic alterations associated with insulin resistance, which is the hallmark of type 2 diabetes. For this we have developed an independent cohort and study them prospectively.

MAJOR RESEARCH AREA

- The laboratory investigates the use of MS-based metabolomics and how independent risk factors for type 2 diabetes evolve over time in developing insulin resistance.
- Besides, we study the functional significance of cardiac mitochondrial subpopulations in type 2 diabetes in our population.
- Our laboratory also investigates on the effect of Lp(a) on angiogenesis and its role in the early appearance of calcification on placenta during pre-eclampsia.

WORK REPORT

- ASSESSMENT OF CLINICAL, METABOLIC AND EPIGENETIC VARIATIONS TO EVALUATE THE RISK FOR TYPE 2 DIABETES MELLITUS: A PROSPECTIVE STUDY.
- COMPREHENSIVE MASS SPECTROMETRY-BASED CLINICAL LIPIDOMICS PLATFORMS FOR PROMOTING BIOMEDICAL RESEARCH AND ADVANCED TRAINING FOR INDIAN RESEARCHERS.
- ELUCIDATING THE ROLE OF LIPOPROTEIN(A) IN IMPAIRED ANGIOGENESIS IN PLACENTA DURING PRE-ECLAMPSIA AND ITS IMPACT ON THE VASCULAR HEALTH OF WOMEN.
- FUNCTIONAL SIGNIFICANCE OF CARDIAC MITOCHONDRIAL SUBPOPULATIONS IN TYPE 2 DIABETIC ASIAN INDIANS.

1. ASSESSMENT OF CLINICAL, METABOLIC AND EPIGENETIC VARIATIONS TO EVALUATE THE RISK FOR TYPE 2 DIABETES MELLITUS: A PROSPECTIVE STUDY

This study is a follow-up of those earlier study participants (n=110) of normoglycemic young adults after 6 years to see how many of them contracted T2DM or prediabetes and to determine their metabolic and epigenetic alterations retrospectively. Out of 110 participants 94 have been studied in the follow-up and found that 9 developed T2DM, 51 had prediabetes and 34 remained normal. Increased insulin resistance and elevated future T2DM risk were observed even among those who remained normoglycemic. Baseline levels of Phosphatidylethanolamine (PE) (20:3_18:0), 3beta,7alpha-Dihydroxy-5-cholestenoate, and Tridecanoic acid showed good predictive potential for future T2DM (Figure-1). DNA methylation analysis identified seven hypermethylated genes at baseline in future T2DM participants. In participants who progressed to prediabetes, six genes were hypermethylated and five hypomethylated. ABCG1 hypermethylation was present at baseline in individuals with impaired glucose tolerance at follow-up. The study revealed metabolite and methylation patterns predicting future T2DM.

2. COMPREHENSIVE MASS SPECTROMETRY-BASED CLINICAL LIPIDOMICS PLATFORMS FOR PROMOTING BIOMEDICAL RESEARCH AND ADVANCED TRAINING FOR INDIAN RESEARCHERS

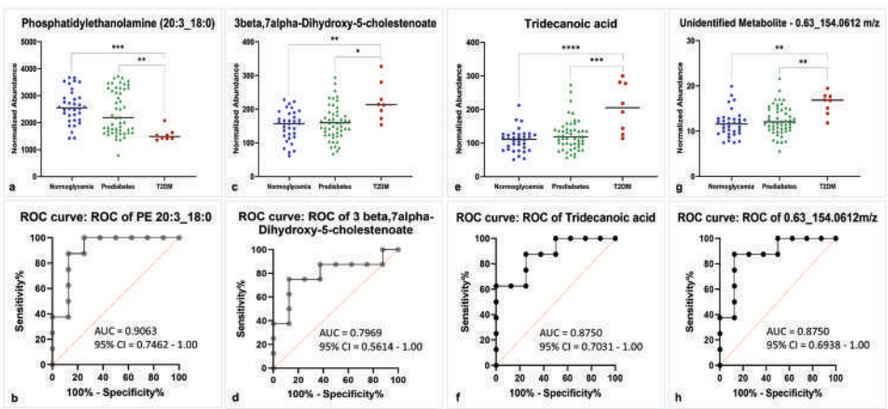
The goal of this project is to establish a panel of more than 300 lipid molecules/species, which comes under major lipid classes. At present our panels include 311 lipid molecules, which come under 25 lipid classes and 2 metabolites of one carbon metabolism. These panels are being established in our facility to meet the research needs of investigators.

3. ELUCIDATING THE ROLE OF LIPOPROTEIN(A) IN IMPAIRED ANGIOGENESIS IN PLACENTA DURING PRE-ECLAMPSIA AND ITS IMPACT ON THE VASCULAR HEALTH OF WOMEN

Higher plasma Lipoprotein(a) [Lp(a)] level is an independent risk factor for pre-eclampsia and cardiovascular diseases (CVD). We studied whether maternal phenotype of higher plasma Lp(a) level (> 75 nM per L) and the accompanying downstream responses predispose vascular dysfunction and impaired angiogenesis leading to pre-eclampsia and future CVDs. In our study population of pregnant women, a good proportion of individuals showed plasma Lp(a) level higher than 75 nmol per L diagnosed with and without pre-eclampsia. ELISA and western-blotting experiments revealed higher plasma Lp(a) level adversely affect the angiogenic profile of pregnant women irrespective of their disease condition. Our results suggest the importance of considering maternal higher plasma Lp(a) level as a biomarker for pre-eclampsia and future vascular dysfunction in women.

4. FUNCTIONAL SIGNIFICANCE OF CARDIAC MITOCHONDRIAL SUBPOPULATIONS IN TYPE 2 DIABETIC ASIAN INDIANS

One of the major reasons behind T2DM associated cardiac functional impairments is mitochondrial dysfunction. Based on the cellular localization, cardiac mitochondria are classified as subsarcolemmal and interfibrillar subpopulations. The current study is focused on analyzing the mitochondrial function and metabolism of type 2 diabetic cardiac patients. The major finding of the study is that the subsarcolemmal mitochondria have diminished fatty acid-mediated oxygen consumption in type 2 diabetic human cardiac tissue. Metabolomics profiling showed impaired linoleic acid metabolism in diabetic myocardium thereby influencing mitochondrial respiration. Levels of cer18:0/16:0 is also significantly higher in diabetic myocardium than the non-diabetic group.



The figure illustrates the significantly altered metabolites at baseline between group of participants who developed T2DM and who remained normoglycemic during follow up. The figure also shows the corresponding ROC curves with AUC (Area Under the Curve) values. Top panels show normalized abundance of (a) Phosphatidylethanolamine (20:3_18:0), (c) 3β,7α-Dihydroxy-5-cholestenoate, (e) Tridecanoic acid, and (g) an unidentified metabolite (m/z 154.0612, retention time 0.63 min) across normoglycemic, prediabetic, and T2DM groups. (b, d, f, h) present the corresponding ROC curves with AUC values for each metabolite, evaluating their ability to distinguish T2DM from normoglycemia. AUC > 0.7 and $p < 0.05$ were considered significant.

TEAM

Aswathy S, Susmi T R,
Riya Elizabeth Saji, Dr Abdul Jaleel,
Dr Nandini R J, Gopika Satheesh,
Dr Kalaivani V, Jeeva Prasannan
(From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows:2 / PhD Students:1 / JRF: 2 / SRF: 1 / Project Assistant: 1
Lab Assistant: 1

PUBLICATIONS:

- Bhattacharyya C, Subramanian K, Uppili B, Biswas N K, Ramdas S, Tallapaka K B, Arvind P, Rupanagudi K V, Maitra A, Nagabandi T, De T, Singh K, Sharma P, Sharma N, Raghav S K, Prasad P, Soniya E V, Jaleel A, Nelson Sathi S, Joshi M, Joshi C, Lahiri M, Dixit S, Shashidhara L S, Senthil Kumar N, Lalhruaitluanga H, Nundanga L, Shivakumar V, Venkatasubramanian G, Rao N P, Ganie M A, Wani I A, Jha G, Dalal A, Bashyam M D, Varadwaj P K, Bs S, Simmhan Y, Jain C, Sundar D, Gupta I, Yadav P, Sinha H, Narayanan M, Raman K, Padinjat R, Sabarinathan R; GenomeIndia Consortium; Narahari Y, Ravindranath V, Thangaraj K, Sowpati D T, Faruq M, Basu A, Kahali B. Mapping genetic diversity with the GenomeIndia project. Nat Genet. 2025 Apr;57(4):767–773.

- Chandran M, Rameshkumar K B, Jaleel A, Ayyappan J P. Embelin Elevates Endoplasmic Reticulum Calcium Levels and Blocks the Sterol Regulatory Element-Binding Protein 2 Mediated Proprotein Convertase Subtilisin/Kexin Type 9 Expression and Improves the Low-Density Lipoprotein Receptor Mediated Lipid Clearance on Hepatocytes. ChemBiol Drug Des. 2025 Feb;105(2):e70055.

- Haseena PA, Basavaraju N, Chandran M, Jaleel A, Bennett D A, Kommaddi R P. Mitigation of synaptic and memory impairments via F-actin stabilization in Alzheimer's disease. Alzheimer's Res Ther. 2024 Sep 7;16(1):200.

- Chandran M, Abhirami, Shareef B, Surendran A, Jaleel A, Ayyappan J P. Valencene ameliorates ox-LDL induced foam cell formation by suppressing inflammation and modulating key proteins involved in the atherogenesis on THP-1 derived macrophages. Human Gene 2024;42:201330.

INVITED TALKS [PI ONLY]:

- Talk on Early Metabolic Predictors of Type 2 Diabetes mellitus (T2DM) in Normoglycemic Adults: Insights from a Six-Year Follow-Up Study at International Academy of Cardiovascular Sciences (India Section) meeting with JIC 2025 at Ahmedabad from 10th to 12th January 2025.

- Talk on Mass Spectrometry-based proteomics at CSIR Sponsored workshop on Proteomics for Crop Improvement at IARI-RBGRC,Aduthurai,Tamil Nadu on 24 Feb 2025.

- Talk on Interactome by Mass spectrometry at National Symposium on Proteomics for Life: The Intra and Interplay of Proteins in Plants and Microbes jointly organized by IARI-RBGRC, Aduthurai, TN and Central University of Tamil Nadu, Thiruvarur, India on 18th March 2025

CONFERENCE PRESENTATION:

- Organized a 3-Day national symposium on mass spectrometry-based lipidomics from 20th to 22nd February at BRIC-RGCB.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	
01	Comprehensive mass spectrometry-based clinical lipidomics platforms for promoting biomedical research & advanced training for Indian researchers	Department of Biotechnology	2021	4 Years	PI

Ananthalakshmy Sundararaman, PhD

Scientist C & DBT-Ramalingaswami Fellow
Cardiovascular Diseases & Diabetes Biology

BRIEF THEME OF LABORATORY

Intracellular Trafficking in Mitochondrial Quality Control and Angiogenesis

MAJOR RESEARCH AREA

The lab works on Intracellular Trafficking in Cardiovascular Health and Diseases.

- Role of RhoJ in junctional protein trafficking in endothelial cells and Angiogenesis
- Role of Mitochondria-derived vesicles in Mitonuclear communication
- Biogenesis and Mito-lysosomal Trafficking of Mitochondria-derived vesicles and their importance to cardiac pathophysiology.
- RhoJ as a target in oral tumor angiogenesis.

WORK REPORT

- NUCLEAR TRANSIT OF MITOCHONDRIAL PYRUVATE DEHYDROGENASE- RELEVANCE TO CARDIAC HEALTH AND DISEASE

Pyruvate dehydrogenase complex (PDH) is classically a protein in the mitochondrial matrix that converts pyruvate to acetyl-CoA. This reaction links glycolysis and the TCA cycle and is a critical component of energy production in all forms of life on earth. Recently, it was shown that PDH can directly translocate to the nucleus, the nuclear form continues to be active, enabling acetyl-CoA production, which serves as a substrate for histone acetylation. The role of nuclear PDH in cardiac physiology and pathophysiology remains unexplored. Importantly, the mechanism of entry of this large multi-subunit complex into the nucleus is also unclear. We show that under basal states, differentiation or when cells use the electron transport chain almost exclusively for energy production, as seen under growth in galactose with pyruvate, we see an increased nuclear pool of PDH. Surprisingly, increased cellular stress in terms of doxorubicin-induced cardiotoxicity or ischaemia-reperfusion injury decreased the nuclear pool of PDH. We hypothesise that nuclear transit of PDH is a physiological response to cause sustained epigenetic changes necessary for cellular adaptation or differentiation, while stress response is dominated by mitochondrial damage, triggering PDH delivery to lysosomes or mitophagy activity that reduces the nuclear pool of PDH. We are working to understand if physiological nuclear PDH transit is through mitochondria-derived vesicles and whether that pathway can be modulated for improve cardiac bioenergetics.

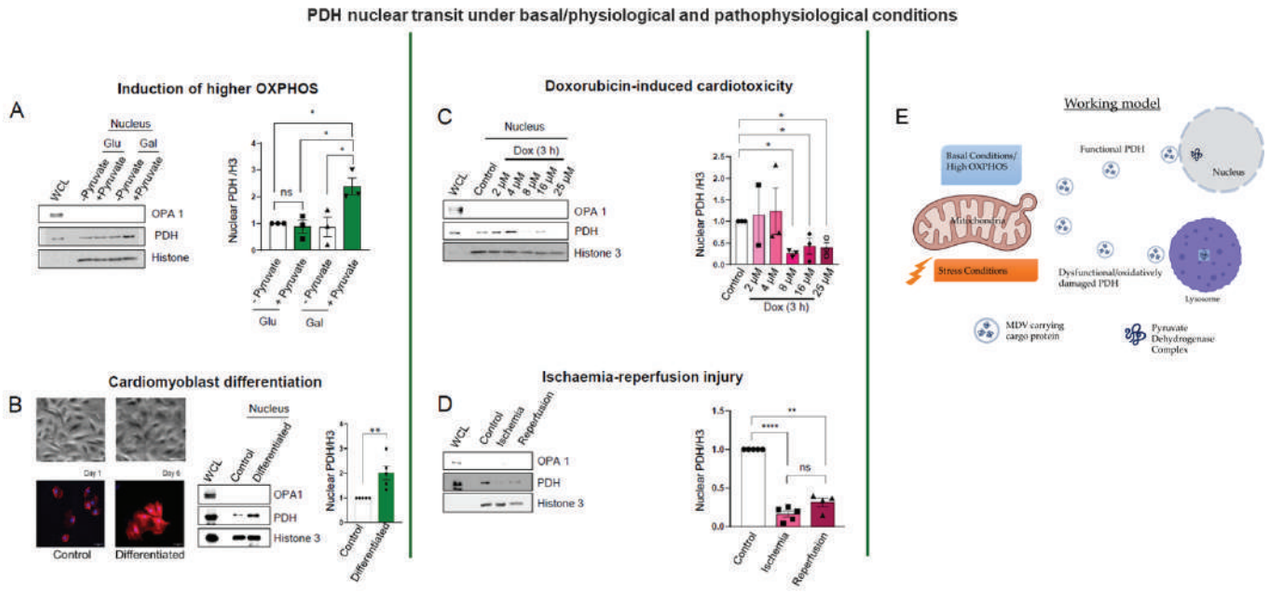
(A) Nuclear PDH level increases in cells grown for 24 hours in galactose rich media with pyruvate Glu: Glucose. Gal: Galactose.

(B) Cardiomyoblast differentiation increases nuclear PDH levels.

(C) Nuclear PDH levels decrease with higher doses of doxorubicin treatment for 3 hours.

(D) Nuclear PDH level decreases in ischemia as well as ischemia-reperfusion conditions.

(E) Working model suggesting different MDV subsets carry functional or damaged PDH in cells with different cellular targets.



TEAM

Dipak Shil, Adnan Mohamed,
Thejaswitha Rajeev,
Dr. Anathalakshmy Sundararaman,
Greeshma G Nair,
Mohammed Roshan (From L to R)

LABORATORY STRENGTH

PhD Students: 3 / JRF: 1 / Project Assistant: 1

AWARDS [STUDENTS]:

- Dipak Shil, Best Poster, Proteomic Characterization of Cardiac Mitochondria-derived Vesicles (MDVs) to Understand Mito-Nuclear Communication, National Symposium on Mass Spectrometry-based Lipidomics, from 20-22nd Feb at BRIC-RGCB.

CONFERENCE PRESENTATION:

- Dipak Shil, Poster Presentation, Proteomic Characterization of Cardiac Mitochondria-derived Vesicles (MDVs) to Understand Mito-Nuclear Communication, National Symposium on Mass Spectrometry-based Lipidomics from 20-22nd Feb at BRIC-RGCB.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Characterising Mitochondria-derived Vesicle Trafficking through a Proximity Labelling Approach- A possible Novel Mito-nuclear Communication	Anusandhan National Research Foundation	2023	3 Years	PI
02	Role of RhoGTPases in the Intracellular Trafficking of Mitochondria Derived Vesicles (MDVs) and Angiogenesis	Department of Biotechnology	2020	5 Years	PI

Ani V Das, PhD

Senior Program Scientist
Cancer Research

BRIEF THEME OF LABORATORY

The main focus of my research is to understand the involvement of non-coding RNAs and associated proteins in the stem cell maintenance and also their correlation with HPV-mediated tumorigenesis in cervical cancer. My research also involves elucidation of epigenetic mechanism behind the regulation of multidrug resistance in germ cell tumors.

MAJOR RESEARCH AREA

- RFX1 as a negative regulator of cancer stemness in embryonal carcinoma (NT2) cells.
- RFX1 overexpression compromised the oncogenic and stem-like properties of NT2 cells in vitro and in vivo.
- RFX1 could influence stemness through down-regulation of canonical Wntsignaling by directly targeting the FZD5 receptor.
- Another mechanism by which RFX1 could affect CSCs is by negatively regulating Oct4 via directly targeting LRH1, an activator of Oct4.
- On the other hand, Oct4 negatively regulated RFX1 by directly binding to its promoter, with HDAC1 as an inevitable partner, suggesting the existence of an inter-regulatory mechanism between RFX1 and pluripotency factor Oct4.

WORK REPORT

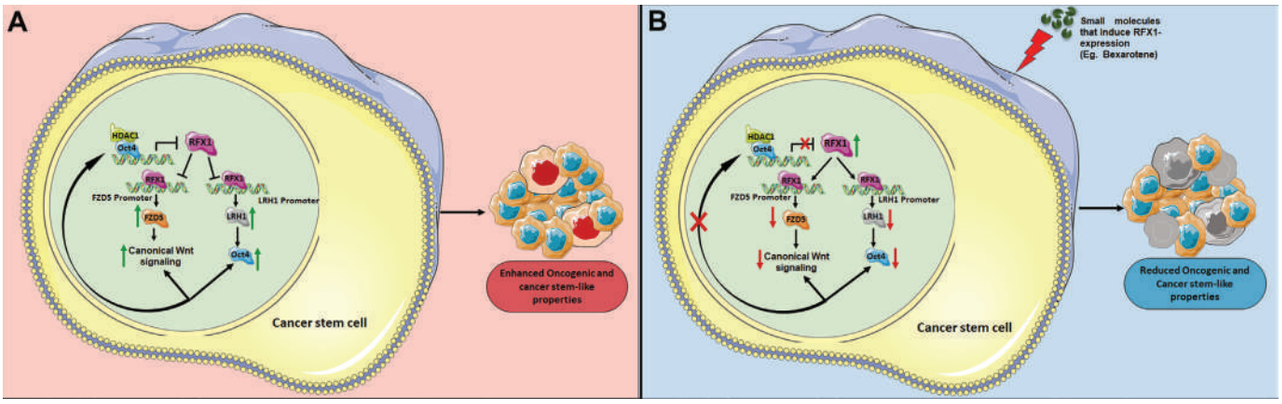
- **RFX1 REGULATES CANCER STEMNESS BY MODULATING OCT4 ACTIVATION AND CANONICAL WNTSIGNALING IN EMBRYONAL CARCINOMA CELLS.**

Background: Regulatory factor X1 (RFX1), a multifaceted pleiotropic transcription factor, exhibits inhibitory effects on many of its targets, such as multidrug resistance genes, and has been seen to be down-regulated in many cancers. This suggests a possible role for RFX1 in tumorigenesis and cancer stem cell maintenance. Here, in this study we investigated the role and regulation of RFX1 in cancer stem cells.

Methods: Using embryonic carcinoma (NTERA2/NT2) cells, we provided evidence for the role of RFX1 as an anti-oncogenic factor and negative regulator of cancer stemness. For this, we generated RFX1-overexpressed (RFX1OE) stable NT2 cells. Both in vitro and in vivo analyses were carried to assess the effect of RFX1 on the oncogenic and stemness-associated properties of NT2 cells. RNA seq analysis was performed to identify the targets of RFX1 in NT2 cells. Transcription factor-target interactions were analysed by luciferase reporter and ChIP assays. Oct4-associated factors that regulate RFX1 transcription were identified by CoIP and proteomic assays.

Results: RFX1 overexpression compromised oncogenic and stem-like properties of NT2 cells in vitro and in vivo. RNA sequencing analysis revealed that RFX1 positively regulates apoptotic/cell death pathways while downregulating cell proliferation/stemness-associated targets. One mechanism by which RFX1 influences stemness is the downregulation of canonical Wntsignaling by directly targeting the FZD5 receptor. In addition, we show another mechanism which is through downregulating Oct4 by directly targeting LRH1 (NR5A2), an activator of Oct4. Importantly, we report an inter-regulatory mechanism between RFX1 and Oct4 in cancer stem cells. Oct4 negatively regulates RFX1 by directly binding to its promoter, and HDAC1 is an inevitable partner in the down-regulation of RFX1. On the other hand, RFX1, by directly targeting FZD5 and LRH1, affects Oct4 expression and, thereby, cancer stemness.

Conclusions: Together, we prove that RFX1 is an anti-oncogenic factor and negatively regulate stemness in NT2 cells. Our study delineates a new link between RFX1 and cancer stemness maintenance. The RFX1/Oct4 inter-regulatory axis indicates that the balance of interactions between stemness factors and other regulatory factors is crucial for maintaining stemness.



RFX1 regulates cancer stemness through regulation of Wntsignaling and by forming an inter-regulatory mechanism with Oct4 through its target genes. Our study elucidates the role and regulation of RFX1 in cancer stemness. A) RFX1 expression is downregulated in cancer stem cells that leads to increased oncogenicity and stemness. The investigation into possible mechanism downregulating RFX1 in cancer stemness revealed Oct4 mediated downregulation of RFX1 expression in association with HDAC1 to maintain cancer stemness. B) On the other hand, upregulation of RFX1, through small molecules like Bexarotene, can lead to disruption of cancer stem cell maintenance as it affects Wnt/β-catenin pathway through downregulation of its target gene FZD5 and stemness factors such as Oct4. RFX1 regulates Oct4 through downregulating LRH1, a known Oct4 activator. Our study indicates that upregulation of RFX1 expression holds significant therapeutic implications for addressing cancer stemness.

PATENTS APPLIED/ GRANTED:

- "Screening Methods For Cancers Using piR-019324 As A Biomarker", INDIA Patent Application No. 202341040690

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Midhunaraj K	Elucidating the role and regulation of PiwiL1in HPV-mediated cervical cancer	Manipal Academy of Higher Education	Awarded	2024
02	Pooja SR	Deciphering the role of RFX1 in the regulatio of cancer stemness	Manipal Academy of Higher Education	Awarded	2025

Anish Kundu, PhD

Scientist C
Plant Biotechnology & Disease Biology

BRIEF THEME OF LABORATORY

The Lab works on:
Characterization of plant's defense mechanism against oomycete pathogens.
Identification and characterization of novel defense metabolites in plants and pathogen elicitors and effectors for bio-controlling crop disease.

We use Mass-spectrometry based integrative 'omics' to computationally map plant's defense pathways against oomycete pathogens. We also use untargeted metabolomics to identify bioactive plant metabolites and elicitor molecules which can be exploited for bio-controlling crop disease.

MAJOR RESEARCH AREA

- Identified early and late phase classifiers associated with defense by integrative 'Proteomics and Metabolomics'.
- Identified phenylpropanoid pathway-associated proteins as potential defense associated biomarkers and therefore, can be potential targets for increasing the P. myriotylum resistance.
- Identified a functionally novel metabolite and which showed strong bioactivity against P. myriotylum.
- Showed sustainable growth and yield promotion in rice upon P. indica colonization in rice roots.
- Identified brassinosteroid metabolism pathway as major pathway for growth and yield promotion in rice.
- Elucidated JA signaling is crucial for constitutive as well as herbivore induced primary metabolism in plant.

WORK REPORT

- MULTI-OMICS MAPPING AND CHARACTERIZATION OF PLANT GROWTH AND DEFENSE.

Project 1: Mapping of ginger defense metabolism against Pythium

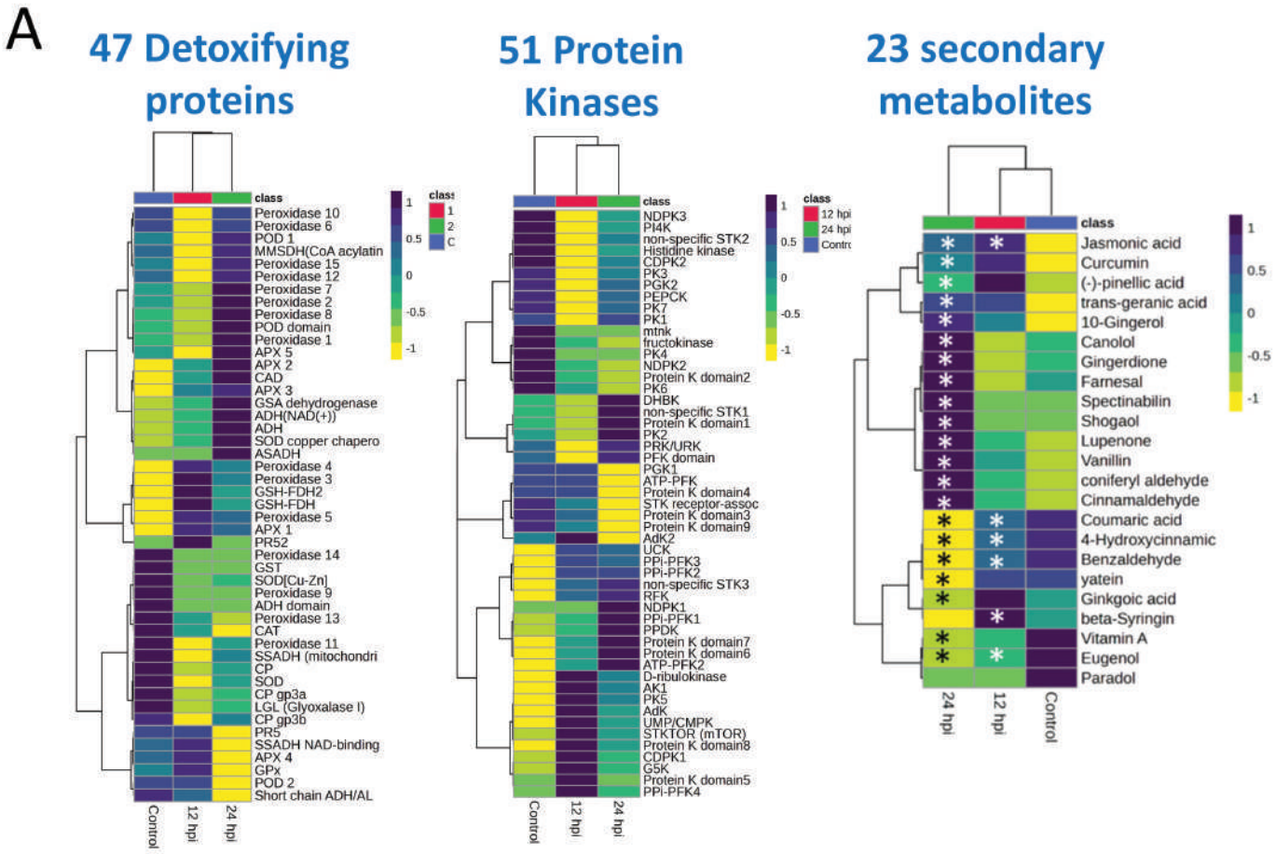
A pre-defined integrative 'multi-omics' data analysis pipeline with computational statistical framework to identified significant proteins and metabolites involved in defense activation and specialized metabolism in Ginger against P. myriotylum. We observed temporal alteration of proteome and metabolome in a correlated manner and specific set of detoxifying proteins, kinases are activated and supressed at early and late phases of infection (Fig. 2A). We also identified specialized metabolism associated protein biomarkers (LOX, PAL, CAD and C4H) that are involved in both early and late phase of defense against the infection. We observed the involvement of specific secondary metabolites (phenylpropanoids and terpenoids) those are upregulated majorly at late phase of infection and we also found a significant correlation of Jasmonic acid with these metabolites. This work revealed the identification of detoxifying proteins, kinases and secondary metabolites involved in immunity of the Ginger and also showed their correlation with Jasmonic acid biosynthesis.

Project 2: Molecular exploration of P. indica mediated yield promotion in rice

A phenotypic screening of 15 indigenous rice varieties was conducted to assess growth promotion upon Piriformosporaindica inoculation. Seed parameters like width, length, and 1000-seed weight helped identify three high-yielding (Dani Gora, Pokkali, Valiathondi) and three low-yielding (Chomala, Njavera N96, Njavera N68) varieties. These six were used for further screening. Dani Gora and Njavera N96 showed the best growth, with Dani Gora selected for detailed studies. Significant improvements were observed in root and shoot biomass, root thickness, and leaf height in treated Dani Gora plants. Moreover, at the maturation stage, P. indica-treated Dani Gora plants showed enhanced panicle initiation and improved yield traits. Metabolomics analysis using LC-HRMS revealed distinct metabolic profiles in treated plants. Key pathways such as diterpenoid, carotenoid, brassinosteroid, and steroid biosynthesis were significantly upregulated, confirming P. indica's role in promoting rice growth via metabolic reprogramming. Additionally, expression levels of panicle development associated and brassinosteroid metabolism genes were found to be significantly induced in P. indica colonized plant's panicle.

Project 3: Mapping the herbivory induced Jasmonic acid signaling mediated primary metabolism in Arabidopsis

Jasmonic acid signaling mediated modulation of primary metabolites and their metabolic pathways in plants are mostly unmapped from metabolomics perspective. We applied gas chromatography-mass spectrometry based untargeted metabolomics aided with machine learning based statistical frameworks on wild type Arabidopsis, mutants of active jasmonic acid receptor (i.e. coronatine-insensitive 1 or COI1-1) and downstream transcription factor (i.e. MYC2) to identify the major herbivory induced chemical classes, pathways and to navigate the jasmonic acid mediated primary metabolism alterations during herbivory. We observed JA signaling is crucial for constitutive as well as herbivore induced primary metabolism and topology of their interaction networks. JA signaling majorly modulated alterations of sugars, amino acids and related metabolites. Herbivory mediated sugar depletion and induction of methionine for aliphatic glucosinolates are also dependent on JA signaling. We also found out a strong correlation of major soluble sugars' (glucose, fructose and sucrose) depletion in leaves with JA level which is associated with herbivore mediated sugar reallocation.



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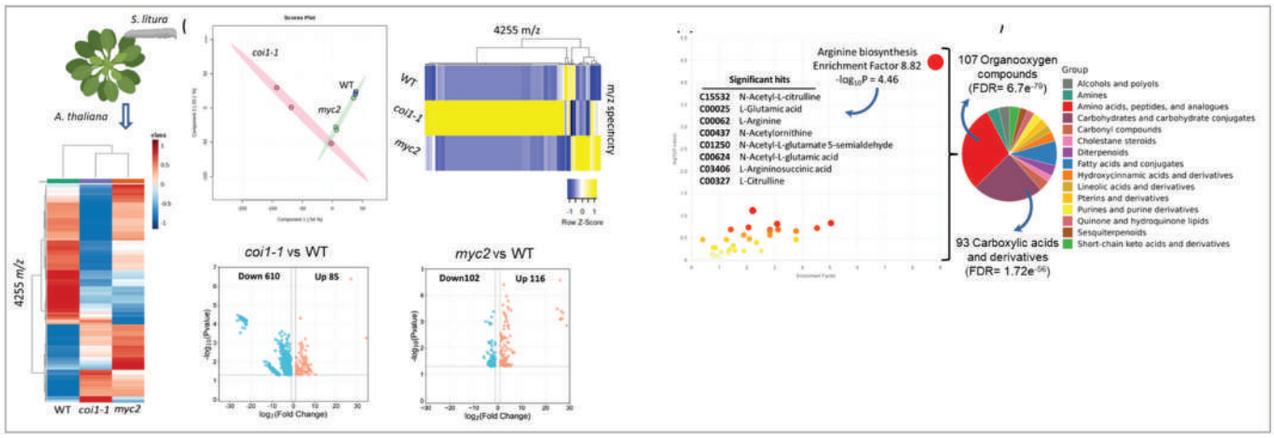

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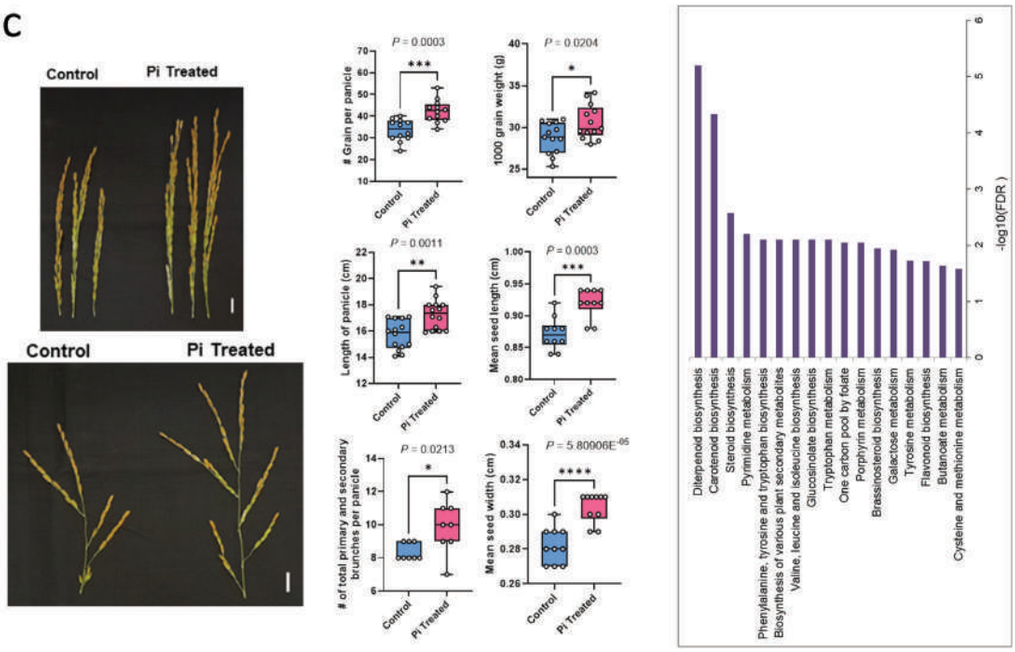


(A) Identified classifiers (detoxifying proteins, kinases and secondary metabolites in Ginger collar region after 12 hpi and 24 hpi of Pythium myriotylum infection.
(B) Visualization and estimation of yield associated trait induction in rice upon P. indica colonization and significantly enriched pathways in P. indica colonized root.
(C) Briefing of primary metabolic alteration in Arabidopsis wild type and JA mutants (coi1-1 and myc2) upon 24 h of Spodopteralitura herbivory.

TEAM

Febina Fernandes, Kalapriya V S, Aiswarya Prathap, Dr. Anish Kundu, Manjima A M, Vinitha M R (From L to R)

LABORATORY STRENGTH

PhD Students: 3 / Lab Assistant: 1

PUBLICATIONS:

- Kundu A, Bera P, Mishra S, Vadassery J. Deep metabolomics revealed trajectories of jasmonatesignaling-mediated primary metabolism in Arabidopsis upon Spodopteralituraherbivory. Physiol Plant. 2025 Jan-Feb;177(1):e70035.
- Kundu A. 2023. Antimicrobial to anti-herbivore: Sakuranetin in rice efficiently inhibits brown planthopper by targeting their beneficial endosymbionts. Physiol Plant. 2023 Nov-Dec; 175(6):e14110.

Book Chapter (Invited) :

- Mohanan M, Fernandez F, Kundu A. 2025. Plant Immunity inducers: discovery and delivery for crop protection. In: "Sustainable Crop Production: New Research Paradigms in Plant Sciences" Ed. Varshney R, Das S, Singh A. Springer Nature (Accepted)

AWARDS [STUDENTS]:

- Manjima A M, Best Abstract Award and invited for oral presentation at National Symposium on Mass Spectrometry-Based Lipidomics, Organized by BRIC-RGCB at Thiruvananthapuram, Kerala, India on February 20-22, 2025.

INVITED TALKS [PI ONLY]:

- Discovery of plant's molecular and pathway biomarkers and temporal metabolic model in response to pathogen through mass spectrometry at National Symposium on Mass Spectrometry-Based Lipidomics, Organized by BRIC-RGCB, at Thiruvananthapuram, Kerala, India on February 20-22, 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Exploiting Defense Priming in Tea (Camellia sinensis) for crop protection against the major insect pests(Tea mosquito bug (Helopeltistheivora) & Red spider mites (Oligonychuscoffeae) and diseases (blister blight, Exobasidiumvexans and grey blight, Pestalopsistheae) and metabolome-assisted identification of biomarkers for quality improvement	National Tea Research Foundation	2024	3 Years	Co-PI

Arun Sankaradoss, PhD
Scientist C
Pathogen Biology

BRIEF THEME OF LABORATORY

Our group deals with fundamental and translational aspects of flaviviruses with a particular focus on Dengue. Our primary objective is to develop thermostable nucleic acid-based vaccines for dengue and ZIKA and to understand the molecular mechanisms of protective versus pathogenic immunity. Focus areas of research include: 1) Developing small animal models for dengue 1-4 that can be harnessed for vaccine efficacy studies, 2) Identifying the critical role of T cells and IFN-γ signalling in the protective mechanism of dengue.

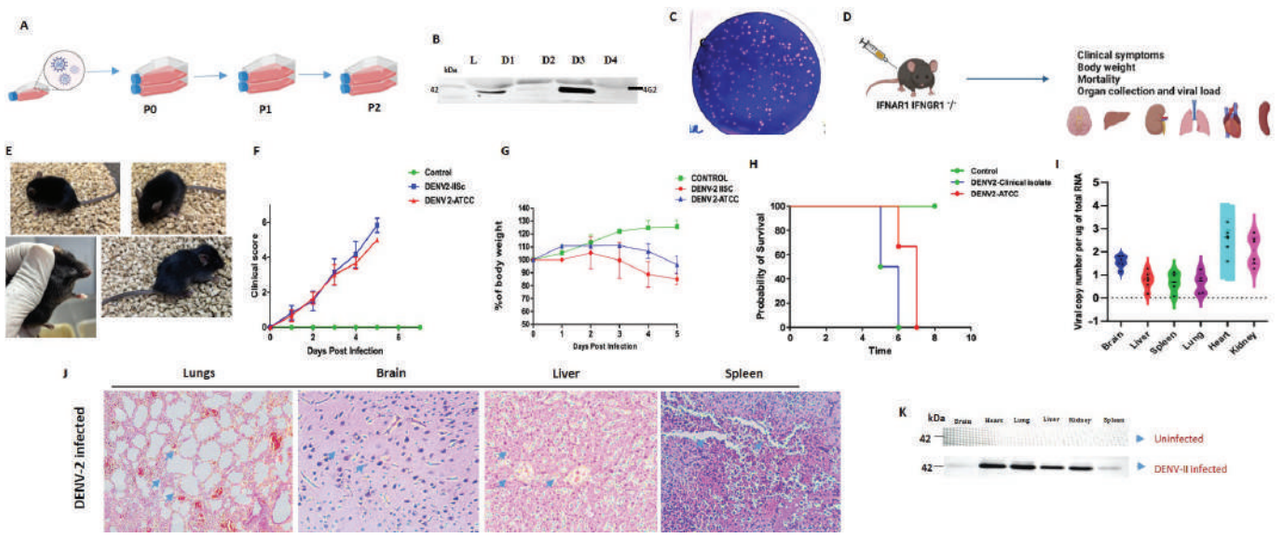
MAJOR RESEARCH AREA

- Developed murine models for DENV 1 and DENV 2 infection using Indian clinical strains and international strains.
- Developed NanoDNA vaccine for DENN- Preclinical studies are ongoing.

WORK REPORT

- A TRANSGENIC ANIMAL MODEL FOR DUAL APPLICATION: A PLATFORM FOR DENGUE VACCINE SCREENING AND UNDERSTANDING THE ROLE OF T CELLS AND IFN-SIGNALLING IN SEVERE DENGUE PROTECTION.

It is becoming increasingly evident that generating effective and durable immunity is a critical prerequisite for protective immunity against DENV. Although antibodies often correlate with vaccine efficacy, T cells are crucial components of the recall response to viral antigens. They are a likely mechanism of protection, especially in endemic settings, where antibodies alone do not provide sterilizing immunity. These T cell responses include the production of IFN-γ by both CD4+ T cells and CD8+ T cells. IFN-γ is considered to be a signature cytokine of activated T cells. Here, we use transgenic mice models to study the role of IFN-γ-driven cellular immune response against DENV infection. We develop two transgenic mouse models, one with intact IFN-II response and IFN-I knockout response and the other with both IFN-I and IFN-II knockout responses. We started with DENV 2 as a model; we infected both mouse strains with DENV-2 at high (1 × 10^7 PFU) and low dose (1 × 10^4 PFU) via the subcutaneous route. The animals were monitored for body weight change, clinical score and survival. Compared to IFNAR1-/- IFNGR1-/-mice, body weight reduction was significantly slower in the IFNAR1-/- in both low-dose and high-dose experiments. In IFNAR1-/- IFNGR1-/-, the development of DENV symptoms starts with ruffled fur, hugged back, and slow movement, which is followed by facial edema and paralysis. In the 6-DPI, the clinical score reached a maximum, and 100% mortality was observed. In contrast, IFNAR1-/- in high-dose experiments, the clinical score reached only a maximum of 4, and 70% of animals survived during the experimental period. The clinical score of all the surviving IFNAR1-/- mice was fully restored to normal by 15DPI. Moreover, in low-dose experiments, IFNAR1-/- mice exhibited very few clinical symptoms of DENV on DPI 5 and 6 and recovered from DPI 7 and 100% of animals survived during the experimental period. We then evaluated DENV RNA levels in Brain, Liver, Lungs, Spleen, Kidney and Heart between IFNAR1-/- IFNGR1-/- and IFNAR1-/- animals following DENV – 2 infections. In all organs, IFNAR1-/- DENV-2 recovered mice had significantly lower viral RNA levels than the IFNAR1-/- IFNGR1-/- mice. The same trend was observed in western blotting experiments while detecting viral E protein using 4G2 antibody. A similar result was obtained in the brain, lungs, and liver immunofluorescence staining. Taking the results together, IFN-II response protected from debilitating and lethal DENV-2 infection. Studies are ongoing to understand the mechanism of IFN-II response-induced protection against DENV in mouse models.



(A)Schematic of the passaging of DENV serotypes.
(B) DENV antigen expression in virus cultures using the 4G2 antibody.
(C) Representative image of DENV-2 plaque
(D) Diagram of the experimental design of DENV-2 infection in IFNAR1-/- IFNGR1-/- mice.(E-H) Clinical symptoms, clinical scores, body weight and Kaplan-Meier survival curves indicating the percentage of survival of mice.
(I &K) Viral copy numbers and antigens in vital organs of infected mice.
(J) Representative H&E staining.

TEAM

First Row: Thiriveni, Dr. Arun Sankaradoss, Reeya Roy (From L to R)
Second Row: Vaishakh Varma, Ramkumar, Sruthi Gonugunta (From L to R)

LABORATORY STRENGTH

PhD Students: 2 / Project Assistant: 1

AWARDS [PI]:

- Received 1st Prize for the oral presentation at the Young Scientist Conclave at IISF 2024, held at IIT Guwahati from 30th November till 3rd December, 2024.

INVITED TALKS [PI ONLY]:

- A Protective Next-Generation Nucleic-Acid-Based Vaccine for Pan Dengue Serotype Infection at Stakeholder Meeting on Leveraging Technology in Vector Borne Diseasesorganized at ICMR-RMRC, In Collaboration with National Disease Modelling Consortium (NDMC) IIT Bombay, in collaboration with the Women's Collective Forum (WCF) on17.03.2025 & North East, Dibrugarh.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Investigating the Safety Profile of NanoDNA-LNP Dengue Vaccine against Antibody-Dependent Enhancement of Dengue and Other Flaviviral Infection in Mouse Models.	Anusandhan National Research Foundation	2025	3 Years	PI

S Asha Nair, PhD

Scientist G & Dean (Research Administration & Faculty Affairs)
Cancer Research

BRIEF THEME OF LABORATORY

The rising incidence of early-onset colorectal cancer in India calls for understanding its molecular basis. Our research focuses on tumor hierarchy and the niche supporting cancer stem cell states. We also explore signaling pathway crosstalk involved in tumorigenesis and drug resistance. Using in vitro models, clinical samples, and orthotopic systems, we study stemness-regulating genes like FoxM1 to uncover mechanisms driving this preventable, lifestyle-related disease.

MAJOR RESEARCH AREA

- Identified STIL as a key regulator linking WNT and SHH pathways in colorectal cancer. STIL modulates GLI1, beta-catenin, and AKT signaling, influencing beta-catenin phosphorylation, cleavage, and nuclear localization. This crosstalk reveals novel therapeutic targets and highlights STIL's role in promoting transcriptionally active beta-catenin in CRC progression.
- Synthesized a novel biotin-conjugated Aza-BODIPY (DPR2B) with strong potential for photodynamic therapy and cancer detection. Demonstrated high photodynamic efficiency and selective cytotoxicity in MDA-MB-231 and MCF7 breast cancer cells, confirming DPR2B's specificity and therapeutic promise. Enabled targeted therapy while sparing normal cells, supporting further preclinical studies.

WORK REPORT

- STIL- A MOLECULAR REGULATOR OF SHH AND WNTSIGNALING A MEDIATING STEMNESS IN CRC.
- MOLECULAR EFFICACY OF A PHOTOSENSITIZER- BIOTIN-CONJUGATED AZA-BODIPY INPHOTODYNAMIC THERAPY OF BREAST CANCER

Targeted therapies often require molecular information regarding the pathways altered. Therefore, unraveling how the pathways and the key molecules linking them are altered would help to develop novel therapeutic targets in CRC. WNT and SHH are the two major developmental pathways altered in colorectal cancer. We have observed a STIL mediated crosstalk between these pathways by regulating the effector molecules GLI1 and Beta catenin (Fig 2A) as well as their target genes (Fig 2B & C). We also found that STIL mediated regulation of GLI and the target genes of SHH could be dependent on SHH pathway. Chemical inhibition of Wnt pathway altered STIL, but not the beta catenin levels which suggests a WNT independent regulation of beta catenin. We observed that STIL could regulate the expression of AKT, and pAKT (Fig 2D). AKT is a known modulator of Beta catenin that phosphorylates the Ser552 of beta catenin. This phosphorylation results in cleavage and nuclear translocation of beta catenin. The resultant short fragment is reported to be transcriptionally more active and is abundant in CRC and colitis. Upon STIL silencing, we observed a reduction in short fragment and accumulation of full-length beta catenin in nuclear fraction(Fig 2E). This indicates that STIL might be regulating the phosphorylation and cleavage of beta catenin through AKT.

Photodynamic therapy (PDT) is an emerging cancer treatment that utilizes photosensitizers (PS) as pro-drugs. Upon light activation at a specific wavelength, these PSs generate reactive oxygen species (ROS), leading to targeted cancer cell death while sparing healthy cells. Aza-BODIPY, a unique PS class, holds promise in PDT and bioimaging due to its favorable chemical and physical properties.

In collaboration with CSIR-NEIST Jorhat (Dr.Pranjal Gogoi), we synthesized a novel Aza-BODIPY bioconjugate, DPR2B, incorporating a biotin moiety for PDT and multimodal cancer detection. To assess DPR2B's cell line specificity, we performed an MTT assay on seven cancer cell lines and a normal cell line. Our cytotoxicity data showed that Aza-BODIPY exhibited the highest photodynamic efficiency in MDA-MB-231 and MCF7 breast cancer cells, leading us to select these for further studies.

(Fig 1A) Immunoblot showing expression of CD133 and CD44 and drug efflux proteins in STIL silenced HT29 cells.

(Fig1 B) Showing reduction in size of tumorospheres formed in control and STIL silenced cells.

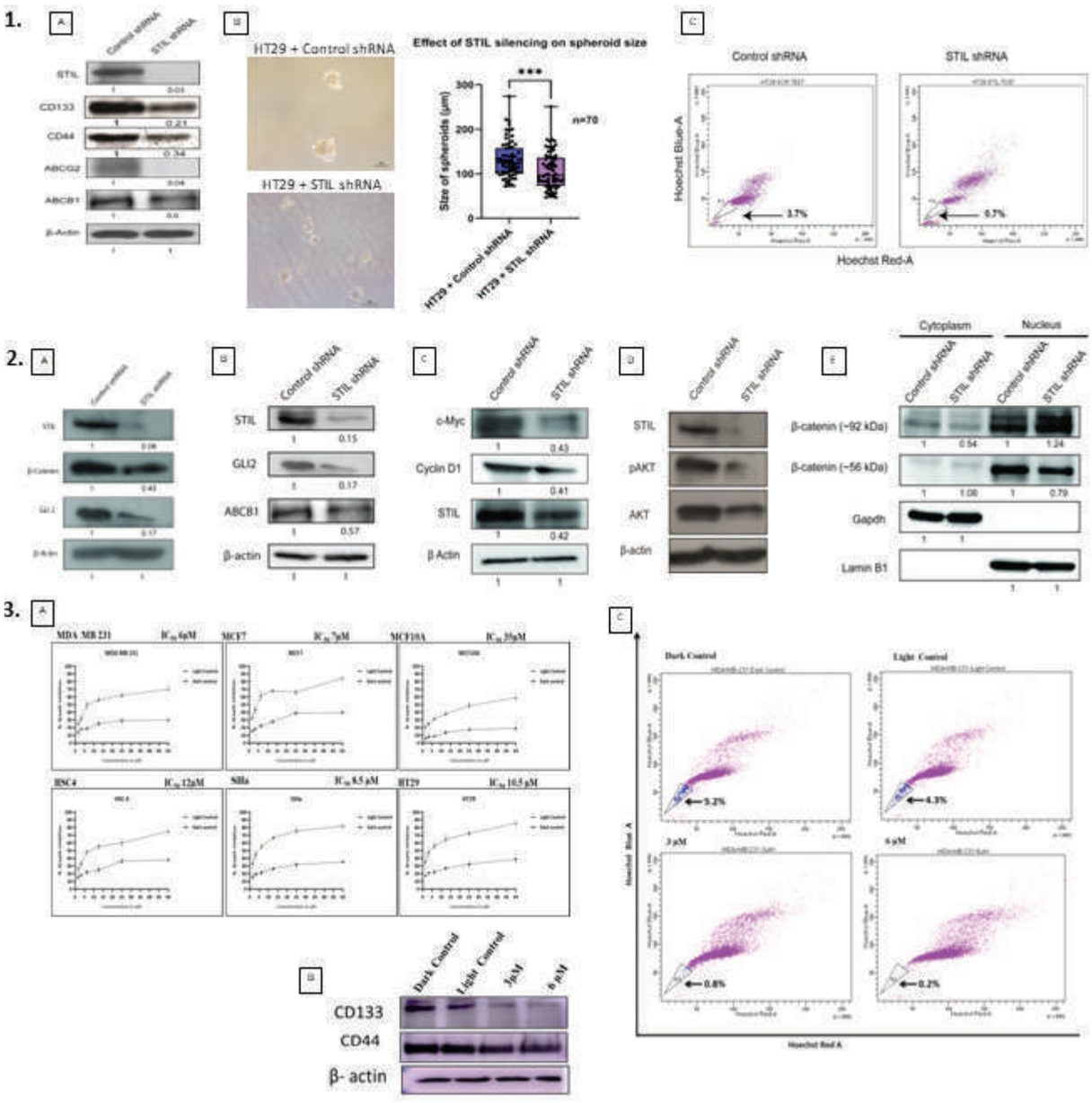
(Fig 1C) FACS data showing reduction in percentage of side population with STIL silencing.

Fig 2-Western blot showing reduction in SHH and WNT effector molecules

(Fig 2A) and target genes

(Fig 2B & C) in STIL silenced cells.

(Fig 2D) Expression of AKT and PAKT reduced upon STIL silencing.



(Fig 2E) Immuno blot showing nuclear and cytoplasmic expression of beta catenin upon STIL silencing.
(Fig 3A) Photocytotoxicity of aza-BODIPY- biotin conjugates in the presence and absense of light in various cancerous cell lines.
(Fig 3B) Western blot of CD133 CD44 expression in MDAMB231 cells after DPR2b treatmenet.
(Fig 3C). Reduction in stemcell population post PDT(0.8% & 0.2%) compared to light(4.3%) and dark control(5.2%)

TEAM

First Row: Rajshree R Nair, Meera R Nair, Dr. Asha S Nair, Aneesha K, Evangeline Surya Hermon, Krishna R (From L to R)
Second Row: Divya Jayalakshmi, Abhijeeth M Nair, Poornima S R (From L to R)

LABORATORY STRENGTH

PhD Students: 5 / JRF: 1 / Project Assistant: 1 / Lab Assistant: 2

PUBLICATIONS:

- Soman A, Asha Nair S. Unfolding the cascade of SERPINA3: Inflammation to cancer. BiochimBiophysActa Rev Cancer. 2022 Sep;1877(5):188760. Dutta, Dhiraj, et al. "Biocompatible Aza-BODIPY-Biotin conjugates for photodynamic therapy of cancer." ACS omega 8.29 (2023): 26180-26190.
- Mahajan K, Das A V, Alahari S K, Pothuraju R, Nair S A. MicroRNA-532-3p Modulates Colorectal Cancer Cell Proliferation and Invasion via Suppression of FOXM1. Cancers (Basel). 2024 Sep 2;16(17):3061.
- Soman A, Pradhan T, Krishna R, Hermon E S, Somanathan T, George J E, George G, Pothuraju R, Nair S A. Decoding early-onset of colorectal cancer: Insights into SERPINA3 expression patterns. Heliyon. 2024 Nov 6;10(22):e40119.
- John S, Kalathil D, Pothuraju R, Nair S A. Deciphering ETS2: An indispensable conduit to cancer. BiochimBiophysActa Rev Cancer. 2025 Jun 7;1880(4):189368.

CONFERENCE PRESENTATION:

- Krishna R, Oral Presentation on STIL mediated crosstalk between SHH and WNT pathways in CRC at 13th International conference, Bioradiance 2025 Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla.
- Rajshree R Nair, Oral Presentation on STIL mediated crosstalk between SHH and WNT pathways in CRC at 13th International conference, Bioradiance Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Addressing STIL as a major driver of drug resistance in colorectal cancer, independent of Shh pathway	Indian Council of Medical research	2023	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Samu John	Elucidating role of ETS2 in cell cycle and colorectal cancer progression	University of Kerala	Awarded	2024
02	Anjana Soman	Identification of SERPINA3 in early onset of colorectal cancer and investigating its molecular manifestation	University of Kerala	Awarded	2024
03	Ketakee Mahajan	he Interplay Between MicroRNAs and FOXM1: The Impact in Colorectal cancer	University of Kerala	Awarded	2025

Prof.Chandrabhas Narayana, FASc, FRSC, FNASc

Director
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

The molecular contents of exosomes are known to reflect the characteristics of their parent cells. We are currently investigating exosomes as potential biomarkers for early cancer diagnosis. Exosomes are being isolated from various cancerous and non-cancerous cell lines and characterized using transmission electron microscopy (TEM), dynamic light scattering (DLS), Raman spectroscopy, and surface-enhanced Raman spectroscopy (SERS). The goal is to develop a comprehensive database that will facilitate the identification and analysis of cancer-specific exosomal biomarkers.

MAJOR RESEARCH AREA

Major achievements include identifying compositional differences in exosomes from distinct cell lines using Raman spectroscopy and developing a SERS-based strategy for probing exosomal biomarkers.

- Exosome-Based Cancer Diagnostics: Identifying cancer-specific exosomal biomarkers for early detection.
- Raman & SERS Spectroscopy: Characterizing exosomal contents and enhancing sensitivity using Raman and surface-enhanced Raman techniques.
- Signal Optimization & Mechanisms: Investigating nanoparticle-biomolecule interactions and distance-dependent SERS effects for reliable diagnostics.

WORK REPORT

- HARNESSING RAMAN SPECTROSCOPY FOR EARLY DETECTION OF DISEASE.

Alzheimer's Disease (AD) is characterized by the accumulation of Amyloid β (Aβ) aggregates in the brain. Current diagnostics (MRI, CT, PET) detect neurodegeneration or plaques, offering limited early intervention. Small soluble Aβ oligomers correlate with disease severity, making them attractive targets for early diagnostics. However, they exist at very low concentrations among many biomolecules, necessitating highly sensitive and selective detection methods.

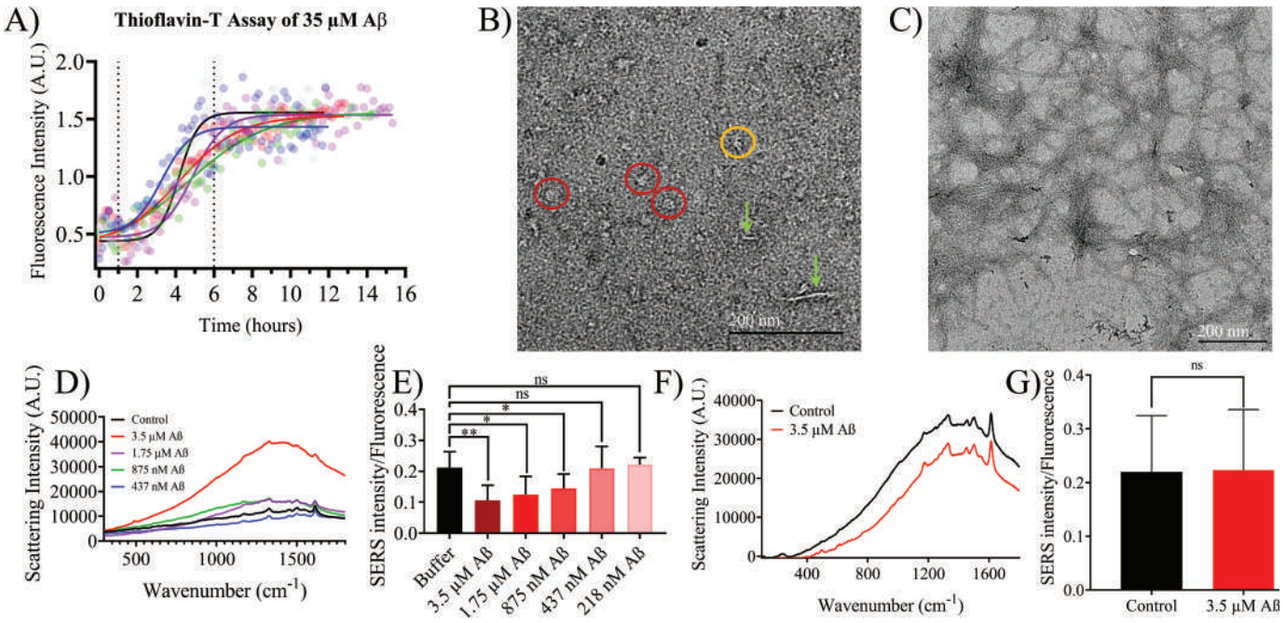
We developed a Surface-Enhanced Raman Spectroscopy (SERS)-based platform to detect Aβ oligomers. Monodisperse silver nanoparticles (AgNPs) were synthesized using tannic acid and trisodium citrate, achieving uniform plasmonic properties. AgNPs were functionalized with Rose Bengal (RB) dye, specific for Aβ oligomers, via short cysteamine (2-carbon) linkers, allowing some flexibility for RB reorientation upon oligomer binding. This reorientation alters the SERS signal in proportion to oligomer concentration.

Aβ aggregation was induced by diluting 1 mM Aβ42 (pH 11) into pH 7.4 phosphate buffer (35 μM final concentration) and incubating at 25°C. Thioflavin-T assays tracked aggregation kinetics, showing a lag phase of 2–4 hours (monomer to oligomer formation) and a growth phase indicating protofibril formation, ending after 6–9 hours. TEM imaging confirmed morphological transitions from oligomers (~1 h) to protofibrils (~19 h) and fibrils (~4 days).

SERS measurements revealed that the nanoconstruct provided reproducible and selective detection of small Aβ oligomers, showing significant changes in the ~1612 cm^{-1} peak for 3.5 μM Aβ during early aggregation. Lower concentrations or later aggregation times produced smaller

intensity changes, consistent with oligomer dynamics.

This work demonstrates that SERS using RB-functionalized AgNPs can sensitively and selectively detect early-stage Aβ oligomers in solution, offering a promising approach for early AD diagnostics. Optimizing nanoparticle functionalization and linker design allows precise control of analyte proximity and signal enhancement, addressing challenges in detecting low-abundance toxic oligomers in complex biological samples.



(A) Thioflavin T assay for 35 µM aggregating Aβ solution showing aggregation kinetics.
(B &C) TEM images of Aβ aggregation at 6 h and 19 h, respectively; small ring-shaped oligomers (red circles) and rod-like protofibrils (green arrows) are visible at 6 h.
(D) Changes in SERS and fluorescence signals from the nanoconstruct 1 h into aggregation, showing decreased SERS and increased fluorescence with rising Aβ concentration.
(E) SERS-to-fluorescence ratio at 1612 cm^{-1} for different Aβ concentrations after 1 h.
(F) Minimal changes in SERS and fluorescence signals from the nanoconstruct 4 days post-aggregation.
(G) SERS-to-fluorescence ratio at 1612 cm^{-1} with and without Aβ after 4 days, indicating reduced detection of larger aggregates.

TEAM

Abhirami Ajith, Athira Baiju, Poornendhu, Prof. Chandrabhas Narayana, Dr. Debanjan Bhowmik, Lakshmi Babu, Harikrishnan K S (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / Technical Assistant: 1 / Lab Assistant: 1

PUBLICATIONS:

- Rathee M, Surendran H K, Thakur A, Narayana C, Lo R, Misra A, Jayaramulu K. Tailoring Functional Graphene-Derived Geopolymer Nanocomposites: Interfacial Interactions and Mechanical Strength Enhancement. ACS Mater Au. 2025 May 9;5(4):698-708.

- Pathak R, Joseph A, Dutta P, Joseph B, Duhan J, Chandra S, Narayana C, Pal K, Biswas K. Impact of Pressure on Metavalent Bonding in BiTe Influencing Electronic Topological Transitions. Angew Chem Int Ed Engl. 2025 Apr 1;64(14):e202422652.

- V Amrutha, Kanakangi S Nair, Chandrabhas Narayana, Harish C Barshilia. Fabrication and performance evaluation of a highly stable micro/nanostructured surface using rapid thermal treatment of Si-coated stainless steel for solar thermal applications. Journal of Alloys and Compounds, 2025, 1010, 178093.

- Yadav V, Arkoti N K, Gautam S K, Kuppireddy S, Yendrapati T P, Modem S, Narayana C, Lee H D, Siddhanta S, Jayarmaulu K. Recent advances in nanoporous NOx gas sensors: synergizing Raman spectroscopy, IoT, and machine learning for high-performance detection. Nanoscale. 2025 Sep 18;17(36):20704-20733.

- Bonizzi A, Signati L, Grimaldi M, Truffi M, Piccotti F, Gagliardi S, Dotti G, Mazzucchelli S, Albasini S, Cazzola R, Bhowmik D, Narayana C, Corsi F, Morasso C. Exploring breast cancer-related biochemical changes in circulating extracellular vesicles using Raman spectroscopy. Biosens Bioelectron. 2025 Jun 15;278:117287.

- Dutta A, Swain D, Porob D G, Sunil J, Narayana C, Guru Row T N. Phase Transitions in a Vanthoffite-Type Compound, Na6Zn(SO4)4: Insights from In Situ PXRD and Raman Spectroscopy. J Phys Chem A. 2024 Dec 12;128(49):10587-10597.

- K R Pradeep, Priyanka Jain, K T Suhas, Vadim Murzin, Chandrabhas Narayana, Ranjani Viswanatha. Structure of Mixed Halide Perovskite Nanocrystals at Various Length Scales. The Journal of Physical Chemistry C, 2024, 128, 39, 16781-16790.

- Sharma, Akashdeep , Lee, Hyeon-Seung, Yeom, Chae-Min, Surendran, Harikrishnan, Narayana Chandrabhas, Eadi, Sunil , Zboril Radek, Lee, Hideok, Jayaramulu, Kolleboyina. (2024). Tailoring Conductive MXene@MOF Interfaces: New Generation of Synapse Devices for Neuromorphic Computing. Chemistry of Materials. 36. 10.1021/acs.chemmater.4c01596.

- Rathee Manali, Surendran, Harikrishnan, Narayana Chandrabhas, Lo, Rabindranath Misra, Anurag, Jayaramulu, Kolleboyina. (2024). Interfacial Chemistry of Ti 3 C 2 T x MXene in Aluminosilicate Geopolymers for Enhanced Mechanical Strength. ACS Applied Engineering Materials. 2. 10.1021/acsaenm.4c00184.

- Mallick, Bidyut, Palit, Mainak, Jana, Rajkumar Das, Soumik Ghosh, Anudeepa Sunil, Janaky Maity, Sujan Das, Bikash, Kundu, Tanima, Narayana, Chandrabhas, Datta, Ayan & Datta, Subhadeep. (2024). Pressure-induced insulator-to-metal transition in few-layer FePS 3 at 1.5 GPa. Physical Review B. 109. 10.1103/PhysRevB.109.235417.

AWARDS [PI]:

- Selected for CRS Gold Medal Award. The award was conferred at IISER Kolkata, during the symposium "Science Beyond Boundary: Invention, Discovery, Innovation, and Society - Rasayan 19".

- Selected for the Dr. APJ Abdul Kalam National Award given by the APJ Abdul Kalam Study Centre.

- The Government of Kerala nominated Professor Chandrabhas Narayana, Director BRIC-RGCB, to the governing body of Cochin Cancer Research Centre.

INVITED TALKS [PI ONLY]:

- Delivered an invited lecture on "Raman: A Healthcare and Diagnostics Tool " at INVICTUS'24 organized by the School of Agricultural Sciences, Division of Biotechnology, Karunya Deemed University, Coimbatore on 7th October 2024

- Delivered an invited lecture on "Protein structure-function, drug discovery and diagnostics with Raman spectroscopy" at BRICS Workshop on Biophotonics - 2024 on 3rd October 2024 at MAHE, Manipal. The conference is attended by scientists and researchers from BRICS countries of various fields of science involved in the application of optics, photonics, and imaging technologies to solve urgent problems in biology and medicine.

- Delivered an invited lecture at the 90th Annual Meeting of the Indian Academy of Sciences, Bangalore. The topic of the session was "A journey of Raman spectroscopy from physics to biology" conducted on 8th November at PathaniSamanta Auditorium, NISER, Bhubaneswar.

- Chaired the panel discussion on “Contributions of BharatheeyaSaastras to Western Scientific Discoveries and Innovations” at the International Seminar "BharatheeyaShaasthras and Samskritham," themed "Bridging Traditional Wisdom & Modern Innovation for Viksit Bharat,” held at BRIC-RGCB on January 3-4, 2025.

- Delivered his special message on National Science Day 2025 with various programs.
  Over 100 students from various schools and colleges visited the laboratories, central instrumentation facilities and exhibition stalls.

- Delivered a keynote session on "Raman Spectroscopy an example of Trans disciplinary Research for Biotechnology, at Kristu Jayanti College, Bengaluru, on March 6th 2025.

CONFERENCE PRESENTATION:

- Abhirami Ajith, Poster Presentation on Probing of Amyloid ß oligomers by SERS, aiming at early diagnosis of Alzheimer's disease at BRICS Workshop on Biophotonics 2024 from October 3-5, 2024 at Manipal Academy of Higher Education.

- Abhirami Ajith, Poster Preseentation on Probing of disease specific exosomes using Raman spectroscopy at Indo-French Seminar 2024 at PushpVatika Resort & Lawns, Village Pale Budruk Taluka Panvel, Navi Mumbai, Maharashtra 410206 from 28th - 30th October 2024 organized by ACTREC.

- Abhirami Ajith, Poster Presentation on Probing of disease specific exosomes using Raman spectroscopy and SERS at International Conference on Optics Within Life Sciences (OWLS-17) held in IIT Bombay from November 16 to November 21, 2024.

- Athira B, Poster Presentation on Deciphering effect of having different branch-lengths in Gold nanostars in their ability to avoid sequestration by protein-corona at International Conference on Optics Within Life Sciences (OWLS-17)held in IIT Bombay from November 16 to November 21, 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Scientific Reinvention of Ethnic Food and Medicine from Kerala for Functional Food and Drug Development.	Department of Science & Technology- Science & Heritage Research Initiative.	2021	3 Years	PI
02	Development of Portable Raman Spectrometer for Identifying the Amyloid Deposition in the Peripheral Region of the Body.	Department of Science & Technology	2021	3 Years	PI
03	Creation of national network of existing and upcoming high risk pathogens laboratories (BSL- 3/4) labs across departments and keeping their interlinkages functional for use during outbreak response across sectors under NOHM component of PM-ABHIM.	Indian Council of Medical Research	2024	3 Years	PI

Debanjan Bhowmik, PhD

Scientist C
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

Our lab focuses on developing fluorescence and Raman spectroscopy-based diagnostics. We employ techniques including fluorescence cross-correlation spectroscopy (FCCS), FRET, SERS, etc. for probing.

We also have expertise in designing surface-functionalized gold nanoconstructs for theranostic applications. We are currently studying the efficiencies of such nanoconstructs by confocal imaging, in-situ probing of single nanoparticle dynamics in live cells, and measuring cytotoxicity at the cellular level prior to testing their efficiencies in animals.

MAJOR RESEARCH AREA

- The laboratory has made significant progress in developing fluorescence and Raman spectroscopy-based diagnostic tools and surface-functionalized metal nanoconstructs for theranostic applications. A recent publication in Biosensors and Bioelectronics (2025) demonstrated Raman spectroscopy–based detection of breast cancer–related biochemical changes in circulating extracellular vesicles. The lab has successfully designed HER2-targeting gold nanoconstructs capable of evading serum protein corona formation and selectively inducing cytotoxicity in HER2-overexpressing cancer cells. Additionally, students have received multiple awards for outstanding posters and presentations at national and international conferences (BRICS Biophotonics 2024, Indo-French Seminar 2024, OWLS-17, etc.), highlighting the lab's strong research impact in nanotheranostics and optical biosensing.

WORK REPORT

- SURFACE-FUNCTIONALIZED METAL NANOCONSTRUCTS FOR THERAPEUTIC AND DIAGNOSTIC APPLICATIONS

One of the primary goals of our lab has been to design nanoconstructs that effectively counteract the sequestration effect of serum protein adsorption while efficiently targeting receptors on cancer cell membranes.

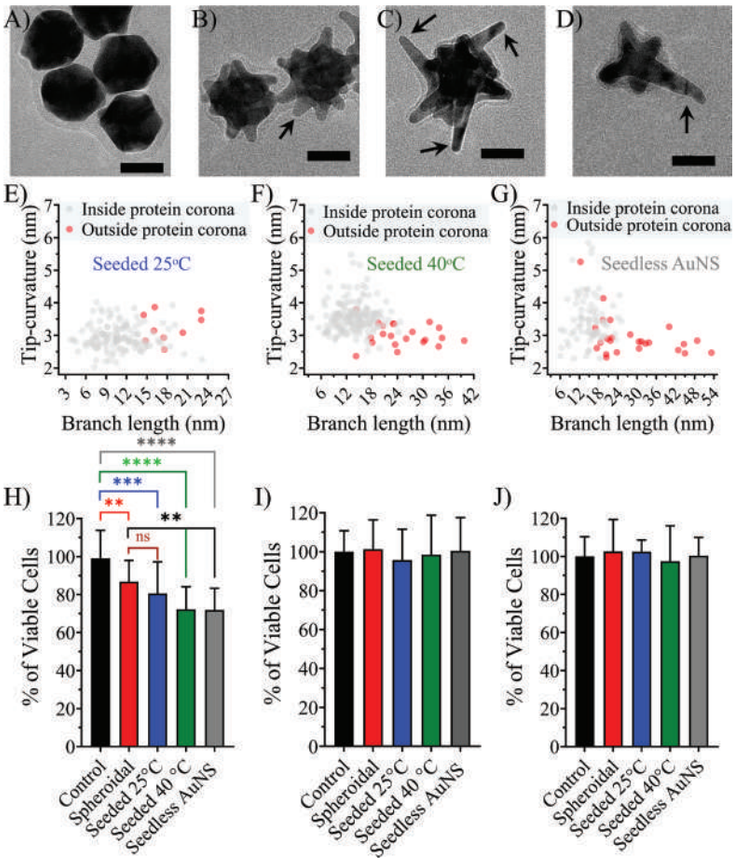
Last year, to assess the impact of nanoparticle (NP) shape on serum protein adsorption, we synthesized star-shaped gold nanoparticles (AuNPs) with controllable branch lengths and functionalized them with HER2-targeting aptamers (HApt-AuNPs). These HApt-AuNPs were then incubated in serum-containing medium for one hour. The protein corona layers adsorbed onto the NP surfaces were visualized via TEM using Uranyless staining. TEM imaging revealed that nearly all spheroidal AuNPs were fully coated with protein corona layers (Figure A). Similarly, most branches of seeded-AuNS-25°C were also trapped under the protein corona (Figure B). However, longer branches on seeded-AuNS-40°C (Figure C) and seedless-AuNS (Figure D) protruded beyond the adsorbed protein layers.

Further TEM image analysis and a tip-curvature vs. branch-length plot revealed that only a few longer branches of seeded-AuNS-25°C extended beyond the protein corona (Figure E, red dots), whereas most remained trapped inside (Figure E, gray dots). In contrast, seeded-AuNS-40°C and seedless-AuNS exhibited significantly more long branches extending beyond the protein corona (Figures F and G). Across all three nanoconstruct types, approximately 30% of branches longer than 15 nm remained exposed, increasing to 68% for branches exceeding 20 nm.

Next, we evaluated the cytotoxic activity of four HApt-functionalized nanoconstructs—spheroidal-AuNPs, seeded-AuNS-25°C,

seeded-AuNS-40°C, and seedless-AuNS—against the HER2-overexpressing ovarian cancer cell line SKOV3. All four HApt-functionalized nanoconstructs exhibited cytotoxic effects, with seedless-AuNS and seeded-AuNS-40°C displaying the highest potency (Figure 3A). The longer branches of these two nanoconstructs helped them evade protein corona effects more effectively, enhancing their ability to target HER2 and induce apoptosis in SKOV3 cells.

In contrast, none of the CApt-functionalized nanoconstructs induced cytotoxicity in SKOV3 cells (Figure 3B). Additionally, when tested against the ER/PR-positive, HER2-negative MCF-7 breast cancer cell line, none of the HApt-functionalized AuNPs exhibited cytotoxic effects (Figure 3C), confirming their specificity for HER2-overexpressing cancer cells.



(A to D) TEM images showing the protein corona on spheroidal-AuNPs, AuNS-25°C, AuNS-40°C, and seedless-AuNS, respectively.
(E to G) Analysis of the curvature and lengths for branches that are sequestered under the protein corona layer (grey) and those that remained outside the protein corona layers.
(H and I) SKOV3 cells remaining after the addition of HApt and CApt functionalized nanoconstructs, respectively.
(J) MCF7 cells remaining after the addition of HApt functionalized nanoconstructs.

TEAM

Harikrishnan K S, Lakshmi Babu, Athira Baiju, Dr. Debanjan Bhowmik, Abhirami Ajith, Poornendhu, Preetha Nair (From L to R)

LABORATORY STRENGTH

PhD Students: 3 / JRF: 1 / Technical Assistant: 1 / Lab Assistant: 1

PUBLICATIONS:

- Bonizzi A, Signati L, Grimaldi M, Truffi M, Piccotti F, Gagliardi S, Dotti G, Mazzucchelli S, Albasini S, Cazzola R, Bhowmik D, Narayana C, Corsi F, Morasso C. Exploring breast cancer-related biochemical changes in circulating extracellular vesicles using Raman spectroscopy. BiosensBioelectron. 2025;278:117287.

AWARDS [STUDENTS]:

- Abhirami Ajith, Best Poster on Probing of Amyloid ß oligomers by SERS, aiming at early diagnosis of Alzheimer's Disease at BRICS Workshop on Biophotonics 2024. From October 3-5, 2024 at Manipal Academy of Higher Education.
- Abhirami Ajith, Best Flash Presentation poster on Probing of disease specific exosomes using Raman spectroscopy at Indo-French Seminar 2024 at PushpVatika Resort & Lawns, Village Pale Budruk Taluka Panvel, Navi Mumbai, Maharashtra from 28th - 30th October 2024 organized by ACTREC.
- Abhirami Ajith, Best Poster on Probing of disease specific exosomes using Raman spectroscopy and SERS at International Conference on Optics Within Life Sciences (OWLS-17), held in IIT Bombay from November 16 to November 21, 2024.

INVITED TALKS [PI ONLY]:

- Designing of HER2-targeting metal nanoconstructs for therapeutic and diagnostic applications, at International Conference on Optics Within Life Sciences (OWLS-17) held in IIT Bombay from November 16 to November 21, 2024.

CONFERENCE PRESENTATION:

- Abhirami Ajith, Poster Presentation on Probing of Amyloid ß oligomers by SERS, aiming at early diagnosis of Alzheimer's Disease at BRICS Workshop on Biophotonics 2024 from October 3-5, 2024 at Manipal Academy of Higher Education.
- Abhirami Ajith, Poster Presentation on Probing of disease specific exosomes using Raman spectroscopy at Indo-French Seminar 2024, at PushpVatika Resort & Lawns, Village Pale Budruk Taluka Panvel, Navi Mumbai, Maharashtra, from 28th - 30th October 2024 organized by ACTREC.
- Abhirami Ajith, Poster Presentation, on Probing of disease specific exosomes using Raman spectroscopy and SERS, at International Conference on Optics Within Life Sciences (OWLS-17), held in IIT Bombay from November 16 to November 21, 2024.
- Athira B, Poster Presentation on Deciphering effect of having different branch-lengths in Gold nanostars in their ability to avoid sequestration by protein-corona at the International Conference on Optics Within Life Sciences (OWLS-17), held at IIT Bombay from November 16 to November 21, 2024.

Debasree Dutta, PhD

Scientist F
Regenerative Biology

BRIEF THEME OF LABORATORY

The laboratory's primary objective is to exploit clues derived from research conducted during pre- and post-implantation development to gain insights into disorders including pre-eclampsia, leukemia, and breast cancer. These cues are being utilized to develop more effective methods for disease detection, assessment of new biomarkers, and the creation of therapeutic interventions.

MAJOR RESEARCH AREA

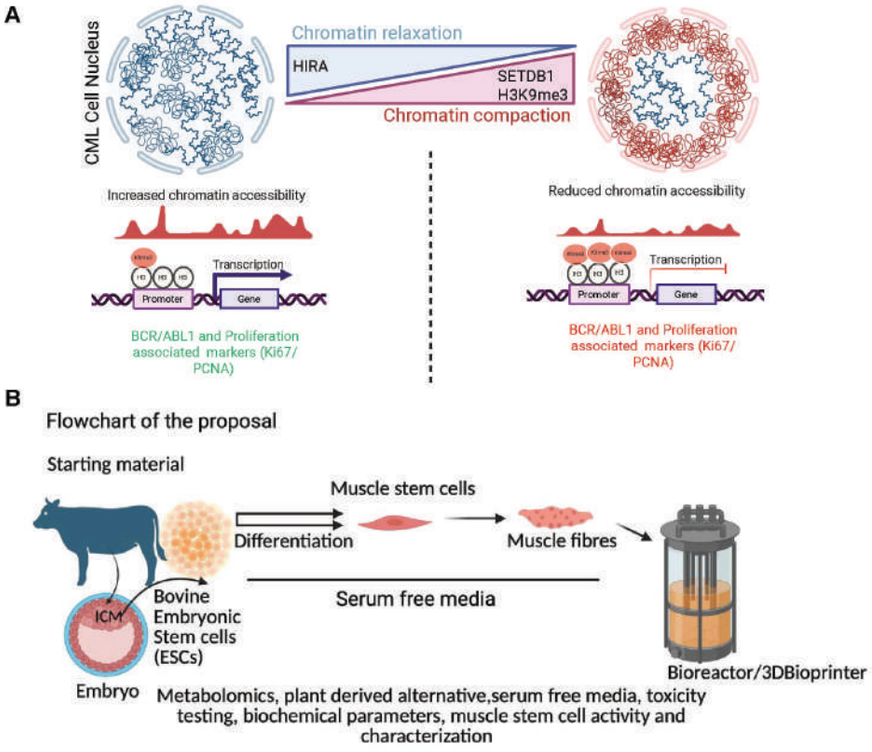
- Histone epigenetic in pre- and post-implantation of mammalian embryonic development and pre-eclampsia
- Regulation of chromatin architecture in hematopoiesis vs leukemogenesis
- Stem cells and centrosome
- Evaluation of histone epigenetic factors as biomarkers for breast cancer and pre-eclampsia
- Biomanufacturing- cultivated meat as smart protein

WORK REPORT

- PROJECT 1: HIRA-SETDB1-H3K9ME3 AXIS REGULATE CHROMATIN ARCHITECTURE IN LEUKEMIA CELLS.
- PROJECT 2: ALTERNATE NUTRITION- HARNESSING THE POTENTIAL OF EMBRYONIC STEM CELLS IN GENERATION OF SMART PROTEIN.

Project 1: Histone cell cycle regulator A (HIRA) confers chromatin accessibility and regulates developmental hematopoiesis. However, whether HIRA plays a similar role in leukemia, a condition resulting from abnormalities in hematopoiesis, remains elusive. Our earlier report demonstrated increased expression of HIRA in chronic myeloid leukemia (CML) patient samples relative to normal healthy individuals. While we showed that HIRA can influence the proliferation versus differentiation of K562 cells of CML origin, but the mechanistic understanding of the findings remained unexplored. We demonstrated the association of HIRA with chromatin organization components by analyzing data from proteomics, genome-wide, and molecular studies in K562 normal and HIRA-depleted cell line models. Downregulation of HIRA enhanced chromatin compaction, altered the spatial distribution of chromatin towards the nuclear periphery, and decreased chromatin accessibility at the promoter and gene bodies. Enhanced chromatin compaction was attributed to increased histone H3K9me3 level mediated by histone methyltransferase SETDB1. Incorporation of histone H3.3 within the SETDB1 promoter in HIRA-knockdown cells induced SETDB1 expression. Increased chromatin compaction contributed to loss in cell proliferation and its markers. Interestingly, chromatin compaction mediated by loss in HIRA resulted in downregulation of BCR-ABL1 fusion protein, the marker of CML. We anticipate that the exploration of this axis would introduce new paradigm in understanding, designing and targeting molecules that could inhibit or delay CML progression.

Project 2: As animal protein is the best source of proteins, the global consumption of animal proteins reached 327,683 kt in 2019–2021, with a market value expected to reach 7.3 trillion dollars by 2025. However, large-scale production of animal derived proteins is one of the main drivers of biodiversity loss, climate change and freshwater depletion. Livestock production accounts for 80% of global greenhouse gas emissions and uses 83% of farmland. Additionally, 60 % of known and 75% of new infectious diseases threatening humans come from animals. Hence, efforts are being made for large-scale dietary modifications that are likely to lessen these consequences and can potentially find a solution to this growing problem. With increase in population of the world, feeding this demand would be difficult. This will create a significant pressure on natural resources. Hence, a sustainable alternative is very important to be harnessed and processed that could serve the population its need for a healthy diet. The alternative is "smart proteins". These are food products, which can reliably and predictably substitute the consumption of animal-derived meat, eggs, and dairy. Sustainability of the process is a major roadblock and to overcome this, there is an absolute need to use the resources available in India and exploit them to generate the cultivated smart proteins. Usage of alternative indigenous resources to generate cruelty free culture meat as the smart protein formed the basis of this proposal. Usage of embryonic stem cells as starting material, plant derived alternative for serum and plant derived scaffold material are exploited to overcome the limitation of the production of cultured meat.



(A). Model demonstrate the regulation of chromatin architecture by histone chaperone HIRA in CML cells.
(B). Model depicting the generation of cultured meat from embryonic stem cells.

TEAM

First Row: Bindhu M S, Chirantani Halder, Dr. Debasree Dutta, Fathima Hameed, Anjusha M R, Namrata Chatterjee (From L to R)
Second Row: Mayur Balkrishna Shirude, Parth Mishra, Neeraj J M (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / JRF: 3 / SRF: 1 / Lab Assistant: 1 / Project Associate: 1

PUBLICATIONS:

- Rajam S M, Varghese P C, Shirude M B, Syed K M, Devarajan A, Natarajan K, Dutta D. Kinase activity of histone chaperone APLF maintains steady state of centrosomes in mouse embryonic stem cells. Eur J Cell Biol. 2024;103:151439.
- Nandy D, Shirude M B, S A, Devarajan A, Mukherjee A, Dutta D. Nuclear localization of APLF facilitates breast cancer metastasis. BiochimBiophysActaMol Basis Dis. 2025;1871:167537.

AWARDS [PI]:

- CSIR ASPIRE award on April 2025.

AWARDS [STUDENTS]:

- Mayur Balkrishna Shirude, recived SERB travel award for attending Cold Spring Harbour workshop, USA, 2024.
- Debparna Nandy, recived CSIR and SERB travel award for attending ASBMB conference, 2024.

INVITED TALKS [PI ONLY]:

- Invited talk at SRIHER, Chennai on July 2024.
- Invited talk at Rhetor 5.0, IISER Thiruvananthapuram on August 2024.
- Invited talk at NASI, Kerala Chapter on September 2024.
- Invited talk at National Symposium on Mass Spectrometry-Based Lipidomics, DBT-SAHAJ workshop, February 2025.
- Invited talk atCentral University of Tamil Nadu on March 2025.

CONFERENCE PRESENTATION:

- Mayur Balkrishna Shirude, Poster Presentation on Histone chaperone HIRA regulates chromatin architecture in leukemia., at CSHL workshop, 2024.
- Debparna Nandy, Poster Presentation on Nuclear APLF in the regulation of breast cancer metastasis, at ASBMB 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Normal vs. abnormal hematopoiesis- result of a deregulated chromatin regulated by Histone chaperone HIRA	Anusandhan National Research Foundation	2022	3 Years	PI
02	Epigenetic regulation of trophoblast stem cells involved in women reproductive health and diseases: an observational and functional study	Indian Council of Medical Research	2023	3 Years	PI
03	Dissecting domains of APLF chaperoning EMT in development	Anusandhan National Research Foundation	2023	3 Years	PI
04	Centrosome duplication in stem cells- a novel function of histone chaperone APLF in shaping development	Department of Biotechnology	2024	3 Years	PI
05	Designing a kinase inhibitor cocktail by targeting phosphorylation of histone chaperone APLF in regulation of breast cancer metastasis	Council of Scientific & Industrial Research	2024	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Sruthy MR	Role of Histone chaperones in pre-implantation embryo development	Manipal Academy of Higher Education	Awarded	2025

Devasena Anantharaman, PhD

Scientist F & Wellcome Trust-India Alliance
Intermediate Fellow
Cancer Research

BRIEF THEME OF LABORATORY

The research focus of the lab is to elucidate the molecular basis for cancer etiology towards an improved disease stratification, particularly for oral and oropharyngeal cancers. In addition, an important thrust area is to understand adaptive immune responses towards human Papillomavirus (HPV) vaccination. We build large epidemiologic studies that integrate high throughput analytical methods to achieve these goals.

MAJOR RESEARCH AREA

- My lab has been involved in the landmark WHO funded Indian multicentre study that has generated important evidence for policy recommendations on HPV vaccination globally. Over the last year we have generated extended evidence at a median of 15 years and demonstrate that there is no waning of the vaccine efficacy. Not a single additional HPV16 persistent infection was detected in any of the dose cohorts in the intervening period. The only breakthrough HPV16 persistent infection detected earlier in a single dose recipient cleared over time.

WORK REPORT

- SINGLE DOSE HPV VACCINE EFFICACY: EVIDENCE FORM THE IARC-INDIA MULTI-CENTRE STUDY.

HPV infections are sexually transmitted and responsible for nearly 95% of cervical cancers, vast majority of which are diagnosed in low and middle –income countries. HPV vaccines are highly effective in prevention of infections as well cervical neoplasias caused by serotypes 16 and 18. WHO has announced the visionary global strategy to accelerate the elimination of cervical cancer as a public health problem, through the joint implementation of HPV vaccination and cervical screening. This vision is impeded by the global crisis of vaccine shortage. The alternative of a single dose administration of the HPV vaccine offers a pragmatic solution to the problem.

Through the updated analysis at 15 years after initiation of study recruitment in the IARC- India HPV multi-centre vaccine study that was initiated in 2009, we demonstrate that the vaccine efficacy of single dose quadrivalent HPV vaccination is similar to that of two or three doses in preventing persistent and incident HPV16/ 18 infections and cervical neoplasia. Participants in the 1-, 2-, and 3-dose groups (4949, 4980, and 4348 respectively) in this randomized multicenter study in India were assessed for incident and persistent infections by genotyping of cervical samples collected yearly for 4 consecutive years (after marriage). Age- and site-matched unvaccinated married women were recruited as comparator group. Vaccine efficacy was assessed using proportional incidence ratios. Not a single additional HPV16 persistent infection was detected in any of the dose cohorts in the intervening period. The only breakthrough HPV16 persistent infection detected earlier in a single dose recipient cleared over time. Few breakthrough HPV18 persistent infections were detected during this period in the different dose cohorts in equal numbers; HPV 18 persistent infections were detected in 5 participants in the 2 or 3 dose groups and 3 in single dose group. The proportion of persistent HPV 18 infections was substantially higher among unvaccinated women (0.9, 95% CI: 0.4–1.5) compared to the single dose group (0.1, 95% CI: 0.0–0.3). Vaccine efficacy against persistent HPV 16 and 18 infection was 92.0% (95% CI: 87.0% to 95.0%) in 3022 recipients of the single dose; and compared to the 2-dose arm (94.8%, 95% CI: 90.0% to 97.3%) and the 3-dose arm (95.3%, 95% CI: 90.9% to 97.5%). We observed no waning of efficacy with repeat assessment at a median of 12 years and involving larger number of single-dose recipients (N=3022) from the cohort.

This study has shown convincing evidence for the long-term efficacy of a single dose of HPV vaccination. Using 2 independent genotyping

technologies (Luminex and HPV screening tests) performed in laboratories completely blinded to dose allocations, this study confirms the high protective efficacy of a single dose against persistent HPV 16 and 18 infections. The cohort size in our study to assess single-dose efficacy is the largest in any trial reported to date. This ongoing study will continue to generate evidence on longer-term efficacy and immunogenicity so that national and international stakeholders can recommend a single dose of the vaccine with greater confidence.

Type of HPV infection and dose received	Incident persistent HPV infections in participants with at least 2 samples tested		
	Women assessed, No.	Women with persistent infections, No.	Proportion of persistence, % (95% CI)
Women with samples tested	10 981	47	
Vaccine-targeted HPV (16, 18, 6, and 11) infections			
Unvaccinated group	1273	38	3.0 (2.1–4.1)
Vaccinated group	9708	25	0.3 (0.2–0.4)
1 dose	3022	7	0.2 (0.1–0.5)
3 doses (days 1, 60, and ≥180)	2172	6	0.3 (0.1–0.6)
2 doses (days 1 and ≥180)	2311	5	0.2 (0.1–0.5)
2 doses (days 1 and 60)	2203	7	0.3 (0.1–0.7)
HPV 16 and 18 infections			
Unvaccinated group	1273	35	2.7 (1.9–3.8)
Vaccinated group	9708	12	0.1 (0.1–0.2)
1 dose	3022	4	0.1 (0.0–0.3)
3 doses (days 1, 60, and ≥180)	2172	2	0.1 (0.0–0.3)
2 doses (days 1 and ≥180)	2311	2	0.1 (0.0–0.3)
2 doses (days 1 and 60)	2203	4	0.2 (0.0–0.5)
Nonvaccine-targeted HPV infections excluding 31, 33 and 45			
Unvaccinated group	1273	81	6.4 (5.1–7.8)
Vaccinated group	9708	370	3.8 (3.4–4.2)
1 dose	3022	115	3.8 (3.2–4.6)
3 doses (days 1, 60, and ≥180)	2172	98	4.5 (3.7–5.5)
2 doses (days 1 and ≥180)	2311	89	3.9 (3.1–4.7)
2 doses (days 1 and 60)	2203	68	3.1 (2.4–3.9)

Figure represents the analysis of persistent HPV infections by doxes of HPV vaccine received. Each horizontal panel is separated by HPV types assessed. CI= confidence interval.

TEAM

First Row: Nayana Jose, Dr. Devasena Anatharaman, Anandi Shivarani, Aiswarya Mohandas (From L to R)
Second Row: Simla Rani P, Subha S, Sinumol George, Lekshmy S R (From L to R)
Third Row: Prashant Kumar, Jinu Austin, Kannan T R (From L to R)

LABORATORY STRENGTH

PhD Students: 3 / JRF: 2 / SRF: 1 / Project Assistant: 2 / Technical Assistant: 2
Lab Assistant: 1 / Project Associate: 1

PUBLICATIONS:

- Malvi S G, Esmy P O, Muwonge R, Joshi S, Poli U R R, Lucas E, Verma Y, Lucksom P G, Shah A, Patel B, Zomawia E, Pimple S, Jayant K, Hingmire S, Chiwate A, Divate U, Vashist S, Mishra G, Jadhav R, Siddiqi M, Sauvaget C, Sankaran S, Kannan T P R A, Shastri S S, Pillai M R, Anantharaman D, Bhatla N, Sankaranarayanan R, Basu P. A prospective cohort study comparing efficacy of 1 dose of quadrivalent human papillomavirus vaccine to 2 and 3 doses at an average follow up of 12 years postvaccination. J Natl Cancer InstMonogr. 2024 Nov 1;2024(67):317-328.
- Sherief P A, Madhavan Nair L, Ravikumar R, Sara George P, Cessal Thommachan K, Rafi M, S L, Anantharaman D, M R P, Ramadas K. Prevalence of HPV Positivity and the Correlation Between P16INK4A Expression and HPV DNA Positivity in Carcinoma Oropharynx and Their Correlation With Survival Outcomes: A Retrospective Study From a Tertiary Cancer Centre in South India. Cureus. 2025 Jan 8;17(1):e77162.

AWARDS [STUDENTS]:

- Sinumol George, Best Oration Award for Genomic characterization of mutational landscape of no-habit Indian oral cancer: A computational genomics approach at the International Conference on Biotechnology The Way Forward (ICBWF-2024), Department of Biotechnology, University of Kerala, India from 20-22, November, 2024

INVITED TALKS [PI ONLY]:

- Vaccine Development and Predictors of Vaccine Protection at the 18th Annual Conference of Indian Society for Clinical Research (ISCR) from 30th January to 1st February 2025 at CIDCO Convention Center, Vashi, Navi Mumbai, INDIA.
- Vaccine Efficacy against Persistent HPV16/18 Infection:Evidence from an Indian Multicentre, Prospective, Cohort Study at BRIC-RGCB International Research Conference, from 1st October to 3rd October 2024 at ZuriKumarakom Resort, Kumarakom, Kerala.
- Insights from IARC-WHO's HPV vaccine studyHPV Vaccination to Protect Generations Against Cervical Cancer – India PreparesCancer Foundation of India, Beat Cervical Cancer (BCC) on November 14, 2024,Webinar.

CONFERENCE PRESENTATION:

- Sinumol George, Oral Presentation on Genomic characterization of mutational landscape of no-habit Indian oral cancer: A computational genomics approach at the International Conference on Biotechnology The Way Forward (ICBWF-2024) at Department of Biotechnology, University of Kerala, India from 20-22, November, 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	HPV genotyping for efficacy testing of generic qHPV vaccine development: Serum Institute of India study	Serum Institute of India	2019	5 Years	PI
02	Accurate and satisfactory analysis of all high risk HPV types and some of the low risks including HPV 6 and 11 antibody titers for the 2-versus 3 dose HPV vaccination clinical trial in India – Follow-up study	International Agency for Research on Cancer-WHO	2020	5 Years	PI

Dileep Vasudevan, PhD
Scientist F
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

Our laboratory focuses on chromatin and infectious disease structural biology. We primarily work on nucleosome-interacting proteins. We also study protein machinery from pathogenic organisms. We study the proteins by an integrative structural biology approach. In addition, structural biology projects are being taken up from time to time on a collaborative basis. As an experimental structural biology research group, our major tools are X-ray crystallography, small-angle X-ray scattering, and cryo-electron microscopy.

MAJOR RESEARCH AREA

- Nucleosome core particles composed of human core histones as well as Arabidopsis core histones and Widom's 145 bp DNA have been reconstituted.
- Our work on the structure-function analysis of a nucleoplasmin from the malarial parasite Plasmodium falciparum has been accepted for publication in the Journal of Biological Chemistry.
- The cryo-EM structure of a 55 kDanucleoplasmin domain that was completed to 2.0 Å resolution has been communicated for publication.
- The cryo-EM structure of Oryzasativa cytoplasmic ClpB protein, revealing an unusual heptameric organization, was completed and has been communicated for publication.

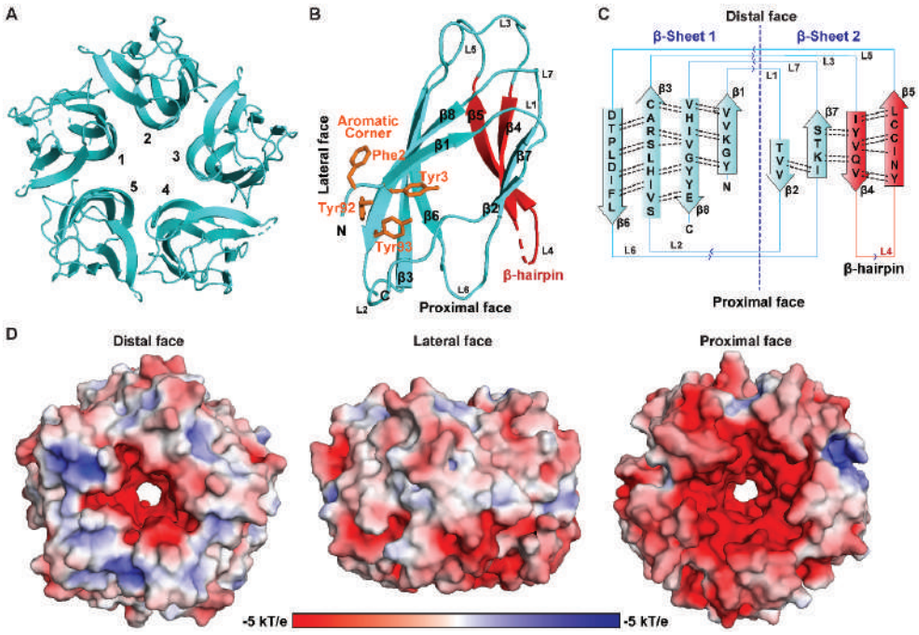
WORK REPORT

- STRUCTURE-FUNCTION STUDIES OF A NUCLEOPLASMIN ISOFORM FROM PLASMODIUM FALCIPARUM

Plasmodium falciparum causes the most fatal form of human malaria. Chromatin dynamics and its regulatory factors play a key role in controlling the cellular homeostasis of the parasite during its intra-erythrocytic developmental cycle. Histone chaperones are major players controlling chromatin dynamics, and in this study, we aimed to characterize a putative histone chaperone from P. falciparum belonging to the nucleoplasmin class (PfNPM).

Our sequence, domain, and phylogenetic analysis suggested the presence of a nucleoplasmin isoform in P. falciparum. The protein revealed an N-terminal nucleoplasmin core domain, followed by three variable-sized acidic tracts, and a C-terminal nuclear localization signal. We have completed the crystal structure of the PfNPM N-terminal domain (NTD; core nucleoplasmin domain). The crystal structure of PfNPM NTD was solved at 3.25 Å (Figure 1), wherein an asymmetric unit contained five polypeptide chains. The PfNPM NTD revealed a distinct arrangement resembling a doughnut, composed of five monomers arrayed radially along a five-fold symmetry axis, typical of nucleoplasmin. Each monomer features eight beta strands antiparallel to one another, yielding a beta-sandwich fold arranged in two sheets. The beta-sandwich fold is the signature of nucleoplasmin family proteins. The beta strands exhibit a parallel orientation with respect to the 5-fold symmetry axis, wherein the β6 strand is situated in closest proximity, while the β4-β5 hairpin is located at the farthest distance from the 5-fold axis. A hydrogen bonding arrangement between neighbouring antiparallel beta strands stabilizes the β-sandwich fold. The residues Phe2, Tyr3, Tyr92, and Tyr93 of all five monomers form aromatic corners towards the distal face of the structure. The distribution of apolar residues allows strong hydrophobic interactions between the β-sheets of a monomer and between two adjacent monomers, likely contributing to a compact and highly stable PfNPMpentamer.

Further, we have explored the protein further for its in-solution oligomeric nature, stability, and in vitro histone binding and chaperoning properties. SAXS was used to study the structure of PfNPM and its histone oligomer complexes. PfNPM exists as a pentamer in solution, and the NTD exhibits thermal and chemical stability features typical of nucleoplasmin. PfNPMpentamer interacts individually with assembled H2A/H2B dimer and H3/H4 tetramer with an equimolar stoichiometry, wherein the acidic tracts of PfNPM were found to be necessary for these interactions. Further, H3/H4 displays a higher binding affinity for PfNPM than H2A/H2B, potentially due to stronger electrostatic interactions. The interaction studies also suggested that H2A/H2B and H3/H4 might share the same binding site on the PfNPM distal face, wherein H3/H4 could substitute H2A/H2B due to a higher binding affinity. Intriguingly, PfNPM neither demonstrated direct interaction with the nucleosome core particles nor displayed nucleosome assembly function, suggesting it may not be directly associated with histone deposition on the parasite genomic DNA. Immunofluorescence assays indicated predominant localization of the protein within the nucleus of the early blood stages of the parasite, such as the ring and the trophozoite. Altogether, we provide the first report on the structural and functional characterization of P. falciparum nucleoplasmin.



Crystal structure of PfNPM NTD. (A) Cartoon representation of PfNPM NTD pentamer structure. (B) Cartoon representation of PfNPM NTD monomer. The important structural features are labelled. (C) The 2D topology diagram of the PfNPM NTD monomer. The hydrogen bond distribution in both β-sheets is shown as dotted black lines. (D) The surface electrostatic properties of PfNPM NTD calculated using PyMOL plugin APBS electrostatics.

TEAM

First Row: Sonali Ghosal, Anagha Das, Dr. Dileep Vasudevan, Neethu M, Arya P Nair (From L to R)
Second Row: Purushottam Patnaik, Bimal Jana, Dr. Dharma Rao Tompa, Jinan Parvin (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 4 / JRF: 1 / SRF: 1 / Lab Assistant: 1

PUBLICATIONS:

- Sundaram R, Gandhi S, Jonak C, Vasudevan D. Characterization of the Arabidopsis thaliana chromatin remodeler DEK3 for its interaction with histones and DNA. Biochimie. 2024;227(A):248-261.
- Saharan K, Baral S, Gandhi S, Singh A K, Ghosh S, Das R, Nagaraj V A, Vasudevan D. Structure-function studies of a nucleoplasmin isoform from Plasmodium falciparum. J Biol Chem. 2025; 301(4): 108379.

INVITED TALKS [PI ONLY]:

- Safari pentapus: A structure-function journey with plant nucleoplasmins, National Conference on Exploring Synergies: Insights in Life Science and Structural Biology (ESILS - 2024), 3-4 April 2024, Kannur University, Kannur.
- Characterization of a Plasmodium falciparum protein as a nucleoplasmin: A structure-function approach, National Conference on Omics in Redefining Healthcare (ORAH-24), 23-24 August 2024, Jubilee Centre for Medical Research, Thrissur.
- A structure-function journey with plant nucleoplasmins, 2nd Prof. M. Vijayan Memorial Annual Symposium on Structural Biology and Bioinformatics of Infectious Diseases, 18-19 October 2024, SASTRA Deemed University, Thanjavur.

PATENT GRANTED:

- Composition for enhancing intracellular nitric oxide generation. Balachandran Ravindran, Diwakar K. Singh, Shailendra Asthana, Sagar Gaikwad, DileepVasudevan, Narottam Acharya. (ILS and THSTI) 2024. US Patent, Appl No.: 18/253,739.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Cryo-EM structure of a plant nucleoplasmin and its complex with nucleosome	Department of Biotechnology	2024	3 Years	PI
02	Functional dissection of host protein import by Plasmodium for non-metabolic purposes	Department of Biotechnology	2024	3 Years	Co-PI
03	Deciphering the structural and functional attributes of the putative nucleoplasmin from Plasmodium falciparum	Anusandhan National Research Foundation	2024	3 Years	PI

Harikumar K.B, PhD

Scientist E-II
Cancer Research

BRIEF THEME OF LABORATORY

The main focus of the laboratory is understanding the role of inflammation in physiology (innate immune response) and pathophysiology (cancer). We are particularly interested in the roles of Sphingosine 1-phosphate (S1P) in inflammation and carcinogenesis. Another area of our interest is Immunometabolism in cancer. The major question is to understand the crosstalk between immune cells and the tumor microenvironment (TME) and how TME modulates the metabolic process within immune cells

MAJOR RESEARCH AREA

- Functional role of STAT3 in obesity driven pancreatic cancer.
- Elucidating the implications of dynamic association of ER alpha with epigenetic modifiers in breast cancer.

WORK REPORT

- DECODING OBESITY-DRIVEN PDAC REMODELING THROUGH STABL MACHINE LEARNING.

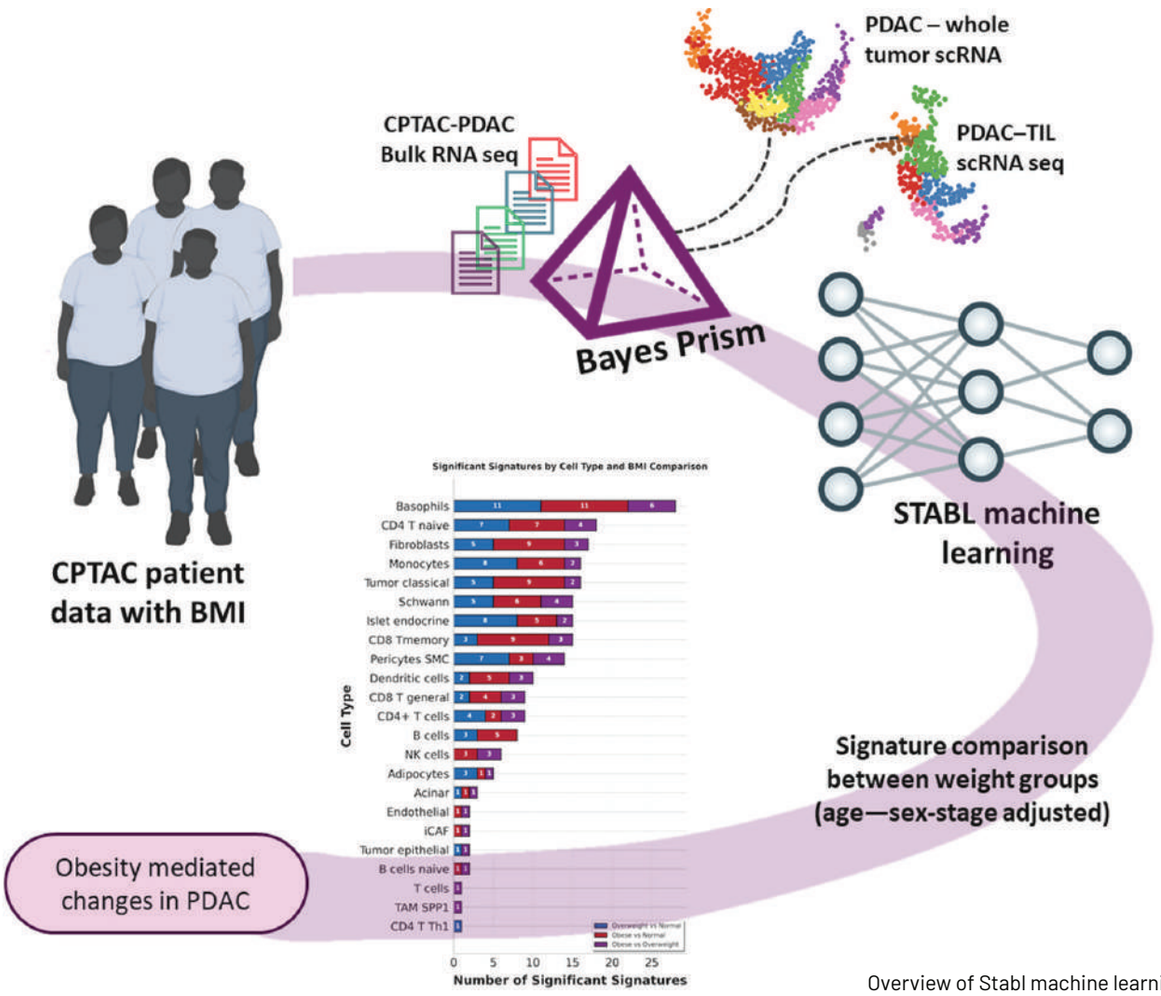
Decoding Obesity-Driven PDAC Remodeling Through Stabl Machine Learning Pancreatic ductal adenocarcinoma (PDAC) is one of the deadliest cancers. Obesity Significantly increases the risk and worsens outcomes. We examined how obesity graduallyAlters the tumor environment by

analyzing 127 pancreatic tumor samples from the Clinical Proteomic Tumor Analysis Consortium. We compared samples from patients of normal weight, overweight, and obese categories.

We created single-cell RNA-sequencing reference profiles from two publicly available PDAC datasets. Using CopyKAT, we identified malignant cells through copy number analysis. SingleR helped us determine cell types, resulting in 23 immune and 19 non-immune cell populations. We applied these references to analyze bulk tumor data using BayesPrism, revealing the cellular composition of each tumor. We measured dysfunction signals across cell types and analyzed them with Stabl, a machine learning algorithm that filters out unreliable findings while emphasizing the most trustworthy biological signals. Stabluncovered non-linear patterns and threshold effects across weight categories that traditional methods might overlook. We identified overweight as a critical turning point, where cellular compensation fails and immune function begins to decline. The analysis revealed distinct temporal patterns, with specific cell types becoming vulnerable at different BMI stages. Non-immune populations showed significant threshold effects. Inflammatory cancer-associated fibroblasts (iCAF) exhibited robust stress responses, with notable disruptions in JAK-STAT signaling and lipid metabolism. Acinar cells showed increasing dysfunction in oxidative stress, metabolic pathways, and AMPK signalling across the entire obesity range. Pericytesdemonstrated dysregulation in calcium signalling and activation of the p53 pathway, especially during the transition from overweight to obese. Pancreatic islet cells experienced mitochondrial dysfunction, while neural cells showed defects in synaptic transmission. Tumor epithelial cells displayed signs of dedifferentiation, and adipocytes had disrupted steroid hormone metabolism due to obesity.

Immune populations exhibited vulnerability patterns specific to each transition. Early changes from normal to overweight included reduced CD4+ T cell proliferation, disruption of TCR signaling, and decreased mitochondrial function in CD8+ effector cells. The shift from overweight to obese marked a crucial tipping point, characterized by a sharp decline in regulatory T cell function, emergence of complement activation, and microbiome response signals, alongside increased adipose signaling. Throughout the obesity spectrum, cumulative effects included CD4+ naive cell anergy, CD8+ memory cell senescence linked to Wnt signaling disruption, improved lipid antigen processing, impaired DNA repair, anddysregulation of mTOR signaling in immune cells.

This highlights the importance of intervening during the overweight stage. It underscores the need for aggressive weight management before irreversible dysfunction occurs and identifies specific therapeutic targets for each stage.



Overview of Stabl machine learning approach

TEAM

First Row: Prameela Kumari T K, Arun V, Anna T Varghese, Dr K B Harikumar, Shirly James, V Sneha Suresh Babu, Prianka Kumari (From L to R)
Second Row: Krishnendu B, Aparna J S, Parvathy G, Rajeev J Thampi, Dr Vini Ravindran (From L to R)
Third Row: Anjana S S, Savitha R K (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 4 / JRF: 2 / SRF: 2 / Project Assistant: 4
Lab Assistant: 1

PUBLICATIONS:

- Vijayan Y, Sandhu J S, Harikumar K B. Modulatory Role of Phytochemicals/Natural Products in Cancer Immunotherapy. Curr Med Chem. 2024;31(32):5165-5177.
- Keerthana C K, Aiswarya S U, Rayginia T P, Vijayan Y, James S, Shifana S C, Sundaram S, Induja D K, Lankalapalli R S, Harikumar K B, Anto R J. A Novel Combinatorial Regimen Using Sorafenib and Uttroside B, A US FDA-designated 'Orphan Drug', for the Treatment of Hepatocellular Carcinoma. Anticancer Agents Med Chem. 2024;24(19):1431-1441.
- Ravindran S, Vini R, Rajavelu A, Harikumar K B, Sreeja S. Navigating the complexities of epigenetic dysregulation in breast cancer and its implication in therapeutic interventions: a comprehensive overview. Mol Cell Biochem. 2025 Oct 23. (Epub ahead of print).

AWARDS [PI]:

- Best teacher award, selected by MSc Biotechnology (2022-2024 Batch).

INVITED TALKS [PI ONLY]:

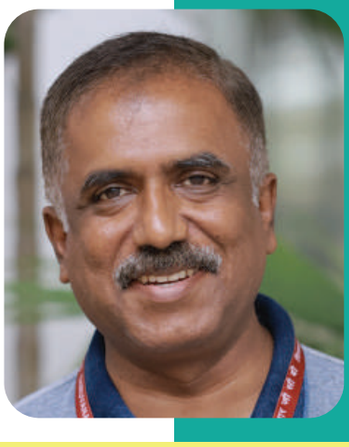
- Transgenic animal models: a paradigm shift in oncology at Advance Hands-on Workshop Cells, Embryos and Microinjection at BRIC-RGCB on 8th January 2025.

CONFERENCE PRESENTATION:

- Nashat Akhtar: Sphingosine-1-Phosphate (S1P) Signaling: a key determinant of Immunotherapy Response in Pancreatic Cancer at the 44th Annual meeting of Indian Association for Cancer Research and international Conference on Convergence of Fundamental and Translational Approaches in Cancer Theranosticsat Kolkata from 16-18th January 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	DOT1L regulate the metabolic and epigenetic alterations in pancreatic cancer	Anusandhan National Research Foundation	2021	3 Years	PI
02	A lipid perspective on immune evasion mechanisms in pancreatic cancer metastasis	Indian Council of Medical Research	2023	3 Years	PI
03	Sensitizing of immune unresponsive colorectal cancers to checkpoint inhibitors through silencing of Acid Ceramidase expression	Anusandhan National Research Foundation	2023	3 Years	PI



Jackson James, PhD

Scientist G
Regenerative Biology

BRIEF THEME OF LABORATORY

The main focus of our lab is to understand the early developmental cues that promote neural Stem cell maintenance and fate specific differentiation which will shed light in developing possible therapeutic strategies against neurodegenerative diseases.

MAJOR RESEARCH AREA

- Two functionally distinct Hes1-expressing neural stem cells exist in ventricular zone of developing cortex.
- NIHes1 expression knock-out leads to increase in RGCs and astrocytes, decrease in IPCs, and aberrant neuronal migration.
- NIHes1 NSCs produce RGCs and IPCs.
- Embryonic NIHes1 NSCs are set aside to form adult NSCs.

WORK REPORT

- HETEROGENEOUS NEURAL STEM CELLS OF EMBRYONIC CORTICAL NICHE VARY IN POTENCY AND LINEAGE COMMITMENT.

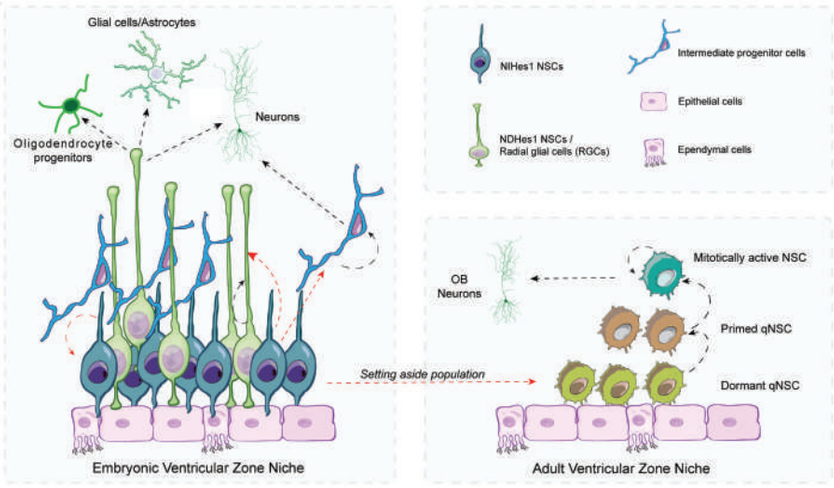
The neural stem cell (NSC) niche of ventricular zone (VZ) of vertebrate cortex has prominently active Notch signaling that plays a pivotal role in the maintenance, proliferation, and differentiation of neural stem cells and progenitors. Even though Notch signaling and its immediate downstream candidate, Hes1, are well documented in stem cell systems, there are reports regarding the non-canonical activation of Notch target genes in vertebrates. Using in-utero electroporation of the reporter construct that simultaneously marks Notch-independent Hes1 (NIHes1) and Notch-dependent Hes1 (NDHes1) expressing cells, we have previously identified a differential mode of Hes1 expression in the developing neocortex (Dhanesh, et.al,Cerebral Cortex, Volume 27, Issue 8, 2017, Pages 3943–3961). We showed that the NIHes1-expressing neural stem cells are maintained in the developing VZ, and as neurogenesis proceeds, they transit into NDHes1-expressing radial glial cells (RGCs). However, the functional significance of this unique subpopulation of NIHes1 NSCs in the neural stem cell niche of the developing neocortex remained unknown.

We have utilised single-cell RNA sequencing analyses to elucidate the functionally distinct gene signatures of NIHes1 and NDHes1 NSCs. Our analyses identified that NIHes1 NSCs are unique: devoid of Notch/CBF1 interaction and predominantly driven by Wnt and Hippo signaling mediated transcriptional program. These cells had neuronal signatures as opposed to NDHes1 NSCs with elevated glial signatures. Gene ontology and lineage tracing of all SVZ cell clusters revealed that NIHes1 NSCs higher stemness and proliferation potential and act as the precursors for other stem cell subpopulations of the embryonic stem cell niche.

To understand the significance of NIHes1 expression, a Nestin-CreERT2:NIHes1fl/fl mouse model was generated where the NIHes1 promoter region can be conditionally knocked out (at the desired developmental time point) in Nestin-expressing cells. We observed an overall reduction in the total number of cells and a consequent reduction in thickness of the VZ in the NIHes1 KO neocortex. Moreover, reduction in BrdU incorporation and in proliferation marker expression in NIHes1 KO SVZ confirmed that NIHes1 expression has a significant role in the maintenance of proliferating NSCs. Further, we could observe an increased number astrocyte cells and evident defects in neuronal positioning in the differentiated cortical layers of NIHes1 KO v/s control, due to excessive differentiation and altered neuronal migration. Our

bulk transcriptomic analyses corroborate the downregulation of neural stem/progenitor markers and proliferation markers together with an upregulation of radial glial markers in the E18 KO cortex compared to control. Depletion of proliferative NIHes1 NSC pool thus causes a precocious transition to Notch dependent RGC fate, and causes imbalance in the composition of the NSC niche.

We also found that the adult quiescent NSCs are embryonically set aside quiescent NSCs maintained through NIHes1 expression. In vivo conditional knockout studies using a triple mutant mouse line, NIHes1fl/fl :: Nestin CreERT2 :: Stopfl/fltdTomatoreveled that NIHes1 knockout alters adult neurogenesis leading to precocious differentiation and migration of neurons to OB. Altogether our study demonstrates that NIHes1 expression is critical to maintain NIHes1 NSCs and the heterogeneity of the neural stem niche during embryonic and adult neurogenesis.



Panel depicting the model of embryonic and adult stem cell niche with all the subtypes of cells

In the embryonic neural stem cell niche of the cortex, we characterized a heterogeneous pool of stem cells/progenitors composed of NIHes1 NSCs in addition to RGCs and IPCs using a Nestin-CreERT2;NIHes1fl/flcKO mouse model. Our analyses show that NIHes1 NSCs are the precursor NSCs that produce RGCs and IPCs. Further, the loss of NIHes1 expression significantly alters the NSC niche, leading to increased gliogenesis and aberrant projection neuronal migration. The NIHes1 NSCs are set aside at embryonic stages as adult quiescent stem cells and upon activation, they are maintained by NIHes1 expression. In conclusion, NIHes1 NSCs are functionally distinct Hes1-expressing NSCs other than RGCs, which are critical for establishing the embryonic and adult NSC niches and, thereby, the overall cortical development.

TEAM

Dr. Jackson James, Jyothi P Nair, Surya Suresh, Aryasree K, Sandra S Hari, Biju S Nair, Rahul Jose, Sreedevi L R (From L to R)

LABORATORY STRENGTH

PhD Students: 5 / JRF: 1 / Project Assistant: 1 / Technical Assistant: 1

PUBLICATIONS:

- Parvathy S, Basu B, Surya S, Jose R, Meera V, Riya P A, Jyothi N P, Sanalkumar R, Praz V, Riggi N, Nair B S, Gulia K K, Kumar M, Binukumar B K, James J. TLX3 regulates CGN progenitor proliferation during cerebellum development and its dysfunction can lead to autism. iScience. 2024 Nov 5;27(12):111260.

- V Meera, S Surya, S Parvathy, N P Jyothi, P A Riya, B S Nair, J James; Notch1 is essential for maintaining adult SVZ neurogenic niche and its knockout leads to aberrant neurogenesis and fine olfactory dysfunction: Gene Reports, (2025)39, 102200.

AWARDS [PI]:

- Was elected as Fellow of Indian Academy of Neurosciences, at Advances In Mechanisms and Approaches to Neuro-Therapeutics (AIM-AT) & XLII Annual Meeting of Indian Academy of Neurosciences 2024 (IAN 2024) on November, 2024.

AWARDS [STUDENTS]:

- Surya Suresh won the Best Oral Presentation award at the International Conference on 'Biotechnology- The Way Forward' (ICBWF – 2024), organized by Department of Biotechnology, University of Kerala, India, held from November 20-22, 2024.
- Surya Suresh won the Best Poster award at the National Symposium on Biotechnology for Sustainable Development, 2024 organized by BRIC-RGCB on 20th April 2024.
- Jyothi P Nair got a Travel award and Childcare grand to attend the annual meeting of International Society for Stem Cell Research-2024 held at Hamburg, Germany from July 10th - 13th, 2024.

INVITED TALKS [PI ONLY]:

- Keynote Speaker at International Conference on Central Nervous System Disorders: From mechanisms to Medicine (ICCNS-2M -2025) at Institute of Pharmaceutical Education and Research (NIPER), Ahmedabad on February, 2025.
- Invited talk on Biotechnology Lecture Series at Department of Biotechnology, University of Kerala, Thiruvananthapuram on June, 2024.

CONFERENCE PRESENTATION:

- Surya Suresh, Poster Presentation at the Federation of European Neurosciences Conference, 2024 (FENS Forum-2024) held at Vienna, Austria during 25th -29th June 2024.
- Jyothi P Nair, Poster Presentation at Annual Meeting of International Society for Stem Cell Research-2024 (ISSCR-2024) held at Hamburg, Germany from July 10th - 13th, 2024.
- Jyothi P Nair, Poster Presentation at National Symposium on Biotechnology for Sustainable Development-2025 organised by BRIC-RGCB held on 16th May 2025.
- Jyothi P Nair, participated and presented her work at Biotechnology - The Way Forward; ICBWF-2024 at University of Kerala from November 20-22, 2024.
- Rahul Jose, Poster Presentation at Advances In Mechanisms and Approaches to Neuro-Therapeutics (AIM-AT) & XLII Annual Meeting of Indian Academy of Neurosciences 2024 (IAN-2024), from November 11-14, 2024.
- Aryasree R, Poster Presentation at Advances In Mechanisms and Approaches to Neuro-Therapeutics (AIM-AT) & XLII Annual Meeting of Indian Academy of Neurosciences 2024 (IAN-2024) from November 11-14, 2024

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Functional relevance of a unique subclass of Notch independent Hes-1 (NIHes-1) expressing neural stem cells in developing/adult cortex	Anusandhan National Research Foundation	2022	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Meera V	Role of Notch and related regulatory pathways in the maintenanace and fate specification of adult neural progenitors	University of Kerala	Submitted	2024

John Bernet Johnson, PhD

Scientist E-II
Pathogen Biology

BRIEF THEME OF LABORATORY

The overarching goal of our laboratory is to understand the complex mechanism of interaction of viruses with the innate arm of the immune system with a special emphasis on the human complement system. We aim to unravel innate-adaptive cross-talk, immune response, immune modulation and immune evasion by pathogens of significance including Chandipura virus, rabies virus, chikungunya virus etc. We also are on the frontline of developing viral vector based platforms as vaccine and oncolytics.

MAJOR RESEARCH AREA

- Unraveling the unique features of rabies virus-human complement interactions and the resultant effect on virus neutralization.
- Gaining a step closer to understanding the basis of Chandipura virus dissemination by exploiting the complement system.
- Identifying the consistency in the profile of complement activation and resistance in different cell lines generated, Chikungunya virus.
- Generate modalities for the development of an attenuated, safe and potent Chandipura virus platform for oncolytic virotherapy.

WORK REPORT

- HOST CELL ORIGIN DRIVES DIVERGENT COMPLEMENT NEUTRALIZATION MECHANISMS OF CHANDIPURA VIRUS

Our research is primarily focused on exploring the dynamics of host-pathogen interaction of the members of the Rhabdoviridae (Chandipura virus, rabies virus) and Togaviridae (Chikungunya virus) family. Extensive studies were carried out to understand Chandipura virus (CHPV) human complement interaction. Chandipura virus, a potent human pathogen predominantly reported in the Indian sub-continent, is known to cause paediatric encephalitis with a high case fatality rate. A previous study from our lab showed that Chandipura virus (CHPV), a neurotropic rhabdovirus, activates the human complement system (CS) in a concentration and time-dependent manner and undergoes classical pathway-mediated, C1q-dependent virus neutralization via virus aggregation. Chandipura virus grown in the Vero E6 cell line was used in that study. However, several studies have highlighted host cell-dependent differences in the outcome of RNA virus-complement interactions. To

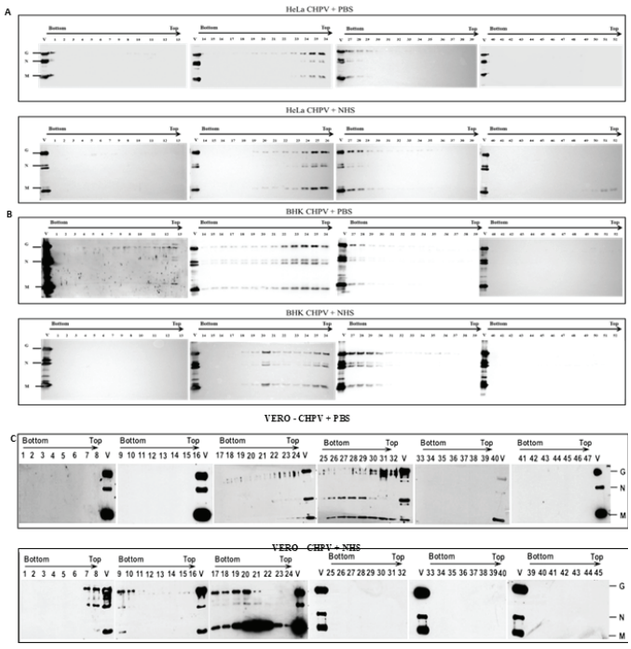
investigate this, CHPV was cultured in HeLa, BHK-21, and Vero E6 cells. Purified virus particles were incubated with either normal human serum (NHS) or phosphate-buffered saline (PBS), and the extent of complement activation by each virus was analyzed by immunoblotting to detect the presence of the complement activation product C3a. Using complement factor-depleted and reconstituted sera, the complement pathway activated by each virus was also studied. CHPV grown in different cell lines activated the classical pathway of the CS to a similar extent. Complement activation by viruses often results in their neutralization via virus aggregation, membrane attack complex (MAC)-mediated virolysis, or opsonization.

To determine if CHPV grown in different cell lines undergoes virus neutralization via the same mechanism, CHPV purified from HeLa, BHK-21, and Vero E6 cells were incubated with NHS or PBS for 30 minutes at 37°C. The mixtures were layered onto a 15% to 60% linear sucrose gradient and subjected to ultracentrifugation. Fractionated samples were analyzed via immunoblotting to detect viral proteins and evaluate complement-mediated neutralization outcomes.

HeLa-derived CHPV showed no significant shift in viral distribution between NHS- and PBS-treated samples, indicating resistance to complement-mediated neutralization. This suggests the incorporation of complement regulators or structural adaptations that prevent complement activation. In contrast, BHK-21-derived CHPV exhibited a notable shift of viral fractions towards the top of the gradient upon NHS treatment, consistent with virus lysis (virolysis) and demonstrating susceptibility to complement-mediated destruction. Vero E6-derived CHPV showed a shift of viral fractions towards the bottom of the gradient, indicative of viral aggregation, which serves as a neutralization mechanism that effectively reduces infectious viral particles.

These results suggest that despite the marked similarity in the upstream activation patterns, downstream neutralization fate varies depending on the host cell of origin. Comparable studies have highlighted similar host cell-dependent differences in other viral systems. Influenza A virus and VSV, for example, exhibit altered complement interactions based on their cell line of origin, often linked to differences in membrane composition and incorporation of host cell proteins.

These results underscore the significance of host cell origin in shaping virus-complement interactions. Further exploration of the molecular determinants responsible for these differences could reveal novel therapeutic targets to enhance complement-mediated virus neutralization.



Viruses from different cell lines show distinct neutralization patterns.
(A) With no shift observed in the virus distribution in the gradient, HeLa-derived CHPV resists neutralization by normal human serum (NHS).
(B) BHK-21-derived CHPV undergoes virolysis upon NHS treatment, with a shift toward the top of the gradient.
(C) Vero E6-derived CHPV undergoes aggregation, with a shift toward the bottom. Labels G, N, and M denote CHPV glycoprotein G, nucleocapsid, and matrix protein.

TEAM

First Row: Aranya A, Dr. John B Johnson, Sandra S, Devika S R, Dr. Lakshmi V S, Karthika Rajeevan (From L to R)
Second Row: Amarjit D, Hega V, Priti K, Gopika S (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 5 / Project Associate: 1

PUBLICATIONS:

- Parveen S, Bhat C V, Sagilkumar A C, Aziz S, Arya J, Dutta A, Dutta S, Show S, Sharma K, Rakshit S, Johnson J B, Nongthomba U, Banerjee A, Subramanian K. Bacterial pore-forming toxin pneumolysin drives pathogenicity through host extracellular vesicles released during infection. iScience. 2024; 27(8):110589.

CONFERENCE PRESENTATION:

- Dr.Umerali K, Poster Presentation on Host Cell Origin Drives Divergent Complement Neutralization Mechanisms of ChandipuraVirus, at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Dr.Lekshmi V S, Poster Presentation on Discovery of Antiviral drugs against SARS-CoV-2 using HiBiT tagged VLP system , at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Aranya Anunaya, Poster Presentation on Deciphering the role of M-protein in cytopathic property of the Chandipura virus, at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Aranya Anunaya, Poster Presentation on Deciphering the role of M-protein in cytopathic property of the Chandipura virus, at American Society for Virology's 44th Annual Meeting (ASV 2025) held o0 July 14-17, 2025, at the Palais des congrès de Montréal in Montréal, Québec, Canada and hosted by McGill University.

- Karthika Rajeevan, Poster Presentation on Identification and functional characterization of the CHPV and complement interacting partners, at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Devika S R, Poster Presentation on Activation of the Human Complement System by Rabies Virus is Classical Pathway-Dependent, at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Devika S R, Oral Presentation on Activation of the Human Complement System by Rabies Virus is Classical Pathway-Dependent, at the International Conference on Nipah and Other Zoonotic spillovers, organized by Institute of Advanced Virology, Bio 360 Life Sciences Park, Thonnakkal PO, Thiruvananthapuram, on July 11th, 2025.

- Priti Kumari, Poster Presentation on Human complement activation by Chikungunya Virus and resistance to neutralization is independent of its cell origin' , at EMBO Satellite meeting and Hands-on workshop on Infection Biology-from microbes to host interface at Indian Institute of Science Education and Research Tirupati (IISER-Tirupati), India from 14-15 February 2025.

- Priti Kumari, Poster Presentation on Deciphering the molecular basis of the interaction of Chandipura virus signatures with human complement system, at the International Conference on Nipah and Other Zoonotic spillovers, organized by Institute of Advanced Virology, Bio 360 Life Sciences Park, Thonnakkal PO, Thiruvananthapuram, on July 11th, 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Molecular characterization of the cytopathic property of Chandipura virus to engineer an attenuated oncolytic vector	Anusandhan National Research Foundation	2023	3 Years	PI
02	Understanding measles vaccine failure (and success) in Southern India	National Institutes of Health -USA	2017	5 Years	Co-PI

Karthik Subramanian, PhD

Scientist E-I
Pathogen Biology

BRIEF THEME OF LABORATORY

Our laboratory investigates the molecular pathogenesis of Streptococcus pneumoniae, focusing on host-pathogen interactions and antimicrobial resistance. We delineate the functional role of host extracellular vesicles (EVs) in modulating pneumococcal virulence and leverage engineered EVs for precision drug delivery. Utilizing a drug repurposing pipeline, we screen small molecules targeting specific bacterial virulence determinants. Concurrently, we also wish to study the gene signatures that determine bacterial fate within specific host niches.

MAJOR RESEARCH AREA

- Bacterial Pathogenesis and Host–Pathogen Interaction: Investigating the molecular mechanisms of S. pneumoniae virulence, with emphasis on toxin-mediated host cell damage.
- Extracellular Vesicle Biology: Deciphering the role of host EVs in modulating pneumococcal pathogenicity and engineering EVs for targeted antimicrobial delivery.
- Drug Discovery & Repurposing: Screening small molecules against bacterial virulence determinants using structure-guided drug repurposing strategies.
- Transcriptomic Signatures of Infection: Characterizing gene expression profiles that define bacterial fate within distinct host tissue niches.

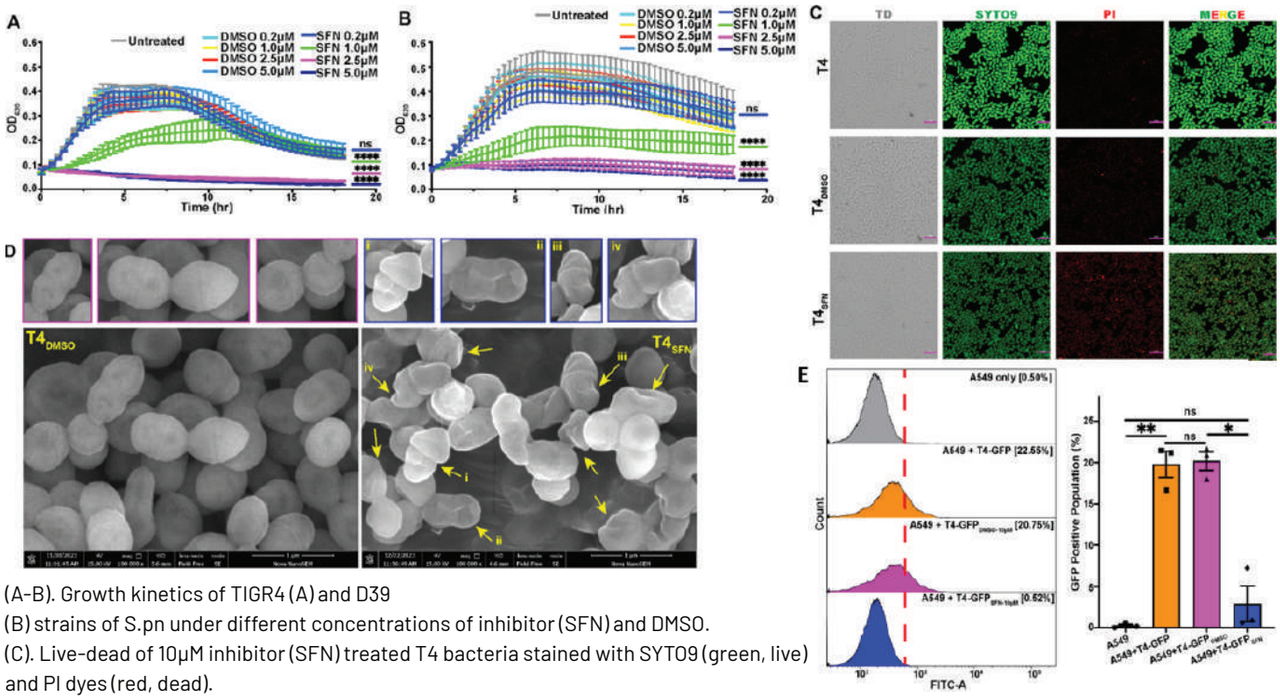
WORK REPORT

- IDENTIFICATION OF BACTERIAL KINASE INHIBITOR AS POTENTIAL ANTI-MICROBIAL FOR PNEUMOCOCCAL INFECTIONS.

Streptococcus pneumoniae, a respiratory bacterial pathogen that kills over a million people worldwide, encodes a eukaryotic-like Serine/Threonine Kinase Protein (StkP) which catalyzes the phosphorylation of downstream proteins vital for proper cell division. StkP in association with several unique cell division proteins like FtsZ, FtsX, MapZ, GpsB provides a unique stringent coordination of bacterial cell division. In this project, we aimed to develop inhibitors against multiple virulence factors as antimicrobials for treating pneumococcal infections. Unlike conventional antibiotics that target single protein or pathway making themselves prone to a faster resistance development, we aim to inhibit bacterial growth and viability by targeting multiple virulence factors.

Our approach is to screen libraries of compounds against pneumococcal virulence factors using computational tools, to identify potential compounds, screen them in vitro and validate the target by virulence inhibition assays. Since the crystal structure of the kinase domain of StkP (StkP-KD) is not available, the structure of StkP kinase domain was modelled using alpha fold and homology modelling was performed to validate the structure by aligning with homologous kinases in other bacterial species such as Staphylococcus and Mycobacterium. Next, we screened 38 host-targeted kinase inhibitors by high-throughput virtual screening and molecular dynamics simulation for their binding affinity with pneumococcal StkP. The lead compound was identified by performing growth kinetic assays of the top two compounds identified, using serotypes 4 (TIGR4) and 2 (D39) strains as well as clinical multi drug-resistant strains. The lead compound showed strong interactions with catalytically active residues of StkP-KD in silico, blocking the kinase activity, even in the presence of natural substrates of StkP. Bacterial

growth kinetic assays using serotype 4 (ATCC BAA-334/TIGR4) and serotype 2 (NCTC 7466/D39) showed dose-dependent growth inhibition with MIC of 2.5mM (Figure 1A, B). Since StkP coordinates cell wall synthesis, a membrane permeability assay using SYTO9 and Propidium Iodide (PI) and scanning electron microscopy was performed to check the cell wall morphology of inhibitor treated bacteria. Live-dead staining assays showed significant uptake of PI indicating a compromised membrane permeability and cell death upon inhibitor treatment (Figure 1C). In agreement with StkP's role in cell wall synthesis, inhibitor-treated bacteria showed membrane deformations during scanning electron microscopy (Figure 1D). Further, we also found that inhibitor treatment reduced bacterial infection of A549 lung epithelial cells (Figure 1E). Work is ongoing to test whether StkP is a potential target by creating inducible knockout strains and kinase activity assays in the presence of inhibitor. Further, we will also validate this in-vivo using a mouse model of pneumonia.



(A-B). Growth kinetics of TIGR4 (A) and D39
(B) strains of S.pn under different concentrations of inhibitor (SFN) and DMSO.
(C). Live-dead of 10μM inhibitor (SFN) treated T4 bacteria stained with SYTO9 (green, live) and PI dyes (red, dead).
(D). SEM images of 10μM inhibitor treated T4 bacteria.
(E). Flow cytometry analysis showing the infectivity of T4-GFP strain into human A549 pneumocytes after treatment with 10μM inhibitor, bar graph shows the percentage of GFP positive cells.

TEAM

Himani Dhyani, Aswathy C S,
Dr. Karthik Subramanian,
Joeel Abraham, Sabna A R (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / JRF: 1 / Project Assistant: 1

PUBLICATIONS:

- Parveen S, Bhat C V, Sagilkumar A C, Aziz S, Arya J, Dutta A, Dutta S, Show S, Sharma K, Rakshit S, Johnson J B, Nongthomba U, Banerjee A, Subramanian K. Bacterial pore-forming toxin pneumolysin drives pathogenicity through host extracellular vesicles released during infection. iScience. 2024 Jul 25;27(8):110589.

AWARDS [PI]:

- Invited speaker at Streptococcal Biology Gordon Research Conference, 11-16 August 2024, Sunday River, Maine, USA- Received SERB International travel award for attending the conference.

- Invited to join Early Career Board member at ACS Infectious Diseases.

AWARDS [STUDENTS]:

- Joel Abraham won Best Poster Award for Targeting the Serine/Threonine Kinase Protein of Streptococcus pneumoniae for potential antibacterial therapeutics at ALARM 2024, Amrita Legion for Antimicrobial Resistance Management, International Symposium on Antimicrobial Resistance on 22-23 November 2024 at Amrita School of Biotechnology, Amritapuri, Kerala.

INVITED TALKS [PI ONLY]:

- Host-Extracellular Vesicles in Pneumococcal Infections- Small Entities with Big Impact at Streptococcal Biology Gordon Research Conference: Paradigms of Microbial Evolution and Adaptation for Fitness in Host and Environmental Niches on August 11 - 16, 2024, at Grand Summit Hotel at Sunday River, Maine, USA.

- Toxic encounter: Host extracellular vesicles transmit bacterial pore-forming toxin and mediate inflammation within the host at 2nd BRIC-RGCB Research Conference on 25th -28th September 2024, at Zuri Kumarakom Resort, Kerala.

- Host-extracellular vesicles drive pore-forming toxin mediated pathogenicity during pneumococcal infection at Immunocon 2024- Annual Meeting of the Indian Immunology Society on 17-20 October 2024 at Indian Institute of Science, Bengaluru.

- Role of exosomes in bacterial pathogenesis- friend or foe? At International workshop on "Biomanufacturing and Characterization of Extracellular vesicles for Biomedical Applications-ExoVIT 24 on 24-25th Oct 2024 at Vellore Institute of Technology, Vellore.

- Identification Of Bacterial Kinase Inhibitor As Potential Anti-Microbials For Pneumococcal Infections at Amrita Legion for Antimicrobial Resistance Management (ALARM) 2024, International Symposium on Antimicrobial Resistance on 22-23 November 2024 at Amrita School of Biotechnology, Amritapuri, Kerala.

CONFERENCE PRESENTATION:

- Aswathy C. Sagilkumar, Poster Presentation on Host extra-cellular vesicles containing pore-forming pneumolysin toxin elicit pathogenicity during streptococcal infections, at Immunocon 2024- Annual Meeting of the Indian Immunology Society from 17-20 October 2024 at Indian Institute of Science, Bengaluru.

- Joel Abraham won Best Poster award on Targeting the Serine/Threonine Kinase Protein of Streptococcus pneumoniae for potential antibacterial therapeutics at ALARM 2024, Amrita Legion for Antimicrobial Resistance Management, International Symposium on Antimicrobial Resistance on 22-23 November 2024 at Amrita School of Biotechnology, Amritapuri, Kerala.

- Aswathy C. Sagilkumar, Poster Presentation on Streptococcal Infections Alter the Proteomic Profile of the Host Extracellular Vesicles to Influence Immune Responses at National symposium on Biotechnology for sustainable development, at MR Das Convention Centre, BRIC-RGCB. May 16, 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Investigating pneumococcal adaptation to intracellular survival within the host and characterization of infection derived host extracellular vesicles for immunotherapy.	Ramalingaswami Re-entry grant, Department of Biotechnology	2021	5 Years	PI
02	Disarming bacterial pathogens using novel peptides that target pore-forming toxins: from in silico to in vivo	INSPIRE Faculty grant, Department of Science and Technology	2020	5 Years	PI
03	Building unnatural peptide pores targeting bacterial membranes against antibiotic resistance	Indian Council of Medical Research	2024	3 Years	Co -PI

Karthika Rajeeve, PhD

Scientist E-I
Pathogen Biology

BRIEF THEME OF LABORATORY

Our lab works on two infectious pathogens, Mycobacterium tuberculosis and Chlamydia trachomatis. We investigate the molecular mechanism by which these human pathogens evade the host immune response. These findings might help us to develop therapeutics against these infectious agents.

MAJOR RESEARCH AREA

- Discovered how Chlamydia trachomatis reprograms human neutrophils to a long-lived phenotype to enable its survival and spread.
- Submitted a patent on the discovery of a smart protein that acts as a stem cell activator.

WORK REPORT

- CHLAMYDIA TRACHOMATIS REPROGRAMS HUMAN NEUTROPHILS TO A LONG LIVING PHENOTYPE TO ENABLE ITS SURVIVAL AND SPREAD.

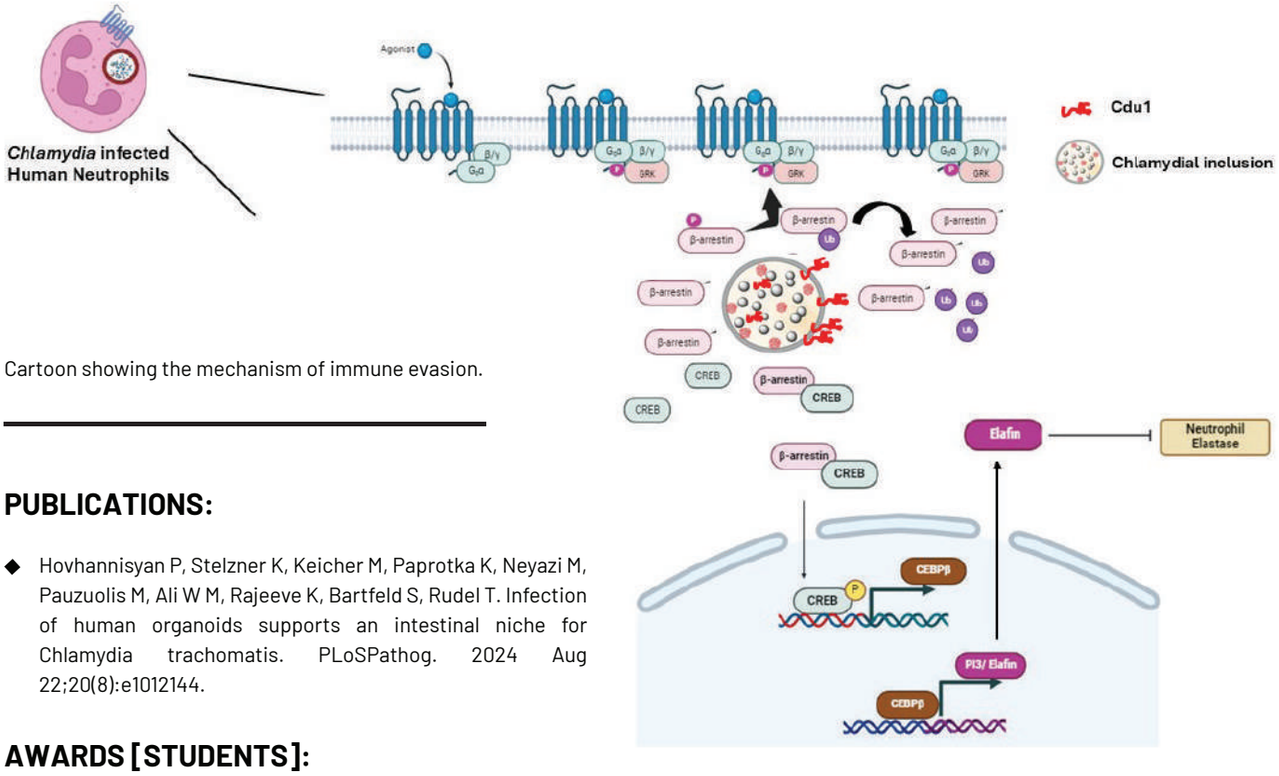
Chlamydia trachomatis (CT), a major cause of sexually transmitted infections, is an intracellular pathogen known for its asymptomatic mode of infections. Neutrophils, key immune cells fail to detect and clear Chlamydia. Surprisingly, on encountering Chlamydia, neutrophils turn paralysed and fail to respond to any external stimuli. Interestingly, regardless of the MOI (multiplicity of infection) Chlamydia infects only a small subset of neutrophils. We employed single-cell sequencing to discover that Ct-infected neutrophils segregate into eight distinct clusters. The subset, harbouring the bacterium, is enriched in Elafin, a potent neutrophil elastase inhibitor. Elafin is significantly up-regulated and secreted, protecting neighbouring cells from cell death, entailing a long-living phenotype to the neutrophils. Further, we show that the Chlamydial deubiquitinase (Cdu1) stabilizes β-arrestin 2 resulting in desensitisation of GPCR. This blocks cAMP signalling but activates CREB and cEBP pathways to enhance Elafin expression. Cdu1-deficient Chlamydia fails to induce this protective phenotype. This discovery is a paradigm shift in neutrophil biology as it reveals the existence of a sub-population of pathogen-associated neutrophils (PAN) with an unexpected role in nurturing Chlamydia thus supporting its replication and spread.

TEAM

Athulya T, Paridhi Agarwal,
Dr. Karthika Rajeeve, Nijisha M,
Rajalakshmi K G (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / SRF: 2 / Project Assistant: 1 / Technical Assistant: 1 / Lab Assistant: 1



Cartoon showing the mechanism of immune evasion.

PUBLICATIONS:

- Hovhannisyan P, Stelzner K, Keicher M, Paprotka K, Neyazi M, Pauzuolis M, Ali W M, Rajeeve K, Bartfeld S, Rudel T. Infection of human organoids supports an intestinal niche for Chlamydia trachomatis. PLoSPathog. 2024 Aug 22;20(8):e1012144.

AWARDS [STUDENTS]:

- Nijisha M, Best Poster award for the Deciphering the role of Rv0464c in the reactivation of Mycobacterium tuberculosis at National Symposium on Biotechnology for Sustainable Development-2024 on 20th April 2024 at Rajiv Gandhi Centre for Biotechnology.

INVITED TALKS [PI ONLY]:

- Served as a resource person and delivered an invited talk for National Symposium on Environment, Health and Disease:Ecogenetics and Toxicogenomicson 3rd and 4th October 2024 at V.O.Chidambaram College, Tuticorin. (funded by DST).
- Invited talk at Agriculture college Vellayani on 5th October 2024.
- Invited talk on three days international hands on training workshop on advanced flow cytometric techniques and application March18, 2025.

CONFERENCE PRESENTATION:

- Nijisha M, Poster Presentation, Unveiling Rv0464c: A Key Driver of Mycobacterium tuberculosis Reactivation and Survival. EMBO: Host and pathogen heterogeneity in tuberculosis from February 9th-12th 2025 at CSIR-CCMB, Hyderabad.
- Nijisha M, Poster Presentation, Deciphering the role of Rv0464c in the reactivation of Mycobacterium tuberculosis at National Symposium on Biotechnology for Sustainable Development-2024 on 20th April 2024 at Rajiv Gandhi Centre for Biotechnology.
- Paridhi Agarwal, Poster Presentation on Masterful manoeuvre: Exploring the ingenious tactics of Chlamydia trachomatis to evade host immune response at BRIC-RGCB Research Conference 2024, from 25th – 28th September, 2024.
- Paridhi Agarwal, Poster Presentation on Decoding a novel immune evasionstrategy: Single-Cell sequencing reveals how Chlamydia trachomatis subverts neutrophil-mediated defense at BRIC-RGCB National symposium on Biotechnology for sustainable development on May 16th , 2025.
- Paridhi Agarwal, Poster Presentation on Ingenious Intricacies: How Chlamydia trachomatis Skillfully Evades the Host Immune System at IMMUNOCON 2024, IISc Bengaluru, from 17th -20th October 2024.

PATENTS APPLIED/ GRANTED:

- Patent Application No. 202341056900 - A Novel Stem Cell Activator (Sca) Protein And Its Preparation Method Thereof

Kathiresan Natarajan, PhD

Scientist E-I
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

Tubulin isotype composition in neurons is crucial for neuronal development and functions like neuroblast migration and transport. Mutations in tubulin isotypes can cause neurological disorders called "tubulinopathies," causing developmental and neurodegenerative abnormalities. Understanding how tubulin isotypes and mutations affect microtubule dynamics is limited, but understanding these mutations could provide new insights into the structural regulation of microtubule dynamics and their relevance in neurodevelopmental diseases and rare genetic disorders.

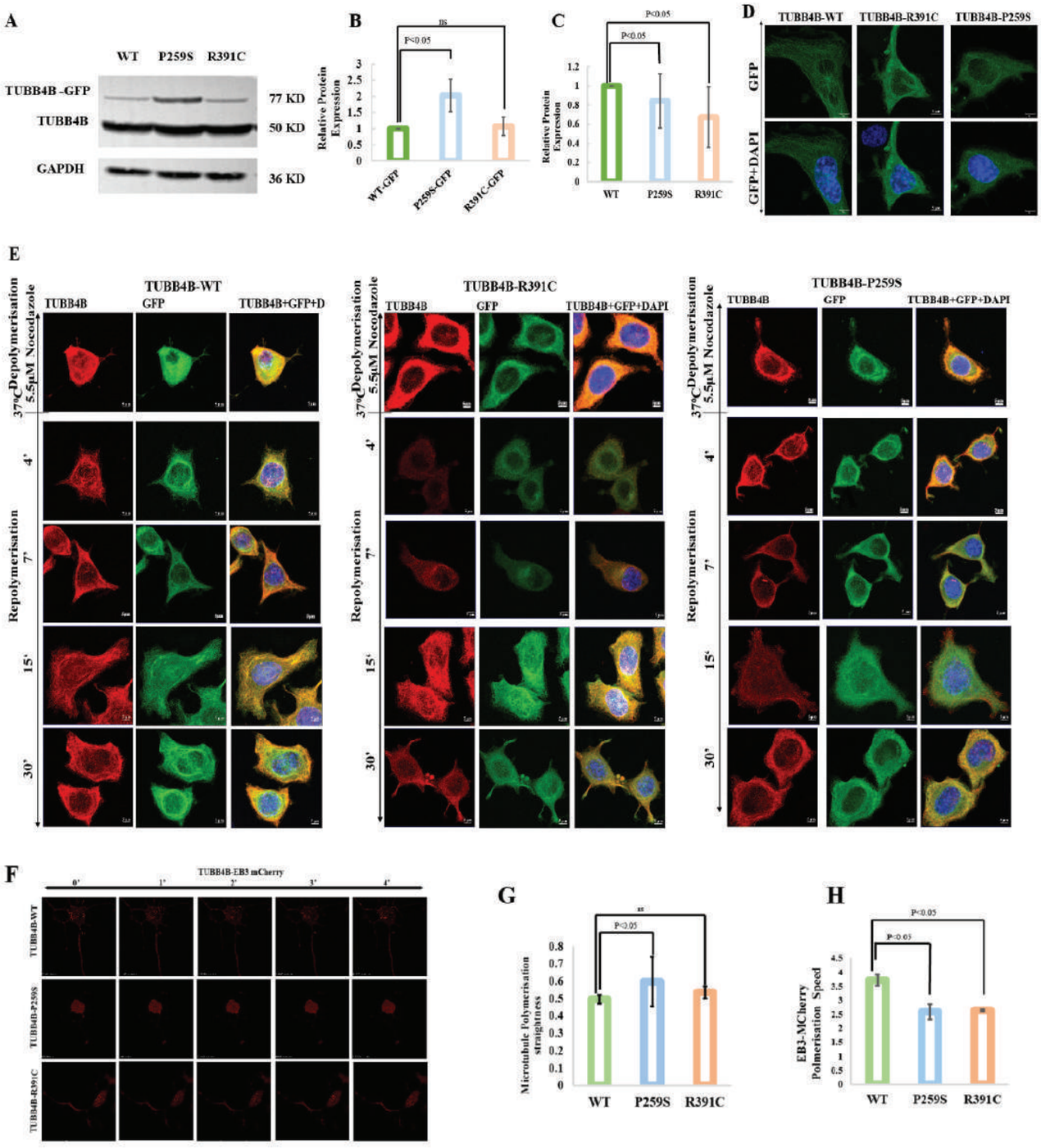
MAJOR RESEARCH AREA

- We investigated the role of TUBB4B mutations in rare genetic disorders on the dynamic instability and molecular properties of microtubules.
- TUBB4B mutants were generated and expressed in the N2A neuroblastoma cell line.
- Molecular characterization of the mutants was performed using immunoblot analysis, real-time PCR analysis, and microscopy studies.
- Findings reveal an unexpected role of the TUBB4B isotype in rare genetic disorders, particularly in the polymerization dynamics of microtubules and their stability.
- The mutation significantly affects the microtubule straightness in the TUBB4B-P259S mutant.

WORK REPORT

- UNRAVELLING THE ROLE OF TUBB4B TUBULIN ISOTYPE IN MICROTUBULE DYNAMICS

Microtubules, a crucial component of the cytoskeleton, exhibit high structural homology across all eukaryotic organisms. They achieve functional specialization via interactions with microtubule-associated proteins (MAPs) and through tubulin Post-Translational Modifications (PTM). The identification of tubulin isotypic mutations in human brain malformations, collectively known as tubulinopathies, has increased interest in the functional role of tubulin isotypes. Most tubulinopathies arise from a single point mutation in a tubulin isotype, allowing us to investigate its potential role in various neuronal disorders. In this research project, we investigated the role of TUBB4B tubulin isotype mutations associated with rare genetic disorders on the dynamic instability and molecular properties of the microtubules. We generated TUBB4B mutants through site-directed mutagenesis and stably expressed them in the N2A neuroblastoma cell line. Molecular characterization of the mutants was performed using immunoblot analysis, real-time PCR analysis, and microscopy studies through immunofluorescence staining and live super-resolution confocal imaging. The structural perturbations of the mutations were further studied using molecular dynamics simulations. Our findings reveal an unexpected role of the TUBB4B isotype in rare genetic disorders, particularly in the polymerization dynamics of microtubules and their stability. Structural analysis of the microtubule network through confocal microscopy unveiled that the mutants were forming a hyper-stabilized network (Figure 1 D). Indirect immunostaining using TUBB4B antibody along with nocodazole-dependent microtubule dynamics study, we found that the depolymerization kinetics is slower in the mutants and hence the repolymerisation kinetics as well (Figure 1 E). Study of live microtubule dynamics by co-transfecting with EB3 mCherry revealed that the TUBB4B-P259S and TUBB4B-R391C have slower polymerization kinetics, which is consistent with the nocodazole-dependent polymerization kinetics of the microtubule (Figure 1 F, G). We also found that TUBB4B-P259S mutant is significantly affecting the microtubule straightness (Figure 1 E).



(A) Immunoblot analysis of WT and mutants.
(B) Relative protein expression of stable cells.
(C) Relative protein expression of endogenous TUBB4B.
(D) Structural imaging of TUBB4B-WT and mutants.
(E) Microtubule dynamics of TUBB4B-WT and mutants after nocodazole treatment in N2A neuroblastoma stable cell lines.
(F) Live microtubule dynamics in EB3 mCherry co-transfected and differentiated N2A stable cell lines.
(G) Microtubule Polymerisation straightness.
(H) EB3 mCherry polymerisation speed.

TEAM

Dhanya Damodaran, Krishna Priya, Dr. Kathiresan Natarajan, Thasni Fazil, Anju Krishnan, Rudra Samson (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 2 / PhD Students: 3 / JRF: 1

PUBLICATIONS:

- Sharanya, C S, Natarajan Kathiresan. Microbial Enzyme Therapeutics as Anti-Inflammatory Agents. In Microbial Enzymes as Potential Biotherapeutics in Human Healthcare, pp. 49-61. CRC Press.
- Jyothy A, Hussain J, S S C, Chandraprabha V R, Nair M G, Vasudevan S, Sreedharan H, Abraham B, Maliekal T T, Natarajan K, Sengupta S. α-Fodrin-CENP-E interaction is critical for pancreatic cancer progression and drug response. Cell Cycle. 2024 Jul-Aug;23(13-16):847-871.
- Rajam S M, Varghese P C, Shirude M B, Syed K M, Devarajan A, Natarajan K, Dutta D. Kinase activity of histone chaperone APLF maintains steady state of centrosomes in mouse embryonic stem cells. Eur J Cell Biol. 2024 Sep;103(3):151439.
- Sharanya C S, Wilbee D S, Sathi S N, Natarajan K. Computational screening combined with well-tempered metadynamics simulations identifies potential TMPRSS2 inhibitors. Sci Rep. 2024 Jul 13;14(1):16197.
- Mazzaferro S, Kang G, Natarajan K, Hibbs R E, Sine S M. Structural bases for stoichiometry-selective calcium potentiation of a neuronal nicotinic receptor. Br J Pharmacol. 2024 Jul;181(13):1973-1992.
- Hasan M, He Z, Jia M, Leung A C F, Natarajan K, Xu W, Yap S, Zhou F, Chen S, Su H, Zhu K, Su H. Dynamic expedition of leading mutations in SARS-CoV-2 spike glycoproteins. Comput Struct Biotechnol J. 2024 May 24;23:2407-2417.

AWARDS [STUDENTS]:

- Thasni Fazil, Best Paper award for Poster Presentation in National Conference on Omics in redefining Healthcare, 23 & 24 August, 2024 organized by Jubilee Centre for Medical Research.
- Thasni Fazil, Best Poster award in conference on Omics Technologies in Agriculture and Human Health, 7 & 8 October,2024 organized by Indo German NachKontakt Association (IGNA), IICT Hyderabad, Telengana.
- Wilbee D Sasikala, Best Poster award, Screening of Allosteric Inhibitors of RdRp of SARS-CoV-2 Based on Drug Repurposing Strategy using Well Tempered Metadynamic Simulations, Regional Young Investigators Meeting-2024, 19-20 September-2024, GITAM University, Vishakapatanam.
- Wilbee D Sasikala, Best Oral Presentation award, Computational screening combined with well-tempered metadynamics simulations identifies potential TMPRSS2 inhibitors, Kerala Pharmaceutical Congress- KPC-2025 , 21-22 Feb 2025, Caritas College of Pharmacy, Kottayam.
- Rudra Samson, Best Poster Presentation award at the 37th Kerala Science Congress in the biotechnology category for the poster titled Deciphering the binding interactions and allosteric modulation of α7 nicotinic acetylcholine receptor by curcumin.

INVITED TALKS [PI ONLY]:

- Unravelling the binding mechanisms of HCV RdRp allosteric inhibitors for the rational design of inhibitors against future SARS-COV-2 outbreaks, National conference on Biotechnological Innovations for sustainable development, 8-9 Jan, 2025 at Thiagarajar College, Madurai, Tamil Nadu.

- Impact of TUBB4B mutations on microtubule dynamics Second edition of Winter School on Biomedical Optics, 7 Jan, 2025 at IIITDM Kanjeepuram, Tamil Nadu.
- Mysteries in Computational Biophysics, on Sept 9, 2024 at The American College, Madurai, Tamil Nadu.

CONFERENCE PRESENTATION:

- Thasni Fazil, National Symposium on Biotechnology for Sustainable Development, April, 20, 2024, organized by Rajiv Gandhi Centre for Biotechnology.
- Thasni Fazil, Cancer NEXT 2024 on 30th November 2024, organized by Bharath Advanced Therapeutics, Nizam's Institute of Medical Sciences (NIMS), Hyderabad.
- Thasni Fazil, Pan IIT Meeting and Conference on Engineering in Medicine 2024, 6th – 8th December 2024 at Department of Biological Sciences and Bioengineering, IIT Kanpur.
- Anju Krishnan, Unravelling the role of α7 nAChR mediated calcium signalling in neurological diseases, International Conference on Advances and Challenges in Medical Technology Translation, from 12-14 December 2024 at SCTIMST, Thiruvananthapuram.
- Wilbee D Sasikala, Poster Presentation, Screening of Allosteric Inhibitors of RdRp of SARS-CoV-2 Based on Drug Repurposing Strategy using Well Tempered Metadynamic Simulations, Regional Young Investigators Meeting-2024, 19-20 September-2024 at GITAM University, Vishakhapatnam.
- Wilbee D Sasikala, Oral Presentation, Computational screening combined with well-tempered metadynamics simulations identifies potential TMPRSS2 inhibitors, Kerala Pharmaceutical Congress- KPC-2025, 21-22 Feb 2025, Caritas College of Pharmacy, Kottayam.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Alpha7 nicotinic acetylcholine receptor as a pharmacological target for treating neuronal disorders	Anusandhan National Research Foundation	2023	3 Years	PI
02	Understanding Prakriti and its inheritance pattern in health and predominant disease predisposition from a regional perspective- A genetic and Epigenetic study	Central Council for Research in Ayurvedic Sciences	2024	3 Years	Co -PI
03	Affinity-tuned CAR T cells targeting refractory CD20 (+) B lineage malignancies for enhanced safety and antitumor functions.	Indian Council of Medical Research	2024	4 Years	Co -PI

Leny Jose, PhD

Scientist E-I
Pathogen Biology

BRIEF THEME OF LABORATORY

Human Papillomaviruses (HPVs) are small, non-enveloped viruses with a circular double-stranded DNA genome. High risk HR-HPV types are the primary etiological agents for a significant proportion of human cancers, including virtually all cases of cervical cancer, a large fraction of other anogenital cancers (vulvar, vaginal, penile, anal), and a growing number of oropharyngeal carcinomas. Understanding the molecular mechanisms of HPV infection and oncogenesis remains a critical area of research in my laboratory.

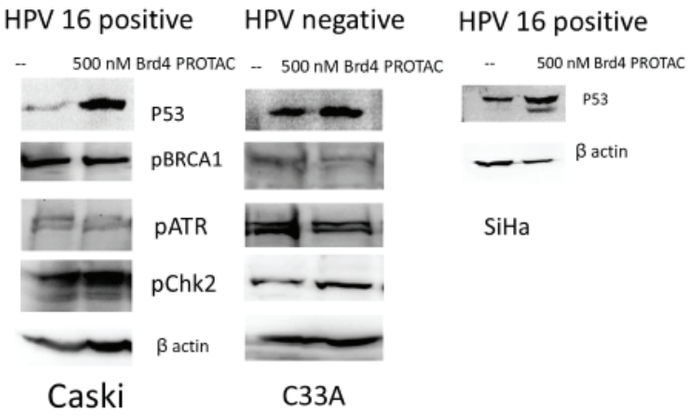
MAJOR RESEARCH AREA

- Key HPV interacting proteins from the host were identified from literature. Three of them Brd4, SMARCA2 and SMARCA4 proteins were selected for further study. PROTACs to degrade these protein targets were validated in HPV positive cell lines.

WORK REPORT

- TARGETING HOST EPIGENETIC REGULATORS TO INHIBIT HPV ONCOGENE EXPRESSION.

Given the established dependencies of HPV-positive cancers on BRD4 and the presumed critical roles of SWI/SNF ATPases SMARCA2 and SMARCA4, leveraging PROTAC technology to induce their degradation presents an attractive therapeutic avenue. For BRD4, PROTAC-mediated degradation could offer advantages over BET inhibition by achieving more complete and sustained target removal, potentially leading to a more profound suppression of E6/E7 expression and anti-tumour effects, and possibly circumventing BETi resistance mechanisms. MZ1 is a well-characterized BRD4 PROTAC that recruits the VHL E3 ligase and has demonstrated potent BRD4 degradation and anti-cancer activity in various preclinical models. For the SWI/SNF ATPases SMARCA2 and SMARCA4, PROTAC-mediated degradation offers a novel approach to interrogate their function and therapeutic potential in HPV-positive cancers. ACBI1 and ACBI2 are recently developed PROTACs designed to target SMARCA2 and SMARCA4 for degradation, often showing preferential degradation of SMARCA2 over SMARCA4 or vice-versa depending on cellular context or specific PROTAC design. Degrading these core ATPases could disrupt the integrity and function of SWI/SNF complexes more effectively than attempting to inhibit their ATPase activity, potentially leading to significant disruption of the viral life cycle and cancer cell viability. This study aimed to address these questions by utilizing the BRD4 degrader MZ1 and the SMARCA2/4 degraders ACBI1 and ACBI2 in HPV-positive cell line models. The specific aims were to investigate the efficacy of novel PROTAC degraders targeting BRD4 and SMARCA4/SMARCA2 on HPV E6/E7 expression and viability in HPV positive cell lines. We also investigated the effects of these PROTACs on HPV E2 transcription activity and assessed the DNA damage responses due to PROTAC mediated degradation. We saw that treatment with these PROTACs significantly reduced E6 and E7 expression in HPV 16 positive Caski cells. The drugs concomitantly induced a dramatic increase in p53 protein levels. Furher studies are ongoing to tease out the molecular mechanism of these findings



Effect of PROTAC treatment in HPV positive vs negative cell lines.

TEAM

Sreekutty Ravi, Dr. Leny Jose
(From L to R)

LABORATORY STRENGTH

PhD Students: 1 / Lab Assistant: 1

PUBLICATIONS:

- Jose L, Smith K, Crowner A, Androphy E J, DeSmet M. Senataxin mediates R-loop resolution on HPV episomes. J Virol. 2024 Aug 20;98(8):e0100324.

INVITED TALKS [PI ONLY]:

- Understanding the mechanisms of HPV-induced oncogenesis, Refresher course in Biological Science organized by MMTC on October 19, 2024 at University of Calicut.

Lightson N.G, PhD

Scientist E-I
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

The lab focuses on studying two aspects of bionanotechnology: (a) developing next-generation advanced portable bioanalytical platforms for biomedical and environmentally relevant biomarkers by exploring aptamer oligonucleotides, synthetic peptides, biomimetic materials, nanomaterials, etc.; (b) developing novel, safe, and effective therapeutics based on nanoscale components and their combinations in the field of nanomedicine. We aim to contribute to cutting-edge technologies and emerging fields by bringing advanced biomaterials, functional materials, and nanoscale platforms to diagnostics and therapeutics.

MAJOR RESEARCH AREA

- We published the recent findings on the pH-dependent delivery of efficiently loaded doxorubicin for cancer therapy using carbon nanodots.

WORK REPORT

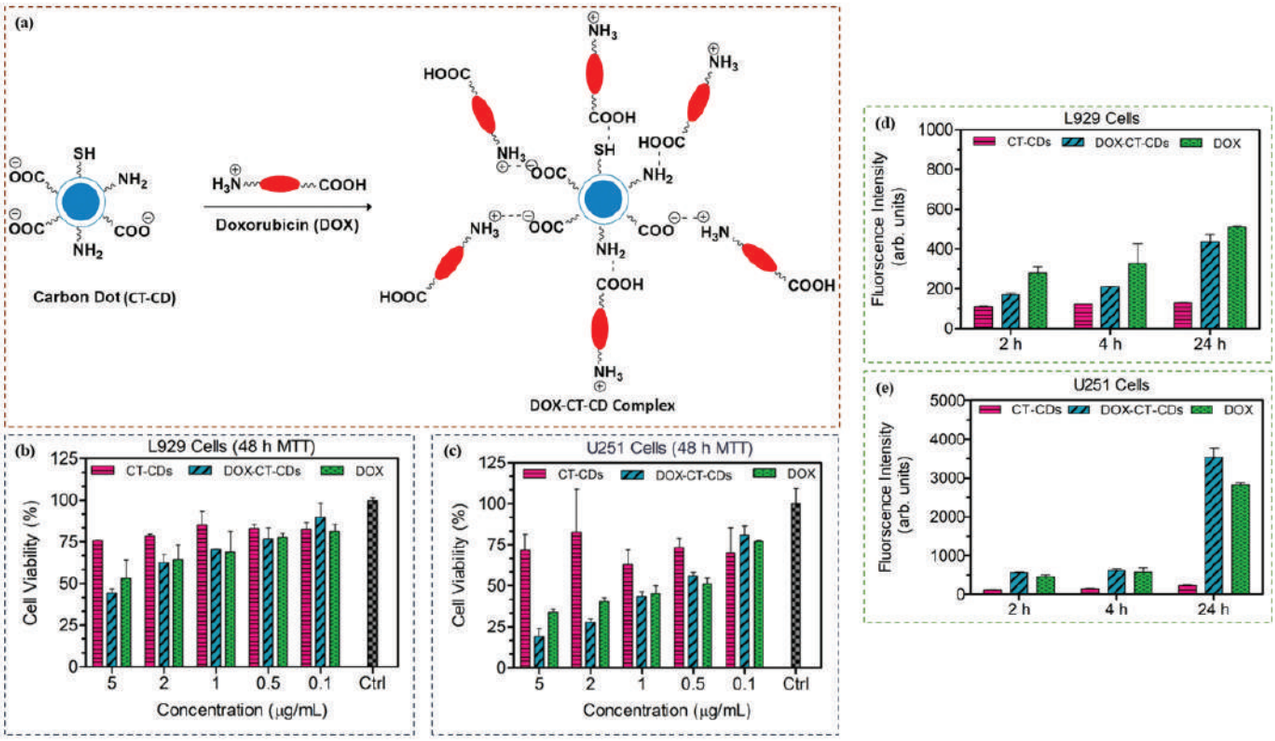
- NANOFORMULATION OF DOXORUBICIN WITH CARBON NANODOTS TO ENHANCE CANCER THERAPY.

Cancer has become one of the leading causes of mortality worldwide. Chemotherapy, the most extensively employed technique, entails potent medicines that kill cancer cells. However, chemotherapy possesses many disadvantages, such as poor specificity, low therapeutic efficiency, and severe side effects. In contrast, reducing the potentially fatal adverse effects of chemotherapy is critical for making the treatment more efficient, safer, and tolerable. Conventional drug delivery systems require frequent administration and higher drug doses to attain therapeutic efficiency due to the poor bioavailability and non-specificity of many therapeutic agents.

To address these critical challenges, innovative drug delivery systems with superior features for the loading, release, tracking, and targeting of chemotherapeutic medicines are indispensable in cancer detection, and therapy-targeted drug delivery systems depend on the site-specific release of therapeutics predominantly at the cancerous tissues while minimizing the effect on normal tissues. Therefore, researchers must find a carrier for efficient and precise delivery to specific tumour sites. Nanoparticles as smart drug delivery vehicles have become a very strategic endeavor. Nano drug carriers possess the advantages of improved efficacy of tumor chemotherapy, enhanced biodistribution, selective cancer targeting, reduced toxicity, and fewer side effects.

Carbon dots (CDs) are recently developed carbon nanomaterials that have drawn considerable interest in bionanotechnology. CDs have become potential nanomaterials due to their intriguing features, such as high solubility, low toxicity, and resistance to photobleaching, especially their easily tuneable fluorescent properties and flexibility in surface modifications. The excellent physical and chemical properties of CDs with low toxicity, rich surface groups, and biocompatibility can make them a potential nanocarrier for drug delivery. However, obtaining highly efficient loading and sustained release of DOX using CDs as nanocarriers is still challenging, which would influence therapeutic efficacy tremendously. We proposed to use CDs with multiple functional groups on the surface, developed novel functional carbon dots (CDs) and investigated the therapeutic efficacy by studying the loading efficiency and release behavior of the anticancer drug doxorubicin (DOX). Functional groups, morphology, particle size, and zeta potential of synthesized CDs and CDs loaded DOX were investigated by UV-visible, Fluorescence, DLS, Zeta Potential measurements, FTIR, and TEM. In vitro, drug release studies confirmed pH-dependent biphasic drug release, with an initial burst effect and sustained release of DOX. The CDs were non-toxic and biocompatible with L929 fibroblast cells. The cytotoxic effect of DOX-CDs showed a concentration-dependent effect after 48 h with Glioblastoma U251 cells. In the future, this work will be further assessed by in-vivo studies. In the meantime, the synthesized CDs will be studied on different cancer cell lines. Drug loading profile and in-depth mechanism of interaction between drug-carbon dots can also be investigated to provide further insight into efficient nanocarrier systems for better cancer therapeutics and outcomes. Additionally, the properties of the CDs may be modulated by incorporating different chemical functional linkers and molecular modification.

Nanoformulation of DOX with CDs as nanocarrier system.
(a) Electrostatic interaction between CDs and DOX.
(b) & (c) Cell viability studies of the CDs-DOX nanoconjugate.
(d) & (e) Cell uptake studies of the CD-DOX nanoconjugates.



TEAM

Dr. Lightson N G,
Tharakan Srinithya Chandramohan
(From L to R)

LABORATORY STRENGTH

PhD Students: 3 / JRF: 1

PUBLICATIONS:

- Ngashangva L, Martin S. Organ-on-chip for advancing CAR therapy. ClinTransl Immunology. 2025 Feb 26;14(2):e70024.
- Anagha Das, Aswathy Prasad, Aman Grewal, Lightson Ngashangva. Fluorescence-based detection of uric acid and iron using novel carbon nanodots. IEEE Xplore 2024, 1-6.
- Prasad A, Sekar R P, Razana C A M, Sudhamani S D, Das A, Athipettah J, Ngashangva L. High loading and sustained-release system of doxorubicin-carbon dots as nanocarriers for cancer therapeutics. Biomed Mater. 2024 Oct 4;19(6).

AWARDS [STUDENTS]:

- Athulya V A, Best Poster Presentation Award at the 15th National Workshop on Fluorescence and Raman Spectroscopy, and 17th International Conference on 'Optics Within Life Sciences (OWLS17) held at IIT Bombay, India (16-21 Nov 2024), titled Enzyme-free detection of uric acid using fluorescent carbon quantum dots.

INVITED TALKS [PI ONLY]:

- International Conference on Pure and Applied Chemistry – ICONPAC 2025 on Next Generation Sensors and Biosensors, organized by the Dept. of Chemistry, KL University, Guntur, 2-4 Jan 2025 titled Optical Biosensors: Miniaturized Bioanalytical System for Onsite Detection and Point-of-Care Diagnostics.

CONFERENCE PRESENTATION:

- Athulya V A, Poster Presentation on Enzyme-free detection of uric acid using fluorescent carbon quantum dots, at 15th National Workshop on Fluorescence and Raman Spectroscopy, and 17th International Conference on Optics within Life Sciences (OWLS17) held at IIT Bombay, India from 16 to 21 Nov 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Studies of non-enzymatic paper-based bioanalytical devices for point-of-care diagnostics	Anusandhan National Research Foundation	2022	3 Years	PI
02	Studies and Development of Multiplex Aptasensor for Real-Time Monitoring of Pharmaceutical Residues in Aquatic Sample	Water Technology Cell - Department of Science & Technology	2025	3 Years	Co -PI
03	Analysis of tumor characteristics and therapeutic strategies for β-hCG positive breast cancer patients from Kerala using microfluidic organ-on-a-chip culture device	Indian Council of Medical Research	2024	3 Years	Co -PI
04	Preclinical Studies on Targeting beta-hCG as a treatment Strategy for BRCA1 Promoter Hypermethylated Breast Cancers	ASPIRE- Council of Scientific and Industrial Research	2024	3 Years	Co -PI
05	Functional membrane-spanning amyloid pores: from structure and assembly to medicine	Department of Biotechnology	2024	3 Years	Co -PI

Mahendran K.R, PhD

Scientist E-II
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

The major interest of my laboratory is the engineering of transmembrane pores for applications in biotechnology and medicine. In particular, we focus on synthetic peptides-derived alpha-helical pores and biological transmembrane pores and explore their biophysical and electrical characterization using single-channel and single-molecule electrical sensing studies. Our research has important implications for developing stochastic sensors for biomolecules and chemical moieties and therapeutic development.

MAJOR RESEARCH AREA

- We report a synthetic α-helical peptide pore, pPorA, derived from the porinPorACj, which assembles autonomously into octameric pores of large and small conductance states, confirming dual pore architectures.
- Using large-diameter pores, we achieved real-time, label-free detection of conformational states of α-Synuclein and its pathological mutants associated with Parkinson's disease.
- Multiple pathological α-synuclein proteins were simultaneously introduced into the bilayer system and were individually resolved and classified based on their distinct current signatures.
- The small-diameter pores were used to discriminate conformational variants of the mitochondrial peptide Humanin and its disease-associated mutants, offering insight into their apoptotic roles.

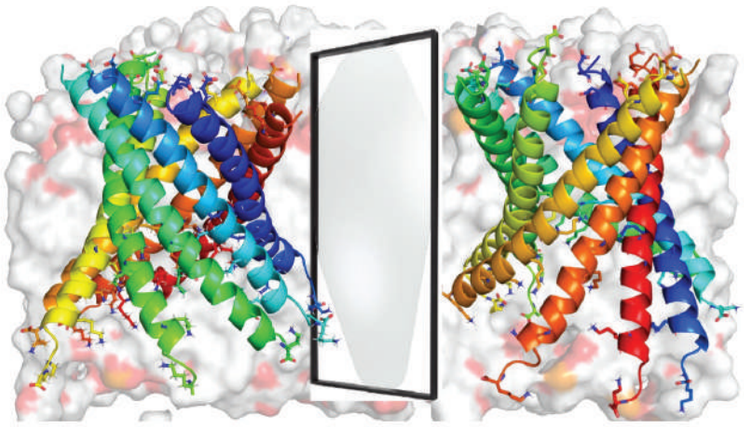
WORK REPORT

- ASSEMBLY OF DUAL-DIAMETER A-HELICAL NANOPORES FOR PATHOLOGICAL PROTEIN DETECTION.

Synthetic nanopores are promising candidates for single-molecule protein sensing, with α-helical nanopores offering a powerful platform for chemical modifications and tunable selectivity. Inspired by the naturally occurring α-helical PorACj from Corynebacteriumjeikeium, a synthetic peptide, pPorA, with an identical sequence to PorACj was designed. Both wild-type pPorA and its mutant pPorA K24C formed stable, high-conductance pores with distinct ion selectivity. Uniquely, pPorA K24C, with a cysteine at position 24, pre-oligomerized into an autonomously assembled octamer. In this work, a D-form cysteine was site-specifically introduced at the same position into an otherwise all-L-form peptide, generating LpPorA K24c(D).The LpPorA K24c(D) peptide was synthesized via solid-phase peptide synthesis, purified using HPLC, and its identity confirmed by mass spectrometry. SDS-PAGE analysis of LpPorAK24c(D) revealed an oligomeric band at approximately 35 kDa, consistent with a stable octameric assembly. The extracted octamers were reconstituted into a DPhPC bilayer for single-channel recordings, revealing two conductance states: ~50% at 2.4 ± 0.2 nS and ~50% at 3.5 ± 0.2 nS.

Site-specific incorporation of unnatural amino acid enabled structural control, yielding large and small-diameter pores of identical subunits. The functionality of these large and small diameter pores were tested using cyclic sugars and linear peptides. Large cyclic sugars bind to small-diameter pores without translocation but traverse through the large-diameter pores, confirming the structural flexibility and size-dependent selectivity of these pores in line with rapid translocation of small unstructured peptides through large pores. Furthermore, using large-diameter pores, we achieved real-time, label-free detection of conformational states of α-Synuclein and its pathological mutants. α-Synuclein is a presynaptic cytosolic protein involved in neurotransmitter release, and its aberrant aggregation is linked to Parkinson's

disease. Wild-type (WT) α-Synuclein, Charge-Reversed α-Synuclein, Del C α-Synuclein, and the A30P mutant each produced distinct ion current blockages, enabling their differentiation. Del C and A30P are highly pathogenic forms. Multiple variants of C-terminally truncated α-Synuclein (Del C-α-Syn) are found in both healthy and Parkinson's disease (PD) brains and have been extensively studied due to their strong propensity to aggregate and form pathological fibrils. In vitro, Del C-α-Syn accelerates the formation of oligomers and fibrils compared to the full-length protein. The A30P mutant is associated with familial early-onset PD and is reported to promote α-Synucleinoligomerization in vitro, suggesting a critical role in the aggregation mechanism of α-Synuclein. When multiple pathological α-Synuclein variants were simultaneously introduced into the bilayer system, they were individually resolved and classified based on their unique current signatures.Small-diameter pores were employed to discriminate between conformational variants of the mitochondrial peptide Humanin and its disease-associated mutants, providing insights into their apoptotic roles. Humanin is known for its cytoprotective, neuroprotective, and anti-apoptotic functions, primarily through the inhibition of mitochondrial apoptosis pathways. Mutations in Humanin can abolish these protective effects. We successfully detected these pathological mutants by their characteristic ion current blockages.These findings establish the functional versatility and conformational flexibility of α-helical peptide pores for complex protein sensing and demonstrate their application in developing next-generation nanopore diagnostics and therapeutic screening tools.



(a) Structure of the modelled LpPorAK24C(D) monomer and SDS-PAGE showing self-assembled pre-oligomer (red circle) and monomer bands.
(b) Single L- and S-state insertions at +200 mV, with conductance histogram shown in the inset.
(c) Competitive addition of α-synuclein variants: Delta-C, charge-reversed, and A30P using the L-state at +50 mV.
(d) Sensing of Humanin variants: WT, C8A, and P3A using the S-state at +50 mV.

TEAM

First Row: Dr. Neethu Puthumadathil, Swati Lakshmi, Raechel Aji Paramban, Dr. Mahendran K R, Vedasmiritha T S, Archa Sasikumar, Smitha Devi S (From L to R)
Second Row: Archana Samal, Arya Krishna, Sarath Thomas B S, Varsha Shaji, Neilah Firzan C A, Arjun B S (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 2 / PhD Students: 6 / JRF: 1 / SRF: 1 / Technical Assistant: 1
Lab Assistant: 1

PUBLICATIONS:

- Sharavanakkumar S K, Majumdar B B, Vikraman D, Mahanta K, Soman A, Rajavelu A, Mondal J, Mahendran K R. A Dynamic Sugar-Selective Bacterial Nanopore for Targeted Antibiotic Transport. Small. 2025 Jun;21(25):e2502110.
- Niitsu A, Thomson A R, Scott A J, Sengel J T, Jung J, Mahendran K R, Sodeoka M, Bayley H, Sugita Y, Woolfson D N, Wallace M I. Rational Design Principles for De Novo α-Helical Peptide Barrels with Dynamic Conductive Channels. J Am Chem Soc. 2025 Apr 9;147(14):11741-11753.
- Satheesan R, Janeena A, Mahendran K R. Hetero-Oligomeric Protein Pores for Single-Molecule Sensing. J Membr Biol. 2025 Aug;258(4):257-267.
- Krishnan R S, Firzan Ca N, Mahendran K R. Functionally Active Synthetic α-Helical Pores. AccChem Res. 2024 Jul 2;57(13):1790-1802.

AWARDS [STUDENTS]:

- Arya Krishna, Best Presentation award for Conformational dynamics of membrane porinscontrol cyclic sugar transport at Indian Biophysical Society Meeting 2025 (IBS2025) from March 6-9, 2025 at Indian Institute of Technology Madras.
- Varsha Shaji received Department of Biotechnology-Travel Award, Alpha Helical pores for sensing. Nanopore conference from 14th March to 15th March, 2025 at Tokyo, Japan.
- Neilah Firzan C A received ANRF International Travel Award. Fabrication of Cytotoxic Mirror Image Nanopores, Single-molecule protein sequencing conference from Jan 18th to 24th, 2025 at Bolzano, Italy.

INVITED TALKS [PI ONLY]:

- Fabrication of Mirror Image Nanopores at Molecular and Cellular Level, Guha Research Conference 2024, 5th November to 9th November 2024, Kaziranga, Assam.
- Building Transmembrane Pores for Nanotechnology and Medicine, Nanopore Meeting 2025 , 14th March to 15th March, 2025, Tokyo, Japan.

CONFERENCE PRESENTATION:

- Neilah Firzan C A, Poster Presentation on Fabrication of Cytotoxic Mirror Image Nanopores, at 2nd BRIC-RGCB Conference, Sep 25th to 28th 2024, Kumarakom, Kerala.
- Neilah Firzan C A, Oral Presentation on Fabrication of Cytotoxic Mirror Image Nanopores, Single-molecule protein sequencing conference, Jan 18th to 24th 2025, Bolzano, Italy.
- Neilah Firzan C A, Oral Presentation on Fabrication of Cytotoxic Mirror Image Nanopores, 10th Indian Peptide Symposium, from Feb 26th to 28th 2025 at IISER, Pune.
- Varsha Shaji, Poster Presentation on Tuning geometry and functionality of alpha helical nanopores through site specific incorporation of natural and unnatural amino acids , Indian Biophysical Society Meeting 2025 (IBS2025) , March 6-9, 2025, at Indian Institute of Technology Madras.
- Arya Krishna, Poster and Oral Presentation on Conformational dynamics of membrane porins control cyclic sugar transport, at Indian Biophysical Society Meeting 2025 (IBS2025) from March 6-9, 2025, Indian Institute of Technology Madras.
- Varsha Shaji, Poster Presentation on Functionally tuned α-helical nanopores through natural and unnatural and aminoacid incorporation, at Nanopore Meeting 2025 , 14th March to 15th March, 2025, Tokyo, Japan.
- Neilah Firzan C A, Poster Presentation on Dual Functional Alpha-Helical Pores for Enhanced Amyloid Detection, at 8th International Conference on Nanoscience and Nanotechnology (ICONN-2025), from Mar 24th to 26th, 2025 at SRMIST, Chennai.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Engineered alpha-helical pores for single-molecule sensing of amyloid structures	Anusandhan National Research Foundation	2022	3 Years	PI
02	The porin passport control for antibiotic translocation: From single-molecule detection to biological relevance	Department of Biotechnology	2023	3 Years	PI
03	Functional membrane- spanning amyloid pores: from structure and assembly to medicine	Department of Biotechnology	2024	3 Years	PI

04	Functional studies on novel porin from malaria parasite and its implications as a therapeutic drug target	Indian Council of Medical Research	2025	3 Years	PI
05	Building unnatural antimicrobial peptide pores targeting bacterial membranes against antibiotic resistance	Indian Council of Medical Research	2025	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Remya S	Membrane Pores as Single Molecule Biosensors	Manipal Academy of Higher Education	Awarded	2024
02	DevikaVikraman	Substrate Translocation across Bacterial Membrane Pores: From Single Molecule Detection to Biological Relevance	Manipal Academy of Higher Education	Awarded	2024

Manjula S, PhD

Scientist F
Plant Biotechnology & Disease Biology

BRIEF THEME OF LABORATORY

Our lab focuses on gaining molecular insights into the Piper nigrum L. X PhytophthoracapsiciLeonianpathosystem through 'omics' and ensuing functional approaches with the ultimate aim of devising better crop protection strategies in black pepper against 'foot-rot'.

MAJOR RESEARCH AREA

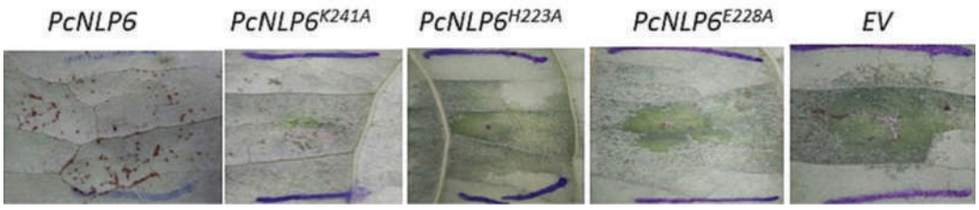
- Identification of crucial virulence factors from the oomycete pathogen Phytophthoracapsici affecting black pepper through proteomics approaches.
- Functional approaches for validation of the identified pathogen effector genes.
- Identification and validation of putative drug targets in P.capsici.

WORK REPORT

- FUNCTIONAL ANALYSIS OF THE PATHOGEN APOPLASTIC EFFECTOR NLP6 IN PIPER NIGRUM THROUGH SITE DIRECTED MUTAGENESIS AND AGRO INFILTRATION.

Oomycete effectors have emerged as valuable tools for investigating plant immune responses and studying host-pathogen evolution. They are pathogen molecules that alter the structure and function of host cells, aiding in infection and/or eliciting defense responses. Despite being an important spice crop, understanding host-pathogen interaction from the pathogen's perspective is limited in the P. capsici-black pepper pathosystem. While traditional methods of heterologous gene expression involve stable transgenic plants, which are time-consuming, transient expression systems like agroinfiltration offer a rapid and straightforward alternative. We established the feasibility of using agroinfiltration-mediated transient expression and site directed mutagenesis in black pepper to investigate effector roles. Nicotianabenthamiana plants were used along with black pepper plants to optimize agroinfiltration strategy. Nicotianabenthamiana plants were grown under a 24°C temperature regime with a 16-h light and 8-h dark cycle until they reached the eight-leaf stage. The binary vector pCAMBIA1305.2, was used for the study. The β-glucouronidase (GUS) gene in the pCAMBIA1305.2 was replaced by the P. capsiciapoplastic effector PcNLP6 or its site-directed mutants. Three amino acids -K214, H223, and, E228 -from the conserved domain of PcNLP6 were replaced by alanine through site-directed mutagenesis. The genes were synthesized and delivered in pCAMBIA 1305.2 by GeneArt Custom Gene Synthesis, ThermoFisher Scientific to generate pCAMBIA 1305.2:: NLP6, pCAMBIA 1305.2:: NLP6 K241A, pCAMBIA 1305.2:: NLP6 H223A, and, pCAMBIA 1305.2: NLP6 E228A. The constructs were introduced into A. tumefaciens strain GV3103 by the freeze–thaw method. The same method was employed for the transient expression study of PcNLP6 in black pepper on the second and third mature detached leaves. A GUS histochemical assay was performed following the agroinfiltration of the empty vector pCAMBIA1305.2-GUS before infiltrating them with wild-type PcNLP6 and its mutants. Cell death was detected using trypan blue staining.

In black pepper leaves infiltrated with A. tumefaciens GV3103 harboring pCAMBIA1305.2, GUS staining assay showed blue colouration as early as 2 days post infiltration whereas no color was observed in black pepper leaves infiltrated with A. tumefaciens GV3103 alone. The presence of GUS gene transcripts was also confirmed by RT-PCR .Trypan blue staining of these regions in black pepper confirmed the cell death activity. These brown spots were absent in the mutants as well as in the empty vector control (Figure 1). These results collectively highlight PcNLP6 as a candidate effector of interest for studying its functional role in quick wilt disease of black pepper.



Black pepper leaves agroinfiltrated with PcNLP6 wildtype or its mutants at four days post infiltration. EV stands for empty vector.

TEAM

Mookul Samader, Dr. Manjula S, Gayathri G S, Raveena C Pereira (From L to R)

LABORATORY STRENGTH

PhD Students: 1 / JRF: 1 / SRF: 1 / Project Assistant: 1

PUBLICATIONS:

- Vijayakumar S, Saraswathy G G, Sakuntala M. Transcriptomic analysis reveals pathogenicity mechanisms of Phytophthoracapsici in black pepper. Front Microbiol. 2024 Nov 18;15:1418816.
- Mahadevan C, Shafi K M, Nagarathnam B, Sakuntala M, Sowdhamini R. Transcriptional regulation of hormone signalling genes in black pepper in response to Phytophthoracapsici. BMC Genomics. 2024 Sep 30;25(1):910.

PATENTS APPLIED/ GRANTED:

- An Antifungal Synthetic Peptide Derived from Osmotin Protein, Inventor: S.Manjula No. 548799, Indian Patent, August 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Exploiting Defense Priming in Tea (Camellia sinensis (L.) O. Kuntze) for crop protection against the major insect pests (Tea mosquito bug (Helopeltistheivora) & Red spider mites (Oligonychuscoffeae) and diseases (blister blight, Exobasidiumvexans and grey blight, Pestalopsistheae) and metabolome-assisted identification of biomarkers for improving tea quality	National Tea Research Foundation	2024	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Indu M	Molecular Insights into 'Priming' as a Potential Crop Protection Strategy in Piper nigrum L'	University of Kerala	Awarded	2025

Moinak Banerjee, PhD

Scientist G
Neurobiology

BRIEF THEME OF LABORATORY

Genetics and Epigenetics of Complex disorders of brain

MAJOR RESEARCH AREA

- Resolved genetic diagnosis for more than 80 rare disease condition.
- Identified genomic, epigenomic and proteome-based markers for teratogenic impact of antiseizure medications.

- Identified genomic, epigenomic and proteome-based markers for potential side effects of antihypertenive medications.
- Developed tool for predicting the regulatory functions of non-coding variants and their significance in neurological conditions.
- Developed tool for predicting latent factors and markers associated with stroke in presence of comorbidities.
- Identified CNVs that pose risk for developing Non-syndromic hearing loss.
- Developed deep learning based tools for predicting functional implication of mutations.

WORK REPORT

- MISSION PROGRAM ON PEDIATRIC RARE GENETIC DISORDERS (PRAGED)

Pharmacoepigenetics of antiepileptic drugs:

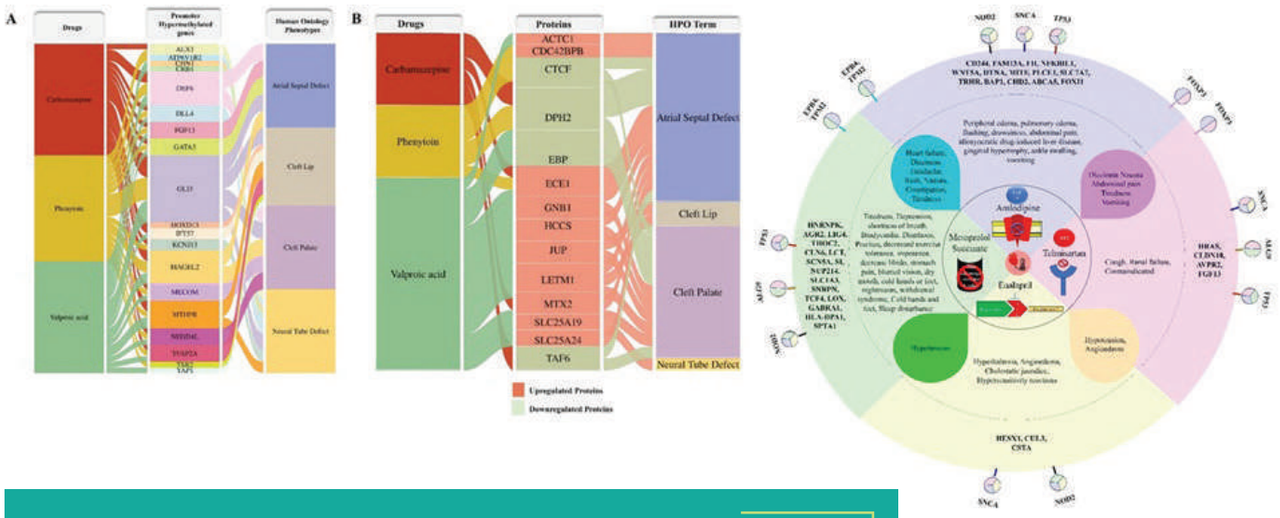
Fetal exposure to antiseizure medications (ASMs) can impact organogenesis resulting in elevated risk of congenital malformations. We used an OMIC based approach to understand the impact of ASMs on methylome and subsequently on proteome and how folic acid (FA) supplementation can counter these effects. ASMs was seen to induce global DNA hypomethylation which was influenced by dysregulation of DNMT and TET expression. Interestingly, FA co-treatment partially restored DNA methylation as evidenced by global DNA methylation and epigenetic gene expression, and also by compensatory effect via one-carbon metabolism. Genome-wide DNA methylation revealed site-specific hypermethylation at key developmental genes, several of which were reversed with FA. Proteomics analysis identified downregulation of developmentally critical proteins, including those linked to key metabolic processes, while FA co-treatment reversed expression of several such proteins. Integrative methylome–proteome analysis revealed coordinated regulation of target genes that are linked to congenital abnormalities

Pharmacoepigenetics of antihypertensive drugs: The trial-and-error mode of antihypertensive use can result in adverse impact. Pharmacoepigenetics provide clues to these adverse outcomes. The epigenetic gene expression pattern upon amlodipine, enalapril, telmisartan and metoprolol treatment indicated a drug, dosage, and duration dependent expression of DNMTs and TETs. Global methylation and hydroxy-methylation patterns overlap with the gene expression patterns of DNMTs and TETs for amlodipine and telmisartan, but variability was observed with metoprolol and enalapril. This was followed by genomewide methylation, small-RNA sequencing and proteome analysis. Gene specific methylation pattern revealed several drug specific differential methylated genes. Similarly significant differential regulation of several miRNAs and proteins, were seen, among these a few reflected reverse relationships of miRNA regulation and protein expression. Certain miRNAs and their corresponding target proteins seems to distinguish between good therapeutic outcomes and potential side effects.

Genetics and epigenetics of Hearing loss: Early detection of NSHL is highly challenging due to lack of consensus on genetic and mutational background across phenotypes and ethnicities. The study identified 225 unique CNVs that were exclusively present in patients. Among the total number of CNVs that were enriched in NSHL cases, several known overlapping NSHL genes COL11A2, EPS8L2, NARS2, ESRRB,OSBPL2,DSPP were identified.

Artificial intelligence in health: Stroke has a complex etiology, which is further influenced by the genetics of ethnicity and its comorbid conditions. A genomic structure equation model was applied to identify the latent factors for stroke and its comorbid conditions in European and East Asian population. Two latent factors characteristic to the population emerged in each of the populations - one was an inflammation factor and other a metabolic factor. A total of 99 new loci associated with stroke and its latent factors were identified. Expression quantitative trait loci highlight the differential effect of change in gene expression of the colocalizing variants among the two populations. Additionally, we developed AGAAT a software for cross platform whole genome genotyping application and ISANREG and NEURALLY software's which can predict regulatory functions of a variant, and its implications in brain.

Alluvial plot illustrating the association between ASM treatments and their corresponding developmental phenotypes.
Unique and Overlapping DMPs for each drug and genes associated with phenotype specific side effects.



TEAM

Ruchira Menghal, Rashmi Sukumaran, Ardra M, Dr Moinak Banerjee, Archisha Banerjee, Shabith Raj, Neethu Mohan, Samyukta Bhass (From L to R)

LABORATORY STRENGTH

PhD Students: 6 / JRF: 1 / SRF: 3 / Project Assistant: 1 / Project Associate: 1

PUBLICATIONS:

- Krishna S, Fasaludeen A, Jose M, Banerjee M, Sundaram S, Radhakrishnan A, Menon R N. Impact of variant subtype on electro-clinical phenotype of Dravet syndrome- a South Indian cohort study. Seizure. 2024;115:81-86.
- Jose M, Fasaludeen A, Pavuluri H, Rudrabhatla P K, Chandrasekharan S V, Jose J, Banerjee M, Sundaram S, Radhakrishnan A, Menon R N. Metabolic causes of pediatric developmental & epileptic encephalopathies (DEE)- genetic variant analysis in a south Indian cohort. Seizure. 2024 Jan 3;115:20-27.
- Polakkattil B K, Vellichirammal N N, Nair I V, Nair C M, Banerjee M. Methylome-wide and meQTL analysis helps to distinguish treatment response from non-response and pathogenesis markers in schizophrenia. Front Psychiatry. 2024 Mar 7;15:1297760.
- Sukumaran R, Nair A S, Banerjee M. Ethnic and region-specific genetic risk variants of stroke and its comorbid conditions can define the variations in the burden of stroke and its phenotypic traits. eLife. 2024 Sep 13;RP94088.
- Thanseem I, Banerjee M, Melempatt N, Prakash A, Iype M, Anitha A. Comprehensive Genetic Study of a Monozygotic Triplet Discordant for Autism Spectrum Disorder. Neurol India. 2024 Mar 1;72(2):384-387.
- Anitha A, Banerjee M, Thanseem I, Prakash A, Melempatt N, Sumitha P S, Iype M, Thomas S V. Rare Pathogenic Variants Identified in Whole Exome Sequencing of Monozygotic Twins With Autism Spectrum Disorder. Pediatr Neurol. 2024 Sep;158:113-123.
- Raj K S, Jayakrishnan K, Kavitha L S, Banerjee M, Kumar G P. Clinical Insights into Semen Parameters of Men Reporting to Two Fertility Centres in Thiruvananthapuram, Kerala, India. J Endocrinology Reproduction. 2024 Dec 6:117-24.
- Thanseem I, Banerjee M, Melempatt N, Prakash A, Iype M, Anitha A. Comprehensive Genetic Study of a Monozygotic Triplet Discordant for Autism Spectrum Disorder. Neurol India. 2024 Mar 1;72(2):384-387.
- Fasaludeen A, McTague A, Jose M, Banerjee M, Sundaram S, Madhusoodanan U K, Radhakrishnan A, Menon R N. Genetic variant interpretation for the neurologist - A pragmatic approach in the next-generation sequencing era in childhood epilepsy. Epilepsy Res. 2024 Mar;201:107341.

- Jose M, Fasaludeen A, Pavuluri H, Rudrabhatla P K, Chandrasekharan S V, Jose J, Banerjee M, Sundaram S, Radhakrishnan A, Menon R N. Challenges in genetic testing for metabolic causes of developmental epileptic encephalopathy- relevance of genotype-phenotype correlations. Seizure. 2024,117:307-308.
- Anil Prakash, Moinak Banerjee AGAAT: Automated computational tool integrating different genotyping array and correctional methods for data analysis. bioRxiv 2025.02.25.637414.
- Fasaludeen A, Jose M, U Aswathy, Prasannakumar S, Banerjee M, Sundaram S, U K Madhusodhanan, Radhakrishnan A, Menon R N. A real-world comparison between the diagnostic yield of trio-whole exome sequencing and proband-only targeted exome sequencing in complex childhood epilepsy. Seizure. 2025;129:51-54.
- Anju Mathew, Ann Mary Alex, Chathathayil Mohammedali Shafeeque, Saboora Beegum Muthubeevi, Vijayakumar Krishnapillai, Moinak Banerjee. Genetic predictors of attempted suicide among South Indian adolescents and young adults: A case-control study. Biomarkers in Neuropsychiatry, 2025,12, 100126.

AWARDS [PI]:

- L D Sanghvi Oration award for Life time contribution to Human genetics from Indian Society of Human Genetics (ISHG) during the 49th Annual Meeting of Indian Society of Human Genetics (ISHG) and International Conclave on Neurogenetics, at NIMHANS, Bengaluru from Jan. 20-22, 2025.

AWARDS [STUDENTS]:

- Neethu Mohan: Unraveling the pharmacoepigenetic effects of antiepileptic drugs presented at FEBS Advanced Lecture Course: 5th Danube Conference on Epigenetics, at Budapest , Hungary from 28th -31stOctober 2024 [FEBS Youth Travel Grant and DBT CTEP Travel Award].

INVITED TALKS [PI ONLY]:

- Talk on How to dissect a complex disease at National seminar on NanoGenPro Triad: Exploring the future science on 10th Jan 2024 at SB College Changanasserri.
- Talk on Genetic and Epigenetic Dissection of Complex brain disorders on 11th March 2024 at Central University of South Bihar, Gaya.
- Talk on Dilemma's in biomedical research and way to resolve on 12th March 2024, at ICAR-Indian Institute of Agricultural Biotechnology, Ranchi.
- Talk on Resolving complexities of stroke needs a precise stratification approach at GATC2024, ICGEB, New Delhi from 12-14th April, 2024.
- India Genomics Conclave 2024 at Sheraton New Delhi on 5th September,2024.
- Talk at 31st Swadeshi Science Congress, ICAR-CIFT, Kochi from 7-9 November 2024.
- IEEE International Conference on Smart Technologies for Sustainable Development Goals (ICSTSDG'24) at SA Engineering College, Chennai from November 6- 8, 2024.
- Regional meeting of GATC, Thiruvananthapuram on 17 Nov 2024.
- NBRC Foundation Day symposium. Brain and Society: Clinical and physiological perspective of brain disorders at NBRC, Manesar from 13th – 15th Dec. 2024.
- Talk on Complex journey of common to rare (disease): Dissecting the dilemma LD Sanghvi Oration lecture at ISHG 2025. NIMHANS, Bangalore on Jan 20, 2025.
- Talk at Science Day, Dept. of Biotechnology, University of Kerala on Feb. 28th 2025.

CONFERENCE PRESENTATION:

- Samyukta Bhass, Poster Presentation on Pharmacogenetic insights into hypertension with intracranial aneurysm as an outcome: Implications for precision medicine in Annual Meeting of American Society of Human Genetics at Denver, Colorado, U.S from November 5-9, 2024.

- Samyukta Bhass, Oral Presentation on Pharmacogenetic Perspectives on Hypertension and Intracranial Aneurysm: The Relevance of Precision Medicine at the National Conference on Omics in Redefining Healthcare "ORAH," from August 23- 24, 2024 organized by Jubilee Centre for Medical Research, Thrissur.

- Neethu Mohan, Unraveling the pharmacoepigenetic effects of antiepileptic drugs presented at FEBS Advanced Lecture Course: 5th Danube Conference on Epigenetics at Budapest , Hungary from 28th -31st October 2024 [FEBS Youth Travel Grant and DBT CTEP Travel Award].

- Neethu Mohan, Evaluating the effect of first generation antiepileptic drugs on epigenetic genes presented at Clinical Epigenetic International Conference 2024, Warsaw, Poland from 5th-7th June 2024 [Meeting abstracts of the CLEPIC 2024. Clinical Epigenetics 16 (Suppl 1), 150 (2024).

- Neethu Mohan, Poster Presentation on Mitigating developmental toxicity of antiseizure medications via folic acid: Insights from a Multi-Omics approach at American Society of Human Genetics 2025 Annual Meeting, Boston, MA,US.

- Ardra M, Effects of noncoding variations in the chromatin organization in nonsyndromic hearing loss. National conference on OMICS in Redefining Healthcare (ORAH) from 23-24 August 2024, at JCMR Thrissur, Kerala.

- Ardra M, Noncoding variants disrupts chromatin organization in Nonsyndromic hearing loss at International Conference of Genetics Society of Korea 2024 from 16-18 October 2024.

- Ardra M, Crosstalk between genetics and epigenetics in nonsyndromic hearing loss at the 49th Annual Meeting of Indian Society of Human Genetics (ISHG) and International Conclave on Neurogenetics. NIMHANS, Bengaluru from Jan. 20-22, 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Genetics of complex pediatric epilepsy syndromes: electro-clinico-imaging based genotype-phenotype correlations in an Indian cohort.	Indian Council of Medical Research	2019	5 Years	Co-PI
02	A whole exome sequencing study to identify novel gene variants in Moyamoya disease in the Indian population	Indian Council of Medical Research	2023	2 Years	Co-PI
03	Mission mode project on pediatric rare disease	BRIC- Department of Biotechnology	2023	5 Years	Co-PI
04	Understanding Prakriti and its Inheritance Pattern in Health and Predominant Disease Predisposition from a Regional Perspective -A Genetic and Epigenetic Study	Ministry of AYUSH	2024	3 Years	Co-PI
05	An Exploratory Trial for the Evaluation of Immunological Profiling, Autonomic Effect, and Psychoneurological Responses of Shirodhara in Apparently Healthy Individuals	Ministry of AYUSH	2025	2 Years	Co-PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Anil Prakash	Evaluating an integrative model for genotypic heterogeneity in Autism Spectrum disorder	University of Kerala	2024	2024
02	Binithamol Polakkattil	Identifying The Epigenetic Signatures Of Treatment Response In Schizophrenia	University of Kerala	2024	2024
03	Rashmi Sukumaran	Identifying genetic and functional correlates of comorbidity factors in Stroke	University of Kerala	2025	2025
04	Alfiya Fazal	Genotype phenotype correlations in complex childhood epilepsies and developmental epileptic encephalopathies in an Indian cohort	SCTIMST	2025	2025
05	Trinath M	Understanding the effects of Add-on yoga therapy on immuno-inflammatory markers in Schizophrenia	NIMHANS	2025	2025

Moumita Srivastava, PhD

Scientist C
Plant Biotechnology & Disease Biology

BRIEF THEME OF LABORATORY

We aim to elucidate the mechanisms underlying plant stress responses during necrotrophic infections, with a particular focus on the role of post-translational modifications, especially SUMOylation. Additionally, we are interested in exploring how different wavelengths of light, particularly blue light, regulate cellular responses under abiotic stress conditions.

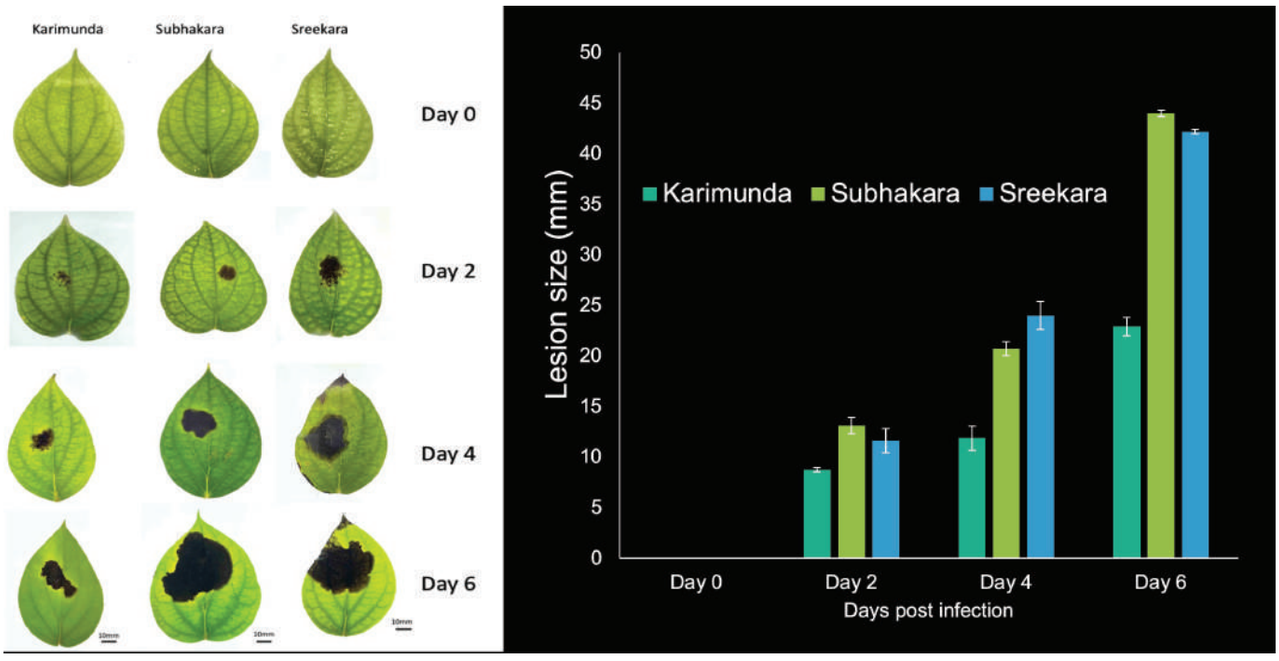
MAJOR RESEARCH AREA

- Identified the SUMO machinery components in Black pepper (Piper nigrum).
- Transcriptional analysis of SUMO machinery components during Phytophthoracapsici infection.
- Identified a class of transcription factors (WRKYs) in Black pepper (Piper nigrum).
- Transcriptional analysis of WRKY transcription factors during Phytophthoracapsici infection.

◆ DECODING CELLULAR RESPONSES DURING NECROTROPHIC INFECTION IN PLANTS

The sequence for the PnSUMO1 has be identified from the genome sequence of black pepper published by Hu et. al., (Hu et. al., 2019) through in silico analysis. As the SUMOylation machinery in black pepper has not yet been identified, we are using the SUMO machinery from Arabidopsis for the SUMOylation assay. We are use pCDFDuet-AtSUMO1(GG)-AtSCE1 and pACYCDuet-AtSAE1a/b-AtSAE2 for the experiment. We replaced AtSUMO1(GG) with the active form of Piper nigrum SUMO1, PnSUMO1(GG), to generate pCDFDuet-PnSUMO1(GG)-AtSCE1. As a negative control for SUMOylation, the C-terminal Gly-Gly motif of SUMO1 in the pCDFDuet vector will be mutated to Ala-Ala by site directed mutagenesis. The constructs thus generated will be used for in vitro SUMOylation assay. The different combinations of DUET plasmids will be used for the SUMOylation assay. Proteins will be extracted from the transformed bacterial cells and used directly for immunoblot analyses (Augustine et. al., 2016).

We are also focusing to understand the transcriptional reprogramming event during the P. capcisi infection. To address this question, we performed semi-quantitative RT-PCR to know the transcriptional reprogramming of WRKY transcription factors. We infected the 6-week-old plants with P. capcisi and collect the sample at different time points, 0, 6 and 12 hours post-infection and total RNA was isolated for semi-quantitative RT-PCR. We used Karimunda, Sreekara and Subhakara varieties to study if any variations in the transcriptomic profile contribute to the varying susceptibility in the different varieties (Figure 1). The data provides the global transcriptional landscapes and also provide the transcriptional changes in black pepper WRKY transcription factors during infection.



Phytophthoracapsici–host interaction studies on the black pepper (Piper nigrum):
(A) Infection time course assay performed on black pepper (Piper nigrum) leaves. Photographs were taken at the time points indicated.
(B) Infection rates at different time points. Each column is a mean of sites infected from three repeating experiments.

TEAM

Abin Regy, Dr. Moumita Srivastava, Silpa M G, Priyanka T (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / Technical Assistant: 2

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Unraveling the mechanism of blue light mediated endoplasmic reticulum stress responses in plants	Anusandhan National Research Foundation	2025	3 Years	PI

Nagarjun Narayanaswamy, PhD

Scientist C

Transdisciplinary Biology

BRIEF THEME OF LABORATORY

Our lab at BRIC-RGCB primarily focuses on developing new activity-based fluorescence probes/bioconjugation tools to uncover the biology of non-enzymatic protein-posttranslational modifications (PTMs), non-apoptotic cell death forms and intracellular organelle membrane contact sites (MCS). Further, we are also interested in developing DNA-based biosensors for detecting small molecular and protein biomarkers in liquid biopsy samples.

MAJOR RESEARCH AREA

- Designing new activity-based fluorescence probes for studying non-apoptotic cell death pathways.
- DNA-based pattern-ID fluorescence probes for the detection of pathogens and protein biomarkers.
- Development of organelle specific fluorescence probes to understand the role of calcium signaling at organelle membrane contact sites (MCS).

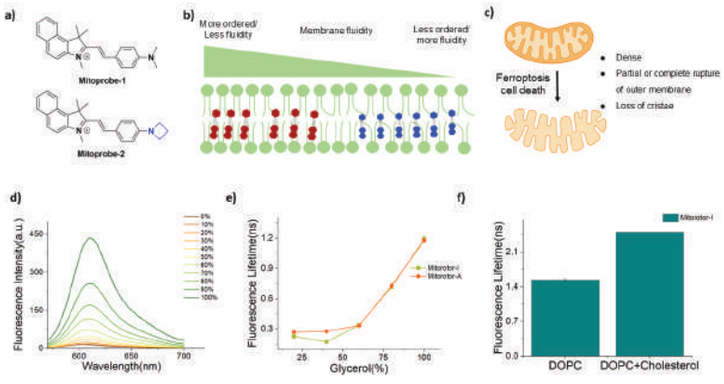
WORK REPORT

◆ EVALUATE THE EFFECT OF MITOCHONDRIAL FLUIDITY IN FERROPTOSIS CELL DEATH

Ferroptosis is a new form of non-apoptotic cell death characterized by iron-dependent peroxidation of polyunsaturated fatty acids (PUFAs). Three significant factors such as metabolism, reactive oxygen species (ROS) and iron homeostasis, contribute to the fundamental understanding of ferroptosis mechanisms, biological relevance and therapeutic significance. Recent observations demonstrate that other membrane-bound organelles such as endoplasmic reticulum, mitochondria and lysosomes are also susceptible to lipid peroxidation during ferroptosis. However, it is still unclear how intracellular organelles, especially mitochondria (epicenter for ROS) contribute to the initiation and progression of ferroptosis physiologically and pathologically. Mitochondrial membrane composition is highly heterogeneous, and lipids concentration is low compared to most protein compositions on the membrane. Interestingly, the presence of PUFA is higher than that of other intracellular organelles. PUFAs are more prone to undergo lipid peroxidation in the presence of Fe2+ and ROS; however, it is still yet to be understood how lipid peroxidation on the mitochondrial membrane induces ferroptosis cell death. In this regard, understanding the role of mitochondrial membrane fluidity under ferroptosis conditions can shed light on how change in mitochondrial fluidity affects the initiation and propagation of ferroptosis.

Hemicyanine-based molecular rotor probes have been widely explored for the fluorescence imaging of nucleic acids, proteins, free thiols, and reactive oxygen species (ROS). The unique molecular properties of Hemicyanine-based probes, such as long-wavelength excitation/emission, good aqueous solubility, and excellent cell permeability, make them attractive molecular tools for in vivo imaging applications. Here, we designed a molecular rotor-based fluorescence probe to elucidate the role of mitochondrial fluidity under ferroptosis conditions. First, we successfully synthesized hemi-cyanine-based mitochondrial selective molecular rotor probes (Mitoprobes) by simple knoevenagel condensation of methylated trimethyl-indole derivative with p-dimethylaminobenzaldehyde and 4-(azetidin-1-yl) benzaldehyde. Further, these molecular rotor-based fluorescence probes were characterized using LC-MS analysis, HPLC and NMR.

Molecular rotors are intrinsically environmentally sensitive probes; depending on the local viscosity and biological membrane ordering, these molecular rotor probes exhibit increased quantum yields and fluorescence lifetime. To ascertain the environmental sensitivity of Mitoprobes, we performed fluorescence studies of Mitoprobes by changing the solvent viscosity by increasing the glycerol percentage in methanol solvent. Fluorescence studies showed a gradual increase in fluorescence of both Mitoprobe-1 and Mitoprobe-2 with an increase in solution viscosity. Similarly, the fluorescence lifetime studies showed increased fluorescence lifetime of both mitoprobe-1 and mitoprobe-2 with increased solution viscosity. To study the fluorescence lifetime of Mitoprobe on the membrane, we used artificial membrane systems by varying the concentration of saturated and unsaturated fatty acids on the membrane (DOPC: Cholesterol) with Mitoprobe-1. Interestingly, the fluorescence lifetime measurement on vesicular membrane systems showed an increase in fluorescence lifetime with increasing cholesterol percentage, elucidating that Mitoprobe-1 could capture the changes in membrane ordering by varying the fluorescence lifetime. Overall, the above viscosity-dependent studies confirm that Mitorotor probes can report the change in local viscosity around the probe. In the next steps, we will use FLIM-based studies in in vitro systems under ferroptotic conditions to understand the changes in mitochondrial membrane fluidity.



(a) Molecular structure of Mitoprobe-1 and Mitoprobe-2.
(b) Schematic depiction of probing of membrane fluidity using Mitoprobes with a change in fluorescence lifetime.
(c) Morphological changes in mitochondrial membrane under ferroptotic cell-death conditions. (d) Fluorescence spectra showed an increase in fluorescence intensity of Mitoprobe-1 by increasing the glycerol content in Methanol.
(e) Change in fluorescence lifetime of Mitoprobe-1 and Mitoprobe-2 with increasing glycerol percentage in Methanol.
(f) Fluorescence lifetime of Mitoprobe-1 in vesicles made with DOPC and DOPC/Cholesterol.

TEAM

Fathima N, Dr. Nagarjun Narayanaswamy, Anagha S Nair (From L to R)

LABORATORY STRENGTH

PhD Students: 2 / JRF: 1

PUBLICATIONS:

- Ittycheria, S S, Sivakumar, K C, Patra D, Ramachandran B, Neetha R L, Warrier A V, Aiswariya M A, Kaviya S, Suman P, Narayanaswamy N, Srinivas P. Discovery of potential small molecule inhibitors against β-hCG: an in silico study with in vitro validation. RSC advances, 15(25), 19561–19580.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Development of new activity-based probes for understanding the role of non-apoptotic cell death pathways	Department of Biotechnology	2024	3 Years	PI
02	Organelle specific fluorescence probes to study intracellular dynamics and calcium signaling	Anusandhan National Research Foundation - Prime Minister Early Career Research Grant.	2025	3 Years	PI

Pallabi Mitra, PhD

Scientist C

Pathogen Biology

BRIEF THEME OF LABORATORY

Laboratory of Molecular Parasitology works with Apicomplexan parasites like Toxoplasma gondii to better understand their intracellular survival strategies by subversion of host signalling pathways and gene regulatory mechanisms. The aim is to unravel unknown aspects of Apicomplexan parasite biology by focussing on parasite specific molecular events as well as host-parasite interactions.

MAJOR RESEARCH AREA

- We investigate how Toxoplasma co-opts the molecular chaperone-mediated host stress signaling pathway to promote its survival and multiplication in the host cell.
- Given the parasite's reliance on precise gene regulation to transition between developmental stages and maintain chronic infection, we are also exploring the multi-protein transcriptional complexes that regulate gene expression underlying the developmental transition between acute and chronic stages of infection.

WORK REPORT

- ROLE OF THE UNIQUE GLYCINE RICH REPEAT AT THE C-TERMINUS TOXOPLASMA HSP70 IN SELECTIVE DRUG TARGETING IN TOXOPLASMA GONDII.
- TRANSCRIPTOMIC ANALYSIS OF PLASMODIUM SPT4 MUTANT REVEALS SIGNIFICANT CHANGES IN GLOBAL GENE EXPRESSION.

Role of the unique Glycine rich repeat at the C-terminus Toxoplasma HSP70 in selective drug targeting in Toxoplasma gondii.

This project investigates the structural and dynamic effects of a mutation in the TGHSP70 protein by conducting a 1000 ns molecular dynamics simulation using CHARMM27 force field. Comparative analyses were performed between the wild-type (WT) and mutant(MT) systems to assess stability, compactness, flexibility, solvation, and protein-drug interactions.

Objectives: To generate reliable three-dimensional models of both wild-type (WT) and mutant (MT) TGHSP70 (GGMP repeat truncation) proteins using homology modeling,Ø To investigate the binding affinity and orientation of a well characterized HSP70 selective drug 2-PES (Phenylethynesulfonamide) with both WT and MT TGHSP70 proteinsØ To perform long-timescale molecular dynamics (MD) simulations (1000 ns)Ø To compare key structural and energetic parameters (RMSD, RMSF, Radius of Gyration, SASA, and hydrogen bonding).

Results: Homology models for both the TgHSP70 Original and TgHSP70 Variant protein sequences were generated. Both models are based on the same high-quality crystal structure (PDB: 7o6r.1.A). The GMQE and QMEANDisCo Global scores indicate reliable model quality for both constructs. The sequence identity of 76.9% and full template coverage provide strong support for template selection. The mutant protein exhibits higher RMSD, suggesting reduced structural stability or altered dynamics while WT remains comparatively rigid, possibly indicating retention of structural integrity. Mutation induces significant backbone fluctuations, potentially impacting function (Figure 2A). Mutant residues are more mobile, possibly due to altered interactions or loss of stabilizing contacts. Increased flexibility might reflect destabilization or partial unfolding in functional regions. Mutant has higher local flexibility, possibly impacting protein ligand binding or domain behaviour (Figure 2B). Higher Radius of gyration in MT indicates a more expanded structure, possibly due to loosening of tertiary packing. WT retains compact, stable folding; MT adopts looser, more dynamic conformation. Mutation leads to partial unfolding or reduced compactness (Figure 2C). MT exposes more surface area to solvent, supporting the observation of structural loosening. May imply reduced hydrophobic core burial or changes in surface residue exposure. Mutation results in higher solvent exposure, possibly destabilizing the protein core (Figure 2D).

II. Transcriptomic analysis of Plasmodium SPT4 mutant reveals significant changes in global gene expression

The PbSPT4 knockout (KO) mutant showed a significant increase in gametocytaemia and defects in schizont maturation. To explore these effects, we performed RNA sequencing on PbSPT4 KO and wild-type (WT) parasites. Differential gene expression (DGE) analysis with DESeq revealed substantial changes in mRNA levels, showing 911 upregulated and 1153 downregulated genes out of 2016 total.

Gene Ontology (GO) analysis indicated that PbSPT4 depletion disrupted genes related to host cell invasion, antigenic variation, parasite survival, and merozoite egress. Conversely, upregulated genes were linked to gametocyte activation and fertilization, indicating compromised growth but enhanced transmission processes.

Further analysis identified downregulated genes, including multigene family sub-telomeric genes and merozoite surface proteins (MSPs), while upregulated genes included cytoskeletal and inner membrane complex proteins. Quantitative reverse transcription PCR (qRT-PCR) validated selected downregulated (e.g., Fam-a, PHIST) and upregulated (e.g., ROVER, P25) genes.

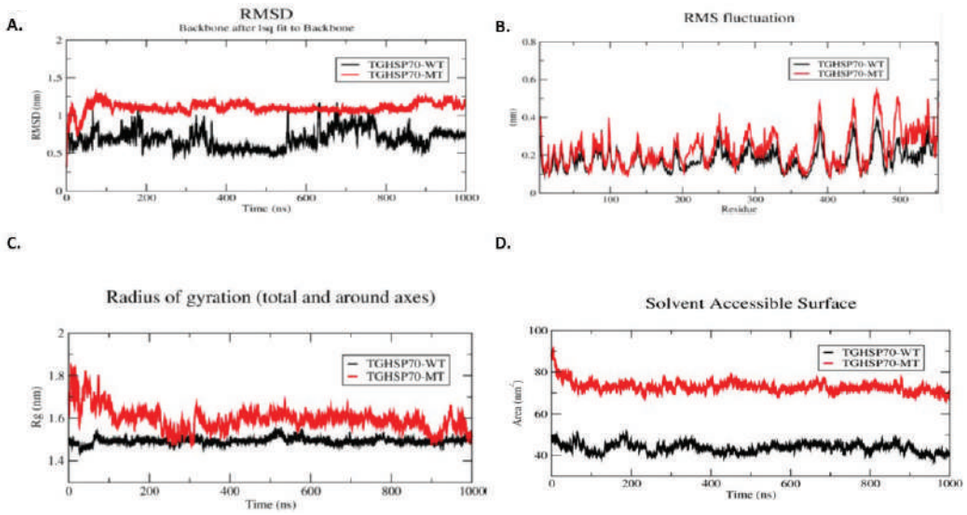
Overall, these findings highlight PbSPT4's crucial role in regulating gene expression for asexual stage propagation and transmission of the parasite.

(A) Root mean square deviation (RMSD) indicates backbone stability: WT (Black Line) stabilizes around 0.6–0.8 nm, indicating good structural stability; MT (Red Line) stabilizes at ~1.0–1.2 nm, with early fluctuations, implying higher conformational drift.

(B) Root Mean Square Fluctuation (RMSF) indicates residue flexibility: MT shows consistently higher fluctuations across residues. Notable peaks between residues ~250–300 and ~400–500 in MT, corresponding to likely loop or flexible domain regions.

(C) Radius of gyration (Rg) indicates compactness: WT Rg remains stable at ~1.45 nm throughout the trajectory. MT starts at ~1.75 nm, gradually decreases but remains higher (~1.6 nm) than WT. Mutation leads to partial unfolding or reduced compactness.

(D) Solvent accessible surface area (SASA): MT exposes more surface area to solvent (MT: Average SASA ~75–85 nm^2) as compared to WT (SASA ~45–50 nm^2), supporting the observation of structural loosening.



TEAM

P Rajesh Kannan

LABORATORY STRENGTH

PhD Students: 1

PUBLICATIONS:

- Mitra P, Deshmukh A S. Proteostasis is a key driver of the pathogenesis in Apicomplexa. BiochimBiophysActaMol Cell Res. 2024 Dec;1871(8):119824.
- Mishra V, Mitra P, Shinde S, Chaudhari S, Deshmukh A S. Neosporacaninum in pigs and pig farmers in India: Examining the prevalence, immunodominant antigens and associated risk factors. MicrobPathog. 2025 Mar;200:107352.

Parijat Senapati, PhD

Scientist C & DBT-Ramalingaswami Fellow
Cancer Research

BRIEF THEME OF LABORATORY

Our laboratory focuses on unraveling the functional roles of the non-coding parts of the human genome. We study DNA elements such as retrotransposons, long non-coding RNAs and enhancers and their roles in disease pathogenesis. We use a combination of functional genomics and computational approaches to understand the genetic and epigenetic underpinnings of diseases such as cancer with the goal of advancing biomedicine. We also work on collaborative projects focusing on epigenetic mechanisms underlying diabetic complications.

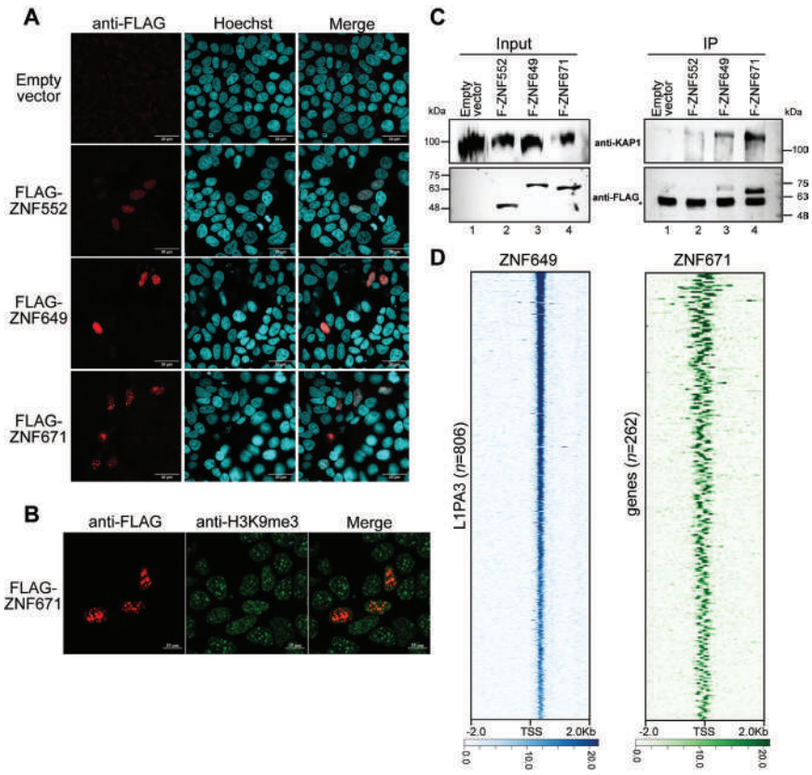
MAJOR RESEARCH AREA

- Identification of KRAB-ZFP genes whose expression is correlated with patient outcomes in breast and head and neck cancers.
- Cloning and expression of uncharacterized KRAB-ZFP genes in mammalian expression constructs.
- Characterization of localization of KRAB-ZFPs and binding with epigenetic repression machinery.
- Identification of target elements (transposable elements/genes) of repression for each KRAB-ZFP.

WORK REPORT

- MOLECULAR MECHANISMS UNDERLYING RETROTRANSPOSON EXPRESSION AND ITS CONSEQUENCES IN BREAST CANCER PATHOGENESIS.

Krüppel-associated box domain zinc finger proteins (KRAB-ZFPs/KZFPs) are responsible for transcriptional and epigenetic silencing of retrotransposon elements in normal cells. However, cancer cells frequently show aberrant expression of retrotransposons due to the loss of faithful epigenetic silencing. To identify the mechanisms for the loss of silencing, we performed an in-depth analysis of the transcriptome datasets in the TCGA-BRCA cohort. We identified the KZFP genes whose expression is correlated with better prognosis. In total, six KZFP genes showed expression correlated with a favorable prognosis. We have successfully constructed 3XFLAG-tagged mammalian expression constructs of all six genes. We have initiated the characterization for a few of them. We confirmed that the KZFPs ZNF552, ZNF649 and ZNF671 have a nuclear localization (Figure 1A). Intriguingly, ZNF649 and ZNF671 showed a sub-nuclear punctate localization instead of a diffuse nuclear one (Figure 1A). Upon further investigation of the identity of these foci, we found that the ZNF671 foci co-localized with H3K9me3 foci (Figure 1B). This result indicated that ZNF671 localizes to heterochromatin foci. To investigate whether these KZFPs interact with KAP1, which recruits the repressive machinery, we performed co-immunoprecipitation analysis with anti-FLAG followed by western blot with anti-KAP1. All three KZFPs bound to KAP1 however, the degree of KAP1 pull down varied (Figure 1C). ZNF671 had the strongest interaction with KAP1 whereas ZNF552 had the weakest (Figure 1C). We further analyzed a published ChIP-exo dataset of HA-tagged KZFPs expressed in HEK293T cells to identify the target sites of these KZFPs. We found that ZNF649 mainly bound to the 5′-UTR of L1PA3 and L1PA4 elements of the primate LINE-1 (L1PA) family (Figure 1D, left panel). On the other hand, ZNF671 showed strong binding to specific gene promoters (Figure 1D, right panel). We are doing further functional assays with all six KZFPs and are in the process of generating overexpression and knockout cell lines. We also plan to do CUT&RUN and other functional assays in breast cancer cell lines to study their role in cancer progression.



ZNF649 and ZNF671 bind to distinct target sites.
(A) Immunofluorescence analysis with anti-FLAG antibody shows the nuclear localization of each KZFP.
(B) ZNF671 shows a distinct puncta-like localization that colocalizes with H3K9me3 foci.
(C) Immunoprecipitation with anti-FLAG antibody followed by KAP1 western blot shows coimmunoprecipitation of KAP1 with indicated KZFPs.
(D) Heatmaps show enrichment of ZNF649 at 5'-UTR of L1PA3 elements (left) and of ZNF671 at gene promoters (right).

TEAM
Shivakami B, Shihabudeen
(From L to R)

LABORATORY STRENGTH
PhD Students: 3 / JRF: 3 / Project Assistant: 1

INVITED TALKS [PI ONLY]:

- Awakening the 'dark matter' of our genome: Roles in aging and cancer, at TDL25 symposium on 18th October, 2024 at Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Molecular mechanisms underlying retrotransposon expression and its consequences in breast cancer pathogenesis.	Department of Biotechnology	2023	5 Years	PI
02	Investigating the Molecular Mechanisms of Epigenetic Vulnerability to PRMT5 and RBBP4 Inhibition in breast cancer.	Anusandhan National Research Foundation	2025	3 Years	PI
03	Mechanism and regulation of RNAPII transcription and associated functions by DSIF like complex during Toxoplasma stage differentiation.	Department of Biotechnology	2025	3 Years	Co-PI

Priya Srinivas, PhD
Scientist G & Dean (Academic Affairs)
Cancer Research

BRIEF THEME OF LABORATORY

The major mandate of my laboratory is to understand the molecular mechanism of tumorigenesis in BRCA1 defective cancers and to identify diagnostic and therapeutic options. Other than this, my second major mandate is to develop non-invasive techniques for cancer diagnosis using body fluids.

MAJOR RESEARCH AREA

- We have identified probable binding regions of BRCA1 on β-hCG promoter.
- We demonstrate the importance of β-hCG as a potential target in BRCA1-deficient carcinomas.

WORK REPORT

- DIRECT DNA BINDING BY BRCA1 ON B-HCG PROMOTER AND ITS CLINICAL IMPLICATIONS

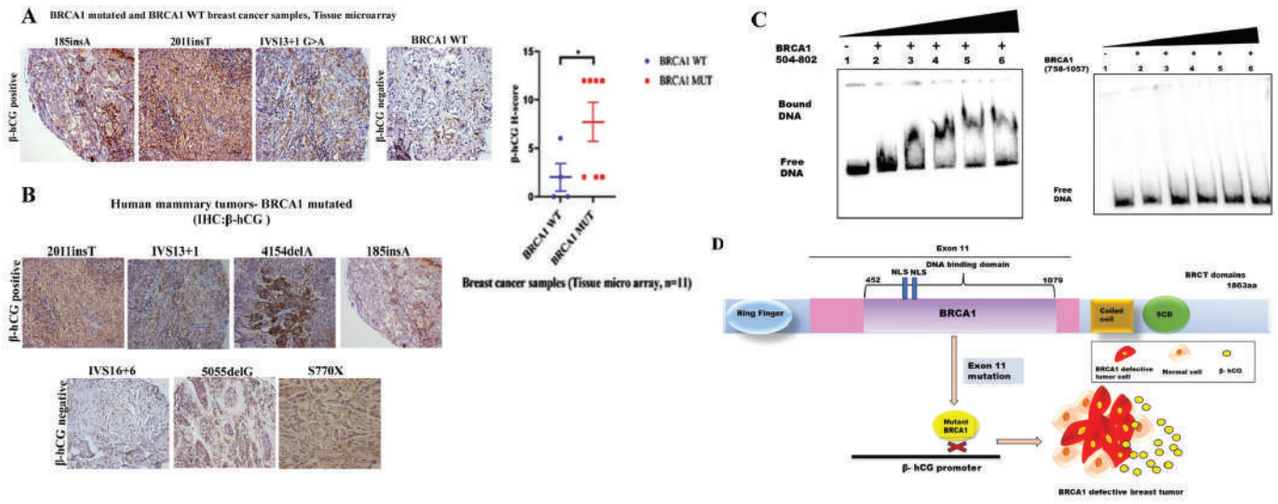
Human Chorionic Gonadotropin (hCG) commonly termed as the pregnancy hormone, is a heterodimeric molecule with α and β subunits, and is mainly secreted by the trophoblastic cells to promote implantation of the embryo. Excess of hCG or free β subunit is produced during the conditions of pregnancy disorders like hydatidiform moles, choriocarcinoma and non-trophoblastic tumors. In our previous study, we have identified for the first time that β-hCG expression is linked to BRCA1 status. β-hCG overexpression was observed in BRCA1mutated or defective breast cancer cells and conditional knockout mouse models (Sengodan et al., 2017). This study is to examine the gene expression and clinical implications of β-hCG and its variants in different cancer types, with a special emphasis on Breast Invasive Carcinoma (BRCA). Additionally, a molecular approach for understanding BRCA1's transcriptional control of β-hCG was investigated.

Data from various comprehensive gene expression platforms like UALCAN, GEPIA2, GENT2, TIMER2, LinkedOmics, and STRING were used to analyse the expression of β-hCG and its clinical implications; Immunohistochemistry and ELISA for β-hCG expression analysis from human breast cancer patients; Electrophoretic mobility shift assay (EMSA) to analyse the direct binding of BRCA1 on β-hCG; Immunoblotting and Luciferase assay to understand the regulation of β-hCG by p53 were performed.

The results of the UALCAN and GENT2 gene expression cancer database showed that high-grade metaplastic carcinoma and TNBC subtypes exhibit increased β-hCG expression, while TIMER2 also found immune cell infiltration in BRCA. Results from TIMER2 analysis demonstrated that when the BRCA1 gene is mutated, most isoforms of β-hCG (CGB) are elevated in breast tumours regardless of hormonal status. When BRCA1 is mutated, similar outcomes have been shown in lymphoid neoplasm diffuse large B-cell lymphoma (LGG) and DLBC (Brain lower grade glioma). These findings align with our previous reports showing β-hCG expression in BRCA1 defective conditions. Additionally, we have found that BRCA1 directly binds to the β-hCG promoter.

The TNBC subtype exhibited β-hCG expression, according to the analysis from TCGA data sets across many platforms. Also, it is well demonstrated that, majority of the BRCA1 deficient breast cancers belongs to TNBC subtypes. Although β-hCG overexpression has been documented in BRCA1 mutant circumstances, it's crucial to understand that not all BRCA1 mutations cause β-hCG expression. Only pathogenic mutations including exon 11 results in expression of β-hCG. Also, the domain of BRCA1 (504-802) which is important in binding and regulating the β-hCG expression belongs to exon 11 and contains two NLS sequences highlighting the significance of this domain in transcriptional regulation of β-hCG. All these findings demonstrate the relevance of β-hCG as a potential target in BRCA1-deficient carcinomas.

β-hCG in breast cancer (BC) tissue microarray by IHC:
(A) β-hCG expression in BRCA1 mutated and wild type BC tissues.
(B) β-hCG expression wrt BRCA1 mutation in human BC tissues. Upper panel showing BRCA1mutated tissues with β-hCG expression and lower panel shows BRCA1mutated tissues (10x & 40x, SB-100μm & 20μm).
(C) Left panel: EMSA Showing the binding of BRCA1 domain (504-802) on β-hCG promoter; L 1: 0 μM, L 2: 5 μM, L 3: 10 μM, L 4: 15 μM, L 5:20 μM, L 6: 25μM. Right panel: EMSA showing no binding of BRCA1 domain (758-1057) on β-hCG promoter in increasing concentrations; L 1: 0 μM, L 2: 5 μM, L 3: 10 μM, L 4: 15 μM, L 5:20 μM, L 6: 25μM.
(D) Schematic representation showing regulation between BRCA1 and β-hCG; Mutation between exon1-11 of BRCA1 results in increased expression of β-hCG.



TEAM

First Row: Aswathy Ashok kumar, Arsha Raj T S, Dr. Priya Srinivas, Aiswarya M A (From L to R)
Second Row: Shreya Sara Ittycheria, Sansiya Yesudasan, Kavitha U K, Keerthana J, Bhavana Ramachandran (From L to R)

LABORATORY STRENGTH

PhD Students: 7 / JRF: 1 / Project Assistant: 1 / Lab Assistant: 1 / Project Associate: 1

PUBLICATIONS:

- Krishnan N, Neetha R L, Warrier A V, Yadev I, Anandan J, Sundaram S, Rajan A, Kumari P, Ittycheria S S, Manasa V G , Mohammed S, S P, Nair R S, Srinivas P. Direct DNA binding by BRCA1 on β-hCG promoter and its clinical implications. Heliyon. 2024 Aug 30;10(17):e37064.
- Warrier A V, Manasa V G, Neetha R L, Krishnan N, Kumari P, Ittycheria S S, Srinivas P. Xenoestrogen and Its Interaction with Human Genes and Cellular Proteins: An In-Silico Study. Asian Pac J Cancer Prev. 2024 Jun 1;25(6):2077-2087.
- Ittycheria S S, Sivakumar K C, Patra D, Ramachandran B, Neetha R L, Warrier A V, Aiswariya M A, Kaviya S, Suman P, Narayanaswamy N, Srinivas P. Discovery of potential small molecule inhibitors against β-hCG: an in silico study with in vitro validation. RSC advances, 15(25), 19561–19580.

AWARDS [STUDENTS]:

- Kavitha U K, Best Oral Presentation Award at the International Conference on "Biotechnology-The Way Forward" (ICBWF-2024) organized by the Department of Biotechnology, University of Kerala, Kerala, India (20-22, November 2024).

INVITED TALKS [PI ONLY]:

- Speaker at 11th International Convention Society for ethno morphology 15th -16th November, 2024.
- Chairperson at the International Conference on "Biotechnology - The Way Forward" (ICBWF-2024), from 20th -22th November, 2024.
- Invited lecture for the Sixth Prof V V Modi Memorial lecture and international seminar on 10th Jan. 2025 at Gujrat.
- Scientific Interaction & Sessions at BRIC-RGCB Science Museum on 28th, February, 2025.

CONFERENCE PRESENTATION:

- Shreya Sara Ittycheria, Poster Presentation, Unearthing potential small molecule inhibitors against β-hCG using in-silico tools and its validation in-vitro, at 2nd BRIC-RGCB Research Conference at Zuri Kumarakom Resort, September 25-28, 2024.
- Kavitha Unnikrishnan, Poster Presentation, Surface-Engineered Small Extracellular Vesicles as a Therapeutic Carrier Targeting Triple Negative Breast Cancer at the second BRIC-RGCB Research Conference 2024 organized by the BRIC-Rajiv Gandhi Center For Biotechnology (BRIC-RGCB) Thiruvananthapuram at the Zuri Kumarakom Resort, India during 25th-28th September, 2024.
- Shreya Sara Ittycheria, Poster Presentation, Delineating small molecule inhibitors against β-hCG in-silico with in-vitro validation: International Conference on "Biotechnology - The Way Forward"(ICBWF-2024), Deparment of Biotechnology, University of Kerala, November 20-22, 2024.
- Kavitha Unnikrishnan, Oral Presentation Therapeutic Targeting of Triple Negative Breast Cancer Using Engineered Small Extracellular Vesicles at the International Conference on "Biotechnology-The Way Forward (ICBWF-2024)" organized by the Department of Biotechnology, University of Kerala, India during 20th -22nd November 2024.

PATENTS APPLIED/ GRANTED:

- Dr.Priya Srinivas, Shreya Sara Ittycheria. [Compounds and Methods for Cancer Treatment] [U.S. Provisional Patent applied]

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Analysis of tumor characteristics and therapeutic strategies for β-hCG positive Breast Cancer Patients from Kerala using microfluidic organ-on-a-chip culture device.	Indian Council of Medical Research	2024	3 Years	PI
02	Preclinical studies on targeting β-hCG as a treatment strategy for BRCA1 promoter hyper methylated Breast Cancers	Council of Scientific & Industrial Research	2024	3 Years	PI
03	Targeting DDR1 signalling – A novel approach for enhancing immune surveillance in TNBC (Mentor) Sanction Order No.TAR/2023/000052	Department of Science and Technology -TARE	2024	3 Years	Mentor
04	Human Resource Development (HRD) scheme for Health Research" of the Department of Health Research (MoHFW) for North Eastern Scientists	DHR-Indian Council of Medical Research	2024	1 Years	Mentor

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Neetha R L	Cancer Associated Fibroblasts: A New Target for Impeding Metastasis in BRCA1 Defective Cancers	University of Kerala	Awarded	2024
02	Neethu Krishnan	Understanding the Transcriptional Regulation of β-hCG by BRCA1 and its Clinical Implications	University of Kerala	Awarded	2025

Radhakrishnan R, PhD

Scientist F

BRIEF THEME OF LABORATORY

Laboratory Medicine and Molecular Diagnostics stands for its special phenomenon in Molecular Diagnostics and Next Generation Sequencing. The division concentrates on personalized medicine and the development of point-of-care testing.

MAJOR RESEARCH AREA

- Co-Developer of Monoclonal Antibody against Nipah Virus.
- Identification of the whole genome of COVID-19 variants using Next Generation Sequencing.
- Major centre for evaluation of diagnostic kits under CDSCO, ICMR, and DBT.
- Co-Developer of PCR for diagnostics of Neonatal Sepsis.

WORK REPORT

- LABORATORY MEDICINE AND MOLECULAR DIAGNOSTICS: A MODERN ERA IN PATIENT CARE

Infectious and Non-Infectious Disease Diagnostics

The portfolio of the division has a total of 260 molecular as well as serological tests. The division helps clinicians to design a treatment strategy for patients with acute and chronic HBV, HIV, HCV, CMV, EBV, etc. The viral load determination of these chronic diseases helps clinicians to start/ manage the anti-viral treatments. The Division has included tests that are relied upon in identifying emerging infections, antibiotic resistance, exposure to toxic substances, and detection of chemical and biological threats into thrust areas of laboratory support. Except for five tests, all the remaining tests are developed and validated in-house. Non-infectious diseases, such as genetic disorders like Cardiovascular Diseases, Cancer markers, Autoimmune diseases, transplant medicine, etc., are also screened. The major highlight of the Division is the TAT and cost-effective testing facility. Genotyping of HBV and HCV was an initiative by LMMD, which sheds light on antiviral therapy resistance. ELISA and Immunofluorescence assays were launched as testing platforms to rapidly detect major diseases. Cloud-based result reporting system has been established in the lab for accurate and timely reporting of the results. The Laboratory Management System (LIS) states that the art technique is used in the laboratory as part of the cloud-based reporting system.

Epidemics and Social Service

The division has always stood out in fighting against all epidemics by timely initiating and accelerating the diagnostic services. Most of the epidemic situations were brought under control by outbreak prediction performed by the division's periodic monitoring of random samples from different parts of Kerala, which includes patient samples, vectors, and the source of origins.

Next Generation Sequencing

The NGS platform of the division is in high demand in oncology and transplant medicine. The division has initiated HLA Typing. The division is already performing the identification of the Gut Microbiome and Vaginal Microbiome. The division performs NGS in the identification of somat-

ic mutations within the exonuclease proofreading domain of DNA polymerase Pol (POLE) gene in ovarian, colorectal, urological, and endometrial carcinoma. The division has been an active participant in DBT projects since 2023 on INSACOG Phase I and Phase II: Genomic Surveillance for SARS-CoV-2 in India, Expansion of INSACOG – Wastewater Genomic Surveillance for Emerging Pathogens and Antimicrobial Resistance through Genomics-Based Methods.

Evaluation of Diagnostic Kits

The division is one of the major evaluation centres of diagnostic kits since 2024. The diagnostic kits have to be evaluated before obtaining a marketing licence. The kits will be evaluated strictly adhering to the rules of CDSCO, ICMR, and DBT. The kits of patient care, such as PCR, ELISA, Lateral Flow Assay, Disinfectants, Instruments for decontamination, etc, are evaluated in the division.

Revenue	
Total Revenue generated from PCR tests	**76,11950 INR**
Total Revenue generated from CDSCO kit validation	**81,42000 INR**
Total Revenue generated from Training programs	**99,0000 INR**
INSACOG-DBT Project fund released during the year 2023-24	**1,12,99876 INR**

Molecular Diagnostic area

TEAM

First Row: Rahul J L, Satheesh D, Karthika V, Dr. Radhakrishnan R, Vineetha P T, Soumya V K, Sooraj Mohan C S, Surjith S B (From L to R)
Second Row: Deepak M S, Veena T M, Heera Pillai R, Chithra S, Rajasree R C, Athira Ashok S, Anupama M S, Shomu S (From L to R)

LABORATORY STRENGTH

Project Assistant: 2 / Technical Assistant: 2 / Lab Assistant: 2 / Project Associate: 4
Lab Technician: 6 / Data Entry Operator: 2

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	INSACOG Phase I and Phase II: Genomic Surveillance for SARS-CoV-2 in India,	Department of Biotechnology	2023	3 Years	PI

Rajeeve Sivadasan, PhD

DBT- Ramalingaswami Faculty Fellow
Neurobiology

BRIEF THEME OF LABORATORY

Our lab investigates the intricate relationships between Amyotrophic Lateral Sclerosis (ALS) and frontotemporal lobar degeneration (FTLD), with a focus on the C9ORF72 repeat expansion and its implications. By studying the activity of small GTPases in neuronal health and function, we aim to uncover critical pathways involved in these neurodegenerative diseases. Our research seeks to identify therapeutic targets that can mitigate the effects of protein aggregation and improve outcomes for patients.

MAJOR RESEARCH AREA

- We developed a global GTPase pulldown assay by mass spectrometry.
- Identified new therapeutic targets that can regulate GTPase dysregulation.

WORK REPORT

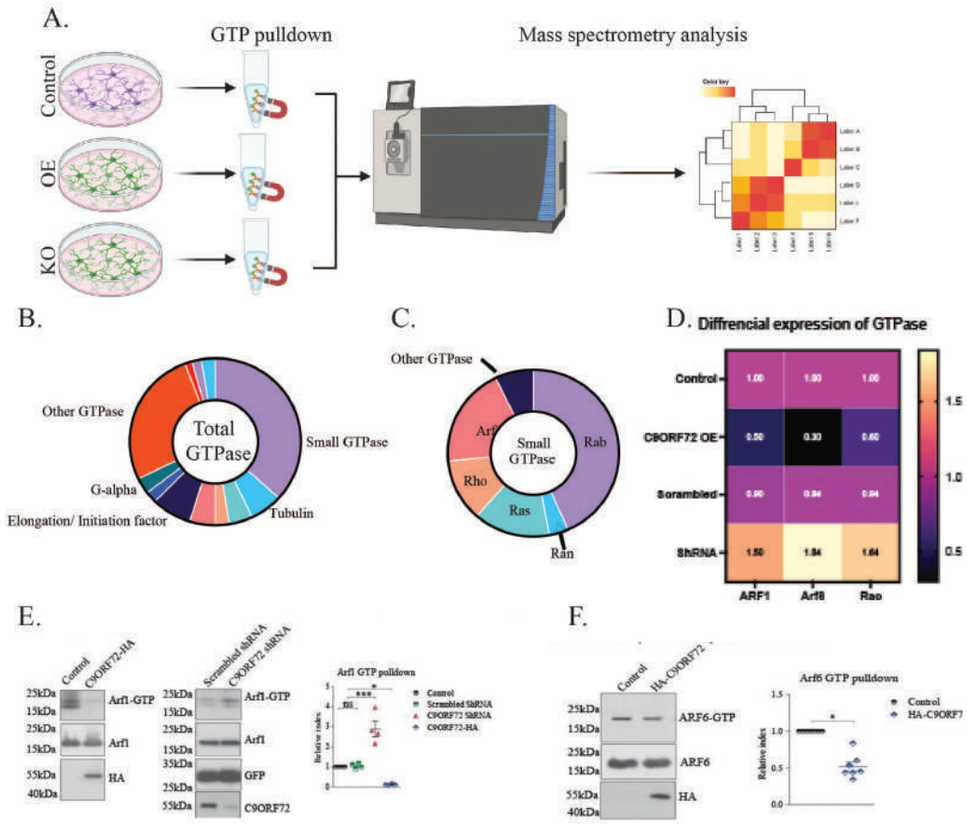
- UNRAVELLING THE CONNECTION: SMALL GTPASES AND THE LINK BETWEEN ALS AND FTLD.

The nervous system is a remarkable and intricate biological system essential for the functioning of living organisms. It is organised into a complex network of neurons and glial cells, comprising various subtypes. Among neurological disorders, Amyotrophic Lateral Sclerosis (ALS) and frontotemporal lobar degeneration (FTLD) display significant clinical and pathological similarities, highlighting an important connection between these conditions. Both sporadic and familial forms of ALS and FTLD involve multiple genes and are characterised by protein aggregation within cells.

Identifying the C9ORF72 repeat expansion is particularly important, as it establishes a direct link between ALS and FTLD and serves as a potential marker for sporadic cases. This discovery provides crucial insights into the underlying mechanisms of these diseases, promising advancements in research and diagnostics. Current investigations focus on how the regulation of small GTPases' activity influences C9ORF72 protein function. Clarifying the specific roles of small GTPases in the pathogenesis of ALS and FTLD can help advance the development of effective therapeutic interventions.

Small GTPases are vital for coordinating intracellular signalling across various neuronal cells. Sudden changes in their activity can significantly impact neuronal health and function. These disruptions are closely linked to disease development, with effects varying based on the specific neuronal tissues involved. Over the past year, substantial progress has been made in understanding small GTPases. We engineered knockdown and overexpressed NPC cells derived from human iPS cells, differentiating them into spinal neuronal cultures to assess global GTPases activity. Using GTP pulldown methodology, we observed a notable pulldown of various GTP-binding proteins, including small GTPases, revealing significant differences in their expression patterns for the first time. Additionally, as a quality control measure, we evaluated the differential expressions of ARF1 and ARF6, uncovering distinctive patterns following overexpression and knockdown.

Researchers are focusing on small GTPases and their regulatory components when searching for therapeutic targets. By understanding the critical role of small GTPases in neuronal networks, we can identify targeted interventions that address complex protein interactions affecting neuronal function. In summary, the connection between ALS and FTLD, the significance of the C9ORF72 repeat expansion, and the role of small GTPases in neuronal health emphasise critical areas for further research. Investigating these elements may lead to valuable insights and potential therapeutic strategies for managing these debilitating neurodegenerative diseases.



(A) A graphical representation of the GTPase assay used to assess global GTPase activity.
(B) Total GTPase-bound protein identified from the mass spectrometry assay.
(C) A spectrum of small GTPase proteins was identified in the analysis.
(D) Differential expression of GTPases with respect to overexpression and knockdown of C9orf72 in Human Motor Neuronal Cells.
(E) and (F) Confirmation of the differential expression data related to Figure D.

TEAM

Udhaya Bharathy,
Dr. Rajeeve Sivadasan (From L to R)

LABORATORY STRENGTH

PhD Students: 1 / SRF: 1 / Technical Assistant: 1

INVITED TALKS [PI ONLY]:

- ANRF Sponsors National Symposium on Environment, Health and Disease: Ecogenetics and Toxicogenomics on Role of small molecular switches in Neurodegenerative disease from 3rd October 2024 – 4th October 2024 at V.O.Chidambaram College, Thoothukudi, Tamil Nadu, India.
- The Role of GTPases in Neurodegenerative Disorders: Insights into C9ORF72 and Neuronal Dysfunction at National Symposium on Mass Spectrometry-Based Lipidomics, from February 20–22, 2025 at BRIC-RGCB, Thiruvananthapuram.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	The study of small RNA in Neurodegenerative Diseases	Department of Biotechnology	2021	5 Years	PI

Rajesh Chandramohanadas, PhD

Scientist E-II
Pathogen Biology

BRIEF THEME OF LABORATORY

The central theme of the Laboratory of Red Cell Diseases is the multidisciplinary study of red blood cell (RBC) biology and pathogenesis, particularly in the context of infectious diseases. We are engaged in understanding Mechanisms of RBC damage and tropism, Host-pathogen interplay in malaria, Biophysical and biochemical profiling of RBCs Drug discovery and phenotypic screening.

MAJOR RESEARCH AREA

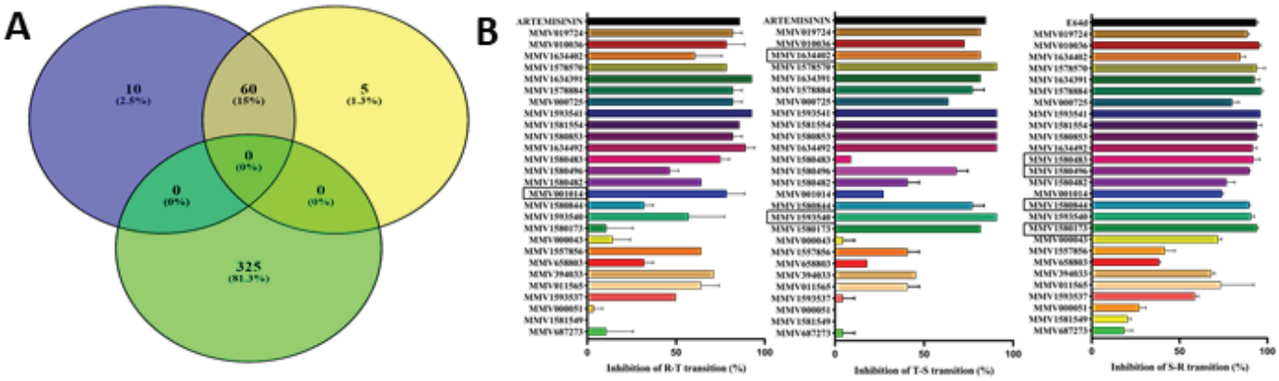
- A high-content phenotypic screen of the MMV Pandemic Response Box led to the discovery of compounds that block Plasmodium falciparum at discrete stages. The lab identified novel molecules from the Pandemic Response Box that likely bind Plasmodium's sodium ATPase (PfATP4), a promising antimalarial target.
- The lab launched mechanistic studies to conclusively demonstrate whether import of host erythrocyte proteins by Plasmodium falciparum- a novel line of inquiry central to understanding parasite survival strategies.
- The laboratory has made significant progress in understanding red cell maturation process with an angle on host RBC tropism and Malaria infection.

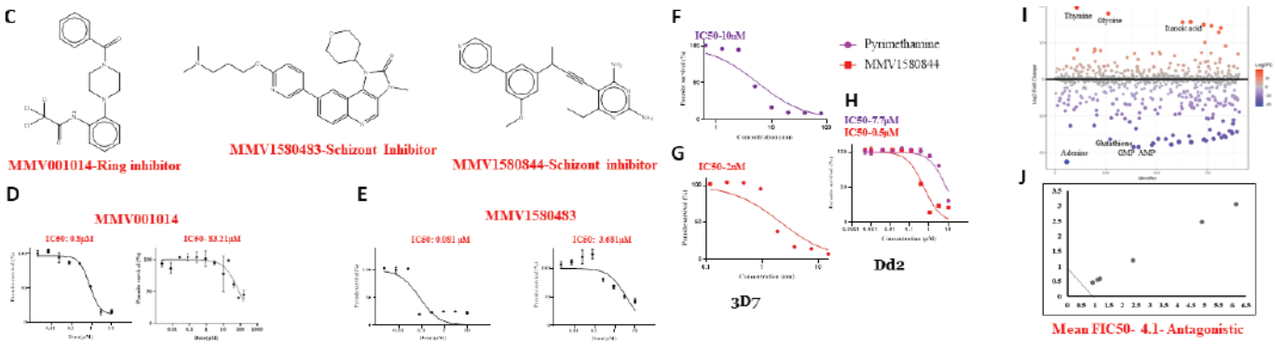
WORK REPORT

- LABORATORY OF RD CELL DISEASES

The lab has a major focus on studying RBC deformations in health and diseases, with a major area of study being host tropism of malaria parasites. In this context, our research has elucidated molecular markers related to red cell maturation, derived new insights into exosome release accompanying the final stages of erythropoiesis and its linkages with Plasmodium infection.

IDENTIFICATION AND MECHANISTIC CHARACTERIZATION OF STAGE-SPECIFIC ANTIMALARIALS





Identification of Novel antimalarials from MMV pandemic response Box.

TEAM

First Row: Abhinav B R, Lakshmi V S, Dr. Rajesh Chandramohanadas, Sreenath M, Lubna M (From L to R)
Second Row: Akhila T P, Darsana K M, Harsha, Christeen Davis (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 5 / JRF: 2 / Project Assistant: 1
Technical Assistant: 2 / Lab Assistant: 1

PUBLICATIONS:

- Keerthy Reghunandanan, V S Lakshmi, Rose Raj, Kasi Viswanath, Christeen Davis, Rajesh Chandramohanadas. A Convolutional Neural Network- Based Deep Learning To Detect Reticulocytes From Human Peripheral Blood. Intelligence-Based Medicine Volume 10, 2024, 100175.
- Prasad R, Kadam A, Padippurackal V V, Pulikuttymadom Balasubramanian A, Kumar Chandrakumaran N, Suresh Rangari K, Dnyaneshwar Khangar P, Ajith H, Natarajan K, Chandramohanadas R, Nelson-Sathi S. Discovery of small molecule entry inhibitors targeting the linoleic acid binding pocket of SARS-CoV-2 spike protein. J Biomol Struct Dyn. 2024 Mar 23:1-15.

INVITED TALKS [PI ONLY]:

- National Congress on Parasitology at IISER, Pune. 2024.
- National Seminar on Emerging Health Issues and Challenges: Perspective from Northeast India as a part of PHYSICON 2024, the 35th Annual Conference of the Physiological Society of India during November 15-17, 2024 .
- National Workshop on Methods in Creating Chemical Models of Disease. CLIF from 21-23 October, 2024, University of Kerala.
- Invited Talk at Cognitopia – An International Conference on Science, Society, and Culture, organized by the Government College for Women, Thiruvananthapuram, January 16th to 18th, 2025.
- Invited Talk as resource person for Symposium on Technology for Healthcare at ICMR-RMRC, NE, Dibrugarh, March 4-5th 2025.
- Invited Talk at IBSC, Manipur on March 6th 2025.

CONFERENCE PRESENTATION:

- Lakshmi V S at National Congress on Parasitology, IISER, Pune.
- Christeen Davis on Host-Cell Dependant Adaptations of Plasmodium falciparum at National Congress on Parasitology, IISER, Pune. 2024.
- Akhila T P Single-Cell Optical Diffraction Tomography to Monitor Cell Host- Plasmodium Interactions at National Congress on Parasitology, IISER, Pune.
- 9th International conference on Plasmodium vivax research (ICPvR), 2025, ICMR-VCRC, Puducherry, India.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Functional Dissection of Host Protein Import by Plasmodium for non- metabolic purposes	Department of Biotechnology	2024	3 Years	PI
02	Deciphering the Role of Novel Reticulocyte surface Proteins in Plasmodium vivax Invasion.	Anusandhan National Research Foundation	2023	3 Years	PI
03	One Health Creation of a national network of existing and upcoming high risk pathogen laboratories (BSL-3/4) across departments and keeping their interlinkages"	Indian Council of Medical Research	2023	5 Years	Co -PI
04	Deciphering the structural and functional attributes of the putative nucleoplasmin from Plasmodium falciparum	Anusandhan National Research Foundation	2024	3 Years	Co -PI
05	I3C Project on AMR	Department of Biotechnology	2025	5 Years	PI

Rakesh S. Laishram, PhD

Scientist F & Swarna Jayanti Fellow
Cardiovascular Diseases & Diabetes Biology

BRIEF THEME OF LABORATORY

Untranslated RNA dynamics in gene expression - implications in cardiovascular diseases

MAJOR RESEARCH AREA

- We discovered that cleavage imprecision is highly regulated as opposed to earlier belief in such a way that cleavage occurs at a primary site followed by a number of subsidiary futile sites.
- Decrease in the futile cleavages and increasing primary site cleavage induces gene expression showing an inverse relationship.
- CSH regulates oxidative stress response where oxidative stress induces antioxidant gene expression via decreasing CSH and increasing primary cleavages.

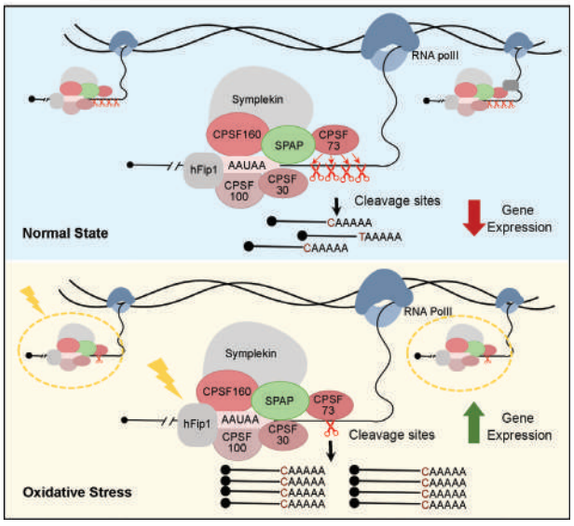
- CSH-mediated control of antioxidant defense has key implication in the regulation of cardiac hypertrophy where pathogenesis is mediated by compromised antioxidant defense pathway.

WORK REPORT

- CONTROL OF UNTRANSLATED RNA HETEROGENEITY IN GENE EXPRESSION AND ITS IMPLICATION IN THE REGULATION OF CARDIAC HYPERTROPHY AND FAILURE

mRNA 3'-end processing is one of the crucial steps in gene expression that is required for the stability and efficient translation. It involves two coupled steps - cleavage followed by addition of a poly(A) tail (polyadenylation), carried out by a cleavage and polyadenylation(CPA) complex assembled at the 3'-UTR. While PA-tails and its regulation are well studied, cleavage site regulation in gene expression is less explored. Moreover, the endonucleolytic cleavage step is considered imprecise that leads to heterogeneity of cleavage site (CS) with hitherto unknown function. Contrary to popular belief, we show that this imprecision in the cleavage is tightly regulated, resulting in the CS heterogeneity (CSH) that controls gene expression in antioxidant response. CSH centres around a primary CS, followed by several subsidiary cleavages determined by CS's positions. Globally and using reporter antioxidant mRNA, we discovered an inverse relationship between the number of CS and the gene expression, with the primary CS exhibiting the highest cleavage efficiency. Strikingly, reducing CSH and increasing primary CS usage induces gene expression. Under oxidative stress (we employ three conditions that induce antioxidant response, tBHQ, H2O2, and NaAsO2) conditions, there is a decrease in the CSH and an increase in the primary CS usage to induce antioxidant gene expression. Key oxidative stress response genes (NQO1, HMOX1, PRDX1, and CAT) also show higher CSH compared to the non-stress response genes and that the number of CSs are reduced to impart cellular response to oxidative stresses. Concomitantly, ectopic expression of one of the key antioxidant response gene (NQO1) driven by the primary CS but not from other subsidiary CSs, or reduction in CSH imparts tolerance to cellular oxidative stresses (H2O2, and NaAsO2). Genome-wide CS analysis of stress response genes also shows a similar result. Compromised CSH or CSH-mediated gene control hampers cellular response to oxidative stress. We establish that oxidative stress induces affinity/strength of cleavage complex assembly, increasing the fidelity of cleavage at the primary CS, thereby reducing CSH inducing antioxidant response. Together, our study reports a novel cleavage imprecision- or CSH-mediated anti-oxidant response mechanism that has implications in the regulation of cardiac hypertrophy in the heart.

Cardiac hypertrophy in the hearts response to pathological stress leading to cardiac remodeling increasing the cardiomyocyte size and ventricular wall thickness. Hypertrophic stimulus induces oxidative stress in the heart that is countered by cellular antioxidant response. However, at a later stage, notwithstanding the persistent oxidative stress, anti-oxidant response get diminished resulting in hypertrophied heart. We have shown that this overall process is regulated through imprecisions of RNA 3'-UTR processing through Star-PAP. We demonstrated that CSH is compromised at the late state but not at the early sate on hypertrophy induction through Star-PAP. Compromised CSH from Star-PAP down regulation diminishes antioxidant response leading to pathogenesis of hypertrophy in the heart. Thus, our study reports a novel mechanism of cardiac remodeling by the control of oxidative stress response pathway that operates through imprecision of cleavage at the mRNA 3' -end.



Schematics of cleavage site heterogeniety and how it regulates antioxdiant respeonse gene expression.

TEAM

First Row: Babitha Jayakumar, Dr. Semim Akhtar Ahmed, Dr. Rakesh S Laisram, Dr. Sumayya Shahzad (From L to R)
Second Row: Diksha Singh, Malaya Ranjan Behera, Athira Anil, Aneesha A R, Revathy A S, Unnimaya Sajeev, Ciji Varghese, Beauty Rani Koch (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 2 / PhD Students: 6 / JRF: 2 / Project Assistant: 1
Lab Assistant: 1

PUBLICATIONS:

- Shaji F, Ali J, Laishram R S. Cleavage site heterogeneity at the pre-mRNA 3'-untranslated region regulates gene expression in oxidative stress response. Redox Biol. 2025 Apr;81:103565.
- Mohanan N K, Shaji F, Sudheesh A P, Bangalore Prabhashankar A, Sundaresan N R, Laishram R S. Star-PAP controls oncogene expression through primary miRNA 3'-end formation to regulate cellular proliferation and tumour formation. Biochim Biophys Acta Mol Basis Dis. 2024 Apr;1870(4):167080.

AWARDS [STUDENTS]:

- Diksha Singh, Best Poster Presentation Award at The International Society for Heart Research (ISHR) 2025 held in IIT madras, Chennai.
- Diksha Singh, Best Poster Presentation Award at the 12th RNA Group Meeting, held at Indian Institute of Technology (IIT) Guwahati, Assam from May 22-24, 2024.
- Diksha Singh, Best Poster Presentation Award at National Symposium on Biotechnology for Sustainable Development-2024, held at BRIC-RGCB on 20th April 2024, Trivandrum.

INVITED TALKS [PI ONLY]:

- 6th iBRIC+ Biotech Spotlight Webinar, August-2025.
- Annual meeting of ISHR (International Society for Heart Research) Indian Section, IIT-Chennai, March-2025.
- Keynote Lecture, Heart failure Conflux, SCTIMS, Trivandrum, February – 2025.
- Guha Research Conference, Kazirnaga, November – 2024.
- 12th RNA Group Meeting, IIT Guwahati, May – 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Omics of Preeclampsia associated cardiovascular complications-An RNAcentric approach towards molecular understanding	Department of Biotechnology	2025	3 Years	PI
02	Cleavage site heterogeneity/stuttering in gene expression and its physiological implications	Anusandhan National Research Foundation	2023	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Neeraja K M	Star-PAP mediated 3'-end processing and alternative polyadenylation in cancer progression	Manipal Academy of Higher Education	Awarded	2024
02	Feba Shaji	Mechanism and Significance of 3' -End Processing of Protein Coding and Non-Coding RNAs	Regional Centre for Biotechnology	Awarded	2025

Ramesh Pothuraju, PhD

Scientist C & Former Ramanujan Fellow
Cancer Research

BRIEF THEME OF LABORATORY

My research focuses on how a Western diet, drugs, and environmental factors lead to gut dysbiosis, inflammation, and disruption of intestinal homeostasis. A key area of interest is the intestinal mucus layer, which plays a vital role in maintaining gut integrity. We investigate how alterations in this layer contribute to metabolic disorders, colorectal cancer, and drug resistance. Using both pre-clinical and clinical models, we aim to uncover mechanisms underlying disease progression and therapy response.

MAJOR RESEARCH AREA

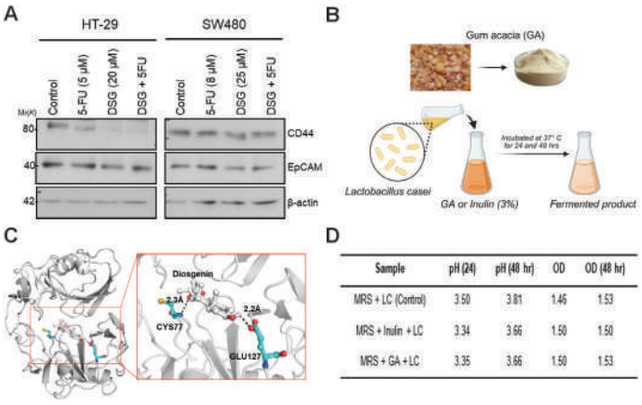
- Identified Diosgenin (DSG) as an effective agent in reducing colorectal cancer (CRC) stemness by downregulating key stem cell markers CD44 and EpCAM, with a stronger effect on CD44.
- Demonstrated synergistic effects of DSG combined with 5-FU in CRC cell lines HT-29 and SW-480, enhancing therapeutic potential.
- Revealed high-affinity binding of DSG to CD44 (–9.4 kcal/mol) via molecular docking, suggesting inhibition of CD44-HA interaction and reduced protein expression.
- Established Gum Acacia (GA) as a prebiotic-like dietary fiber by promoting Lactobacillus casei fermentation, indicated by acid production and increased bacterial growth comparable to inulin.

WORK REPORT

- MODULATION OF CANCER STEMNESS BY DIOSGENIN IN COLORECTAL CANCER.
- INVESTIGATING THE BIOACTIVE POTENTIAL OF FERMENTED GUM ACACIA: IN VITRO ASSAYS

Project 1: A subpopulation within tumors, known as cancer stem cells, is associated with therapy resistance. To explore this, we investigated the role of Diosgenin (DSG) in modulating stemness in colorectal cancer (CRC). CRC cell lines (HT-29 and SW-480) were treated with DSG, 5-FU, or a combination of both. Notably, the combination treatment led to a significant downregulation of stem cell markers, particularly CD44 and EpCAM, with CD44 showing a more pronounced reduction. To further investigate this, molecular docking studies were performed, revealing that DSG binds to CD44 with high affinity (−9.4 kcal/mol). This suggests that DSG may inhibit the binding of CD44 to its natural ligand hyaluronic acid (HA), potentially contributing to the observed decrease in CD44 protein expression in whole cell lysates.

Project 2: Gum Acacia (GA), a natural dietary fiber, is hypothesized to exhibit prebiotic-like properties similar to those of inulin. To evaluate this potential, we conducted fermentation studies using Lactobacillus casei, a well-established probiotic, in the presence of both GA and inulin. Over various time points, a decrease in pH indicated acid production—a key marker of bacterial fermentation. Additionally, increased optical density (OD) values suggested enhanced bacterial growth in the presence of GA, comparable to that observed with inulin.



Sample	pH (24)	pH (48 hr)	OD	OD (48 hr)
MRS + LC (Control)	3.50	3.81	1.46	1.53
MRS + Inulin + LC	3.34	3.66	1.50	1.50
MRS + GA + LC	3.35	3.66	1.50	1.53

(A) Western blot analysis revealed a downregulation of cancer stem cell markers, including CD44 and EpCAM, following treatment with a combination of diosgenin (DSG) and 5-fluoro-uracil (5-FU) in both HT-29 and SW-480 cell lines.
(B) Molecular docking analysis of human CD44 (PDB ID: 4PZ4) showed a complex formation between CD44 (depicted in a 3D cartoon model) and DSG (illustrated as a ball-and-stick model).
(C) A schematic illustration depicting the fermentation of gum Arabic (GA) fiber in the presence of the probiotic Lactobacillus casei.
(D) Fermentation of GA by L. casei led to a decrease in pH and an increase in optical density (OD), indicating bacterial growth. Insulin was used as a positive control.

TEAM

Bejawada Vahini, Diya Maria Siril, Dr. Ramesh Pothraju, A M Vrinda (From L to R)

LABORATORY STRENGTH

PhD Students: 2 / Lab Assistant: 1

PUBLICATIONS:

- Chaudhary S, Siddiqui J A, Pothuraju R, Bhatia R. Ribosome biogenesis, altered metabolism and ribotoxic stress response in pancreatic ductal adenocarcinoma tumor microenvironment. Cancer Lett. 2025 Mar 1; 612:217484.
- Soman A, Pradhan T, Krishna R, Hermon E S, Somanathan T, George J E, George G, Pothuraju R, Nair S A. Decoding early-onset of colorectal cancer: Insights into SERPINA3 expression patterns. Heliyon. 2024 Nov 6;10(22):e40119.
- Mahajan K, Das A V, Alahari S K, Pothuraju R, Nair S A. MicroRNA-532-3p Modulates Colorectal Cancer Cell Proliferation and Invasion via Suppression of FOXM1. Cancers (Basel). 2024 Sep 2;16(17):3061.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Gut health intervention: exploring soluble gum acacia dietary fiber's preventive effects on obesity associated colorectal cancer	Anusandhan National Research Foundation	2025	3 Years	PI
02	Development of activity-based chemical probes for understanding the role of nonapoptotic cell death pathways	Department of Biotechnology	2024	3 Years	CO-PI

Rashmi Mishra, PhD

Scientist E-II

Neurobiology

BRIEF THEME OF LABORATORY

Translational Mechanobiology of Chronic Diseases- Diagnostic, Prognostic and Therapeutic Implications in Cancers, Cardio-and Neurological ailments.

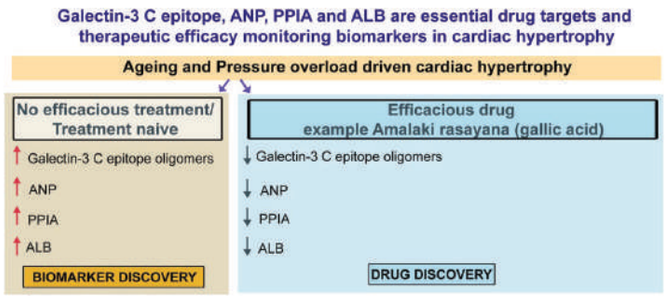
MAJOR RESEARCH AREA

- Galectin-3 C-epitope, ANP, PPIA, and ALB are elevated in aging and pressure overload driven left ventricular hypertrophy.
- Amalaki rasayana (AR) and Gallic Acid (GA) reduce these markers in cardiac tissue and circulation.
- AR and GA inhibit galectin-3 secretion and oligomeric binding to cardiomyocyte surfaces.
- AR and GA regulation predominantly occurs via phosphorylation-dependent cytoplasmic retention of galectin-3.
- These markers serve as potential therapeutic targets and diagnostic biomarkers.

WORK REPORT

- GALECTIN-3 C-EPITOPE, ANP, PPIA, AND ALBUMIN FUNCTION AS DRUG-RESPONSIVE PANEL BIOMARKERS AND THERAPEUTIC TARGETS IN AGING AND PRESSURE OVERLOAD-INDUCED CARDIAC HYPERTROPHY.

Biological aging (BA) and pressure overload-induced cardiac hypertrophy (PO-CH) are marked by myocardial thickening, fibrosis, and functional decline, culminating in an increased risk of heart failure. Effective clinical management requires biomarkers that not only track disease progression but also monitor therapeutic response. Using Amalaki Rasayana (AR), a cardioprotective nutraceutical-based medicine, in rat models of BA and PO-CH, we identified a panel of serum biomarkers whose treatment-induced decline was associated with disease regression. Among them, galectin-3 emerged in both full-length and oligomeric C-epitope cleaved forms, with the latter closely linked to pathological surface remodeling. Treatment with AR and its bioactive component gallic acid (GA) suppressed extracellular galectin-3 C-epitope oligomer accumulation by inhibiting full-length galectin-3 secretion through phosphorylation-dependent mechanisms and promotion of intracellular retention. Concurrently, serum levels of atrial natriuretic peptide (ANP), cyclophilin A (PPIA), and albumin (ALB) were consistently modulated by therapy. Validation in sera from elderly individuals and cardiac hypertrophy patients responding to conventional treatments supported the translational relevance of this biomarker panel. These findings establish a novel, mechanistically grounded biomarker set—galectin-3 C-epitope, ANP, PPIA, and ALB—for monitoring therapeutic response in cardiac hypertrophy, and position AR as a promising medicinal intervention against age- and pressure-induced cardiac pathology.



Aging and pressure overload-driven cardiac hypertrophy result in elevated tissue and circulating levels of galectin-3 C-epitope oligomers, ANP, PPIA, and ALB—key proteins implicated in cardiac damage. Treatment with Amalaki rasayana (AR) or gallic acid (GA) leads to significant improvements in cardiac function, morphology, cellular and molecular parameters, alongside marked reductions in galectin-3 C-epitope oligomers, PPIA, ANP, and ALB levels. These proteins collectively serve as a biomarker panel to monitor therapeutic efficacy.

TEAM

Siddhartha Singh, Dr. Rashmi Mishra
(From L to R)

LABORATORY STRENGTH

PhD Students: 2

PUBLICATIONS:

- Puja Laxmanrao Shinde, Vikas Kumar, Siddhartha Singh, K C Sivakumar, Rashmi Mishra Galectin-3 C-epitope, ANP, PPIA, and albumin function as drug-responsive panel biomarkers and therapeutic targets in aging and pressure overload-induced cardiac hypertrophy.. bioRxiv 2025.05.31.657024.

INVITED TALKS [PI ONLY]:

- Invited as the speaker in MCCM 2024, 3rd National Workshop on Methods in Creating Chemical Models of Disease, Oct 21-2024, Dept, of Biochemistry, University of Kerala, Kariavattom campus. Title of Talk: How brain astrocytes and astrocytic cancer cells sense and respond to the extracellular acidification stress? Insights from the disease models.

- Delivered Flash Presentation at NPSICON 2025, AIIMS, New Delhi, 20-22 February 2025. Title of Talk: How brain astrocytes and astrocytic cancer cells sense and respond to the extracellular acidification stress? Neurotherapeutic Implications.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Understanding and targeting the loss of caveolae landscape of Glioblastoma multiforme-Novel implications on anti-GBM therapeutics.	Council of Scientific & Industrial Research	2024	3 Years	PI
02	How Galectin-3 Drives Pressure Overload Mediated Cardiac Hypertrophy and Heart Failure	Indian Council of Medical Research	2022	4 Years	CO-PI

Santhosh Kumar T. R, PhD

Scientist G
Cancer Research

BRIEF THEME OF LABORATORY

The primary focus of the laboratory is to understand molecular mechanisms of chemo resistance and tumour recurrence in solid tumors. Another area of our interest is development of cell-based assays and preclinical models for identifying molecules that specifically target key pathways in cancer such as cell-cycle, proteasome-Ubiquitin pathway, angiogenesis and Growth factors.

MAJOR RESEARCH AREA

- Developed high throughput assay system to identify lysosomal destabilising agents to target apoptosis resistance in cancer.
- The study using cell lines and animal models demonstrated that hypoxia induced mitophagy generates secondary metabolic heterogeneity with implications in tumorigenesis and metastasis.

WORK REPORT

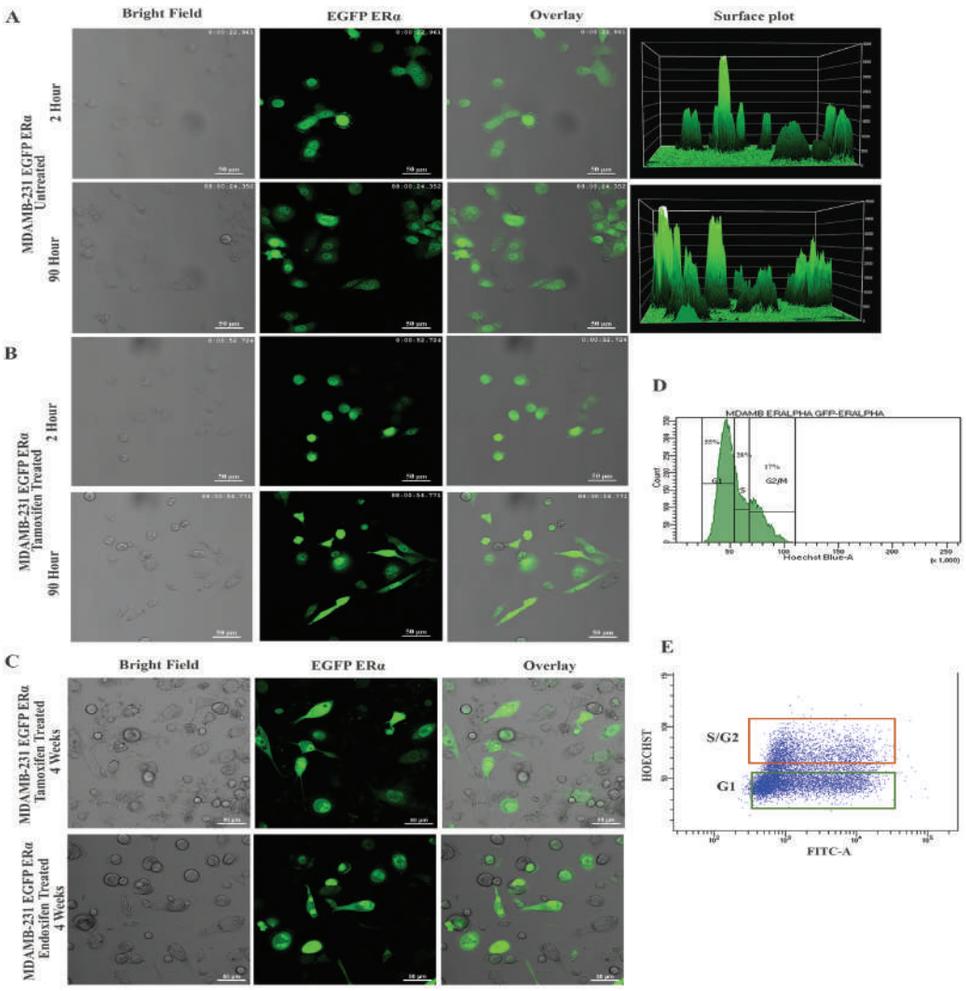
- ESTROGEN RECEPTOR ALPHA DYNAMICS AND PLASTICITY DURING ENDOCRINE RESISTANCE

Estrogen receptor alpha dynamics and plasticity during endocrine resistance

ER-α positive breast cancer, even though they respond to endocrine treatment, half of the patients acquire resistance and progress with metastasis despite ERα status. Spatio temporal changes in ERα and their loss under treatment pressure have been reported in a subset of patients. We have demonstrated that in vitro-generated resistance is correlated with the downregulation of ERα. To study the ERα status

transition in live cells, triple-negative breast cancer cells were engineered to express EGFP-ERα, which further supported the existence of complex intracellular signaling that regulates ERα plasticity even in unperturbed conditions. Single-cell clones generate heterogeneity and loss of expression depending on proliferative cues. However, the initial response of cells to 4-hydroxytamoxifen and endoxifen involves up-regulation of ERα, likely due to its early effect on the proteasome or autophagy pathway. Supporting this, inhibition of autophagy and proteasome further enhanced the expression of ERα. Systematic analysis of RNA sequencing of ERα stable cells further confirmed that ERα regulates diverse intracellular signalling networks such as ubiquitin, proteasome pathways, cell proliferation and Unfolded Protein Responses (UPR), implicating its direct role in post-translational protein modifications. Cell cycle indicator probe expressing receptor-positive breast cancer cells confirmed the ERα expression heterogeneity both in 2D and 3D culture in a cell cycle phase independent manner.

Overall, the study confirms the cell's intrinsic post-transcriptional mechanisms of ERα plasticity that could play a role in receptor heterogeneity and tumor progression under endocrine treatment that warrants further investigation



ERα dynamics in MDA-MB-231 EGFP ERα cells under endocrine treatment and the effect on cell cycle. A. Real-time confocal imaging of MDA-MB-231 EGFP ERα cells to evaluate ERα dynamics under normal conditions (90 hours). Representative confocal images and surface intensity plots are shown. B. Time-lapse confocal imaging of MDA-MB-231 EGFP ERα cells under 4OH tamoxifen treatment for 90 hours. Representative confocal images are shown. C. Endpoint confocal images of MDA-MB-231 EGFP ERα cells treated with endoxifen and 4OH tamoxifen for four weeks. D. Histogram showing flow cytometric cell cycle analysis of MDA-MB-231 EGFP ERα cells. E. Flow cytometry scatter plot showing population distribution using Hoechst and EGFP ERα-FITC (arbitrary gates).

TEAM

Aswathy S, Jain Tifee P J, Zion Mercy, Dr. T R Santhosh Kumar, Dr. Kiran S, Prakash R, Dr. Shine V J (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 3 / Project Assistant: 2 / Technical Assistant: 1
Lab Assistant: 2 / Project Associate: 1

PUBLICATIONS:

- Tiwari S K, Chandrasekharan A, Lupitha S S, Mathew K A, Jancy S V, Halikar A M, Sanjeev V S, Sivakumar K C, Prasad T, Anurup K G, Rather A A, Tiffee P J J, Jayaprasad A G, Sivasailam A, Santhosh Kumar T R. Hypoxia induced mitophagy generates reversible metabolic and redox heterogeneity with transient cell death switch driving tumorigenesis. Free Radic Biol Med. (2025) Mar 16; 230:190-208.
- Christian Y, Redkar A S, Kumar N, Jancy S V, Chandrasekharan A, Retnabai Santhoshkumar T, Ramakrishnan V. Structural regression modelling of peptide based drug delivery vectors for targeted anti-cancer therapy. Drug Deliv Transl Res. 2025 Apr;15(4):1284-1298.
- Chandran A, Shivanshu Kumar T, Aman Halikar M, Santhosh Kumar T R. (2024). Mitochondrial Quality Measures in the Regulation of Tumor Progression and Metastasis. In: Sobti R C, Ganguly N K, Kumar R. (eds) Handbook of Oncobiology: From Basic to Clinical Sciences. Springer, Singapore.
- Jayaprasad A G, Chandrasekharan A, Arun Jyothi S P, John Sam S M, Santhosh Kumar T R, Pillai M R. Telomerase inhibitors induce mitochondrial oxidation and DNA damage-dependent cell death rescued by Bcl-2/Bcl-xL. Int J Biol Macromol. 2024 Apr;264(Pt 1):130151: 1-14.

AWARDS [STUDENTS]:

- Aijaz Ahmad Rather, Best Poster Award at the First International Conference on Breast Cancer organized by the University of Kashmir in collaboration with SERB-DST and JKST on 22-24 November 2024.
- Aijaz Ahmad Rather, Best Oral Presentation award at 4th series on advancements in cell therapy an Asia-Pacific Cell therapy conference organized by ACTREC, Tata Memorial Centre Mumbai on 7-9 March 2025.

CONFERENCE PRESENTATION:

- Aijaz Ahmad Rather, Poster Presentation titled Understanding the Dynamics of CAR T Cell-Induced Cell Death in solid tumors using Genetically Engineered FRET-Based Sensors at the National Symposium on Biotechnology for Sustainable Development, & quot held on April 20, 2024.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Geometry Directed Functional Programming of Peptide Based Drug Delivery	Department of Biotechnology	2025	3 Years	PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Aparna G J	Telomere independent nuclear and mitochondrial functions of human telomerase (hTERT) in the regulation of cell cycle and cell death	Manipal Academy of Higher Education	Awarded	2025
02	Shivanshu Kumar Tiwari	The Implications of Hypoxia Induced Mitophagy in Cancer Cell Survival and Drug Resistance	Manipal Academy of Higher Education	Awarded	2025

Shijulal Nelson Sathi, PhD

Scientist E-I & Co-ordinator, Bioinformatics facility
Transdisciplinary Biology

BRIEF THEME OF LABORATORY

The laboratory uses bioinformatics approaches to better understand the origin, transmission, and evolution of antibiotic resistance and the discovery of novel molecules to combat antibiotic resistance in gram-positive priority pathogens.

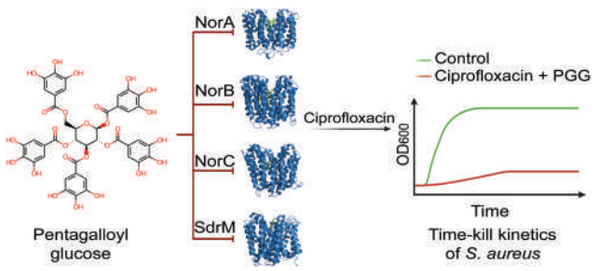
MAJOR RESEARCH AREA

- Discovery of a potential efflux pump inhibitor for combating antimicrobial resistance in Staphylococcus aureus.
- Reconstruction of high-quality metagenome-assembled genomes from shotgun metagenomic sequences of ESKAPE pathogens.

WORK REPORT

- INHIBITORY POTENTIAL OF PENTAGALLOYL GLUCOSE AGAINST EFFLUX PUMPS IN STAPHYLOCOCCUS AUREUS

Antibiotic resistance in Gram-positive priority pathogens is mediated by a diverse set of mechanisms such as target protection, antibiotic inactivation, decreased uptake, antibiotic efflux, etc. In Staphylococcus aureus, efflux pumps of the major facilitator superfamily (MFS) expel various antibiotics and multiple efflux pumps are activated upon antibiotic exposure. Efflux pump inhibitors (EPIs) that can act as antibiotic adjuvants are proposed to be promising solutions to tackle antibiotic resistance. In silico screening of 17,967 phytochemical compounds from Indian medicinal plants (IMPPAT 2.0) against four key MFS efflux pumps activated by fluoroquinolone exposure (NorA, NorB, NorC, and SdrM) followed by in vitro validation identified a tannin derivative, pentagalloyl glucose (PGG), as a potential efflux pump inhibitor (EPI) with high binding affinity. Molecular docking scores (≤ -16.383 kcal/mol) and MM/GBSA binding affinities (≤ -100.62 kcal/mol) indicate a strong interaction between PGG and its targeted efflux pumps. PGG forms stable interactions via hydrogen bonding with key residues of NorA, including GLU222 and ASP307, which are crucial for proton-coupled transport. Likewise, it interacts with essential residues in NorB (SER147, ASN280), NorC (ASN276, LYS398), and SdrM (SER143, GLN283), forming strong hydrogen bonds that contribute to its inhibitory potential. The stability of PGG-bound complexes was confirmed through molecular dynamics simulations over 100 ns in triplicates, along with free energy landscape (FEL) and principal component analysis (PCA). Furthermore, PGG's synergistic action with ciprofloxacin, and effects on S. aureus growth dynamics were validated using the checkerboard assay, and time-kill kinetic studies, respectively. Following further structural optimization and in vivo studies, PGG can be considered a promising therapeutic candidate against multidrug-resistant S. aureus strains.



Pentagalloyl glucose (PGG) was identified as a potential inhibitor of NorA, NorB, NorC and SdrM efflux pumps in S. aureus. PGG was further validated as a ciprofloxacin adjuvant, which declined the growth of the ciprofloxacin-resistant S. aureus strain.

TEAM

First Row: Rehnamol R, Dr. Shijulal Nelson Sathi, Anusree M, Bincy V (From L to R)
Second Row: Jemimah J, Alwin P, Kiran H (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students: 3 / Project Assistant: 1

PUBLICATIONS:

- Bhattacharyya C, Subramanian K, Uppili B. et al. Mapping genetic diversity with the Genome India project. Nat Genet. 2025; 57, 767–773.
- Pillai V S, Ravindran S, Krishna G, Abhinand C S, Nelson-Sathi S, Veettil M V. REST Is Restless in Neuronal and Non-Neuronal Virus Infections: An In Silico Analysis-Based Perspective. Viruses. 2025 Feb 8;17(2):234. ·
- Sharanya C S, Wilbee D S, Sathi S N, Natarajan K. Computational screening combined with well-tempered metadynamics simulations identifies potential TMPRSS2 inhibitors. Sci Rep. 2024 Jul 13;14(1):16197.
- Prasad R, Kadam A, Padippurackal V V, Pulikuttymadom Balasubramanian A, Kumar Chandrakumaran N, Suresh Rangari K, Dnyaneshwar Khangar P, Ajith H, Natarajan K, Chandramohanadas R, Nelson-Sathi S. Discovery of small molecule entry inhibitors targeting the linoleic acid binding pocket of SARS-CoV-2 spike protein. J Biomol Struct Dyn. 2024 Mar 23:1-15.

INVITED TALKS [PI ONLY]:

- Tackling of antibiotic resistance in Gram-positive priority pathogens, National Science Day - Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharath, at Mar Athanasios College For Advanced Studies Tiruvalla (MACFAST).

CONFERENCE PRESENTATION:

- Kiran H, Oral Presentation, Inhibitory potential of a tannin derivative against multiple efflux pumps in Staphylococcus aureus, ET2B from December 5-7, 2024, at Birla Institute of Technology Mesra, Ranchi.
- Dr. Bincy Varghese, Poster Presentation on Identification of Novel mirna Signatures in Hypertensive Disorders of Pregnancy: A Bioinformatics Approach, at 37th Kerala Science Congress, on 7-10 February 2025 at Kerala Agricultural University, Vellanikkara, Thrissur.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Epidemiological Monitoring of SARS CoV-2, and its variants in wastewater systems in the major cities of Kerala, India.	Anusandhan National Research Foundation	2022	2 Years	PI
02	Genomic and evolutionary characteristics of S. aureus circulating in Kerala	Kerala State Council for Science, Technology and Environment	2023	3 Years	PI

Sreekumar E, MVSc, PhD

Scientist F
Pathogen Biology

BRIEF THEME OF LABORATORY

Our research group is committed to develop strategies to combat mosquito-borne viral infections, particularly dengue and chikungunya. We pursue this goal by identifying novel antiviral strategies that act directly on the virus or through host-targeted pathways. Using advanced molecular techniques and host-pathogen interaction models, the lab aims to uncover key mechanisms that can be leveraged for therapeutic intervention.

MAJOR RESEARCH AREA

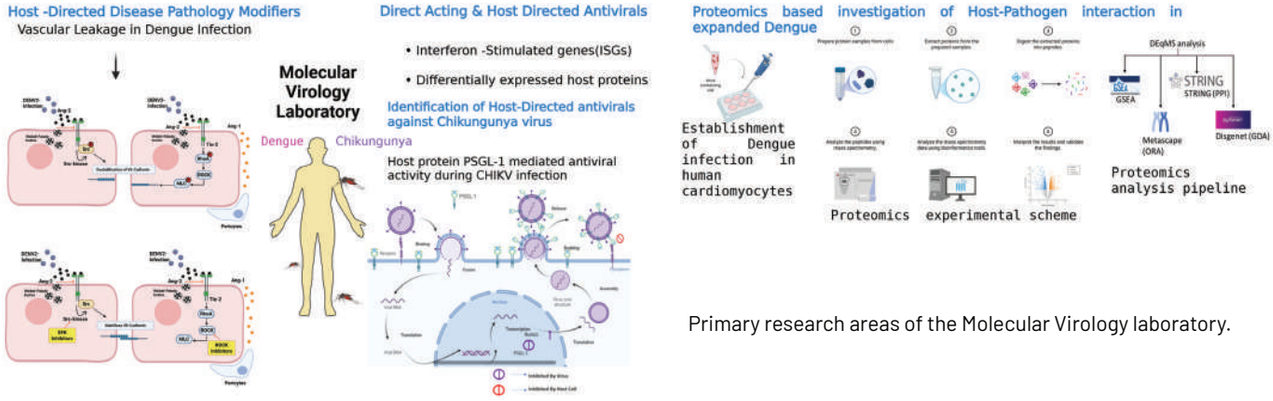
- Therapeutic Development: Ponatinib, an FDA approved molecule, demonstrated potential in restoring endothelial barrier function and reducing vascular leakage in dengue cell-based and animal models indicating a possibility of its drug-repurposing.

WORK REPORT

- UNDERSTANDING HOST RESPONSES TO DENGUE AND CHIKUNGUNYA VIRUS INFECTIONS FOR THE DEVELOPMENT OF NEW THERAPEUTIC AGENTS

Our laboratory focuses on host-targeted disease modifiers in dengue virus infection, where endothelial dysfunction and plasma leakage constitute major determinants of severe disease. Our studies demonstrated that pharmacological modulation of endothelial permeability can mitigate disease severity. Treatment with Fingolimod (FTY720) and Ponatinib and other FDA-approved, Src-kinase inhibitors significantly reduced vascular leakage in cellular and animal models of dengue infection. Ongoing investigations in the lab aim to elucidate the molecular basis of host-pathogen interactions contributing to these manifestations, with the broader goal of identifying novel therapeutic targets for disease intervention. Besides typical symptoms of Dengue infection, some cases may present the expanded symptoms involving organ level manifestation. One of which is cardiac manifestation. Severe dengue cases can involve cardiac complications, observed in 8–25% of patients. We are investigating the molecular basis of dengue-induced cardiac manifestations by analysing differentially expressed proteins and pathways. we have confirmed dengue infection in Human AC16 cells via immunofluorescence and western blot. Proteomic profiling of infected and uninfected cells has revealed differentially regulated proteins, analysed using DEqMS in R. Enrichment via GSEA, Metascape, and DisGeNET linked them to viral replication, cardiac event, and cardiomegaly. Infected mice heart tissues exhibited histopathological changes and Dengue antigen presence, supporting cell line findings. The differential protein expression pattern identified in vitro are being validated in the animal model.

Our laboratory also focuses on identifying the Host-directed Antivirals (HDA), where we try to identify small molecules that can activate Interferon-stimulated Genes (ISGs). Currently, our lab focuses on IFITM family proteins which have been demonstrated to restrict many enveloped RNA virus entries including Dengue and Chikungunya. We have amplified and cloned the putative promoter region of IFITM1, IFITM2 and IFITM3 and cloned it in a Luciferase reporter plasmid and the plasmid was used to generate a stable reporter cell line (HEK293 based). We have developed HEK based IFITM1, 2 & 3 promoter reporter cell lines and validated it with IFNb. Currently we are trying to identify the small molecule that can induce the IFITM proteins and act as antivirals. We also investigated the role of host protein PSGL-1 during CHIKV infection. We show that PSGL-1 is upregulated during CHIKV infection and negatively regulates viral replication. Mechanistically, we demonstrate that PSGL-1 incorporates into virions and interferes with their infectivity, a function that is further modulated by its interaction with CHIKV envelope proteins.



Primary research areas of the Molecular Virology laboratory.

TEAM

Srishti Rajkumar Mishra, Mansi Awasthi, Dr. Sreekumar E, Guhan K S
(From L to R)

LABORATORY STRENGTH

PhD Students: 4 / Lab Assistant: 1

PUBLICATIONS:

- Modak A, Mishra S R, Awasthi M, Aravind A, Singh S, Sreekumar E. Fingolimod (FTY720), an FDA-approved sphingosine 1-phosphate (S1P) receptor agonist, restores endothelial hyperpermeability in cellular and animal models of dengue virus serotype 2 infection. IUBMB Life. 2024 May;76(5):267-285.
- Nair S R, Sreekumar E, Dhanesh V V, Varghese G R, Ariya A, Raj R S. Seroprevalence of Coronaviruses FCoV and SARS-CoV-2 in domestic cats in Kerala, India. J. Vet. Anim. Sci. 2025;56(3):450-6.

AWARDS [STUDENTS]:

- Guhan K S, Best Oral Presentation on Exploring Interferon-stimulated Genes (ISGs) modulation as an antiviral Strategy against emerging RNA viruses at the 2nd international conference on translational research in biomedicine from February 19-21 2025 at Sathyabama institute of science and technology, Chennai, India.

CONFERENCE PRESENTATION:

- Guhan K S, Oral Presentation on Exploring Interferon-stimulated Genes (ISGs) modulation as an antiviral Strategy against emerging RNA viruses at the 2nd international conference on translational research in biomedicine from February 19-21 2025, at Sathyabama institute of science and technology, Chennai, India.
- Mansi Awasthi, Poster Presentation on Differential proteomics analysis of Dengue virus-infected human cardiomyocytes, on 8th Molecular Virology Meeting from18th-20th September at Institute of Advanced Virology, Trivandrum, India.
- Mansi Awasthi, Poster Presentation on Differential proteomics analysis of Dengue virus-infected human cardiomyocytes at National Symposium on Biotechnology for sustainable development on 16th May,2025 at Rajiv Gandhi Centre for Biotechnology, Trivandrum, India.

Sunil Martin, PhD

Scientist E-II
Cancer Research

BRIEF THEME OF LABORATORY

Synthetic immunology for a better anti-tumor response

MAJOR RESEARCH AREA

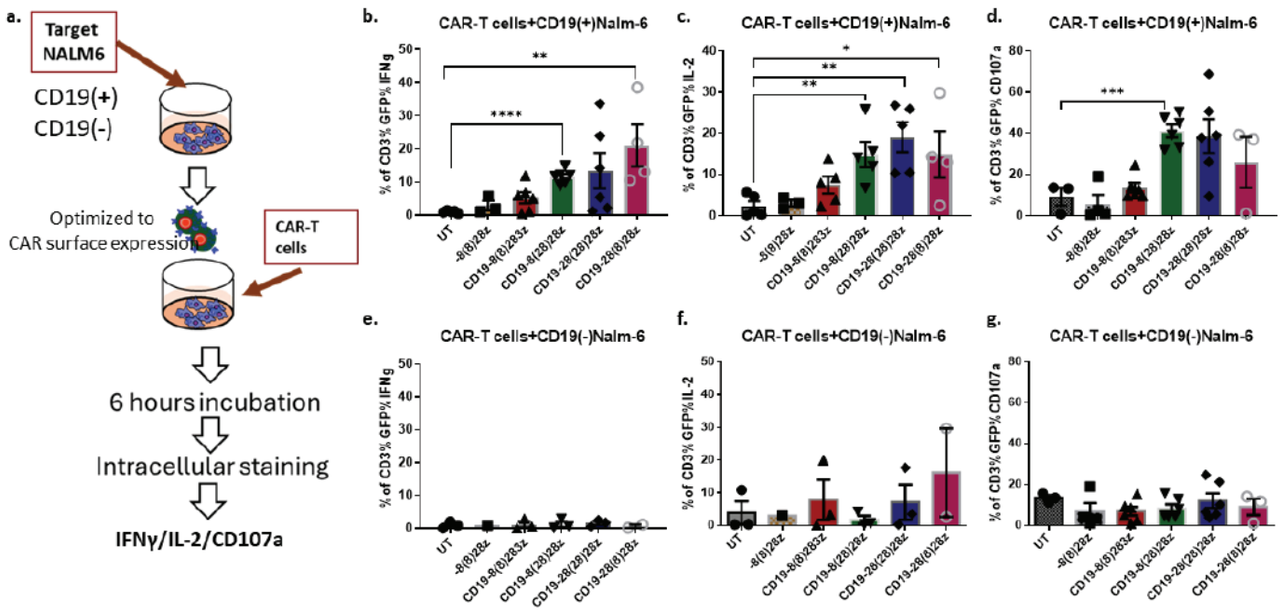
- Optimized a preclinical workflow for engineering and testing the CAR T cells for adoptive immunotherapy.
- Investigated the impact of CD28 derived hinge and transmembrane domains of CARs on the anti-tumor response to CD19 positive blood malignancies.

WORK REPORT

- IMPACT OF HINGE AND TRANSMEMBRANE DOMAIN ON THE ANTI-TUMOR FUNCTIONS OF CAR T CELLS

Refractory leukemia of B lineage origin remains a major challenge among pediatric populations in India. Although CAR therapy is clinically approved for blood malignancies, at least 50% of the patients fail to achieve the intended response. Uncontrolled and dysregulated release of pro-inflammatory cytokines such as IL-6 and IL-1β can drive multi-organ toxicity and even non-relapse mortality. CRS-associated hospitalizations significantly enhance the overall cost for anti-CD19 CAR T cells with CD28 co-stimulatory domain. Fine-tuning the receptor configuration of this modular synthetic receptor is one of the most effective strategies to mitigate the cytokine toxicity. The quality and quantity of amino acids in the hinge and transmembrane (HTM) domains were demonstrated to impact the safety and efficacy of CAR T cells in vivo. Most of the FDA-approved CAR configurations incorporate HTM domains derived either from CD8α or from CD28. The choicest HTM domain for optimal functioning of CAR T cells is yet to be identified. Furthermore, the molecular mechanisms of the CD28 HTM domain on the receptor expression, proliferation, cytokine production, and antigen-specific lysis of blood malignancies remain to be explored. Towards this end, we generated anti-CD19 CAR with hinge and transmembrane domain derived from CD28 and CD8α. We observed the differential role of CD28 domains in the cell surface expression, cytokine production, tumor toxicity, and induction of IL-1β from autologous myeloid cells. CD28 HTM domains were associated with distinct CAR signalling and immune synapse patterns. Currently we are investigating the mechanistic basis of the impact of CD28 elements on the anti-tumor functions in the CAR T cell X NALM-6 co-culture systems.

(a) Workflow for testing the antigen specific induction of cytokines from HTM modified CD19 CAR T cells.
(b) Antigen-specific cytokine release (IL-2 and IFNγ) and degranulation of primary CAR T cells co-cultured against CD19(+) NALM6 (n=3).
(c) CD19(-) NALM-6, n=2: a, BAR graphs shows IFNγ, b, IL-2 and c, CD107a from CAR-T cells co-cultured with CD19 positive NALM-6 cell lines. n=3.



Synthetic Immunology Laboratory, BRIC-RGCB

TEAM

First Row: Dr. Sunil Martin, Namitha C, Archana Praveen, Anjitha S, Praseetha N G, Shabeeba M Ashraf (From L to R)
Second Row: Lalitha Priyadharshini S, Shubham Parve, Diksha Kulshreshtha, Soham Ghosh, Muthuganesh M, Muhamad Shafi K (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 2 / PhD Students: 5 / JRF: 3 / SRF: 2 / Project Assistant: 2

PUBLICATIONS:

- Muthuvel M, Ganapathy T, Spencer T, Raikar S S, Thangavel S, Srivastava A, Martin S. Engineering safe anti-CD19-CD28ζ CAR T cells with CD8a hinge domain in serum-free media for adoptive immunotherapy. Front Immunol. 2025 May 9;16:1545549.
- Ngashangva L, Martin S. Organ-on-chip for advancing CAR therapy. Clin Transl Immunology. 2025 Feb 26;14(2):e70024.

INVITED TALKS [PI ONLY]:

- Talk on Engineering αβ and γδ T cells for adoptive immunotherapy at the 5th International Global Cancer Consortium Conference. Theme - Advances in Cancer and Cancer Immunotherapy, at Amity University, NOIDA Campus, Uttar Pradesh from 28-31st January, 2025.
- Talk on Engineering immune cells for adoptive Immunotherapy. Frontiers in Data Science from January 31 to February 2, 2025, at the IISER Thiruvananthapuram campus.

CONFERENCE PRESENTATION:

- Muthuvel Muthuganesh, Oral Presentation and Poster at the 4th Series on Advancements in Cell Therapy' (SACT) at CIDCO Exhibition & Convention Centre, Navi Mumbai from 7th - 9th March 2025.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	CD19 CAR T cells to target refractory or relapsed B cell Acute Lymphoblastic Leukemia (r/r B-ALL	Department of Biotechnology	2022	3 Years	PI
02	Affinity-tuned CAR T cells targeting refractory CD20 (+) B lineage malignancies for enhanced safety and antitumor functions	Indian Council of Medical Research	2024	4 Years	PI
03	Augmenting off-the shelf γδ T cell therapy in oral squamous cell carcinoma (OSCC) by targeted regulation of EZH2	Department of Biotechnology	2024	3 Years	PI

Tessy Thomas Maliekal, PhD
Scientist E-II
Cancer Research

BRIEF THEME OF LABORATORY

Oral cancer is one of the important cancer with respect to mortality, worldwide and in India. The poor prognosis is due to the relapse of the disease or reappearance of the cancer after treatment, which primarily depends on the self-renewal ability of cancer cells. Our lab focuses on identifying the important signaling pathways and their intermediates regulating this property.

MAJOR RESEARCH AREA

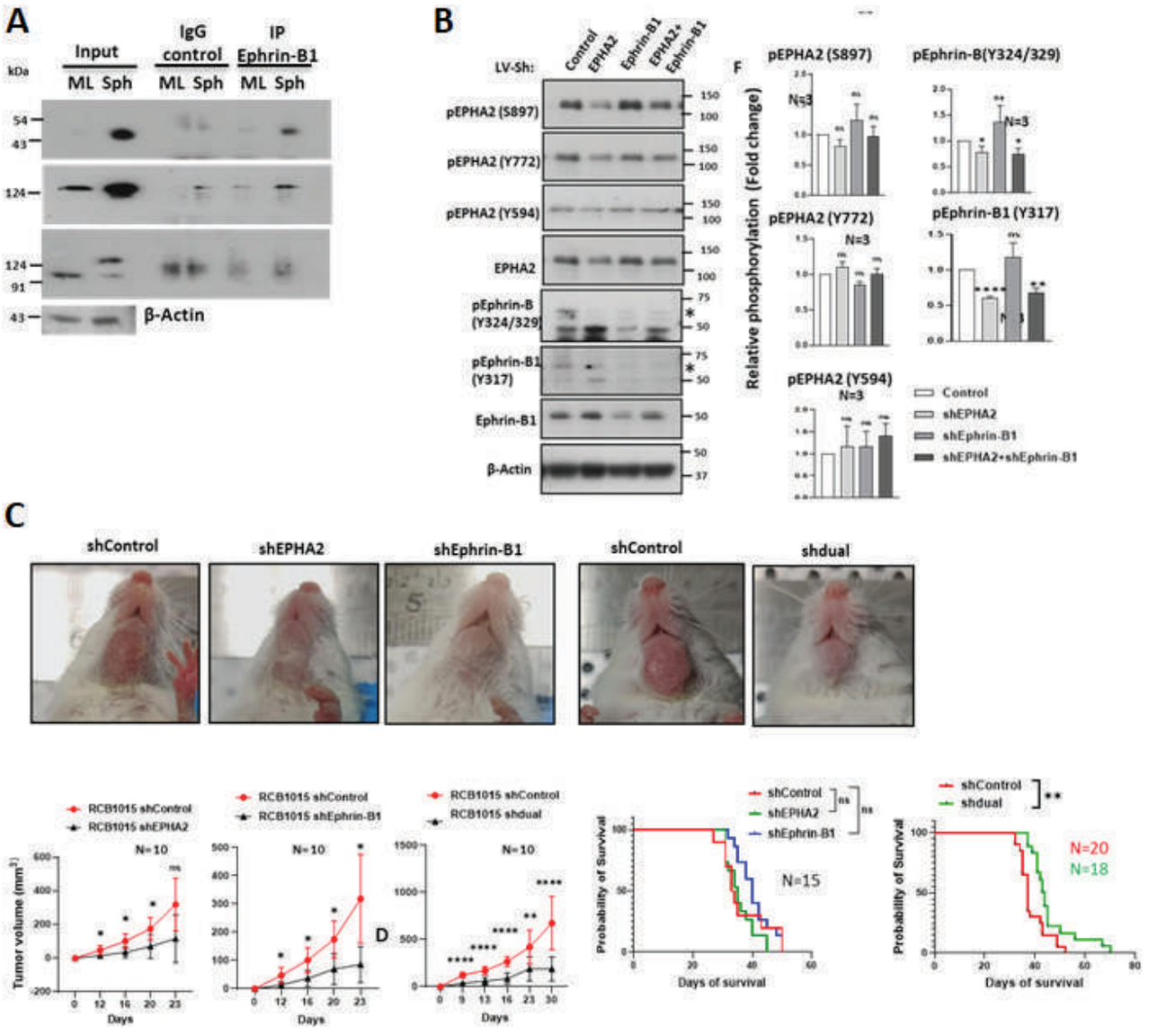
- Elucidated the role of EHPA2/Ephrin-B1 signaling in oral cancer recurrence. We identified that a Cis- signaling of EHPA2/Ephrin-B1 is critical for the maintenance of self-renwal. With mouse models we showed that aborogation of the ligand, receptor or both significatly improves the prognosis of oral cancer.

WORK REPORT

- EPHA2-DEPENDENT EPHRIN-B1 SIGNALING SUPPORTS SELF-RENEWAL ABILITY AND RECURRENCE OF ORAL CANCER

As self-renewal of cancer cells is the underlying cause of recurrence and poor prognosis, understanding its molecular determinants is important. Despite the established role of Ephrin-B1 in the regulation of normal stem cells, its role in the self-renewal of cancer cells is poorly

explored. Here, using proteomic approach, we report that Ephrin-B1 and its signaling is critical for the self-renewal of oral cancer cells. Further, biochemical analyses revealed that the expression of Ephrin-B1 and EPHA2, a known regulator of cancer stem cells (CSCs), are up-regulated in parallel to the enrichment of self-renewal. Unlike the normal context, as reported, this aberrant upregulation enables their cis-interaction, leading to the phosphorylations of EphrinB1 Y324/329 and Y317. Our in vitro and in vivo functional analyses confirmed the role of Ephrin-B1-EPHA2 signaling in enriching CSCs. Using mouse orthotopic models, we show that abrogation of the ligand, receptor or both results in better prognosis. Moreover, the results of the in silico and immunohistochemical analysis of oral cancer samples reinforced the critical involvement of this signaling in the recurrence of the disease.



(A) Immunoprecipitation to prove the interaction of EphA2 and Ephrin-B1.
(B) Western blot showing the dependence of Ephrin-B1 phosphorylation on EPHA2 cis interaction.
(C) In vivo model for overall survival

TEAM

First Row: Sreeja Purushothaman, Reshma Raj, Dr. Tessy Thomas Maliekal, Nandini Datta, S Jannet (From L to R)

Second Row: Zubair Ahmad Mir, Gayathri Mohan, Padmaja K P, Magna Jom (From L to R)

LABORATORY STRENGTH

Postdoctoral Fellows: 1 / PhD Students:5 / JRF: 1 / SRF: 4 / Project Assistant: 1
Technical Assistant: 1 / Lab Assistant: 1

PUBLICATIONS:

- Raj R R, Krishnan U S, Shanmugam G, Datta N, Louis J M, Jeyaram R D, Datta K K, Gowda H, Sarkar M, Nair M G, and Maliekal T T. EPHA2-dependent Ephrin-B1 signaling supports self-renewal ability and recurrence of oral cancer. bioRxiv: 2025:2001. 2003.631197.
- Jyothy A, Hussain J, Suresh S C, Chandraprabha V R, Nair M G, Vasudevan S, Sreedharan H, Abraham B, Maliekal T T, Natarajan K, Sengupta S. α-Fodrin–CENP-E interaction is critical for Pancreatic Cancer Progression and drug response Cell Cycle. 2024 Jul-Aug;23(13-16):847-871.
- Datta N, Snijesh V P, Parvathy K, Sneha A S, Maliekal T T. ALDH1A1 as a marker for metastasis initiating cells: A mechanistic insight. Exp Cell Res2024: 442(1): 114213.
- Sarkar M, Raj R R, Maliekal T T. Finding the partner: FRET and beyond. Exp Cell Res. 2024: 441(2): 114166.
- Nair M G, Mavatkar A D, Naidu C M, Snijesh V P, Anupama C E, Rajarajan S, Sahoo S, Mohan G, Jaikumar V S, Ramesh R S, Srinath B S, Jolly M K, Maliekal T T, Prabhu J S . Elucidating the Role of MicroRNA-18a in Propelling a Hybrid Epithelial-Mesenchymal Phenotype and Driving Malignant Progression in ER-Negative Breast Cancer. Cells. 2024: 13(10):821.

AWARDS [STUDENTS]:

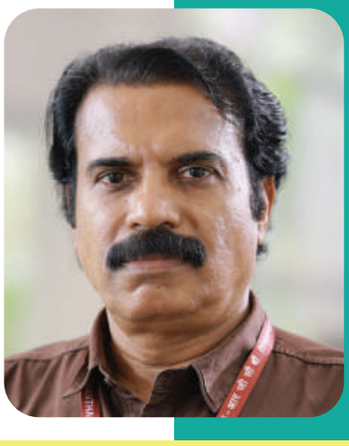
- Reshma Raj R, Best Poster for EphrinhB1 mediated EPHA2 signaling regulates cancer stem cells leading to poor overall survival in oral cancer patients at National Conference on Emerging Trends in Healthcare Biotechnology: Innovations, Challenges and Future Prospects, Thiruvananthapuram from Nov 30 – Dec 02, 2023 at Regional Cancer Centre, Thiruvananthapuram.
- Padmaja K P, Best Poster award The transcriptional regulatory role of TIF1γ in the regulation of self-renewal one-day seminar on National Symposium on Biotechnology for Sustainable Development on April, 20, 2024 at BRIC-RGCB.
- Padmaja K P, Best Poster award The transcriptional regulatory role of TIF1γ in self-renewal leading to recurrence in oral cancer at IACR, 2025, Jan 16-18, 2025, Kolkatta.

CONFERENCE PRESENTATION:

- Reshma Raj R, Best Poster, EphrinhB1 mediated EPHA2 signaling regulates cancer stem cells leading to poor overall survival in oral cancer patients, National Conference on Emerging Trends in Healthcare Biotechnology: Innovations, Challenges and Future Prospects Thiruvananthapuram from Nov 30 – Dec 02, 2023 at Regional Cancer Centre, Thiruvananthapuram.
- Padmaja K P, Best Poster award The transcriptional regulatory role of TIF1γ in the regulation of self-renewal one-day seminar on National Symposium on Biotechnology for Sustainable Development on April, 20, 2024, BRIC-RGCB.
- Padmaja K P, Best Poster award The transcriptional regulatory role of TIF1γ in self-renewal leading to recurrence in oral cancer at IACR, 2025, Jan 16-18, 2025, Kolkatta.
- Gayathri Mohan, Deciphering the molecular mechanism of SSTP1-induced apoptosis in Triple Negative Breast Cancer (TNBC) at IACR, 2025 from Jan 16-18, 2025, Kolkatta.
- Zubair Ahamed Mir, Deciphering The Molecular Mechanism Of Tif1γ Activation And Regulation In Oral Cancer at IACR, 2025, Jan 16-18, 2025, Kolkatta.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Evaluation of the E3-ligase independent function of Transcription Intermediary Factor1γ (TIF1γ) in the regulation of cancer stem cells	Anusandhan National Research Foundation	2023	3 Years	PI



G. S. Vinod Kumar, PhD

Scientist F & Associate Dean (Academic Affairs)
Cancer Research

BRIEF THEME OF LABORATORY

Our group mainly focus on designing and development of peptide synthesis and multifunctional nanostructures for programmed drug delivery targeting systems in cancer and wound healing. Several first and co-authored manuscripts are published in leading scientific journals and in addition hold key patents as inventor on Indian and US patents.

MAJOR RESEARCH AREA

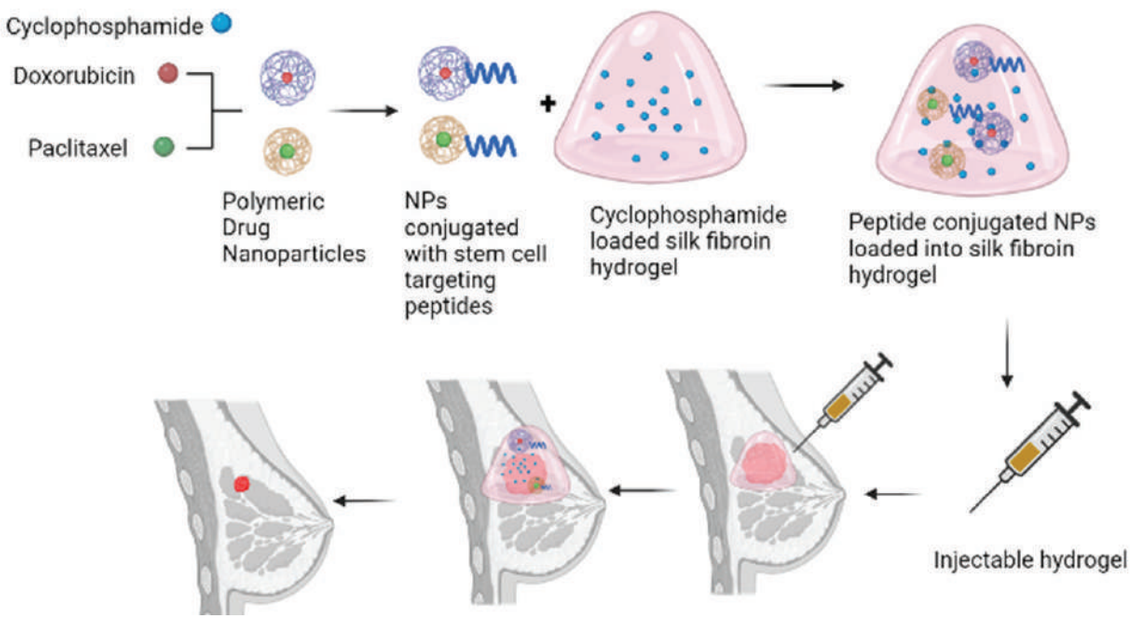
In breast cancer research, we developed an injectable silk fibroin-based hydrogel integrated with drug-loaded nanoparticles to treat triple-negative breast cancer (TNBC).
Advantages:

- The hydrogel, utilizing sonication-induced gelation at 37°C, enables easy intra-tumoral injection and sustained drug release, effectively targeting tumor sites.
- Drug-loaded PLGA nanoparticles (paclitaxel and doxorubicin) exhibited enhanced cytotoxicity compared to free drugs in TNBC cell lines.
- In vitro experiments demonstrated high biocompatibility, apoptosis induction and enhanced tumor spheroid penetration in MDA-MB-231 cells.
- In vivo studies in NOD-SCID mice showed significant tumor volume reduction and minimal systemic toxicity compared to systemic chemo-therapy.

WORK REPORT

- INJECTABLE BIOPOLYMER BASED INTEGRATED NANO DRUG DELIVERY IMPLANT SYSTEM TO TREAT BREAST CANCER.

The title describes a novel injectable system using biopolymer-based hydrogels integrated with drug-loaded nanoparticles to treat breast cancer. This approach enables localized, sustained drug delivery to enhance therapeutic efficacy while minimizing systemic toxicity. By combining silk fibroin hydrogels with nanoparticles targeting triple-negative breast cancer, it offers a promising, less invasive treatment with potential applications for other cancers. Breast cancer, the leading global malignancy, accounts for 12.5% of new cancer cases, with triple-negative breast cancer (TNBC) treated using paclitaxel (PTX), doxorubicin (DOX), and cyclophosphamide (CYP). Systemic chemotherapy often results in multidrug resistance and severe toxicity, requiring high doses that damage healthy cells. This study develops an injectable silk fibroin-based hydrogel integrated with PTX- and DOX-loaded PLGA nanoparticles and CYP directly incorporated into the hydrogel for localized, sustained TNBC therapy. PLGA nanoparticles were synthesized using solvent displacement and emulsion methods, with hydrodynamic diameter and zeta potential analyzed via dynamic light scattering and TEM imaging. UV-spectrophotometry quantified drug entrapment, confirming efficient loading. In vitro studies on MDA-MB-231 TNBC cell lines demonstrated that nanoparticles outperformed free drugs in MTT, live/dead, and clonogenic assays, showing higher cytotoxicity and antitumor potential. Western blot analysis revealed apoptosis through PARP and Caspase-3 cleavage, supported by Rhodamine Phalloidin, DAPI, and acridine orange staining, which indicated cytoskeletal reorganization, apoptosis, and lysosomal disruption, respectively. Annexin V/PI staining via flow cytometry confirmed early and late apoptosis, while tumor spheroid assays showed enhanced nanoparticle penetration and toxicity, mimicking in vivo conditions. Cyclophosphamide's high IC50 (15 mM) necessitated its direct incorporation into the hydrogel, achieving 50% drug release over 30 days in phosphate-buffered saline. In vivo studies involved injecting $5x10^6$ MDA-MB-231 cells into the mammary fat pads of NOD-SCID mice. When tumors reached 75–100 mm^3, mice were divided into Control, Blank Hydrogel, Free Drug (systemic), and Hydrogel@DNPs+CYP (single intra-tumoral injection) groups. The hydrogel group significantly reduced tumor volume and weight, unlike the aggressive growth in control and blank groups. The Free Drug group showed partial tumor suppression but caused systemic toxicity. Histopathological analysis (H&E, Masson's Trichrome) revealed necrosis, reduced nuclear-to-cytoplasmic ratio, and disrupted collagen deposition in the hydrogel group, indicating tumor matrix degradation. Ki-67 and Caspase-3 immunofluorescence confirmed reduced proliferation and increased apoptosis, surpassing systemic treatment efficacy despite a single dose. Systemic toxicity assessment showed the Free Drug group caused extensive off-target damage, including urinary bladder fibrosis, cardiac disorganization, ovarian follicular depletion, neuronal shrinkage, kidney nephrotoxicity, spleen splenomegaly, lung metastatic foci, and liver vacuolation. In contrast, the Hydrogel@DNPs+CYP group preserved normal organ architecture, minimized metastatic spread, and reduced systemic toxicity. Future plans include in vitro degradation studies, SEM and rheology characterization of the hydrogel, in vivo biodistribution, pharmacokinetic studies, and evaluation of stem cell-targeting peptide-conjugated nanoparticles, with synthesis already completed. This single-dose hydrogel system demonstrates superior antitumor efficacy, reduced systemic drug burden, and protection against off-target toxicity compared to repeated systemic chemotherapy, offering a promising, safer, and more effective approach for TNBC treatment with potential applications to other cancers.



Schematic illustration of injectable hydrogel-implant drug delivery system

TEAM

Jyothilakshmi V A, Dr Vinod Kumar G S, Arsha U P, Athira S S (From L to R)

LABORATORY STRENGTH

PhD Students: 4 / Technical Assistant: 1 / Lab Assistant: 1

PUBLICATIONS:

- Mohan A K, Goud L N, Vinod Kumar G S. In Vitro and In Vivo Evaluation of PCL-PEG Nanomicelles for Paclitaxel Drug Release to Treat Breast Cancer. ACS Appl Nano Mater. 2025: 8,11717–11729.

ONGOING GRANTS:

Sl No.	Title	Funding Agency	Year of Starting	Duration	PI/CO-PI
01	Targeted inhibition of EZH2 by precision nanoparticles to augment off-the-shelf γδ T cell therapy in squamous cell carcinoma	Department of Biotechnology	2024	3 Years	CO-PI

PhD AWARDED:

Sl No.	Students Name	Title of Thesis	University	Awarded/ Submitted	Year
01	Vipin C L	Exosome-Laden Multifunctional Hydrogel for Enhanced Burn Wound Healing	Regional Centre For Biotechnology	Submitted	2025

BRIC-RGCB ADMINISTRATION

OFFICE OF THE DIRECTOR

First Row: S Mohanan Nair, Professor Chandrabhas Narayana (From L to R)
Second Row: Vishnu S, Vishnu P, Anoop Radhakrishnan, Venugopalan J (From L to R)

The Office of the Director is responsible for successful leadership and management of the organization according to the strategic directions set by the institute management. This office develops the vision and strategic plan to guidethe organization, develop an operational plan which incorporates goals and objectives ensures that the operation of the organization meets expectations of its stakeholders and funding agencies. The Office of the Director also oversees efficient and effective day-to-day functions of the organization, draft policies for approval of the Governing Body; prepare procedures to implement organizational policies; review existing policies and recommend changes as appropriate; ensure that programs and services offered by the institute contribute to its mission; monitor day-to-day delivery of programs and services to maintain or improve quality, determine staffing requirements for organizational management and program delivery, recruit, interview and select staff that have the right technical and personal abilities to help further the organization's mission. The Office also is responsible to supervise preparation of a comprehensive budget and to secure adequate funding for the operation of the organization.

CHIEF CONTROLLER

S Mohanan Nair

Directs and coordinates the administrative, finance purchase & stores activities at the Institute, business service functions & procedures of the Institute and ensures compliance with all applicable regulations & policies. The Chief Controller is the primary link between the general administration groups and the Office of the Director. The Chief Controller also provides leadership & supervision of business services, administrative duties, all recruitment & promotions, compilation and monitoring of revenue, expenditures etc. The Chief Controller manages all procurements and provision of stores/stock. All legal matters are also supervised by the Chief Controller. The Security, Vigilance, Disciplinary matters are all dealt with by Chief controller.

GENERAL ADMINISTRATION

The management of research and development (R&D) and innovation has emerged as a specialized area within both research and higher education institutions. New modalities of research and innovation have evolved over the last 10 to 20 years against a backdrop of major changes in the tertiary research and education sector as a whole. The Administration Group is backbone of any such organization. An effective administrator is an asset to an organization. The Administration Group is the link between various units and sections of the organization and ensures the smooth flow of information from one part to the other. The Administration Group also provides administrative & technical support in the areas of human resources management, budgetary, strategic planning, legal affairs, pay and allowances, medical benefits, leave management, purchase procedures, management of stores and facilitates security.

The main responsibility of general administration group is to ensure all requirements are implemented for the efficient performance of all research related services at BRIC-RGCB. The General Administration Group serves as the connecting link between the senior management and employees. The major mandates of general administration include good coordination among all the departments ensuring attainment of organizational goals; optimum utilization of resources, minimization of cost, human resources and payroll, transportation, fulfilment of social and economic needs of the employees and organization as well as development and growth of the institute. The General Administration also implements work related to Estate Affairs, House Keeping & Welfare, Legal matters and implementation of various Acts (including RTI), Building Engineering & Construction, Security & Surveillance, Vigilance & Disciplinary matters and official language.

Administrative Office (Main Campus)

First Row: R Kumar, Vishnu S, Jayakrishnan N, Shiby Benny, S Mohanan Nair, Prof Chandrabhass Narayana, Anilkumar R, Vinodlal K A (From L to R)
Second Row: Dileepkumar R, Nitheesh Raj, Priya R, Aneez S, Jayalakshmi U S, Sujitha S, Reena Prasad, Subhash, Sandhya S J, Wilson T, Vinodkumar S R, Ganesh Babu B (From L to R)
Third Row: Sreejith S, Venugopalan J, Preetha J, Neethu S D, Lakshmidarshan S, Vijayan S, Ratheesh R (From L to R)
Fourth Row: Anandhu Ashok, Vishnu P, Akhiljith S, Praveen B, Jayanandhan J, Santhosh S, Ashokkumar S (From L to R)

Administrative Office, IPP (Main Campus)

First Row: Jayakrishnan N, S Mohanan Nair, Prof. Chandrabhass Narayana, Shiby Benny (From L to R)
Second Row: Devika Menon J G, Pavithra Nair, Arathy S, Anjana Krishnan B, Deepika S S, Ambika P Kumar, Athirachandran, Aryasri P, Jyothsree V T, Meena H (From L to R)
Third Row: Lalkumar C, Suresh C, Rahul A S, Asha V S, Anitha, Chithra G S, Smitha L R, Sreevidhya, Prathibha Rani P S, Sajeesh T V, Sreedevi, Athira V L, Abhilal G, Sreejith G S, Hariharan S, Vinu S Nair, Deepu R V (From L to R)
Fourth Row: Byju S, Pradeepkumar B S, Akshaykumar H, Sarath S N, Deepu J, Ratheesh Kumar G, Vaisakh V R, Sathyadas C R, Anoop R, Anandhu R L, Harikrishnan S, Dineshkumar S (From L to R)

FINANCE & IFC DIVISIONS

The Finance Division of BRIC-RGCB has been inventive in budget planning and its real-time reporting, always in absolute synchronization with the scientific fraternity of the Institute. Preparation & Monitoring of Budget and Resource Generation are always aimed to acclimatize the available resources' utilization in achievement of its mandated science, thereby paving the way for productive application of all available resources. Prompt generation and submission of internal management information by the Finance Division always facilitates BRIC-RGCB in taking accurate and apt decisions. Matters related to BRIC-RGCB's Finance Committee, audit, processing of payments, TDS/GST and returns, accounting of receipts & disbursements, revenue refunds, reconciliation of bank accounts and rendition of utilization certificates and statements of expenditure are always promptly implemented by the Finance Division. The Final Accounts along with Audit Report are placed on the tables of both Houses of Parliament through the Department of Biotechnology. The dynamic contributions of Finance Division have always resulted in building organizational strength, enthusiastic and motivated personnel and hence a robust Institution.

A dedicated IFC enhances in all Financial as well as Administrative/Establishment works related to extra-mural funded projects of the Institute, all matters related to PhD, M.Sc, Summer training

Project Engineering Team

Vishnu R S, Gowrisankar A, Narayanan K K, Ashtami M R, Vaisakh H, Shibu Panicker, Anup R, Ganesh Babu B, Anand N P (From L to R)

programs, Post-Doctoral Fellows etc. Accounting in respect of all service facilities of the Institute are exclusively done by this Group. This specialized Group plays an extremely important management role of all extramural and Institute generated funds. It is the connecting link between all funding agencies and BRIC-RGCB. The vital duties of IFC includes implementation of procedures related to accounting, payment, preparation and rendition of Utilization Certificates and Statements of Expenditure in respect of all cases except the Core Grants, Ph.D Fellowships, Post Doctoral Fellowships, Program Scientist Fellowships and fund management of Extra Mural Projects. The IFC is also the internal link in respect of all matters pertaining to purchases in utilisation of such extra-mural funds & receipt and issue of stores.

OFFICE OF ACADEMIC AFFAIRS (OAA)

The Academic Programs at BRIC-RGCB exemplify our commitment to excellence in biotechnology education and research. Here we provides an overview of the MSc and PhD programs, highlighting our innovative curriculum designed to equip students with essential skills for successful careers in biotechnology, research, and academia. The MSc in Biotechnology emphasizes hands-on training and practical applications, enabling students to specialize in pivotal areas such as Disease Biology and Genetic Engineering.

Our PhD program, affiliated exclusively with the Regional Centre for Biotechnology (RCB), employs rigorous selection processes to ensure the enrollment of high-quality candidates. With strong infrastructural support, dedicated faculty mentorship, and a vibrant research environment, BRIC-RGCB remains a catalyst for cultivating scientific talent and advancing biotechnological innovation.

Briji S, Dr. Anish N P, Dr. Priya Srinivas, Beena Nair L (From L to R)

First Row: Dr. Rajesh Chandramohanadas, Dr Lekshmy Srinivas, Remya Raveendran, Dr Lekshmi R S (From L to R)
Second Row: Aswani Kumar, Ajith Gopal (From L to R)

M.Sc Batch 2023 - 2025

First Row: Anwesha Dutta, Sindhu Rai, Payal Anand, Atasi Ghanti, Nishita Thakur, Meghna Das, Saloo Sahu, Sanchari Roy Chowdhury, Divya Aharwal (From L to R)
Second Row: Kaushik Jith, Aritra Kundu, Deepak Bhongale, Soumitra Joshi, Shane Papang, Prateek Nainavat, Nishan Diengdoh, Parmar Mihir, Nirmalendu Mukherjee (From L to R)

M.Sc Batch 2024 - 2026

First Row: Nabeela Ansari, Pradhyotha Babu, Thekkan, Oisi Konar, Joyeeta Bhattacharya, Devshree Dixit, Jyothika S, Anishka Anil Kumar, Drishika Mandal, Rikshita Bhattacharyya (From L to R)
Second Row: Alvan E Swer, Susmelee Mohanta, Ayushi Singh, Rakshit G S, Amitesh Chakraborty, Nashua Rollie Laloo, Borana Udit Sinh, Sumit Avaralli, Shraban Halder (From L to R)

MSC PROGRAMS

The MSc in Biotechnology at BRIC-RGCB offers a comprehensive educational program designed to prepare graduates for careers in biotechnology, research, and academia. The program highlights include hands-on training through laboratory exercises that develop practical skills, a strong research orientation with interactions in ongoing projects at BRIC-RGCB, and integration of entrepreneurship and enterprise elements within the curriculum to prepare students for diverse career paths. The MSc program emphasizes hands-on training to ensure job readiness, preparing students for careers in scientific research, development, innovation, and teaching. Students engage in modern biotechnology techniques within a vibrant research environment, focusing on real-world applications to enhance their learning experience. In their second year, students can choose to specialize in either Disease Biology, which focuses on the biological mechanisms of diseases, pathogenesis, and therapeutics, or Genetic Engineering, which covers techniques for manipulating genetic material, gene therapy, and bioinformatics. Four M.Sc. tutors are assigned to support students with practical sessions, ensuring better hands-on learning. Selected clinical subjects will also include engagement with external expert faculty to enhance academic quality.

The MSc Biotechnology Program, affiliated with the Regional Centre for Biotechnology (RCB), was launched in 2019. Selection is based on GAT-B scores and requires a minimum of 60% in a Bachelor's degree in Life Sciences, adhering to Government of India reservation policies. For the 2024-2026 cycle, 673 applications were received, with 20 students admitted. Students receive a monthly stipend of ₹6000 in the first two semesters, increasing to ₹8000 in the next two. The curriculum includes a two-month project after the second semester and a mandatory full-semester project in the fourth semester at BRIC-RGCB. Internship opportunities with industry partners like Aurigene Oncology and Sun Pharma are actively pursued.

To enhance academic performance and research aptitude among MSc students, BRIC-RGCB has established two awards: the Best Outgoing Student Award, based on overall academic performance, and the Best Dissertation Award, determined by evaluations from internal and external examiners. The Viva Voce for final semester students took place on July 23rd& 24th, 2024, followed by a farewell function on July 27, where the Best Outgoing Student Award was presented to Ms.Sejal Sanjay Raskar (CGPA: 8.79/9.00), and the Best Dissertation Award was awarded to Ms. Ritika Sachdeva.

To encourage the MSc students to improve their academic performance and research aptitude, BRIC-RGCB has introduced two awards, namely, Best Outgoing Student Award and Best Dissertation Award. Best outgoing student award is primarily based

upon the Academic performance. The Best Dissertation Award is considered based upon the grading given by external and internal examiners for the quality of dissertation thesis, presentation, interpretation of data etc. The Viva Voce for final semester students was conducted on July 23rd& 24th, 2024, followed by a farewell function held on July 27. During this event, awards were announced, including the Best Outgoing Student Award presented to Ms.Sejal Sanjay Raskar (CGPA: 8.79/9.00), the Best Dissertation Award awarded to Ms. Ritika Sachdeva.

BRIC-RGCB also assesses the teacher's performance, based on the feedback from the students. Each student will be asked to give a score card which assesses various qualities of teachers like knowledge, skill, experience, creativity, communication, professional interaction with students etc. Selection of the best teachers is based upon the above rating given by the students. 10 best teachers will also be given certificates to acknowledge their service. For 2022–24 Batch Dr.K.B. Harikumar selected as the Best Teacher.

Ms. Anwesha Dutta, BRIC-RGCB MSc student (2023-25 batch) received the prestigious Khorana Internship at Yale University, New Haven, USA, for their summer internship program. The students also qualified in various national-level tests as follows: in 2024, 5 qualified for CSIR NET-LS, 9 for DBT-BET, 4 for GATE-BT, and 3 for GATE-XL.

Best Outgoing Student Award - 2024 presented to Ms. Sejal Sanjay Raskar

Best Dissertation Award-2024 awarded to Ms. Ritika Sachdeva

PHD PROGRAM AT BRIC-RGCB

The BRIC - RGCB offers a PhD program tailored for students passionate about discovery science and its applications in biotechnology, aiming to foster a knowledge economy and business development. Guided by expert faculty, the program integrates rigorous coursework with innovative academic resources. BRIC-RGCB is affiliated with prestigious institutions, including the Regional Centre for Biotechnology, the University of Kerala, and the Manipal Academy of Higher Education (MAHE). Applications are invited twice a year, and selection is stringent; candidates can appear for the interview only after qualifying for a national-level five-year research fellowship.

During 2024-25, the students were admitted in two sessions. In the August 2024 session, a total of 124 applications were received, with 114 candidates shortlisted based on eligibility. After three days of interviews, 27 candidates were selected for laboratory rotations, leading to 17enrollments on August 5, 2024. For the January 2025 session, 97 applications were received, and 91 candidates were shortlisted. The interview process consisted of two stages; 33 candidates were shortlisted after the first assessment and later reassessed by scientists based on student preferences. Ultimately, 19 candidates joined the Institute on January 6, 2025.

The PhD coursework includes compulsory courses and optional courses, selected from specialized subjects such as Infection Biology, Advanced Immunology, Cancer Biology, and others. Certification courses in animal handling and safe use of radioactivity are also offered, although it carry no credits. Coursework is conducted once a year starting from January and is taught by faculty scientists.

Each student's progress is monitored every six months through Doctoral Advisory Committee (DAC) and Students Advisory Committee (SAC) for RCB are to conduct assessment annually. During these meetings, students are expected to present their research progress, a plan for the next six months, and updates based on feedback from previous meetings. The pre-submission seminar can be done when the student is ready to submit the thesis.

Two awards aimed at encouraging and recognizing research excellence among PhD students were also instituted in BRIC-RGCB. Dr. M. R. Das Student Merit Award, instituted in memory of Dr. M. R. Das, is open to students who have completed between 36 to 66 months at BRIC-RGCB. The award is based on a competitive presentation of the student's research story, evaluated on presentation skills, experimental design, data interpretation, and response to questions. The P. K. Iyengar Best Thesis Award is open to students awarded the PhD from BRIC-RGCB. The P. K. Iyengar Best Thesis Award 2024 was conferred on Ms. Smrithi Krishnan R, Ph.D. student under the supervision of Dr. K. R. Mahendran, for her doctoral thesis. The M. R. Das Student Merit Award 2024 was awarded to Dr. Surya Suresh, Ph.D. student under the supervision of Dr. Jackson James.

During the 2024-25 period, a total of 23 Ph.D. students successfully completed and defended their theses, resulting in the awarding of their doctoral degrees. The awardees are categorized by their respective universities of registration, as follows:

Sl No.	Name of the student	Mentor	Date of open defense
	University of Kerala		
01	Ms. Jijimole. G R	Dr. R. Ajay Kumar	14-06-2024
02	Ms. Neetha R L	Dr. Priya Srinivas	26-06-2024
03	Ms. Parvanendhu P	Dr. E. Sreekumar	24-07-2024
04	Mr. Anil Prakash	Dr. Moinak Banerjee	29-07-2024
05	Mr. Jeeva S E	Dr. G Pradeep Kumar	30-09-2024
06	Ms. Binithamol Polakkattil	Dr. Moinak Banerjee	14-11-2024
07	Ms. Rayginia. P. Tennyson	Dr. Ruby John Anto	14-11-2024
08	Ms. Praseeja. R J	Dr. V V Asha	18-11-2024
09	Ms. Lini Varghese	Dr. George Thomas	25-02-2025
10	Ms. Keerthana C K	Dr. K B Harikumar/Dr.Ruby John Anto	18-03-2025
11	Ms. Ketakee Mahajan	Dr. S Asha Nair	26-03-2025
	Manipal Academy of Higher Education (MAHE)		
12	Ms. Midhunaraj. K	Dr. Ani V Das	19-04-2024
13	Mr. Yadu Vijayan	Dr. K B Harikumar	29-04-2024
14	Ms. Devika V S	Dr. K R Mahendran	13-08-2024
15	Ms. Remya S	Dr. K R Mahendran	18-10-2024
16	Ms. Shikha Ramesh. T	Dr. P K Umasankar	26-11-2024
17	Ms. Navyasree K V	Dr. P K Umasankar	27-11-2024
18	Ms. Aparna G J	Prof. M Radhakrishna Pillai	13-12-2024
19	Ms. Neeraja K M	Dr. Rakesh S Laishram	19-12-2024
20	Ms. Sruthy M R	Dr. Debasree Dutta	18-02-2025
21	Mr. Shivanshu Kumar Tiwari	Dr. T R Santhosh Kumar	12-03-2025
	Regional Centre for Biotechnology (RCB)		
22	Mr. Budhaditya Basu	Dr. Jackson James	06-08-2024
23	Ms. Feba Shaji	Dr. Rakesh S Laishram	13-02-2025

EVENTS AND ACTIVITIES FOR THE STUDENTS

The academic enrichment opportunities provided by BRIC-RGCB for students includes Journal Club meetings which will be conducted every week, allowing Ph.D. students to present their research and engage in scientific discussions. In-house workshops and conferences are organized regularly to help students improve their research skills and network with experts in their fields. Students are also be encouraged to take part in exhibitions and competitions organized during national celebrations such as Science Day, Women's Day and Environment Day. Additionally, meritorious students are given the opportunity to present their work at the BRIC-RGCB conference and also at the BRIC-RGCB Scientists SAC meeting.

The Sports Club organize physical activities and events to promote fitness among students. The Bodhi Science Club will serve as a platform for scientific exploration and informal learning. KIRANAM, an association for social work, will provide students with opportunities to engage in community service. Furthermore, the Gym and Yoga Club will remain open to students as part of the campus's wellness program. "Your DOST", an important platform for mental health wellness, offering confidential counselling and emotional support. In addition, medical support will be made available to ensure that students can access health services whenever necessary. Medical support services remain accessible on campus or through affiliated providers.

The institution also offers robust academic support infrastructure. Students have access to over 10,000 e-journals through the One Nation One Subscription (ONOS) initiative. Software tools for plagiarism detection, statistical analysis, and citation management are made available to all researchers. Hostel facilities are excellent and well-maintained. Free inter-campus transportation is provided to ensure ease of commute.

TRAINING & INTERNSHIP OPPORTUNITIES AT BRIC-RGCB

BRIC-RGCB is committed to human resource development by offering dissertation and short term training opportunities for M.Sc, B.Tech, M.Phil, and M.Tech students across various disciplines. During 2024-25, more than 200 postgraduate students have participated, gaining valuable experience in a high-quality biotechnology research environment.

OFFICE OF TECHNOLOGY VENTURES (OTV)

MANAGING INTELLECTUAL PROPERTY AT BRIC-RGCB

The BRIC-RGCB-Office of Technology Ventures (RGCB-OTV) plays a pivotal role in managing the institute's intellectual property (IP). Our dedicated team oversees the evaluation, protection, and licensing of IP generated by our research community. In addition to this, OTV provides guidance to BRIC-RGCB researchers, students, and technical staff about the processes of creating, protecting, and commercializing IP. Our responsibilities also encompass managing the legal aspects of research work, which include drafting, negotiating, reviewing, and administering various agreements such as Memorandums of Understanding (MoU), Memorandums of Association, Sponsored Research/Consultancy Service Agreements, and Technology Transfer Licensing Agreements. We remain committed to disseminating the advantages of our research to society at large.

First Row: Dr. Anish N P, Dr. Asha S Nair (From L to R)
Second Row: Jayakrishnan K S, Gopika G R, Vivek Hari (From L to R)

PATENTS

During the fiscal year 2024-25, OTV processed five patent applications. We received six Preliminary Invention Disclosure Forms (PIDFs) from our scientists, which were subsequently reviewed by the IPR Management Committee.

A significant achievement this year was the granting of an Indian patent for the invention titled "An Antifungal Synthetic Peptide Derived from Osmotin Protein" (Patent No. 548799, granted on August 7, 2024). This innovative 9-mer cyclic peptide, developed by Dr.Manjula, is derived from the osmotin protein found in the wild piper species Piper colubrinum. Exhibiting significant antifungal activity against the pathogen Phytophthoracapsici, this peptide shows potential as a plant-derived antifungal agent for crop protection, functioning both as a priming and antimicrobial agent. Notably, it can be combined with existing antifungals to mitigate environmental hazards and health risks associated with conventional chemical fungicides.

Additionally, a provisional patent application was jointly submitted by BRIC-RGCB and BRIC-THSTI for the invention titled "Monoclonal Antibodies Against Nipah Virus" (Application No. 202411037094, submitted on May 10, 2024).

COMMERCIALIZATION INITIATIVES

This year, BRIC-RGCB entered a Transfer Agreement with Primordia Lifesciences Pvt Ltd to commercialize innovative apoptosis detection assays and kits. These utilize stable cells expressing a recombinant fluorescent conjugate of Annexin V, developed by Dr. T. R. Santhosh Kumar and his team. This novel technology allows for cost-effective purification of next-generation apoptosis detection agents in various color palettes, which are vital for cancer research and drug discovery. Furthermore, it facilitates the real-time monitoring of cellular processes and cell death using standard growth media—a capability currently unmatched by conventional commercial kits.

BRIC-RGCB Director, Prof. Chandrabhas Narayana receiving an upfront payment from Dr. Anu Yamuna Joseph, Managing Director of Primordia marking a significant milestone in the transfer agreement regarding recombinant cell lines.

COLLABORATIONS

During the period of 2024-25, BRIC-RGCB OTV has actively engaged in several research collaborations with various institutions and industries to advance scientific inquiries and innovations. Notable partnerships include a collaboration with the Jawaharlal Nehru Centre for Advanced Scientific Research to investigate genetic and epigenetic drivers of oral cancer in Kaddipudi-habited women. Additionally, BRIC-RGCB partnered with the ICMR - National Centre for Disease Informatics and Research to access cancer registry data, and worked with the University of Kerala to evaluate the efficacy of chitosan derivatives in Black pepper against Phytophthoracapsici. There was also a collaboration with the Regional Cancer Centre (RCC) Trivandrum to analyze the expression levels of piR-019324 in cervical cancer patients. Another key partnership was established with the Central Council for Research in Ayurvedic Sciences for a genetic study on Prakriti, alongside an engagement with Kannur University to research the anti-viral activity of ethno-medicinal plants. Moreover, BRIC-RGCB executed MoU with Amrita Vishwa Vidyapeetham to enhance research and education in biotechnology, as well as another MoU with CCRAS-Regional Ayurveda Research Institute focusing on the genetics of Prakriti.A strategic partnership was formed with the Cochin Cancer Research Centre (CCRC) to build a dedicated Cancer Research Centre in Central Kerala. This initiative aims to create a state-of-the-art research and diagnostic facility to address the increasing number of cancer patients. BRIC-RGCB will serve as the Nodal Agency for this five-year collaboration, overseeing the establishment of the facility dedicated to research related to lung, oral, and breast cancer.

The achievements and collaborations of the BRIC-RGCB OTV during the year 2024-25underscore our commitment to advancing biotechnology research in the country and contributing to public health and societal benefits.

PURCHASE & STORES DIVISION

The Purchase & Stores Group occupies a vital and unique position in BRIC-RGCB. This unit ensures procurement of the right material in right quantities and of appropriate quality. The section ensures procurement from right and reliable source or vendor as well as procurement of the material economically, i.e., at right or reasonable price. The BRIC-RGCB Central Stores serves all four campuses of the institute. The most common yet major responsibilities that are carried by stores include receipt of incoming goods, inspection of all receipts, storage and preservation, identification of all materials stored, materials handling, packaging maintenance of stock records, inventory control and stock-taking.

FACILITIES & SERVICES

ANIMAL RESEARCH FACILITY (ARF)

Main Campus

First Row: Dr. Archana S, Dr. Quienee (From L to R)
Second Row: Vinod, Rajeev R V, Sumaja V, Anwar, Vinod (From L to R)

Kinfra Campus

Neethu S M, Dr Arya Aravind, Anand (From L to R)

The Animal Research Facility (ARF) is a cutting-edge centre that caters to the animal research needs of BRIC-RGCB. Housing mice, rats, rabbits, and zebrafish, the facility operates in strict compliance with CCSEA guidelines and adheres to Biosafety Level II standards, ensuring the highest levels of safety for both animals and researchers.

Animals are maintained in controlled environments tailored to species-specific needs, with temperature, humidity, and air quality precisely regulated. Mice and rats are housed in Individually Ventilated Caging (IVC) systems with HEPA filtration, while zebrafish are reared in recirculating aquatic systems. Continuous health monitoring, veterinary care, and environmental checks ensure optimal welfare.

Equipped with advanced infrastructure, ARF supports a wide range of research activities, including the design of animal experiments, creation of animal models, surgical procedures, imaging, euthanasia, and sample analysis. The facility also conducts hematological and biochemical testing, providing comprehensive research support.

Ethical practices are integral to ARF operations, with oversight by the Institutional Animal Ethics Committee and the Animal House Management Committee, which guide procurement, expansion, and operational decisions. In addition to research services, ARF delivers training through its Certificate Course in Laboratory Animal Science and specialized sessions for PhD students, ensuring that only certified personnel conduct animal experiments. ARF remains committed to excellence in animal care, research support, and capacity building, contributing significantly to the advancement of science while upholding the highest ethical standards.

BIOIMAGING FACILITY

Central Facility- Main Campus

Ciji Varghese, Sreelekshmi A S, Mini K, Viji S, Deepa Mathew, Gayathri L T, Athira S S, Saravana Kumar M (From L to R)

Central Facility- Akkulam Campus

First Row: Anand Mohan, Tilak Prasad, Surabhi S V, Laiza Paul, Anurup K P (From L to R)
Second Row: Vishnu Sajeev, Unnikrishnan V R, Sanjai D (From L to R)

HIGH SPEED FLOWCYTOMETER SORTER SYSTEM: (FACSARIA III)

FACS Aria III, Bench top fixed aligned flow cytometer is a high speed 4 way sorter system from Becton Dickinson, USA and is equipped with the following laser lines 488 nm, 405 nm Violet lasers, 561nm laser and 633 nm laser.

BECKMAN COULTER ASTRIOS EQ HIGH SPEED CELL SORTER

Six-way jet-in-air sorter with 7 lasers (355nm, 405nm, 488nm,532nm, 561nm, 592nm,640nm) and 22 fluorescent color capability. It has dual forward scatter PMTs that allow researchers to analyze biological samples ranging in size from 0.2um to 30um. The instrument is capable of simultaneous 1-6 way sorting and is equipped with Cyclone sorting for single cell sorting. Available nozzle sizes are 70um and 100um. It is contained within a Baker SterilGARD Class II biological safety cabinet for optimised sterile sorting.

LEICA FALCON SP8 WLL

The FALCON (FAst Lifetime CONtrast) is a fluorescence lifetime imaging microscopy (FLIM) platform fully integrated in the confocal microscope from Leica SP8 WLL that can deliver video-rate FLIM with pixel-by-pixel quantification. The single molecule detector (SMD HyD) provide a high detection efficiency. The system includes pulsed white light laser source 470-670 nm as well as a 405 nm pulsed laser. All laser lines area available for spectral imaging as well as lifetime imaging. STED lasers: 592nm, 660nm are also inbuilt in to the unit for super resolution imaging.

CARL ZEISS LSM 980 WITH AIRY SCAN

The laser spectral confocal imager with 405,445,488,514,560,590 and 640 laser lines. Airyscan 2 unit support super resolution imaging.

NIKON A1R SPECTRAL CONFOCAL WITH SPINNING DISK HIGHTHROUGH-PUT IMAGER CSU W1

The laser spectral confocal imaging and CSU W1 enabled spinning disk systems from Yokogawa Life Sciences, integrated with Nikon's AI microscope platform, that supports high speed confocal imaging, Ratio imaging , FRET imaging in highthrough-put applications. Simultaneous two colour imaging of selected dyes and FRET probes for ratio imaging using NIKON NIS Element software is possible.

MULTIPHOTON CONFOCAL IMAGING SYSTEM: NIKON A1R MP

The multiphoton confocal imaging system A1R MP is the dual line IR laser integrated multiphoton confocal with all required accessories and imaging softwares from Nikon, Japan. The system is capable of simultaneous or sequential image collection using galvanometer and resonant scanners and four photomultiplier fluorescence detectors and a DIC transmission detector. The multiphoton component is equipped with dual line tuneable laser excitation in addition to the conventional visible confocal imaging.

Olympus Fluoview FV3000 confocal laser scanning microscope

FACS

Sinsha Prakashan, Dr Asha S Nair, Arya V S, Indu Ramachandran (From L to R)

The FV3000 system supports high-resolution, multi-dimensional imaging with precise optical sectioning, ideal for both fixed and live samples. It features multiple laser lines including 405 nm, 488 nm, 561 nm, 640 nm and 514nm allowing for simultaneous multi-channel fluorescence imaging with common fluorophores such as DAPI, FITC, Alexa Fluor 568, and Cy5. The system is equipped with high-sensitivity GaAsP PMT detectors that offer excellent signal-to-noise ratios, enabling low-light and high-speed imaging. A variety of high-quality objectives are also available, including 10x, 20x, 40x and 60x providing flexibility from wide-field overviews to ultra-high-resolution subcellular imaging. The microscope also supports bright field, DIC, Z-stack, 3D reconstruction, time-lapse imaging, and live-cell imaging using an on-stage incubation chamber with temperature, CO_2, and humidity control. Overall, the FV3000 system offers robust performance for qualitative and quantitative fluorescence imaging, with user support and training provided to ensure optimal use and data quality.

HIGH CONTENT IMAGING SYSTEM: IMAGEXPRESS HT.AI, MOLECULAR DEVICE

The ImageXpress® Confocal HT.ai High-Content Imaging System is an advanced imaging platform with seven-channel laser light source and eight imaging channels to enable highly multiplexed assays while maintaining high throughput by using shortened exposure times. Designed for experiments involving live cells as the spinning disk reduces phototoxicity and enables fast acquisition. The system supports slides and one to 1536-well microplates, round or flat bottom, low to high profile.

CENTRAL HISTOLOGY FACILITY

The histology core facility is equipped with necessary infrastructure to help the ongoing research at BRIC-RGCB. The core has a microtome, cryostat and automatic tissue processor and tissue embedder

BIOINFORMATICS FACILITY

The Bioinformatics Facility is situated within the Bio-Innovation Centre (BIC) on the Akkulam campus of the BRIC- Rajiv Gandhi Centre for Biotechnology (BRIC-RGCB).Considering the growing demand for computational approaches to solve biological problems, the facility is offering various bioinformatics services and training programs to students and researchers from BRIC-RGCB and academia.

We provide (i) Computational infrastructure (Servers and Storages) for performing large scale biological data analysis and storage (ii) Short term (1 day) and long term (6-months/1 year) training programs (iii) Academic projects (Bioinformatics) to both internal and external students (iv) Essential bioinformatics services to students and researchers from academics.

01. COMPUTATIONAL INFRASTRUCTURE (SERVERS & STORAGE)

The Bioinformatics facility provided 43 server accounts to trainees/researchers for high-performance computing and storage from April 2024 to March 2025.

02. SHORT-TERM AND LONG-TERM TRAINING PROGRAM

(i) Short-term Training program (One-day virtual workshops)

Six online workshops were held, covering a wide range of bioinformatics topics. These workshops attracted a diverse group of 412 participants, including both researchers and students, eager to expand their knowledge and skills in this rapidly evolving field.

(ii) Long-term Training Program (Certificate Program in Bioinformatics - 6 months)

This six months certificate program provides a solid base to the use of bioinformatics by providing theory and application training in methods and resources appropriate to all major fields of biological research. It includes best strategies for undertaking bioinformatics analysis, computer programming, statistical methods, data management and reproducibility. In the year 2024-2025, 8 students from different parts of India has been participated in the certificate program in bioinformatics conducted by the bioinformatics facility.

Dr. Sivakumar K C, Dr. Shijulal Nelson Sathi, Dr. Kathiresan Natarajan, Dr. Jamshaid Ali, Harikrishnan G (From L to R)

03. ACADEMIC PROJECTS

We offer academic project training for BSc, MSc, B.Tech, and M.Tech students, providing them with exposure to a bioinformatics research environment of international standards. Project and dissertation opportunities are available for durations of 1 month, 2–3 months, or 4–6 months. During the academic year 2024–2025, a total of 37 students participated in various academic projects conducted by the Bioinformatics facility.

04. BIOINFORMATICS SERVICES

We provide customized, accurate, and specific solutions to the researchers in the following areas:

Molecular Docking, Protein Mutation design and Structural analysis, Protein 3D Structure modelling, Molecular Dynamics Simulations, Functional annotations, NGS analysis and denovo assembly, RNA-Seq analysis, Phylogenetic analysis, Metagenomics, Heat maps/3D plots/Interactive charts. During the year 2024–2025, the facility delivered six protein structure analysis services and provided support for 267 molecular dynamics (MD) simulations.

CONFOCAL RAMAN MICROSCOPE

The Renishaw InViaQontor Spectrometer system is an advanced Raman microscope that significantly enhances our analytical capabilities for biological, chemical, andmaterial research. Featuring both Leica upright and inverted microscope configurations, it delivers flexible sample positioning and comprehensive analysis. The system provides a high spectral resolution of 0.5 cm^{-1}, ensuring precise identification of material properties. It supports multiple excitation sources, including 325nm (25mW), 473nm (25mW), 532nm (100mW), 633nm (17mW), and 830nm (300mW), enabling versatility across a wide range of applications. Objective options include 5x, 10x, 20x, standard 50x, long working distance 50x (10mm), and 63x water immersion lenses, facilitating both routine and advanced microscopy tasks. The integration of a Linkam THM600 temperature stage, operating from –195°C to 600°C, allows us to conduct temperature-dependent Raman experiments, broadening the scope for dynamic studies. Collectively, these features make the InViaQontor Spectrometer system a vital asset, supporting cutting-edge research and enabling robust Raman imaging and mapping for diverse scientific investigations. The income from the Confocal Raman setup for the FY 24-25 is Rs .54875.

DYNAMIC LIGHT SCATTERING (DLS)

The Horiba nanoPartica SZ-100 V2 is a high-precision Dynamic Light Scattering (DLS) instrument used for measuring particle size distribution and zeta potential in liquid suspensions. This advanced system plays a vital role in characterising nanoparticles, emulsions, polymers, and biomolecules, offering valuable insights into their behaviour and stability in solution. Operating over a temperature range of 0°C to 90°C, it employs a 532 nm laser source and supports sample concentrations ranging from 10% to 40% w/v. The system is capable of measuring particle sizes from 0.3 nanometers to 10 micrometers and zeta potential values within a range of -500 mV to +500 mV.The income from the DLS setup for the FY 24-25 is Rs .2360.

BIOSAFETY LEVEL 3 (BSL 3) FACILITY

BSL-3 facility at BRIC-RGCB is a fully operational, high-containment laboratory supporting multiple principal investigator–driven projects and national initiatives under the PM-Ayushman Bharat Health Infrastructure Mission (PM-ABHIM). It currently conducts research on Mycobacterium tuberculosis, rabies, and SARS-CoV-2, with 15 trained researchers engaging in these activities. Facility personnel have also undergone specialized training in sample handling and processing to strengthen surveillance and pandemic preparedness programs. The inclusion of BRIC-RGCB's Standard Operating Procedures (SOPs) in the ICMR One Health Mission Programme (OHMP) SOP Compendium highlights national recognition of the institute's biosafety and operational excellence, as well as its contribution to India's expanding biosafety network. BRIC-RGCB plays a central role in developing a coordinated framework of high-risk pathogen laboratories (BSL-3/4) across the country to ensure rapid, integrated responses during public health emergencies. The facility began implementing preparedness measures aligned with the One Health Mission mandate. As part of this initiative, the BSL-3 unit is also designated to support testing of outbreak samples of unknown origin from animal, human, aquatic, or environmental sources, thereby reinforcing national capacity for early detection, response, and containment of infectious disease threats.

Anakha Manoharan A, Dr. Rashmi Sharma, Dr. Sara Jones, Jayalekshmi D, Dr. Rajesh Chandramohanadas, Sanjai D, Vishnu V M (From L to R)

CENTRAL CLEAN ROOM FACILITY (CCRF)

The Central Clean Room Facility (CCRF) provides state-of-the-art infrastructure to support biological experiments, right from design and fabrication of microfluidic platforms to setting up a wide range of experimental systems. The facility is committed to promoting BRIC-RGCB's core tenets of technology development and innovation, by enabling students and researchers to use microfluidic technology and organ-on-chip systems. By replicating complex biology on a miniaturized platform, the facility is at the forefront of innovation, providing solutions to challenges in biological research, experimental design and methodology. This facility was formally inaugurated on 15th January, 2025.

CLEAN ROOM

The Central Microfluidics facility consists of Class 10000 (10K) Clean room (ISO7) maintained with HVAC-controlled HEPA filtration, that assures a particle-controlled environment enabling sterile, environment-sensitive work. The clean room maintains a positive-pressure environment that reduces the risk of airborne contaminants from entering, thereby ensuring the highest standards of sterility and cleanliness.

EQUIPMENT

01. CNC Milling Machine (ROLAND Modela MDX-50)

The Roland CNC Milling Machine,is used for precise micromachining of molds on acrylic or other substrates, thereby offering flexibility to scientist to develop customisable designs. These custom-made molds can be used in the fabrication of PDMS microfluidic devices. PDMS, being a silicon-based, bio-compatible polymer, potentiates the use of these microfluidic devices for life-science applications such as cell, or tissue based assays, or other microfluidic applications.

02. Eltech Vacuum Plasma System

The Eltechvacuum plasma system is a state-of-the art equipment that allows surface functionalization of PDMS and glass substrates. It ensures leak-proof, strong bonding of the device, which is crucial for downstream research applications.

03. Zeiss Primovert Inverted Cell culture Microscope,
04. Zeiss Stemi 508 Greenough stereo microscope
05. Class II Laminar Air Flow (LAF) Cabinet

The clean room is also equipped with a Class II Laminar Air Flow (LAF) Cabinet, which ensures a sterile environment for microfluidic device assembly, and cell-based assays. The facility also has provision for supporting long term culture of cells under physiological conditions, using a humidified CO_2 incubator. The facility also supports real-time imaging of cells with a Zeiss Primovert Inverted Cell culture Microscope, as well as a Zeiss Stemi 508 Greenough stereo microscopethat assists with applications such as proper assembly of the microfluidic device.

06. Magnetic cell sorter

Additionally, the clean room also has the EasySep Violet Magnetic cell sorter for column-free immunomagneticseparation applications.

CONFOCAL MICROSCOPY AT MAIN CAMPUS

The Confocal Microscopy Facility at BRIC-RGCB main campus is equipped with Olympus Fluoview FV3000 confocal laser scanning microscope,both high-performance imaging system designed for advanced research applications in cell and molecular biology. The FV3000system supports high-resolution, multi-dimensional imaging with precise optical sectioning, ideal for both fixed and live samples. It features multiple laser lines including 405 nm, 488 nm, 561 nm, 640 nm and 514nm allowing for simultaneous multi-channel fluorescence imaging with common fluorophoressuch as DAPI, FITC, Alexa Fluor 568, and Cy5. The system is equipped with high-sensitivity GaAsP PMT detectors that offer excellent signal-to-noise ratios, enabling low-light and high-speed imaging. A variety of high-quality objectives are also available, including 10x, 20x, 40x and 60x providing flexibility from wide-field overviews to ultra-high-resolution subcellular imaging. The microscope also supports bright field, DIC, Z-stack, 3D reconstruction, time-lapse imaging, and live-cell imaging using an on-stage incubation chamber with temperature, CO_2, and humidity control. Overall, the FV3000 system offers robust performance for qualitative and quantitative fluorescence imaging, with user support and training provided to ensure optimal use and data quality. This machine is heviely booked works for more than 1500 hour a year.

GENOMICS FACILITY

01. FACILITY ADVANCEMENTS & STRATEGIC ALLIANCES

The NGS facility, established as a model Public-Private Partnership with Redcliffe Private Limited, Noida features cutting-edge infrastructure:

- Illumina Novaseq 6000 – high-throughput WGS/Exome/Clinical Panels.
- 10x Genomics Chromium Controller – single-cell and spatial omics.
- Oxford NanoporeMinION – portable long-read technology.

These platforms enabled a broad portfolio of services: WGS, Exome, Panel-based NGS, transcriptomics, metagenomics, single-cell analysis, and hybrid sequencing.

Genomics core facility equipped with following instruments.

- 3730 Xl Genetic analyzer
- 3730 Genetic analyzer
- Quant studio 5 (96 well RTPCR)
- Quant studio 5 (384 well RTPCR)

Facility offers comprehensive support for DNA-based genomic research methodologies to BRIC-RGCB and outside researchers across India. The facility is equipped to perform Sanger sequencing and genotyping on a variety of bacterial, viral, plant, and human samples using two Multicapillarry systems 3730 & 3730 XL DNA analyzers, for both internal and external samples. On a fee-for-service basis, research divisions provide internal samples.

Dr. T R Barath Kumar, Dr. Manjula S (From L to R)

For genescan analysis, samples of plants / animals were processed for SSR analysis, SNP genotyping and microsatellite analysis for various research laboratories. The facility is outfitted with Quantstudio 5 (both 96-well and 384-well), for Q-PCR applications. For various research labs of both internal and external investigators, gene expression studies with Real Time PCRs Quantstudio are used in SNP analysis, absolute quantitation, relative quantitation and Allelic discrimination applications using SYBR green/Taqman chemistry.

Genomics Team provided training in DNA Sanger sequencing RTPCR, genotyping and phylogenetic analysis to students and researchers all over India. We have several external users from both academia and industry who are using regularly our facility

INFORMATION TECHNOLOGY

Lekshmi R, Remya Rajan, Anand Mohan (From L to R)

Durga Prasad C

The IT infrastructure of BRIC-RGCB includes 13 Servers, more than 400 Desktops, Laptops, Network Printers, etc.. It houses one of the best computing networks, constantly upgrading to provide students and staff with state-of-the-art facilities. The Institute has been connected to the National Knowledge Network, which provides a 1Gbps leased line with multiple redundant backups.

The highly distributed computing environment at BRIC-RGCB uses sophisticated computer simulations to solve the problems of staff and research scholars. It is managed and actively supported by experienced IT department engineers. The IT department is also responsible for maintaining and administering Mail Servers. The IT department provides technical support to staff and students within the Institute on LINUX and WINDOWS platforms and includes software development for research groups.

IT department designs, develops, updates, hosts, and supports the BRIC-RGCB Website, online admission portal, leave management system for PhD students/ project staff, laboratory management system, online training portal, online portal for various positions at BRIC-RGCB, conference websites, intranet applications for various administration and scientific activities, yearly portals for updating annual reports, SAC and integrating payment gateway for various web applications. The IT team supported the smooth functioning of online classes for MSc and PhD students via Moodle, hosted and fine-tuned by the IT Team.

Internet facilities are provided throughout the campus through 1 Gbps and 100 Mbps leased lines from NKN and BSNL. The Akkulam campus has a fully redundant smart row data center and Internet facility for the Akkulam campus research and hostel blocks.BRIC-RGCB implemented a Fibre Optic Backbone with high-end security for networking across the campuses. Wireless connectivity is provided at strategic locations to provide Internet access to the faculty. The Information Technology Division of the Bio-innovation Centre at KINFRA, Kazhakuttom, provides high-quality services and capabilities to different research groups. It includes a structured infrastructure and a secured network with authentication and dual 100Mbps leased lines.

KRIBS-BIONEST

KRIBS-BioNest, located at the Biotechnology Incubation Zone in KINFRA Hi-Tech Park, Kochi, is the technology incubation center of the Rajiv Gandhi Centre for Biotechnology (BRIC-RGCB), operated in collaboration with Kerala Startup Mission (KSUM).

The facility brings together advanced incubation infrastructure; state-of-the-art biotechnology equipment and expert mentorship to support startups in transforming innovative ideas into scalable technologies.

Spanning 16,000 sq. ft. of dedicated bio-incubation space, KRIBS-BioNest provides startups with customizable laboratory and office facilities. The Central Instrumentation Facility (CIF), covering an additional 10,000 sq. ft., houses cutting-edge biotechnology equipment including:

- Genomics facility with Applied Biosystems 3500 DNA Sequencer
- Proteomics facility with LC-Ms/Ms, HPLC, GC etc

First Row: Aisha Kumari PP, Dr. K Ampady IIS, Dr. Divya Purushothaman, Antony KP (From L to R)
Second Row: M.K Hari, Manoj A, Dr. Amarjith Soman Nair, Deepak, Charutha PP, Smitha S Nair, Roshna R Nair, Resika G Nair (From L to R)

- Molecular Biology facility with PCR, qPCR, Western Blot and Gel Documentation Systems
- Fermenters, Spray Dryer, and Freeze Dryer

In addition, incubatees benefit from access to BRIC-RGCB's central facilities and services and technical expertise from faculty and scientists.

HIGHLIGHTS OF FY 2024–2025

INCUBATION AND GROWTH

The financial year 2024–25 marked a period of significant growth and achievement for KRIBS-BioNest.

- Six new startups joined as incubatees:
    1. Bio Aryavedic Naturals Pvt. Ltd.
    2. Bionre Laboratories Pvt. Ltd.
    3. Cirist Ecosystem Pvt. Ltd.
    4. Indocert Global Services Pvt. Ltd.
    5. Oleospice India Pvt. Ltd.
- Scopeful Bio Research Pvt. Ltd., a long-term incubatee of six years, successfully graduated from KRIBS-BioNest to establish its own R&D facility in Ernakulam. The company continues to remain connected as a virtual incubatee.

By the end of the financial year, KRIBS-BioNest hosted 15 startups, including 11 physical and 4 virtual incubatees.

INNOVATION AND INTELLECTUAL PROPERTY

Innovation continued to thrive among our incubatees during the year.

- Avisa Biotech was granted a patent (IP No. 549028) and filed three additional patents in FY 2024–25.
- Their pioneering research was featured in a peer-reviewed publication:

Kunal et al. (2025). "Melanin from the fungus Gizocephalotrichum simplex protects seeds from the effects of gamma irradiation."- Scientific Reports, 15, 6473.

AWARDS AND FUNDING ACHIEVEMENTS

Several incubatees secured recognition and funding through competitive programs and national platforms:

- Indocert Global Services Pvt. Ltd. and Greenovative Foods Pvt. Ltd. received the KAU RABI RAFTHAAR-RAISE Grant worth ₹5 lakh each.
- Prayaga Scientific Pvt. Ltd. won the AMRUT 2.0 Award from the Ministry of Housing and Urban Affairs, receiving ₹20 lakh for the development of a water testing kit.
- Greenovative Foods Pvt. Ltd. was also a winner at TiE Capital Café 2024.

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EVENTS AND OUTREACH

KRIBS-BioNest actively represented its startups and programs at key national and international events:

- Global Bio India 2024held from 12th to 14th September 2024 at Pragati Maidan, New Delhi.
- India International Science Festival 2024held from 30th November to 3rd December 2024 at IIT, Guwahati, Assam.
- BioConnect 2.0held on 27th and 28th 2024 at Hyatt Regency, Thiruvanathapuram, Kerala.
- Microbiome Conclave (2025)held on 5th March 2025 at KINFRA Hi-Tech Park, Kalamassery, Kochi.

Two incubatees—Greenovative Foods Pvt. Ltd. and Bio Aryavedic Naturals Pvt. Ltd.—were selected for pitch deck presentations at BioConnect 2.0 for VC funding opportunities.

PANEL DISCUSSION ON BIOE3 POLICY

On August 29, 2024, KRIBS-BioNest organized a panel discussion on the BioE3 Policy launched by the Government of India.

The session featured expert speakers including:

- Shri. Praveen Roy, Scientist G, Technology Translation and Innovation Division, DST
- Shri Pramod S, Scientist D, Technology Translation and Innovation Division, DST
- Shri Shardul Rao, Scientist C, Technology Translation and Innovation Division, DST
- Dr. Mohan Kumar, Director, Scopeful Bio Research Pvt. Ltd.
- Dr. Jikku Jose, Scire Tech Pvt. Ltd.
- Dr. Unnikrishnan PG, Greenovative Foods Pvt. Ltd.

The discussion was moderated by Dr. K. Ampady IIS, CEO, KRIBS-BioNest.

TRAINING AND CAPACITY BUILDING

INTERNSHIP PROGRAM

Beginning in May 2024, KRIBS-BioNest launched structured internships in Molecular Biology and Cell Biology.

During the reporting year, three students from B.Tech and B.Sc. (Molecular Medicine) programs successfully completed internships, gaining hands-on experience with modern molecular biology techniques.

INDUSTRIAL VISITS AND OUTREACH

During FY 2024–25, the facility welcomed approximately 450 visitors, primarily students from biotechnology and life sciences backgrounds.

Participating institutions included:

- MSM College, Kayamkulam
- IEDC, Kerala Veterinary and Animal Sciences University
- Sree Sankara College, Kalady
- St. Albert's College, Ernakulam
- St. Philomena's College, Bangalore
- Karunya Institute of Technology, Coimbatore

These visits offered students and faculty valuable exposure to biotechnology incubation practices and direct interactions with startup founders.

MAJOR TECHNOLOGIES

Major technologies/products that have been developed by the Startups incubated at KRIBS-BioNest in the year 2024-25 are given in the table below.

Sl No.	Product Name	Name of Incubate	Uses
01	Melanin and nanolignin based sunscreen	M/s. Avisa Biotech Pvt. Ltd.	Protection from UV rays
02	Melanin based hair dye	M/s. Avisa Biotech Pvt. Ltd.	Hair dye
03	Mixed fruit Extracts	M/s. Spiceor Bio Nutralities Pvt. Ltd.	Used in food, pharmaceutical and cosmetics industries
04	Scire Chitra GelMA- UVS Bioink	M/s. Scire Sciences Pvt Ltd	India's first indigenous Ink for Bioprinting
05	Nutricon C and its derived products	M/s. Scopeful Bioresearch Pvt Ltd	Dietary supplement
06	Sweetrue	M/s. Scopeful Bioresearch Pvt Ltd	Zero calorie natural sweetener
07	Tea 4 All	M/s. Scopeful Bioresearch Pvt Ltd	Health beverage
08	HEKAFLO HFNC	M/s. Heka medicals India Pvt Ltd	High flow nasal oxygen therapy device for the treatment of spontaneously breathing hypoxemic patients
09	HekaNeo Bubble CPAP	M/s. Heka medicals India Pvt Ltd	A non-invasive breathing support system for neonates and preterm babies
10	Meat-like Chunks and 3 variants of ready to green meat preparations	M/s.Greenovative Foods Pvt Ltd	Ready to cook product called "Meat-like Chunks" which can be marinated and cooked just like curry cuts from animal-based meats

LIBRARY AND INFORMATION SERVICES – CENTRAL LIBRARY, BRIC-RGCB

INTRODUCTION

The BRIC-RGCB Central Library serves as a vibrant centre of knowledge and innovation, playing a pivotal role in the institute's advancement in life sciences research and education. Guided by the vision of Shri S.R. Ranganathan—the father of Indian Library Science—who described the library as a "Growing Organism", it continues to adapt to meet the evolving needs of researchers, scholars, and academicians.

Fully automated through advanced open-source Integrated Library Management Systems, the library blends traditional collections with modern digital resources, ensuring seamless access and user-centric services.

Gopakumar G, Shibin S B, Meera N V, Dr. Manjula S, Suma S Nair, Balagopal S (From L to R)

INFORMATION ASSETS

The Central Library houses a comprehensive and diverse collection, including:

- Over 8,500 physical volumes featuring globally acclaimed books in the life sciences
- National and international journals and magazines
- Multilingual newspapers and popular science publications
- Technical manuals, standards, protocols, theses, dissertations, archived volumes, reprints, and BRIC-RGCB-authored research reports

The Online Public Access Catalogue (OPAC) provides global access to the library's holdings and archival records of over 100 journals since 1995, available at https://libraryopac.rgcb.res.in.

DIGITAL RESOURCES

The digital library expands BRIC-RGCBs research capabilities through:

- One Nation One Subscription (ONOS): Access to over 13,000 full-text journals from 30 publishers, available both on-campus and remotely.
- Knimbus: A centralized platform for e-books, e-journals, and scholarly publications with integrated search, remote access, and a mobile app.
- DELNET: National-level interlibrary loan and resource sharing.

User access is further enhanced by multimedia-enabled computer systems within the library.

RESEARCH AND LEARNING SUPPORT

The library offers a wide range of services to strengthen academic and research productivity:

- Access to OPAC and Digital Library resources
- Reference and consultation services
- Reprographic facilities
- Media clippings and current awareness services
- Document delivery (print and digital)
- Citation and bibliographic analysis
- User orientation and training programmes
- Selective Dissemination of Information (SDI)
- New Arrival Alerts to keep researchers informed about the latest additions

RESEARCH PRODUCTIVITY TOOLS

To enhance research quality and efficiency, the library provides access to specialized software and platforms, including:

- Adobe Creative Cloud – Design, editing, and creative tools
- BioRender – Publication-quality scientific illustrations
- EndNote – Reference management and bibliography creation
- Grammarly – AI-powered writing enhancement
- GraphPad Prism – Data analysis and visualization
- FlowJo – Single-cell flow cytometry analysis
- SigmaPlot – Advanced scientific graphing
- MVDA – Multivariate data analysis for complex datasets
- Turnitin – Plagiarism detection and AI-assisted writing review

EXCELLENCE AS A STANDARD

Committed to innovation, accessibility, and academic excellence, the BRIC-RGCB Central Library continues to evolve as a user-centric facility tailored to the institute's growing research needs. Its resources and services not only support individual research projects but also strengthen BRIC-RGCB's overall research ecosystem. By empowering scientists with high-quality literature, advanced analytical tools, and expert guidance, the library plays an integral role in enhancing scientific productivity and maintaining BRIC-RGCB's position as a leader in life sciences research.

MASS SPECTROMETRY & PROTEOMICS CORE FACILITY

The Central Mass Spectrometry and Proteomic Core Facility at BRIC-RGCB is also known as "DBT-SAHAJ National facility for Mass Spectrometry-based Proteomics, Metabolomics &Lipidomics Platforms". The facility has also been supported by the DBT-SAHAJ program awarded in August 2021 under the title "Comprehensive mass spectrometry-based Proteomics, Metabolomics, and Lipidomics platforms for promoting biomedical research and advanced training for Indian researchers".

First Row: Akhila Surendran, Sudha B Nair, Bindhu Asokan, Reeba Parameswaran, Dr. Abdul Jaleel (From L to R)
Second Row: Dr. Anish Kundu, Dr. Arun Surendran, Mahesh Chandran (From L to R)

INFRASTRUCTURE

The facility houses four state-of-the-art systems namely;

1) UltraFlextreme MALDI-TOF/TOF (BrukerDaltonics)

2) SynaptXS Q-TOF connected with nanoAquity UPLC system (Waters)

3) Orbitrap Eclipse Fusion Tribrid MS connected with UltiMate 3000 RSLCnano UHPLC or vanquish UHPLC system (Thermo Scientific) and

4) Altis Plus Triple Quadrupole MS connected with vanquish UHPLC system (Thermo Scientific).

ANALYTICAL SERVICES

The facility offers MS based analyses services for; Molecular weight confirmation, Protein identification, De-novo sequencing, PTM analyses, Polymer analysis, Protein profiling, Label-free relative protein quantification, Quantitative proteomics using labeled methods (TMT or iTRAQ), Protein complexes identification, Phosphoproteomics, Untargeted Metabolomics andLipidomics and finally Targeted analysis of molecules or Absolute quantification.

LIPIDOMICS

As part of the DBT-SAHAJ program, the facility has establisheda panel of more than 300 lipid molecules/species, which comes under 25 major lipid classes. The list of the available panel is given in the link here (https://www.rgcb.res.in/Targeted-Metabolomics-Lipidomic). These panels are established in the MS facility to meet the research needs of investigators on a case-by-case basis.

USERS, SAMPLES AND REVENUE

The analytical services provided by the MS facility are being utilized by researchers in academia and industries across the nation. In addition, trainings and workshops on various MS based methods are being conducted for the investigators and students.

The user details of the year 2024-25 are given in the table below.

Number of Users		Number of Samples	Revenue Generated in INR
Internal Users	122	567	19,829,25.00
External Users	133	862	67,86,325.00
Total	**255**	**1429**	**87,69,250.00**
		Revenue from workshops	**5,72,220.00**

WORKSHOPS AND SYMPOSIA

These workshops / courses / symposiawere structured to provide training on various tools and protocols within the workflow of mass spectrometry-based proteomics, metabolomics and lipidomics.

- The two-days' workshop on Mass Spectrometry-based Untargeted Metabolomics [April 11-12, 2024] for 11 participants
- Online workshop on Proteomics Data Analysis [June 29, 2024] for 31 participants
- Online Workshop on metabolomics Data Analysis [August 2, 2024] for 33 participants
- Online Workshop on Metabolomics Data Analysis [October 4, 2024] for 36 participants
- Online Workshop on metabolomics Data Analysis [November 23, 2024] for 29 participants
- Two-days' work shop on Mass Spectrometry-based proteomics [February 13-14, 2025] for 9 participants.
- Three-day National Symposium on Mass Spectrometry-based Lipidomics in Disease Biology[February 20-22, 2025]for 50 participants

MEDICAL LABORATORY SERVICES (MLS)

MLS delivers affordable diagnostic services through a hub-and-spoke model, operating 10 main centres and 200 collection points. The division also launched Kerala's first Veterinary Medical Laboratory Services unit to support animal health and husbandry. Medical Laboratory Services (MLS) has grown into a well-recognized and trusted provider of diagnostic testing services across Kerala. Its strong reputation for accessibility and affordability has led to increased public demand for service expansion throughout the state.

In association with the State Health Department, MLS operates diagnostic services in government hospitals, including Thiruvananthapuram Medical College and General Hospital, Pala, with a hub-and-spoke model linking over 300 centres statewide. A major initiative to support animal husbandry sector, the division has launched first Veterinary Medical Laboratory Services unit. The BRIC-RGCB's Diagnostic and Research Laboratory at the Cochin Cancer Research Centre, Kalamassery, is nearing completion. Medical Laboratory Services (MLS) has introduced targeted diagnostic panels specifically designed to detect lifestyle-related disorders at an early stage. These panels enable clinicians to identify potentially serious but often undiagnosed conditions such as metabolic syndrome, cardiovascular risk factors, and pre-diabetic states, thus facilitating timely medical intervention. In parallel, MLS has developed a suite of proprietary software tools for sample tracking, process monitoring, and inventory management. These digital solutions have led to a marked reduction in reagent wastage and unnecessary man-hour expenditures, contributing to overall operational efficiency and cost savings.

Dr. Ashok R

B Padmavathy Amma

Dr. Vishnu TS

Ambili S Nair

CENTRAL INSTRUMENTATION MICROINJECTION FACILITY (CIMF)

Central Instrumentation Microinjection Facility (CIMF) was inaugurated on November 1, 2024. The CIMF aims to provide technical expertise for microinjection-related experiments to both BRIC-RGCB and external clients.

Our facility is equipped with the following infrastructure:

- OLYMPUS IX-73 INVERTED MICROSCOPE: Equipped for Phase contrast, Fluorescence, and Micromanipulation System.
- Eppendorf TransferMan® 4th generation micromanipulator.
- CellTram® 4r Air: Pneumatic, manual microinjector.
- FemtoJet 4i: Programmable microinjector with integrated compressor.
- InjectMan® 4: Micromanipulator with dynamic movement control.

CIMF organized three days advanced hands-on workshop on Cells, Embryo, and Microinjection from January 8th to 10th, 2025.A total of 8 participants from various academic institutions attended this training program. The training sections were led Dr. Aurelie Jory, Janvier labs, Le Genest Saint Isle, France. Additionally, Dr. Rupasri Ain from IICB Kolkata and Dr. Ramkumar Sambasivan, Associate Professor, IISER Tirupati interacted with the participants on these topics.

The Central Instrumentation Microinjection Facility (CIMF) is now ready to perform microinjections in various cell types. We will also be commencing embryonic injections by the next year.

Our facility will be organizing training programs and program every year in the future as well.

MOLECULAR FORENSICS & DNA TECHNOLOGIES (MFDT)

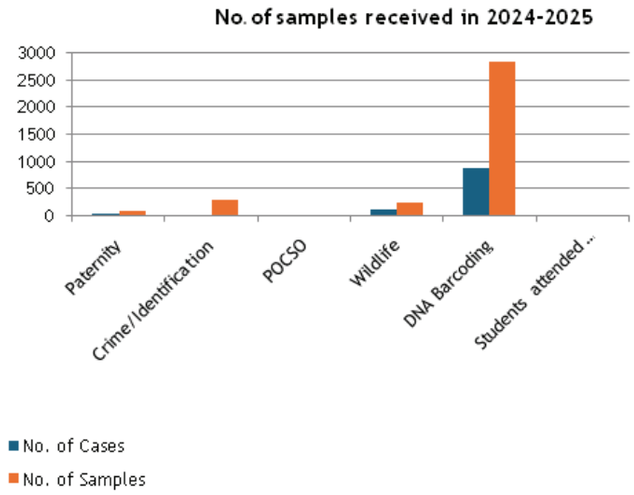
MFDT offers DNA fingerprinting services to legal bodies, crime investigating and law enforcing agencies. The samples analysed at MFDT relates to maternity/paternity disputes, crime, rape incidents and cases involving man missing. CO1-based molecular identification and DNA barcoding of fauna especially for species identification in wildlife forensics is yet another service offered by MFDT

Major Research Achievements

- Accredited by Quality Council of India
- Total 256 samples received in connection with the Wayanad landslide disaster for identification of people who lost their life in the disaster. The report was released in very short turn around time.

MFDT offers DNA fingerprinting services to legal bodies, crime investigating and law enforcing agencies. The samples analysed at MFDT relates to maternity/paternity disputes, crime, rape incidents and cases involving man missing. CO1-based molecular identification and DNA barcoding of fauna especially for species identification in wildlife forensics is yet another service offered by MFDT. Other services offered by this facility include DNA fingerprinting of plants and animals in case-by-case manner using RAPD, AFLP or microsatellite markers and DNA barcoding of animals using CO1 gene and plants using matK and rbcL. The facility also offers hands on training on DNA fingerprinting and DNA barcoding techniques. We have received more than 866 cases for DNA Barcoding/Fingerprinting/Sequencing analysis from various research institutions, colleges and universities from all over India.

Sl No.	Description of Case	No. of Cases	No. of Samples
01	Paternity	24	73
02	Crime/Identification	09	285
03	POCSO	02	06
04	Wildlife	110	231
05	DNA Barcoding	866	2815
06	Students attended training	6 (Applications)	06



First Row: Dr. Radhakrishnan R, Dr. K B Harikumar (From L to R)
Second Row: Parvathy, Preetha Rajan, Vinod Kumar S, Remya R C, Anilkumar P, Rahul Das, Anandhu A, Abhilash M K, Johny G, Ratheesh R V, Sureshkumar V (From L to R)

Sl No.	Description of Case	Amount Received (Rs)
01	Paternity, Identification/Crime, POCSO	6,32,000.00
02	Wildlife	16,88,626.00
03	Barcoding	40,08,035.00
04	Training	1,40,000.00
05	**Total**	**64,68,661.00**

Sl No.	Major Clients for Paternity/ Crime/ POCSO/Wildlife
01	Family Court's of Kerala
02	High Court of Kerala
03	Kerala Women's Commission
04	Child Welfare Committee
05	Judicial First-Class Magistrate, Lakshadweep (POCSO)
06	District & Sessions Court, Kavaratti, Lakshadweep (POCSO)
07	Chief Judicial Magistrate, Amini Island, Lakshadweep (POCSO)
08	All Judicial Courts of Kerala for Crime Cases
09	All Judicial Courts of Kerala for Wildlife Cases
10	Special Court for Forest Offences, Nagercoil, Tamil Nadu
11	Additional Chief Judicial & Judicial Magistrate of First Class, Chintamani, Karnataka.

Sl No.	Major Clients for DNA Barcoding
01	Annamalai University, Tamil Nadu
02	Assam Agricultural University, Jorhat
03	Bharathidasan University, Trichy
04	Bharathiyar University, Coimbatore
05	Botanical Survey of India, West Bengal & Shillong
06	Centre for DNA Fingerprinting & Diagnostics, Hyderabad
07	Cochin University of Science & Technology, Kochi
08	College of Agriculture, Thrissur
09	College of Agriculture, Vellayani, Thiruvananthapuram
10	College of Dairy & Food Technology, Maharana Prathap University of Agriculture and Technology, Rajasthan.
11	College of Dairy Science & Technology, Wayanad
12	College of Science, Albaha University, Saudi Arabia
13	CSIR-NIIST, Thiruvananthapuram
14	ICAR Sugarcane Breeding Institute, Kannur
15	Institute of Animal Health & Veterinary Biologicals, Thiruvananthapuram
16	Integrated Farming System Research Station, Thiruvananthapuram
17	Jamiat Alkhaneel Tree Trading Palms, UAE
18	Jawaharlal Nehru Tropical Botanic Garden & Research Institute, Thiruvananthapuram
19	Kerala Forest Research Institute, Thrissur
20	Kerala University of Fisheries & Ocean Studies, Kochi
21	Kerala Veterinary & Animal Science University, Thrissur
22	Mormugao Zonal Base of Fishery Survey of India, Goa
23	National Centre for Coastal Research, Chennai
24	Pepper Research Station, Kannur
25	Punjab University, Punjab
26	Rajasthan Agriculture University, Udaipur
27	Rice Research Station, Alappuzha
28	University of Jammu & Kashmir
29	University of Kerala.

30	Vidyasagar University, West Bengal
31	Zoological Survey of India, West Bengal & Calicut
32	G.B. Pant University of Agriculture & Technology, Uttarakhand.

RESEARCH ENGINEERING SERVICES

CORE RESPONSIBILITIES

Equipment Installation and Maintenance:

- Sophisticated and General Research Equipment: The department is responsible for the installation, maintenance, and service of both sophisticated and general research equipment, including Central Instrumentation Facilities at the Main Campus and Bio Innovation Centres.

- Engineering Workshop: Maintains a well-equipped workshop for repairing sophisticated instrumentation systems, which reduces downtime and repair costs. The in-house engineers handle complex hardware issues, saving on annual maintenance contracts (AMC) and comprehensive annual maintenance contracts (CAMC).

Customization and Fabrication:

- Research Automation: Customizes, designs, and fabricates components of research automation systems to meet specific user requirements, enhancing convenience and functionality.

Procurement Support:

- Technical Specifications: Assists in the procurement process by analyzing user needs, evaluating current technology, and preparing technical specifications within budget constraints for purchases.

Calibration Facilities:

- In-house Calibration: Operates calibration facilities for instruments like pipettes, electronic balances, centrifuges, autoclaves, freezers, incubators, and PCR machines. These facilities include standards and measuring instruments with certifications from recognized national agencies, aiding laboratories in achieving NABH/NABL accreditation.

Training Programs:

- Engineering Students: Provides training on the operation, application, calibration, and maintenance of instrumentation systems used in biotechnology and life science research. In the 2023-25 period alone, 63 students benefited from these programs.

Maintenance of Infrastructure:

- Various Systems: Manages a broad array of infrastructure, including:
  - Computers and security surveillance systems
  - Biometric time attendance recorders
  - Online conferencing and communication systems
  - Liquid nitrogen plant
  - Auditoriums and convention center
  - Electrical substations and Central AC plants
  - Automation with PLC/DCS/SCADA control systems
  - Maintenance of various instruments available in variour MLS labs

Impact and Innovation:

- Cutting-edge Technologies: The department is pivotal in integrating advanced technologies to minimize the man-machine interface, thus optimizing instrumentation systems.

- Benchmark Setting: The division has established new standards and benchmarks for similar departments nationwide, positioning itself as a model for excellence and innovation.

The Research Engineering Services Department continues to make significant, though often understated, contributions to the Institute's growth and success. Its commitment to quality and innovation positions it as a leader in supporting the Institute's mission and vision, paving the way for future advancements and achievements.

Instrumentation (Main Campus)

First Row: Rahul C S Nair, Sreelekshmi, Aswathy G Raj, Radhika U, Shaji, Ajithkumar(From L to R)
Second Row: Amal V, Premkumar V, Rajasekharan K, Akhilkumar T, Mohan Nallatt, Ullas Chandran (From L to R)

Instrumentation (Akkulam Campus)

Manoj, Anand Mohan, Sajan I X, Arun, Arunima, Unniraj, Lekshmi C (From L to R)

Substation (Main Campus)

First Row: Ajeesh S S, Sajin G S, Rajasekharan K, Sreekanth S L (From L to R)
Second Row: Shibin J, Jobin T J, Sajith Mohan M L, Sreenath M R, Ajeesh R, Desingh B

Substation (Akkulam Campus)

First Row: Sreejith P sankar, Ratheesh Kumar A, Shaji S, Vinod B, Bibin Dev G B, Santhosh S J, Gopika D (From L to R)
Second Row: Jithu, Sajeev Suresh, Mohamed Sanofar S, Hareesh V R, Jaseel N, Ajay S Kumar, Jagatheeshwara Kumar C, Assem A (From L to R)

CAFETERIA

First Row: Jayakrishnan N, Mohanan Nair S, Gopakumar M S (from L to R)
Second Row: Till Bahadhoor Bashya, Prasanna kumara t R, Sandhya R, Rajani T, Shylakumari, Lisa I, Meena R P (From L to R)
Back Row: Najeeb, Nandhu, Thyagarajan, Rathesh, Manojkumar, Byju, Akhil M K, Sureshkumar (From L to R)

First Row: Bhindu V, Subitha, Rakhi, Kumari Bhindu, Bhindhu A, Deepthi, Shankar (From L to R)
Second Row: Aneesh m, Anoop K C, Ananthakumar A, Sunilkumar K, Nanthakumar A, Manoj S, Sivaprasad, Radhakrishnan, Vivek (From L to R)

An exclusive well-maintained cafeteria is available in all our BRIC-RGCB campuses offering tasty and hygienic food. In order to cater to all the students /staff and visitors from different parts of India and abroad, South Indian, North Indian and Chinese dishes are offered. Food quality and hygiene are the two most important factors in the cafeteria. There is regular quality control and quality checks at the cafeteria to ensure highest standards of hygiene. There is never a compromise on food quality, cleanliness, and overall hygiene at thecafeteria. Be it kitchen or raw materials used for preparation of food, everything goes through a stringent quality check. The "Onam" feast with more than 20 different dishes is just one example of the culinary skills of the cafeteria chefs.

We aim to minimize the impact of catering operations on the environment and promote sustainable practices and consumption. The BRIC-RGCB cafeteria runs on a "no profit no loss basis"

BRIC-RGCB EVENTS 2024-2025

BRIC-RGCB EVENTS 2024-2025

APRIL 20 2024

BRIC-RGCB organized a **one-day National Symposium on Biotechnology** for Sustainable Development-2024, felicitation of senior scientists and a poster session for students.

JUNE 03 2024

BRIC-RGCB welcomed the **BRIDGE-SIP Summer Internship** students for one-month of training at BRIC-RGCB in collaboration with the Regional Centre for Biotechnology (RCB) and the Gujrat Biotechnology Mission (GSBTM).

BRIC-RGCB EVENTS 2024-2025

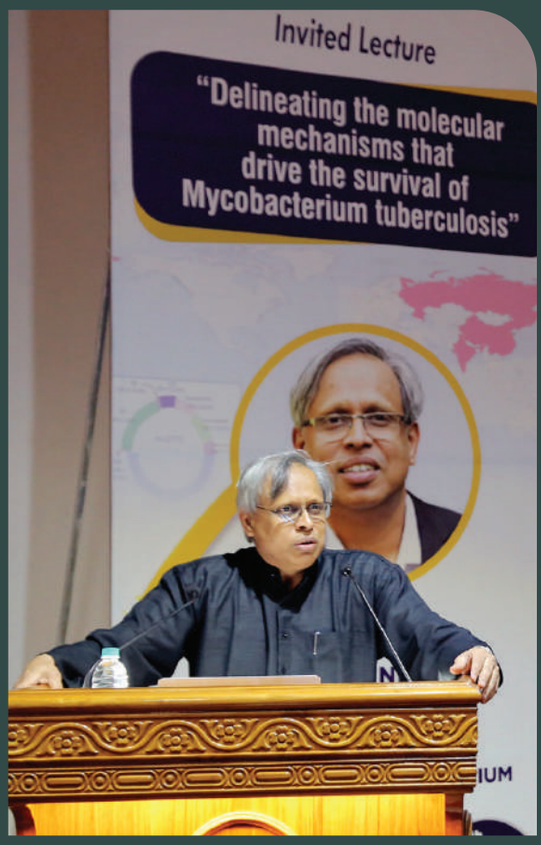
JUNE 05 2024

BRIC-RGCB celebrated **World Environment Day 2024** with the focal theme of Land Restoration, Desertification, and Drought Resilience.

JUNE 21 2024

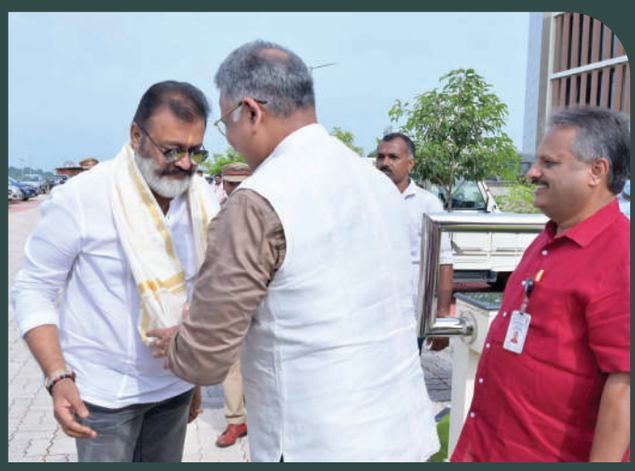
BRIC-RGCB celebrated the **International Day of Yoga** and Dr. Easwar S, from SCTIMST delivered a special talk on the benefits of yoga on brain function.

BRIC-RGCB EVENTS 2024-2025



JULY 11 2024

BRIC-RGCB arranged an **invited talk by Dr Vinay Nandicoori, Director CSIR-CCMB, Hyderabad** and title of the talk was "Delineating the survival strategies of Mycobacterium tuberculosis". After the talk Dr Nadicoori was felicitated by BRIC-RGCB Director Professor Chandrabhas Narayana



JULY 19 2024

Honorable Union Minister of State for Petroleum & Natural Gas and Tourism **Shri Suresh Gopi visited BRIC-RGCB Akkulam Campus.** A warm welcome was accorded to him by Professor Chandrabhas Narayana, Director, Mr. S Mohanan Nair, Chief Controller Dr. Radhakrishnan R Nair, Scientist, and Mr. R Kumar, Deputy Controller of Finance. He interacted with faculty, staff, and students.

BRIC-RGCB EVENTS 2024-2025

JULY 27 2024

The **fourth batch of BRIC-RGCB MSc Biotechnology (2022-2024)** students was given an official send-off by BRIC-RGCB. A total of 19 students completed their master's program affiliated with RCB.

AUGUST 15 2024

15 August 2024 BRIC-RGCB celebrated the **78th Independence Day** of our nation. Professor Chandrabhas Narayana, Director hoisted the National flag in the Main campus and at the second campus (C2) at Akkulam

SEPTEMBER 14 2024

BRIC-RGCB conducted a variety of competitions to commemorate the **Hindi Diwas/Pakhwara** from September 14th to September 29th.

SEPTEMBER 28 2024

The **2nd BRIC-RGCB Research Conference** (RC-2024) started with the plenary lecture of Dr. Senthil K Muthuswamy, NCI, USA. Earlier, Professor Chandrabhas Narayana, Director, BRIC-RGCB, outlined the objectives of this initiative.

OCTOBER 17 2024

Union Minister of State for Science and Technology, **Dr Jitendra Singh inaugurated the Science & Technology Innovation Program** (SC/ST farmers & Artisans meet) supported by Dept Science & Technology at BRIC-RGCB. The event is jointly organized by Swadeshi Science Movement-Kerala (SSM-K), Vijnana Bharati and BRIC-RGCB. Later Dr Singh interacted with BRIC-RGCB faculty.

BRIC-RGCB EVENTS 2024-2025

OCTOBER 28 2024 TO **NOVEMBER 03 2024**

BRIC-RGCB observed the **vigilance awareness week** from 28th October to 3rd November. The **invited lecture was delivered by Shri. G Vijayaraghavan**, Former CEO of Technopark, and Founder Director, NISH, Thiruvananthapuram, on the topic "Securing Science: Cyber Security Vigilance in Biotechnology Research".

NOVEMBER 01 2024

The Central Instrumentation Microinjection Facility (CIMF) at BRIC-RGCB main campus was formally inaugurated by Professor Chandrabhas Narayana, Director.

BRIC-RGCB EVENTS 2024-2025

NOVEMBER 21 2024

MoU was signed between BRIC-RGCB and Cochin Cancer Research Centre, Kochi (CCRC) on cancer research and advanced diagnostics. Professor Chandrabhas Narayana, Director of BRIC-RGCB, and Dr. Balagopal P.G., Director of CCRC, signed the MoU on behalf of BRIC-RGCB and CCRC in the presence of Shri Pinarayi Vijayan, Hon'ble Chief Minister, Kerala State, Smt. Veena George, Hon'ble Minister of Health & Family Welfare, Govt of Kerala, and Shri P. Rajeev, Hon'ble Minister of Law and Industries, Govt of Kerala.

NOVEMBER 26 2024

Observed as Constitution Day, or 'Samvidhan Diwas' every year, which commemorates the adoption of the Constitution of India. The director, staff, and students of BRIC-RGCB participated in the reading of the Preamble to the Constitution.

NOVEMBER 27 2024

BRIC-RGCB, in association with the Indian Academy of Sciences, Bengaluru, **organized a public lecture series**. Dr Sarah Teichmann, Professor and Chair Stem Cell Medicine at the University of Cambridge, UK delivered the invited lecture.

NOVEMBER 30 2024 --- TO --- DECEMBER 03 2024

BRIC-RGCB participated in the Mega Science and Technology Expo, demonstrating ongoing research activities and major achievements at IISF 2024 held at IIT, Guwahati

BRIC-RGCB EVENTS 2024-2025

DECEMBER 04
2024

Visit by European Union Delegation : A delegation representing different member states of the European Union visited BRIC-RGCB. They interacted with the faculty of BRIC-RGCB and provided an overview of different funding opportunities, such as Horizon Europe and EU member states bilateral cooperation opportunities.

DECEMBER 20
2025

TANDEM-ABX Stakeholder Consultation 2024 BRIC-RGCB co-organized the TANDEM-ABX Stakeholder Consultation on developing a sustainable use framework for new antibiotics by focusing on strengthening stewardship along with the Department of Health & Family Welfare, Government of Kerala, ICARS, and Indian School of Business.

JANUARY 08 2025 TO **JANUARY 10 2025**

BRIC-RGCB conducted an advanced hands-on workshop on cells, embryos, and microinjection from 8-10th January 2025. Prof. Chandrabhas Narayana, Director, BRIC-RGCB, inaugurated the workshop. Dr Aurelie Jory, Dr Rupasri Ain, and Dr Ramkumar Sambasivan were the resource persons.

JANUARY 16 2025

The central instrumentation clean room facility (Class 10K/ISO7) was inaugurated at BRIC-RGCB by Professor Chandrabhas Narayana

JANUARY 21 2025

BRIC-RGCB organized a **one-day training program for the students of GHSS Meppadi** to prepare them to guide visitors at the BRIC-RGCB Science Museum.

JANUARY 26 2025

On the occasion of the **76th Republic Day** of Our Nation, Professor Chandrabhas Narayana, Director, BRIC-RGCB, unfurled the national flag

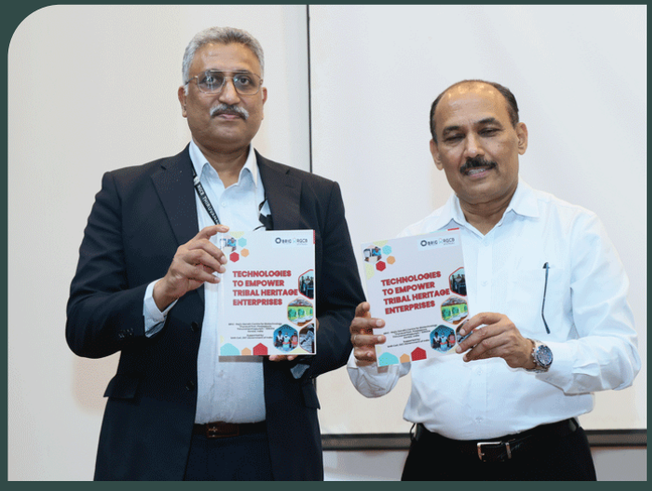
BRIC-RGCB EVENTS 2024-2025

FEBRUARY 21 2025

A two day national symposium in mass spectrometry based lipidomics started at BRIC-RGCB Dr S Asha Nair Scientist and Dean, BRIC-RGCB inaugurated the function. Dr Abdul Jaleel, Organizing Secretary formally welcomed the gathering.

FEBRUARY 28 2025

BRIC-RGCB celebrated National Science Day 2025 with various programs. Dr. J. N. Moorthy, Director, IISER, Thiruvananthapuram, delivered the special lecture.



MARCH 11 2025

BRIC-RGCB **celebrated International Women's Day**. Two invited talks were delivred by Prof Balram Bhargava, and Dr Sharmila Bapat. Earlier, Professor Chandrabhas Narayana, Director, welcomed the gathering.

MARCH 17 2025

BRIC-RGCB organized an **invited lecture by Prof G Karthikeyan,** Executive Director, BRIC-THSTI, Faridabad on the topic 'Bridging the Valleys of Death: Navigating the Barriers to Translation'. After the talk he was felicitated by Professor Chandrabhas Narayana.

BRIC-RGCB EVENTS 2024-2025

MARCH 20
2025

The Central Instrumentation Recombinant Protein Production, Purification & Crystallization Facility at BRIC-RGCB Campus-2 was inaugurated by Prof. Chandrabhas Narayana.

ANNUAL REPORT COMPILATION COMMITTEE 2024-25

Dr. K B Harikumar
Mr. R Kumar
Dr. N P Anish
Ms. R Lekshmi
Ms. Remya Rajan
Mr. Rajeev J Thampi

BRIC
a DBT Organization

RGCB
DISCOVERIES FOR A BETTER TOMORROW

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