ANNUAL REPORT
2019-20

CSIR-CCMB

CENTRE FOR CELLULAR AND MOLECULAR BIOLOGY,
HYDERABAD

CONTENTS

प्राक्कथन

जैसे ही मैंने इस वर्ष कोविड-19 की संकट की इस घड़ी में हमारी वार्षिक रिपोर्ट के लिए लिखना शरू किया वैसे ही एक वैज्ञानिक संस्थान होने के नाते सीएसआईआर - कोशिकीय और आणविक जीवविज्ञान केंद्र (सीसीएमबी) का वह रुप मेरे सामने आया, जो अपनी पूरी निष्ठा और समर्पण के साथ अपने दायित्व निर्वहन में निरंतर लगा रहा । विगत छह महीनों में यह स्पष्ट हो गया कि आने वाले दशकों में जीवन विज्ञान और जैव प्रौद्योगिकी उपकरण मानव सभ्यता को एक नया आयाम देंगे और आने वाले परिवर्तनों से उत्पन्न होने वाली चुनौतियों और अवसरों के लिए सीसीएमबी को तैयार रहना होगा।

सीसीएमबी, महत्वपूर्ण शोधों में सर्वोपरि होने के साथ-साथ अब अपने शोधों के माध्यम से दूसरों के जीवन को प्रभावित करने के तरीके ईजाद करने की ओर प्रयासरत है। हमारे शोध समूहों के कई प्रसिद्ध शोध प्रकाशन और पुरस्कार, विज्ञान के क्षेत्र में हमारी उत्कृष्टता के प्रमाण हैं। हमारे छात्रों ने अपने नए और समयोचित पहल से शहर के शोधार्थियों के आगे बढ़ने के मार्ग प्रशस्त किये हैं। साथ ही हमने, कई स्टार्ट-अप का समर्थन करने के साथ साथ, राष्ट्र के लिए अपनी नैदानिक और विश्लेषणात्मक सेवाएँ दी हैं और शोध नवोन्मेष के लिए एक उन्नत और बेहतरीन परिवेश बनाए रखने के लिए भारत के अन्य शोध संस्थानों, उद्योग, नीति निर्माताओं, मीडिया और जनता के साथ लगातार संपर्क बनाए रखा है।

भारत में संकट काल की शुरुआत से कोविड-19 के शमन में सीसीएमबी निरंतर समर्पित रहा। समाज के प्रति अपना पूर्ण दायित्व निर्वहन करते हुए सबका विश्वास जीता और इस कठिन समय में अपनी निष्ठा का एक सशक्त उदाहरण प्रस्तुत किया। परीक्षण में स्वास्थ्य सेवा कार्यकर्ताओं को प्रशिक्षण देने से लेकर, स्वयं परीक्षण केंद्र स्थापित करने और परीक्षण केंद्रों की स्थापना में अन्य शोध संस्थानों की मदद करने, नमूनों के परीक्षण के नए तरीकों को विकसित करने, टीके और एंटीसेरा विकसित करने के लिए वायरस का संवर्धन और परीक्षण, दवाओं और स्वच्छता उपकरणों और कीटाणुनाशकों का परीक्षण करने के साथ-साथ बीमारी और वायरस के विषय में हमारी बढ़ती समझ पर लगातार प्रतिक्रियाएँ देने में हम निरंतर प्रयत्नशील रहे। इस जंग में सीसीएमबी पूर्ण निष्ठा व समर्पण के साथ अपनी भूमिका निभाता रहा है। ज्ञान अर्जन, इसके प्रकाश से समाज को आलोकित करने का यह जज़्बा और सामाजिक आवश्यकताओं की पूर्ति के लिए इसका उपयोग करना समाज के प्रति हमारी गहन संवेदना और उत्तरदायित्व के निर्वहन का प्रमाण है।

राकेश कुमार मिश्र
निदेशक, सीसीएमबी

FOREWORD

As I pen the foreword for our Annual Report this year amid the COVID-19 crisis, I reflect yet again on the power and responsibilities that a science research institute like CSIR-Centre for Cellular and Molecular Biology (CCMB) holds. The last six months have shown clearly that life sciences and biotechnological tools are going to shape human civilization in the coming decades. And CCMB needs to be ready for the challenges and opportunities this will open up.

CCMB is now at the forefront of fundamental research as well as developing ways of impacting lives of others through our research. The numerous celebrated research publications, awards and collaborations from our research groups are a testimony to our excellence in science. Our students have led the path of bringing together young researchers across the city through novel and timely initiatives. At the same time, we have supported multiple start-ups, enhanced our diagnostic and analytical services to the Nation, and have maintained active conversations with other research institutes in India, industry, policymakers, media and public to create a fertile ecosystem of research and innovation.

A perfect example of showing CCMB's dedication towards reaching various tenets of society is evident from its investment in COVID-19 mitigation, right from the start of the crisis in India. From training healthcare workers in testing, to establishing a testing centre itself and helping other research institutes in establishing testing centres, to develop novel methods of testing samples, growing virus to develop vaccines and antisera as well as testing drugs and sanitization devices and disinfectants and constantly communicating on the development of our understanding of the disease and the virus – CCMB has been instrumental in this fight. And it is this spirit of pursuit of knowledge, spreading it and utilizing it to fulfil societal needs, that our community stands for.

RAKESH KUMAR MISHRA
DIRECTOR, CCMB

CHARTER

The Centre for Cellular and Molecular Biology (CCMB) is one of the constituent national laboratories of the Council of Scientific and Industrial Research (CSIR), New Delhi, India.

The objectives of the Centre are:

- To conduct research in frontier and multi-disciplinary areas of modern biology, and to seek potential applications of this work
- To carry out exploratory work in areas of biology with a view to aid the development of biochemical and biological technology in the country on a sound basis
- To train people in the advanced areas of biology to serve the needs of development in these areas, with special provision for short-term training of staff from other institutions in techniques for which adequate facilities may not exist elsewhere
- To provide centralized facilities in the country for new and modern techniques in the inter-disciplinary areas of biology, and to ensure that these facilities are so organized, maintained and administered that they can be put to maximal use by research workers from other laboratories and institutions in the country
- To interact adequately with other institutions doing basic or applied work in areas related to the activities of the Centre
- To collect, collate and disseminate information relevant to biological research

1.1 Research Programmes

1.1A Research Summaries

AJAY GAUR

Conservation Genetics of Endangered Indian Species

From left to right, starting from top: Ajay Gaur, Mrinalini Bhaskar, Ara Sreenivas, Karthik Kumar D., Urjaswi Sondhi, Chandan Kumar Verma

Research interests

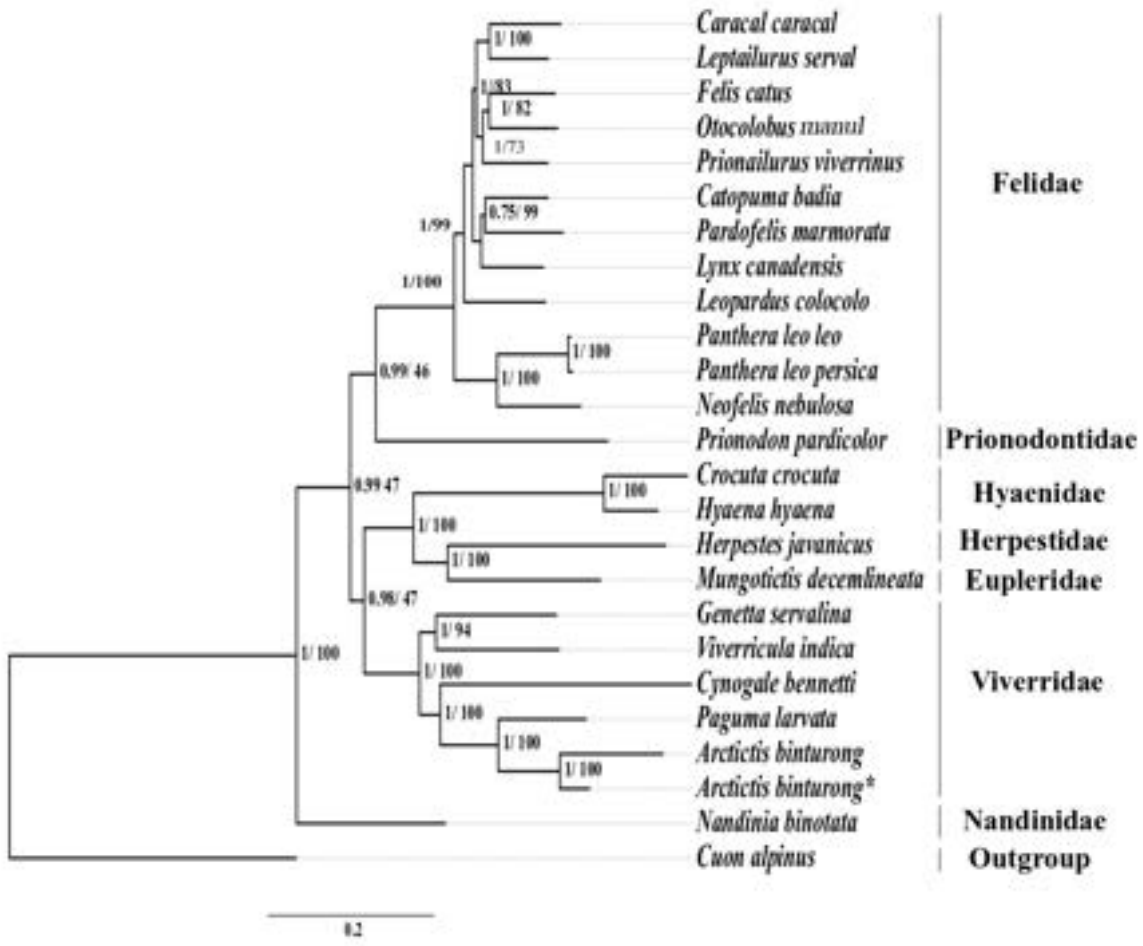
- Conservation genetics of endangered Indian species
- Application of DNA markers in population and evolutionary genetics

Selected recent publications

- Mitra S, Kunteepuram V, Koepfli K, Mehra N, Tabasum W, Sreenivas A and Gaur A (2019). Characteristics of the complete mitochondrial genome of the monotypic genus Arctictis and its phylogenetic implications. ***PeerJ*** 7: https://doi.org/10.7717/peerj.8033.
- Mishra RP and Gaur A (2019). Conservation status of Asiatic Wild Buffalo (Bubalus arnee) in Chhattisgarh revealed through genetic study. Technical report of Wildlife Trust of India and CSIR-CCMB, p17.
- Rai N⁎, Verma S K⁎, Gaur A⁎, Iliescu FM, Thakur M, GollaTR, Chandra K, Prakash S,Tabasum W, Sreenivas A, Singh L, Thangaraj K and Jacobs GS (2020). Ancient mtDNA from the extinct Indian cheetah supports unexpectedly deep divergence from African cheetahs. ***Scientific Reports*** 10: https://doi.org/10.1038/s41598-020-60751-7. ⁎Equal contribution.

Our area of research is conservation genetics of endangered Indian species, especially big cats and ungulates. Our lab focuses on the application of DNA markers in population and evolutionary genetics, and in wildlife forensics. The major emphasis is towards the use of non-invasive sampling protocols and species through the use of specific DNA markers, to examine the genetic structure of existing populations in wild as well as in captivity. We generated the first complete mitochondrial genome sequence of the Indian subspecies of binturong or bear cat (*Arctictis binturong albifrons*) using Next-Generation Sequencing. In the forest ecosystems of Southeast Asia, the frugivorous binturong has co-evolved with fig trees to form a keystone relationship, wherein the animal facilitates and propagates seed germination while the fig tree provides a stable dietary source. Binturongs are presently being poached for their meat, traditional medicines and the pet trade, and alongside habitat destruction, these factors have contributed to their decreased numbers in a few geographical pockets across its former range. The genetic structure of the binturong has not been studied, an aspect that is essential to validate the evolutionary and conservation genetics implications of the existence of nine geographically and morphologically disparate subspecies. The aim of our study was to provide the first molecular phylogenetic and divergence dating analysis of the *Arctictis* in the context of *Viverridae* and other feliform families, based on whole mitochondrial genomes.

The total length of the *A. b. albifronsmito* genome was found to be 16,642 bp. The base composition showed a bias towards higher adenine and thymine content in the binturong mitogenome, amounting to 64.63%, with the individual base proportions amounting to 32.80% A, 31.83% T, 16.46% G and 18.91% C. Phylogenetic analyses (in figure) of the concatenated sequences of the 13 protein coding genes (PCGs) support the monophyly of *Viverridae* among feliforms and monophyly of *Paradoxurinae* among viverrids. Within *Viverridae*, *Paradoxurinae* (*A.binturong* and *Paguma larvata*) and *Paradoxurinae* + *Hemigalinae* (*Cynogale bennetti*) were both monophyletic. Divergence time estimates suggest that the *Viverridae* diversified during the Miocene (22.62 Mya: 95% CI: 20.78-24.54 Mya). This study provides a starting point for further testing the distinctiveness and diversity of the nine putative subspecies of binturong and thereby, provide critical information for designing conservation breeding and management plans for this vulnerable species.



Phylogenetic relationships among mitogenomes of *Feliformia,* reconstructed from concatenated sequences of 13 PCGs using Bayesian Inference (BI) and Maximum Likelihood (ML) method. At each node, the values follow in this order. Bayesian Posterior Probability (BPP) done by Mr. Bayes/ Bootstrap value for ML analysis done by raxmlGUI v1.3

AMIT ASTHANA

Applications of Microfluidics, Micro and Nanotechnology in Life Sciences

From left to right: Amit Asthana, Ira Bhatnagar

Research Interests

- Micro and nanotechnology to address biological problems
- Developing affordable paper-based devices for clinical diagnostics

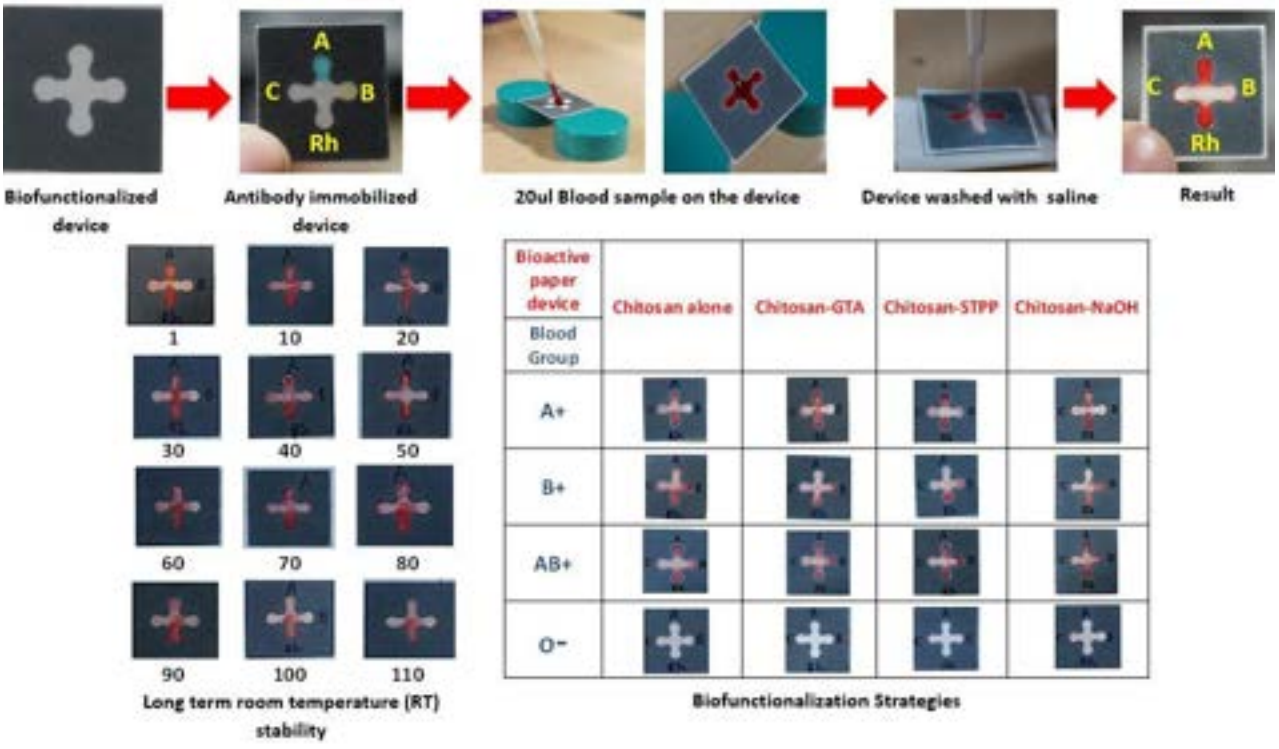
Selected recent publications

- Parween S, Subudhi PD, Asthana A (2019). An affordable, rapid determination of total lipid profile using paper-based microfluidic device. ***Sensors & Actuators: B. Chemical*** 285: 405–412.

Patents Filed

- A novel facile aqueous based extraction of progesterone metabolites from faeces sample for non-invasive, simple, affordable and farmer friendly paper based kit for pregnancy detection in cattle and buffaloes, G. Umapathy, Amit Asthana, Chintalagiri Mohan Rao, Vinod Kumar, Gopi Suresh Oggu; PCT International Application No. PCT/IN2020/050202 Filed on: March 05, 2020, Claiming Priority from Indian Application No.: 201911008655.
- Rapid, low cost process for the preparation of SERS substrate and SERS substrate prepared thereby, Amit Asthana, Mohan Rao Chintalagiri, Saurabh Kumar Srivastava, Gopi Suresh Oggu; PCT International Application No. PCT/IN2019/050102, Filed on: May 08, 2019, Claiming Priority from Indian Application No.: 201811023895.

The long term stability of antibodies used for blood typing at room temperature is a major challenge in the commercialization of point-of-care devices for blood typing. Our group is interested in understanding the effects of four different biofunctionalization processes, to improve the room temperature stability of blood typing antibodies immobilized on paper-based microfluidic devices. The devices used in this work have a flower-shaped design with 4 test zones at each corner. Following biofunctionalization, Anti-A, Anti-B, Anti-D (Anti-Rh) are immobilized in three zones, with a control sample (no antibodies) in the fourth zone. Biofunctionalization of the paper devices was done with (i) chitosan and chitosan cross-linked with (ii) sodium triphosphate pentabasic, (iii) glutaraldehyde, and (iv) sodium hydroxide. These devices were used for blood typing assays using real blood samples. A similar assay was also performed on unmodified paper devices for comparison. The biofunctionalized paper-devices showed better stability at room temperature - up to 100 days compared to 14 days on unmodified paper. Such biofunctionalized paper-based devices will be suitable for on-field and remote testing, without the requirement of either technical expertise or a cold chain.



Flow diagram of long term stability test of chitosan-NaOH biofunctionalized devices for testing different blood groups (a) A+, (b) B+, (c) AB+ and (d) O -.

AMITABHA CHATTOPADHYAY

Membrane and Receptor Biology

From left to right, starting from top: Md. Jafurulla, Sandeep Srivastava, Amitabha Chattopadhyay, Aritri Dutta, Amrita S, G. Aditya Kumar, Bhagyashree D. Rao, Sreetama Pal, Parijat Sarkar, Ashwani Sharma, Subhashree Shubhrasmita Sahu, Sarosh N. Fatakia, Abhishek Kumar, K. Venkatlaxmi

Research Interests

- Interaction of membrane lipids and actin cytoskeleton with G protein-coupled receptors (GPCRs): implications in health and disease
- Role of membrane lipids in the endocytosis and intracellular trafficking of GPCRs, and the entry of pathogens into host cells
- Dynamics of solvent relaxation in membranes and proteins

Selected recent publications

- Shrivastava S, Sarkar P, Preira P, Salomé, L and Chattopadhyay A (2020). Role of actin cytoskeleton in dynamics and function of the serotonin1A receptor. ***Biophysical Journal*** 118: 944-956.
- Sarkar P and Chattopadhyay A (2020). Cholesterol interaction motifs in G protein-coupled receptors: slippery hot spots? Wiley Interdisciplinary Reviews: Systems Biology and Medicine 2020: e1481.
- Kumar, GA and Chattopadhyay A (2020). Statin-induced chronic cholesterol depletion switches GPCR endocytosis and trafficking: insights from the serotonin1A receptor. ***ACS Chemical Neuroscience*** 11: 453-465.
- Prasanna X, Mohole M, Chattopadhyay A and Sengupta D (2020). Role of cholesterol-mediated effects in GPCR heterodimers. ***Chemistry and Physics of Lipids*** 227: 104852.
- Rao BD, Chakraborty H, Chaudhuri A and Chattopadhyay A (2020). Differential sensitivity of pHLIP to ester and ether lipids. ***Chemistry and Physics of Lipids*** 226: 104849.

- Sahu SS, Sarkar P, Shrivastava S and Chattopadhyay A (2019). Differential effects of simvastatin on membrane organization and dynamics in varying phases. Chemistry and Physics of Lipids 225: 104831.

- Pal S and Chattopadhyay A (2019). Extramembranous regions in G protein-coupled receptors: Cinderella in receptor biology? Journal of Membrane Biology 252: 483-497.

- Mohole M, Kumar GA, Sengupta D and Chattopadhyay A (2019). Molecular determinants of GPCR oligomerization, in GPCRs - Structure, Function, and Drug Discovery (Jastrzebska B and Park PS-H., Editors), ***Elsevier***, pp. 97-108.

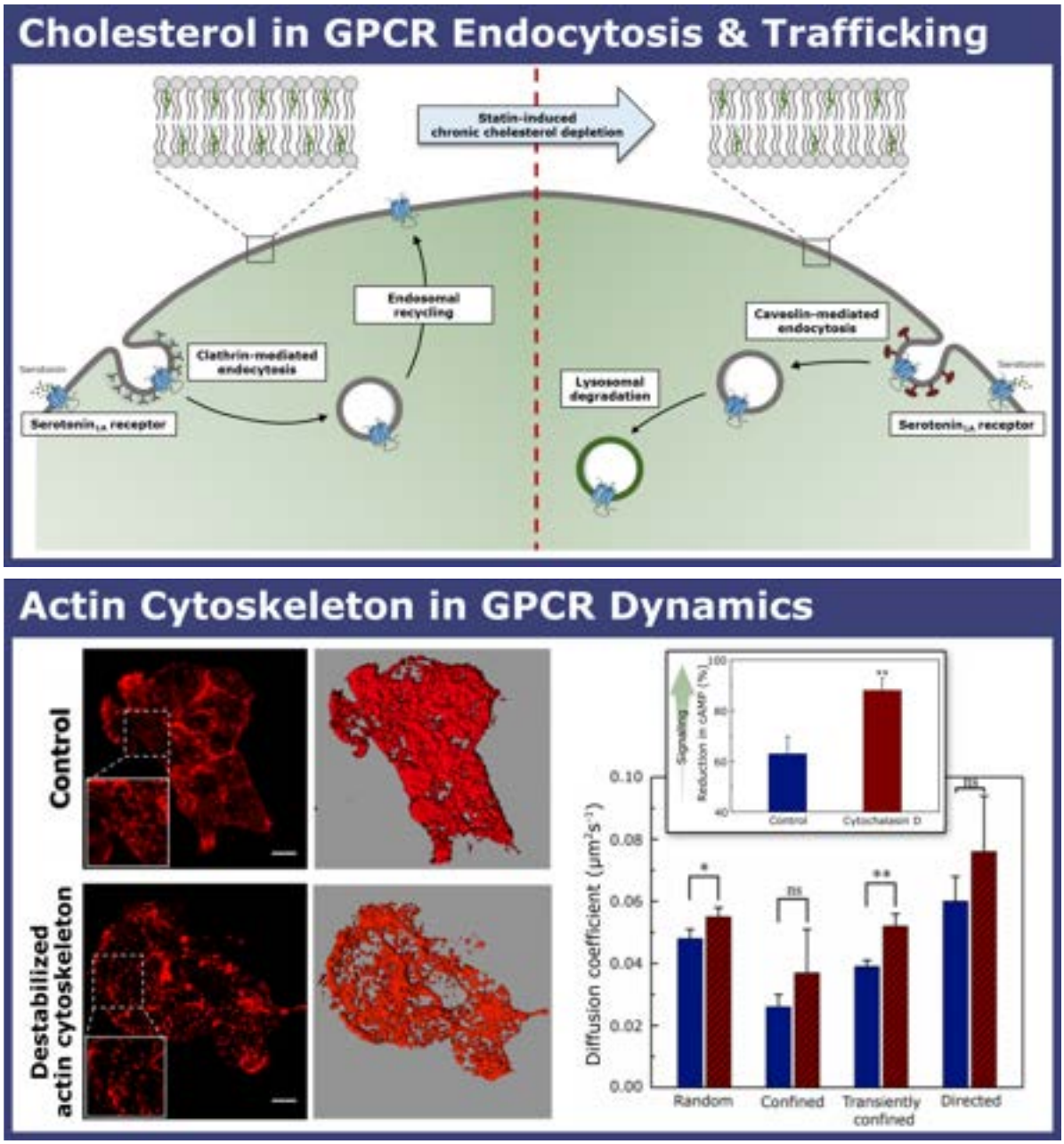
- Kumar GA, Karmakar J, Mandal C and Chattopadhyay A (2019). Leishmania donovani internalizes into host cells via caveolin-mediated endocytosis. ***Scientific Reports*** 9: 12636

- Sarkar P and Chattopadhyay A (2019). Exploring membrane organization at varying spatiotemporal resolutions utilizing fluorescence-based approaches: Implications in membrane biology. Physical Chemistry Chemical Physics 21: 11554-11563 (invited perspective).

- Fatakia SN, Sarkar, P and Chattopadhyay A (2019) A collage of cholesterol interaction motifs in the serotonin1A receptor: an evolutionary implication for differential cholesterol interaction. ***Chemistry and Physics of Lipids*** 221: 184-192.

- Kumar GA, Sarkar P, Jafurulla M, Singh SP, Srinivas G, Pande G and Chattopadhyay A (2019). Exploring endocytosis and intracellular trafficking of the human serotonin1A receptor. ***Biochemistry***. 58: 2628-2641.

Our laboratory focuses on a comprehensive understanding of the subtle interplay between G protein-coupled receptors (GPCRs) and membrane lipids with far-reaching implications in health and disease, utilizing a judicious combination of biophysical, biochemical, cell biological and computational approaches. Signaling mediated by GPCRs enables the cellular exterior to interact with the cellular interior. In our recent work, we studied the effect of destabilization of the actin cytoskeleton on the lateral dynamics of an important neurotransmitter GPCR, the serotonin1A receptor, using single particle tracking (SPT). Our analysis showed that actin destabilization leads to a change in receptor diffusion, which manifests as an increase in ligand binding and cAMP signaling. These results demonstrate the interdependence of membrane protein dynamics with signaling. Endocytosis is a key regulatory mechanism adopted by GPCRs to modulate downstream signaling responses within a stringent spatiotemporal regime. Recent work from our group showed that statin-induced chronic cholesterol depletion switches the endocytic pathway of the serotonin1A receptor from clathrin- to caveolin-mediated endocytosis. Interestingly, under these conditions, a significant proportion of endocytosed receptors is rerouted toward lysosomal degradation, instead of recycling. These results constitute one of the first comprehensive reports on the role of membrane cholesterol in GPCR endocytosis and trafficking. In addition, we showed that *Leishmania donovani*, an intracellular protozoan parasite that causes visceral leishmaniasis, utilizes caveolin-mediated endocytosis to internalize into host cells. These results could have implications in the development of therapeutic strategies that target the host endocytic machinery.



Top: A schematic showing switch in the endocytic pathway of the serotonin1A receptor from clathrin- to caveolin-mediated endocytosis, upon chronic cholesterol depletion using statin. Subsequent to internalization under statin-treated conditions, a significant proportion of the endocytosed receptors are routed toward lysosomal degradation, with a considerable reduction in the component undergoing membrane recycling.

Bottom: Treatment with cytochalasin D leads to depolymerization of F-actin in cells. These conditions lead to considerable change in various modes of receptor diffusion, which results in an increase in signaling by the serotonin1A receptor.

ANANT B PATEL

Brain Energy Metabolism in Neurological and Psychiatric Disorders

From left to right: Varadarajan, Dipak, Shibani, Bedaballi, Akila, Anant, Narayan, Bhargidhar and Kamal

Research interests

- Excitatory and inhibitory neurotransmission in neurodegenerative disorders like Alzheimer's disease and Amyotrophic Lateral Sclerosis Neuronal and astroglial metabolic activity in psychiatric disorders
- Development of non-radioactive tracer based approach for metabolic analysis

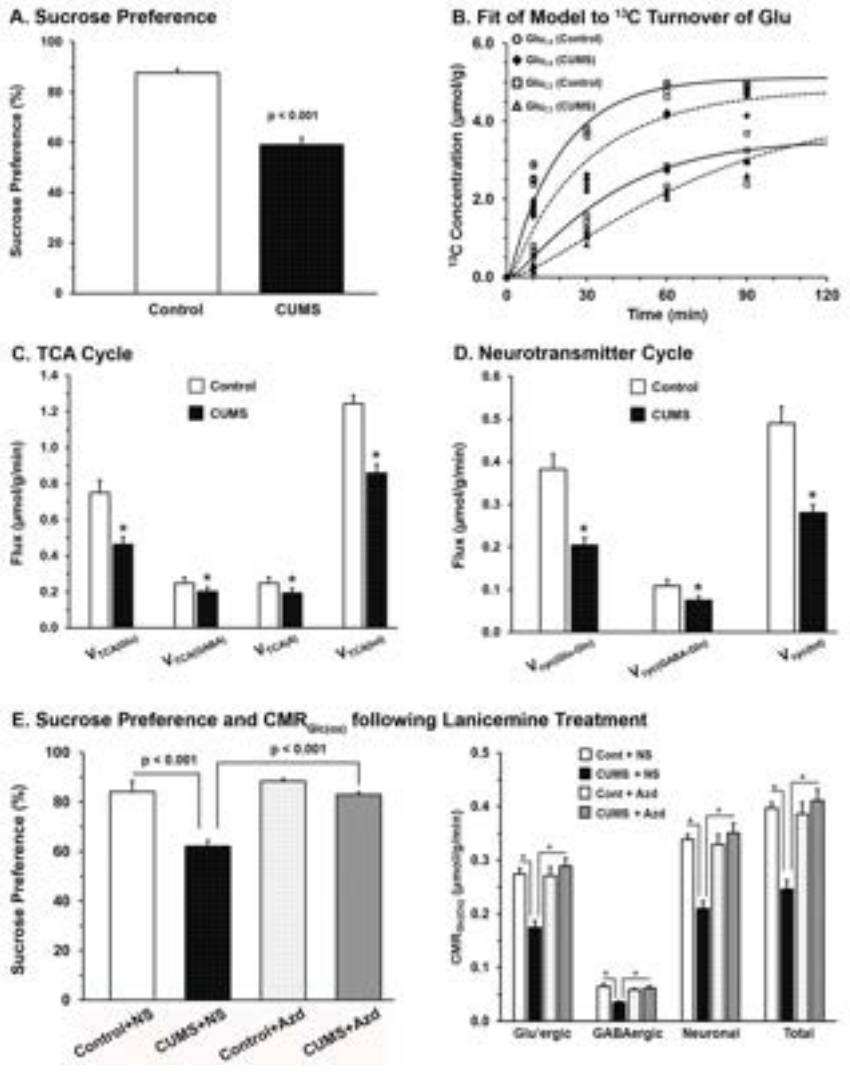
Selected recent publications

- Mishra PK, Adusmilli M, Deolal P, Mason GF, Kumar A, Patel AB (2020). Impaired neuronal and astroglial metabolic activity in chronic unpredictable mild stress model of depression: Reversal of behavioral and metabolic deficit with lanicemine. ***Neurochemistry International.*** 137:104750.

Glutamate and GABA are the most abundant neurotransmitters in the matured nervous system. These neurotransmitters are implicated in several functions such as motor, behavior, cognition and emotion. Our group is interested in understanding energetics of glutamate and GABA in different neurodegenerative and psychiatric disorders.

Depression is the most complex and debilitating neuropsychiatric disorders, and the leading cause of disability and suicide worldwide. We have evaluated TCA cycle and neurotransmitter cycling flux in Chronic Unpredictable Mild Stress (CUMS) model of depression. The CUMS exhibited a reduction in sucrose preference, and increased immobility in Forced swim test (Fig. 1A). The rate of total glucose oxidation was decreased in CUMS mice when compared with controls, which was contributed by a decrease in TCA cycle flux of Glutamatergic and GABAergic neurons (Fig. 1C). Moreover, the rates of glutamate-glutamine and GABA-glutamine neurotransmitter cycle was decreased in CUMS mice (Fig. 1D).

Most of the currently used antidepressants suffer from the drawback of long remission time and low recovery rate. We have evaluated the impact of lanicemine, a low trapping NMDA channel blocker, on behavior and neurometabolic measures in the CUMS mice. The lanicemine treatment improved behavior measures in CUMS mice (Fig. 1E). Most importantly, glucose oxidation in glutamatergic and GABAergic neurons was restored to the control levels (Fig. 1E). These data suggest that depression leads to a reduction in excitatory and inhibitory neurotransmission in PFC, and targeting glutamatergic pathway may have potential therapeutic role in chronic depression.



ARVIND KUMAR

Epigenetics & Neuropsychiatric Disorders

From left to right, starting from top: Arvind Kumar, Sachin Singh, Gajendra Reddy, Unis Bhat, Aditya Undru, Annapoorna PK, Bedaballi Dey, Shams ul-haq Talee, Niharika Awasthi, Bhanu Pranav NS, Arpan Mukhoti, Thasneem Musthafa

Research interests

- Role of diverse epigenetic regulatory mechanisms of neural gene expression in etiology of neurological and psychiatric diseases such as mood disorders, alcohol addiction and comorbid dementia

Selected recent publications

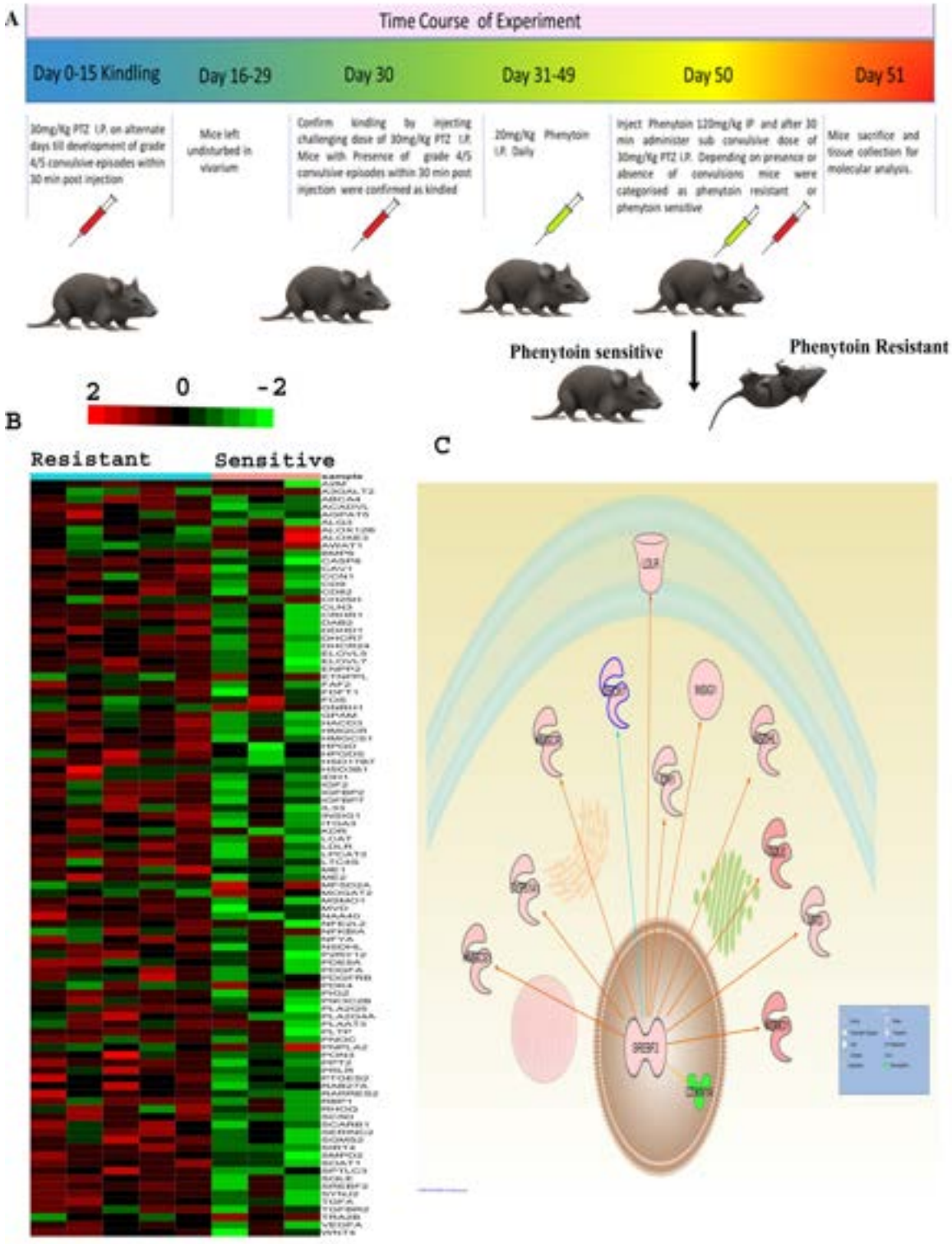
- Khandelwal N, Dey S, Chakravarty S, Kumar A(2019). MiR-30 family miRNAs mediate the effect of chronic social defeat stress on hippocampal neurogenesis in mouse depression model. ***Frontiers in Molecular Neuroscience*** 12: 188.
- Leighton LJ, Wei W, Marshall PR, Ratnu VS, Li X, Zajaczkowski EL, Spadaro PA, Khandelwal N, Kumar A,Bredy TW (2019). Disrupting the hippocampal Piwi pathway enhances contextual fear memory in mice. ***Neurobiology of Learning and Memory*** 161: 202.
- Gajendra Reddy R, Goverdhan S, Dwaipayan B, Sandeep Kumar M, Arpita S, Arunasree MK, Kumar A*, Srinivas Kantevari*, and Chakravarty S (2019). Crafting Carbazole-Based Vorinostat and Tubastatin-A-like Histone Deacetylase (HDAC) Inhibitors with Potent in Vitro and in Vivo Neuroactive Functions. ***ACS Omega*** 4: 17279.
- Ghosh S, Sinha JK, Khandelwal N, Chakravarty S, Kumar A, Raghunath M (2019). Increased stress and altered expression of histone modifying enzymes in brain are associated with aberrant behaviour in vitamin B12 deficient female mice. ***Nutritional Neuroscience*** 23: 714.

Uncovering the molecular mechanisms in drug resistant epilepsy by differential hippocampal gene expression profile

Drug resistant epilepsy (DRE) is a serious problem with an estimated 20 million patients all over the world. Molecular understanding of resistance to antiepileptic drugs (AEDs) has remained obscure due to lack of robust preclinical DRE models. Herein, we show the development of phenytoin resistant epilepsy in pentylenetetrazol (PTZ) kindled mice and further characterization of differential hippocampal gene expression profiles in them, using microarrays. Fig 1A depicts the time line and overall method followed. Animals were sacrificed and hippocampus was dissected out for molecular analysis.

Our mRNA microarray analysis identified 487 (285 upregulated and 202 downregulated) differentially expressed genes (p value ≤ 0.05, absolute fold change ≥ 1.2) between phenytoin resistant and sensitive groups (Fig 1B). Furthermore, gene set enrichment analysis by Ingenuity pathway analysis (IPA) showed cholesterol biosynthesis related pathways among top most regulated pathways with positive Z score of activation in phenytoin resistant gene set, in comparison to phenytoin sensitive group. In addition, mapping the gene expression data from microarray on genes involved in lipid biosynthesis showed overall upregulation of transcripts associated with lipid synthesis in phenytoin resistant group as compared to phenytoin sensitive group. This differential expression of cholesterol biosynthesis genes in phenytoin resistant mice correlated with changes in expression of transcription factor SREBP2 – an upstream regulator of transcription of genes involved in lipid biosynthesis (Fig 1C). These results would augment preclinical models for drug resistant epilepsy and would facilitate the exploration of more specific targets for the management of phenytoin resistance in epilepsy.

On the translational front, our group is involved in screening small molecules using *in vitro* & *in vivo* systems, and testing the efficacy of potential ones in pre-clinical studies (CNS drug discovery endeavours) for developing potential small molecules that are brain permeable and having neurotrophic, neurogenic and anti-neuroinflammatory action. We have also developed some epidrugs that can work at the epigenetic level, such as HDAC inhibitors, for treating neuropsychiatric disorders and aggressive brain tumors like glioma.



(A) Timeline depicts course of experiment and protocol followed to induce phenytoin resistance epilepsy in PTZ kindled mice; (B) Heatmap representation of differential expression of genes associated with lipid biosynthesis in phenytoin resistant and sensitive mice. Log fold change values of microarray data were mapped on respective genes. Shades of red and green colors represent upregulation and downregulation of genes respectively; (C)Represents mapping of microarray data on super pathway of cholesterol biosynthesis in relation with upstream regulator Srebp2 in phenytoin resistant vs sensitive groups. Color coding represents z score (Shades of red represent positive score and green represents negative score).

A S SREEDHAR

Stress Biology and Molecular Medicine

From left to right, starting from top: Pankaj Kumar, Akhil Kotwal, Shrikant P. Dharaskar K.R. Paithankar, A. Vijayalakshmi, A.S. Sreedhar

Research interests

- Unconventional roles of cancer chaperone Hsp90 in tumor adaptations
- Develop novel anti-tumor strategies to combat cancer irreversibly

Selected recent publications

- Ramkumar B, Dharaskar SP, Mounika G, Paithankar K, Sreedhar AS (2020). Mitochondrial chaperone, TRAP1 as a potential pharmacological target to combat cancer metabolism. ***Mitochondrion*** 50: 42-50.
- Kanugovi AV, Joseph C, Siripini S, Paithankar K, Amere SS (2020). Compromising the constitutive p16(INK4a) expression sensitizes human neuroblastoma cells to Hsp90 inhibition and promotes premature senescence. ***Journal of Cell Biochemistry*** 121: 2770-2781.
- Vykuntham NG, Suran S, Siripini S, John S, Kumar P, Paithankar K, Amere Subbarao S (2020). Altered molecular pathways decides the treatment outcome of Hsp90 inhibitors against breast cancer cells. ***Toxicology in Vitro*** (In press).

The molecular chaperone, Hsp90, is involved in the conformational maturation and functional stabilization of cancer-promoting proteins. Using human breast cancer cells, we show that Hsp90 regulates the stability and nuclear translocation of E2F1-3 transcription factors in a cell cycle-dependent manner, and report E2F2 as a novel client of Hsp90. In a different study, we examined the role of Hsp90 in the acquired multidrug resistance and tumor metastasis of HeLa derived cancer cells. We found Hsp90 contributing to drug adaptation and enhanced drug efflux activity of P-glycoprotein by facilitating the cholesterol accumulation at the membrane microdomains. Subsequently, we showed that Hsp90 interacts with cholesterol, possibly to assist its enrichment at the lipid rafts. While understanding the role of Hsp90 in the crosstalk between drug resistance in vitro and tumor metastasis in mice tumor xenografts, we found that the matrix metalloproteinase, MMP7 coordinates with Hsp90 and promote drug resistance and tumor metastasis. Our studies show that enhanced drug efflux activity and tumor metastasis can be independent events, however, they require Hsp90. In another study, using human breast cancer cells, we demonstrated that Hsp90 inhibition interferes with cell proliferation but triggers the activation of stem-like cells, which subsequently exhibits altered homing properties in mice tumor xenografts. We also demonstrated how tumor hypoxia interferes with chemotherapeutic response mediated by Hsp90. From a different study, using human neuroblastoma, we showed that TRAP1 expression correlates with an aggressive cancer phenotype. Subsequently, we showed that TRAP1 overexpression contributes to the activation of oxidative phosphorylation-independent energy metabolism.

GHANSHYAM SWARUP

Molecular Mechanism of Neurodegreneration caused by Mutations in Optineurin

From left to right: Swetha Medchalmi, Ankita Singh, Ghanshyam Swarup, Zuberwasim Sayyad, Rajashree Ramaswamy, Shivranjani Moharir

Research interests

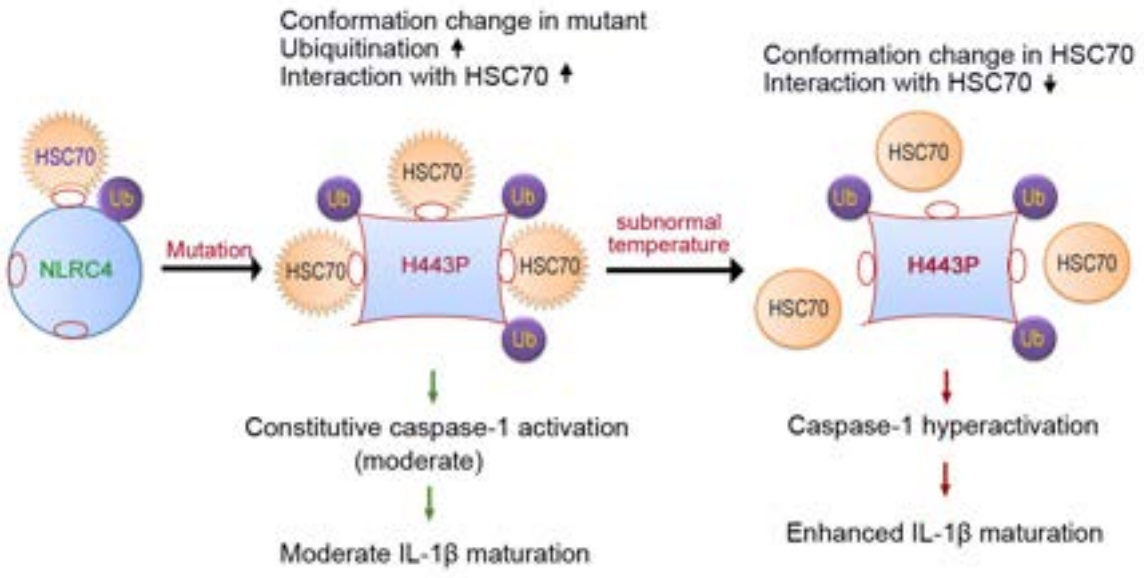
- Role of optineurin in neurodegenerative diseases
- Signaling by the cytoplasmic immune receptor NLRC4 that mediates inflammation

Selected recent publications

- Raghawan AK, Ramaswamy R, Radha V and Swarup G (2019). HSC70 regulates cold-induced caspase-1 hyperactivation by an autoinflammation-causing mutant of cytoplasmic immune receptor NLRC4. ***Proceedings of the National Academy of Sciences of USA*** 116: 21694-21703.

The hallmark of several neurodegenerative diseases like ALS, Huntington's disease and Alzheimer's disease, is the formation of pathological structures containing aggregated proteins - the adaptor protein optineurin (OPTN) is frequently observed in these structures. What role optineurin plays in those aggregates is yet to be explored. Our results show that OPTN promotes aggregation of mutant Huntingtin and mutant Ataxin-3, and reduces cytotoxicity of aggregates. We suggest that OPTN may provide cytoprotection in three different ways- by promoting mutant protein aggregation, by reducing cytotoxicity of aggregates and by autophagy-dependent clearance of aggregates reported earlier. This explains the association of OPTN with various pathological structures seen in neurodegenerative diseases. The mechanisms by which glaucoma and ALS associated mutants cause neuronal cell death are being investigated.

The cytoplasmic immune receptor NLRC4 mediates caspase-1 activation and cytokine maturation upon sensing of certain bacteria. Mutations of NLRC4 and some other cytoplasmic immune receptors cause familial cold autoinflammatory syndrome (FCAS). Individuals carrying NLRC4-H443P mutation show exacerbated inflammation upon exposure to cold environments due to caspase-1 hyperactivation and cytokine release. The mechanism of cold-induced hyperactivation of caspase-1 by none of the FCAS-causing mutants is known. We identified HSC70 as an interacting partner of NLRC4-H443P that negatively regulates caspase-1 activation. Exposure to subnormal temperature reduces interaction of H443P with HSC70, causing caspase-1 hyperactivation. Our study provides a molecular mechanism for exacerbation of inflammation induced by cold temperature in individuals carrying NLRC4-H443P mutation, which might have broader implications for temperature regulation of FCAS-causing mutations of other receptors.



Proposed model for regulation of NLRC4-H443P by HSC70 upon exposure to lower temperature. NLRC4 is present in an inactive closed configuration with low levels of ubiquitination and weak binding to HSC70. Mutation of H443 to proline causes a conformational change in NLRC4, which enables enhanced ubiquitination and more stable interaction with HSC70. H443P mutant shows constitutive caspase-1 activation and moderate IL-1β maturation, causing mild inflammation. Upon exposure of cells to subnormal temperature, HSC70 undergoes a conformational change that lowers its ability to interact with H443P. This allows increased ASC-speck formation by H443P, and caspase-1 hyperactivation leading to enhanced IL-1β maturation and hyper-inflammation. This mechanism of differential interaction of HSC70 with H443P in response to subnormal temperature explains the hyper-inflammation seen in FCAS-patients carrying this mutation.

GIRIRAJ RATAN CHANDAK

Genomic Research on Complex Diseases

From left to right, starting from top: Akshay Dedaniya, PSKDB Punyasri, Alagu Sankareswaran, Neha Dhiman, Sohail Rafik Mansuri, Manisha Arumalla, Shagufta Tasneem, Prachand Issarapu, Giriraj Ratan Chandak, Varsha Kolaria, Nongmaithem Suraj Singh, Ajay Deepak Verma, Shoma Naskar, Amitabh Biswas, Mounika Challapalli, Mobeen Shaikh, Seema Bhaskar, Inderdeo Mali, Sara Sajjadi, Venkateshwarlu Bandi, Swati Bayyana, Vinay Donipadi, Lovejeet Kaur, Ashutosh Singh Tomar, P. Ashok

Research interests

- Genetic and epigenetic basis of complex diseases
- Gene-nutrient interaction, pre- and peri-conceptional nutritional intervention to understand causality

Selected recent publications

- Tanwar VS, Ghosh S, Sati S, Ghose S, Kaur L, Kumar KA, Shamsudheen KV, Patowary A, Singh M, Jyothi V, Kommineni P, Sivasubbu S, Scaria V, Raghunath M, Mishra R, Chandak GR, Sengupta S (2020). Maternal vitamin B12 deficiency in rats alters DNA methylation in metabolically important genes in their offspring. ***Molecular and Cellular Biochemistry*** 468: 83-96.
- Agarwal T, Lyngdoh T, Dudbridge F, Chandak GR, Kinra S, Prabhakaran D, Reddy KS, Relton CL, Davey Smith G, Ebrahim S, Gupta V, Walia GK. Causal relationships between lipid and glycemic levels in an Indian population: A bidirectional Mendelian randomization approach. ***PLoS One*** 15: e0228269.
- Clark DW, Okada Y, Moore KHS, Mason D, Pirastu N, Gandin I, many authors, G R Chandak, many authors, Wilson JF (2019). Associations of autozygosity with a broad range of human phenotypes. ***Nature Communications*** 10: 4957.
- Wadhwani NS, Sundrani DP, Wagh GN, Mehendale SS, Tipnis MM, Joshi PC, Kinare AS, Lalwani SK, Mani NS, Chandhiok N, Chandak GR, Gupte SA, Fall CHD, Joshi SR (2019). The REVAMP study: research exploring various aspects and mechanisms in preeclampsia: study protocol. ***BMC Pregnancy Childbirth*** 19: 308.

Patents filed

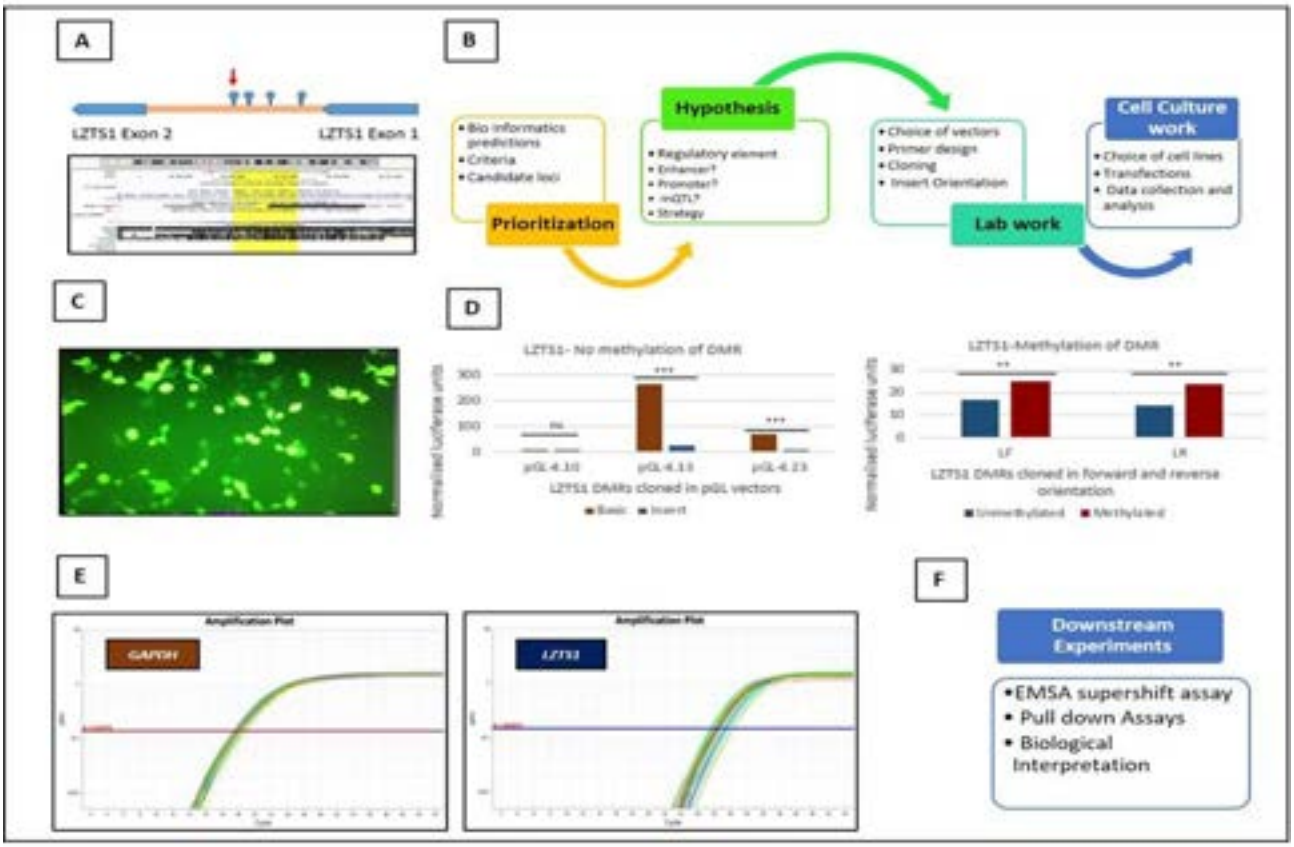
- A method for detecting genetic disorders. Giriraj R Chandak Sumit Paliwal, Swati Bayyana, D Vinay. Application No. 201911038617 (Ref. No. 0087NF2019; Filed on: 16.05.2019 & 25.09.2019; Country: IN & WO)

We have earlier provided evidence that genetic basis of complex diseases like diabetes and cardiometabolic disorders, and related intermediate traits including obesity, insulin resistance is different in Indians. Recently, we showed that nutrient-mediated epigenetic regulation explains a part of missing heritability for type 2 diabetes (T2D) and that it is determined by maternal nutritional factors especially during pregnancy. We investigated the functionality of these associations and asked how the interaction between genetic and epigenetic (methylation variation) mechanisms influences the phenotype. Following on from earlier demonstration that vitamin B12 regulates methylation of T2D-associated genes through a micro-RNA miR21, we characterised another B12 mediated differentially methylated region in PPARD as an insulator, and that methylation alters its binding to CTCF and influences its downstream pathways. Further causality is established by the demonstration that individuals carrying a hypermethylation of specific CpGs are insulin resistant. On similar lines, we also showed that differential methylation of LZTS1, identified from pre-conceptional micronutrient intervention, acts as a repressor and regulates its expression. An epigenome-wide association study of anthropometric and cardiometabolic outcomes has identified various differentially methylated CpGs that also act as methylation QTLS and are reported to be associated with the target phenotype in the GWAS catalogue. These observations confirm an interaction between genetic and epigenetic susceptibility to diabetes and cardiometabolic disorders and have translational potential in maternal and child health, with a focus on future adult diseases.

Under the CSIR-Sickle Cell Anemia Mission, in collaboration with Dr Pradip K Patra, we have screened ~20 lac school-going children from Chhattisgarh, identified patients and carriers, confirmed their genetic status and supported them with directed treatment, social, clinical and prenatal diagnosis and genetic counselling. This has taken our longstanding effort of genetic testing of monogenic disorders to population level.

An unwavering light lit her bright soul, an extraordinary strength she held within, She radiated positivity and shared her spiritual path of life to even those who weren't akin. Such was K Radha Mani, my associate of more than 2 decades. She worked with inspiring dedication in diverse tasks ranging from basic molecular biology and animal models to her most valued contributions in seamlessly managing molecular diagnostics, fast track translation projects and the mission mode sickle cell project, which fetched eminent publications for the team. She always stood as a pillar of strength during difficult times for each one of us on both personal and professional fronts. She was the string who bonded each one of my lab members with her unconditional love, compassion and empathy.

Radha fought the most dreadful disease, cancer like a warrior and has become a sign of bravery for even the weakest minds to look up to. Her eternal absence has created a great void and every moment we spent with her will remain a priceless treasure for each one of us to cherish for lifetime.



A. Graphical representation of CpG coordinates of the differentially methylated region (DMR) in *LZTS1* with the UCSC plot showing various DNaseI hypersensitive, conserved and regulatory regions. The red arrow indicates the lone differentially methylated CpG (DMCpG).

B. The experimental flow of functional characterization of the *LZTS1* DMR.

C. The image showing ~80% transfection efficiency of the MDA-MB-231 cells using nanoparticle-based Xfect reagent with 1ug of enhanced GFP plasmid vector in a 24 well plate.

D. LZTS1 DMR was cloned in both orientations in the pGL4 and CpG free Lucia vectors and their normalised luciferase activity is plotted in X and Y-axes respectively. Reduction in the luciferase activity in the pGL based experiments and increase in the luciferase expression upon methylation confirm the bioinformatic prediction of the strong repressor role of the *LZTS1* DMR.

E. Real-time PCR analysis amplification plots showing Ct values for *LZTS1* expression normalised to the internal control *GAPDH;* Methylation of the *LZTS1* DMR is strongly correlated to its expression.

F. Plan for downstream experiments for understanding the regulatory features of *LZTS1* DMR.

G UMAPATHY

Understanding Species Extinction and Conservation Physiology

From left to right: Divya Sree, Harika Patnaik, Gudimella Anusha, Anupama Sekhar, Manisha Ray, Gopi Krishnan, Govindhaswamy Umapathy, Vinod Kumar, S. Manu, Vinay Teja, Mihir Trivedi, Deepanwita Purohit

Research interests

- Species extinction process in human dominated landscape
- Conservation breeding and conservation physiology
- Genomics in biodiversity monitoring and conservation

Selected recent publications

- Kumar V, Pradheeps M, Kokkiligadda A, Niyogi R and Umapathy G (2019). Non-Invasive Assessment of Physiological Stress in Captive Asian Elephants. ***Animals*** 9: 553.
- Tyagi A, Kumar V, Kittur S, Reddy M, Naidenko S Ganswindt A and Umapathy G (2019). Physiological stress responses of tigers due to anthropogenic disturbance especially tourism in two central Indian tiger reserves. ***Conservation Physiology*** 7: coz045.
- Chakraborty D, Reddy M, Tiwari S and Umapathy G (2019). Land Use Change Increases Wildlife Parasite Diversity in Anamalai Hills, Western Ghats, India. Scientific Reports 9: 11975.
- Sharma A, Umapathy G, Kumar V and Phillips CJ (2019). Hair Cortisol in Sheltered Cows and Its Association with Other Welfare Indicators. ***Animals*** 9: 248.
- Kumar V and Umapathy G (2019). Non-invasive monitoring of steroid hormones in wildlife for conservation and management of endangered species — A review. ***Indian Journal of Experimental Biology*** 57: 307-314.
- Naidenko SV, Berezhnoi MA, Kumar V and Umapathy G (2019). Comparison of tigers' fecal glucocorticoids level in two extreme habitats. ***Plos One*** journal.pone.0214447.

Patents filed

- A non-invasive paper based device for pregnancy detection in cattle and buffaloes. Umapathy G, Asthana A, Rao Ch, Kumar V, Suresh O (2019). Patent filed PCT/IN2020/050202 and 201911008655.

Physiological stress in captive Asian elephants

Asian elephant (*Elephas maximus*) populations, both in the wild and in captivity, have been continually declining over the decades. We have examined the physiological stress response of captive Asian elephants in relation to body condition score and different working conditions. The elephants in forest camps had a higher body condition score than those in more confined spaces. Wild born elephants and females had increased levels of stress hormones compared with captive-born elephants and males, respectively. Elephants engaged in the Dussehra festival had elevated stress compared to their counterparts at Mysore zoo. We recommended a few management practices for the declining captive elephant populations.

Land use change increases wildlife parasite diversity in Western Ghats, India

Anthropogenic landscape changes such as land use change and habitat fragmentation are known to alter wildlife diversity. We assessed how anthropogenic land use change (presence of plantation, livestock foraging and human settlement) and habitat fragmentation may change the gastrointestinal parasite diversity of wild mammalian host species (n = 23) in Anamalai hills, India. We found that presence of plantations, and potentially livestock, significantly increased parasite diversity possibly due to spillover of parasites from livestock to wildlife. Our results showed how human activities may increase wildlife parasite diversity within human-dominated landscapes and highlighted the complex pattern of parasite diversity distribution as a result of co-occurrence of multiple anthropogenic landscape changes.

Land use changes (tea plantation) in rainforests of Western Ghats. By changing the existing landscape we are not just affecting the wildlife but also taking a toll on the weather and rainfall patterns.

HITENDRA K PATEL

Plant-Pathogen Interactions and Plant Breeding

From left to right, starting from top: Md. Jamaloddin, Vishnu Narayanan M, Donald James, Roshan M V, Niranjani, Shailaja Kanumuri, Pranali Vankore, Manideepika M, Raju Madanala, Kranthi Brahma, Komal Awalellu, Namami Gaur, Sohini Deb, Palash Gosh, Gokulan C G, Ram Chandra Panigrahi, Rajkanwar Nathawat, Kamal Kumar Malukani, Hitendra K Patel, Rennya P R, Bipin Kumar

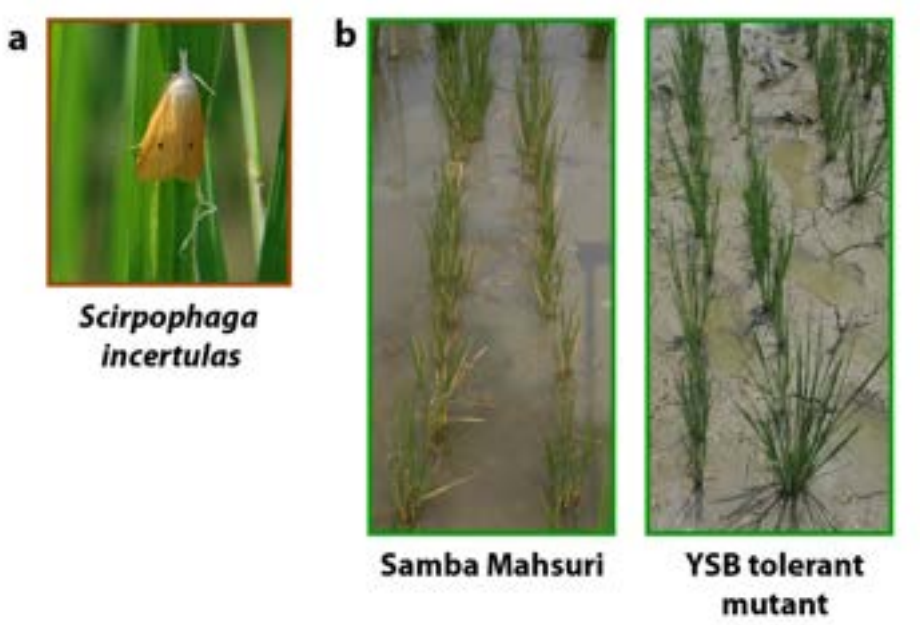
Research interests

- Rice functional genomics
- Plant-pathogen interactions
- Marker-assisted selection in plant breeding

Selected recent publications

- Deb S, Mahesh K. Gupta MK, Patel HK, Sonti RV (2019). *Xanthomonas oryzae pv. Oryzae* XopQ protein suppresses rice immune responses through interaction with two 14-3-3 proteins but its phospho-null mutant induces rice immune responses and interacts with another 14-3-3 protein. ***Molecular Plant Pathology*** 20: 976-989.
- Kanugala S, Kumar CG, Rachamalla, Reddy HK, Palakeeti B, Ramakrishna KVS, Varma N, Chandrasekhar NC, Patel HK, Ganapathi T (2019). Chumacin-1 and Chumacin-2 from *Pseudomonas aeruginosa* strain CGK-KS-1 as novel quorum sensing signaling inhibitors for biocontrol of bacterial blight of rice. ***Microbial Research*** 228, 126301.
- Kachewar NR, Gupta V, Ranjan A, Patel HK, Sonti RV (2019). Overexpression of OsPUB41, a Rice E3 ubiquitin ligase induced by cell wall degrading enzymes, enhances immune responses in Rice and *Arabidopsis*. ***BMC Plant Biology*** 19: 1-17.
- Pillai SE, Kumar C, Dasgupta M, Kumar BK, Vungarala S, Patel HK, and Sonti RV (2020). Ectopic Expression of a Cell-Wall-Degrading Enzyme-Induced OsAP2/ERF152 Leads to Resistance against Bacterial and Fungal Infection in *Arabidopsis*. ***Phytopathology*** 110:726-733.

Samba Mahsuri (SM), an elite rice variety of India is susceptible to several pests and diseases. In order to address these problems and to generate variants for other beneficial traits, an ethyl methane sulfonate (EMS) induced mutant population (~10,000 lines) of SM was developed. In collaboration with ICAR-Indian Institute of Rice Research (ICAR-IIRR), Hyderabad, we have screened the mutant population for several important agronomic traits and identified mutant lines with traits such as higher yield, early maturation and enhanced tolerance to lodging. In addition, we identified lines possessing enhanced tolerance to three biotic stresses - Yellow Stem Borer (an insect pest; Fig), Sheath Blight (fungal disease caused by *Rhizoctonia solani*) and Bacterial Blight (a bacterial disease caused by *Xanthomonas oryzae pv. oryzae*). Using Bulked Segregant Analysis (BSA) and Next-Generation Sequencing (NGS) technology, we are attempting to map causal mutations and to develop molecular markers that can be used in marker-assisted selection for developing newer rice varieties. Our analyses revealed a few possible candidate regions (QTLs) for YSB tolerance in rice. Subsequent to their validation, the identified mutations will be used as markers to impart the pest tolerance phenotype into rice cultivars through breeding. This finding can help to prevent the damage caused by YSB in many rice-cultivated regions in the country. The RNA-Seq analysis performed on tolerant line upon YSB infestation suggests the possible role of secondary metabolism related genes in YSB tolerance. Similar studies are ongoing for sheath blight and other agronomic traits. The identified genes will be further characterized by overexpression, knock-down /knock-out studies. Using marker-assisted selection, we are also developing derivatives of Improved Samba Mahsuri rice that have combinations of advantageous biotic, abiotic and yield related traits.



Yellow stem borer (YSB) is a serious pest of rice leading to a yield loss of 20% to 80%. a. An adult yellow stem borer insect (*Scirpophaga incertulas*); b) The left panel shows the dead heart symptoms caused by YSB in the susceptible Samba Mahsuri and the right panel shows a mutant line of Samba Mahsuri exhibiting tolerance to YSB infestation.

IMRAN SIDDIQI

Plant Reproductive Biology

From left to right, starting from top: Komal Awallelu, M Sai Kiran, Keith Frank, Bhaskar, Jayeshkumar Davda, S Prashanthi, Mamata, Visakha Bharadwaj, Aparna Singh, V Subbiah, I SiddiqiKaladhar Bethoju, Aswan Nalli, Sivakumar Prakash, Survi Mahesh, V Pardha Saradhi, Avinash Kumar Singh

Research interests

- Control of meiosis and germ cell formation in plants using Arabidopsis as a model
- Meiotic chromosome organization, meiotic gene expression, and meiotic cell cycle

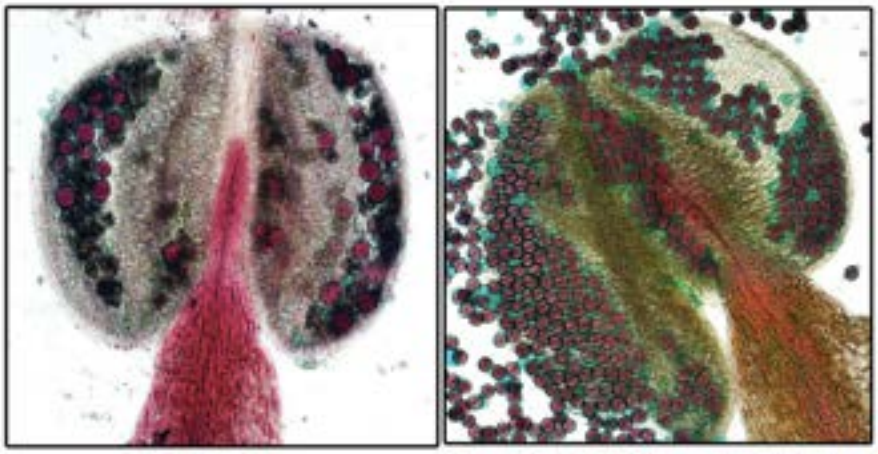
Selected recent publications

- Majumdar P, Karidas P, Siddiqi I and Nath U (2020). The ubiquitin-specific protease TNI/UBP14 functions in ubiquitin recycling and affects auxin response. ***Plant Physiology*** doi: org/10.1104/pp.20.00689.

We characterized a novel gene named SHUKR (SKR) mutation of which causes male sterility. We have shown that SKR is expressed specifically in male meiosis and acts in meiosis as well as postmeiotic development of haploid spores into gametes. SKR associates with chromatin and regulates the transition from the diploid sporophyte to the haploid gametophyte through control of protein homeostasis during pollen development. We have performed a genetic screen for suppressors of *skr* and have identified several suppressor mutants (*ssk*) which restore male fertility and seed set in a *skr* mutant background. Characterization of *ssk* mutants is in progress. We have also also found evidence that SKR is under positive Darwinian selection. Our findings suggest that SKR establishes controls during meiosis that regulate postmeiotic development of the meiotic products into gametes and that this control has been important for plant evolution.

The CDM1 gene encodes an RNA binding protein required for completion of male meiosis. We are studying the role of the CDM1 gene in post transcriptional control of male meiosis and identification of its molecular targets. We have recently identified a suppressor of CDM1 whose characterization should provide insights into the mode of action of CDM1 and its effect on male fertility.

In collaboration with the laboratories of Raphael Mercier and Rajeev Kumar (INRA Versailles, MPI Cologne) we are studying the control of monopolar centromere orientation in meiosis and have identified genes required for monopolar orientation. We are studying the mechanism of these genes and testing pairwise combinations for protein-protein interactions.



The restoration of fertility to *cdm1* (*rfc1*) mutant restores fertility to the *cdm1* mutant. *cdm1* anthers contain mostly inviable pollen (green). *rfc1 cdm1* anthers contain a large number of viable pollen (purple).

JAHNAVI JOSHI

Systematics, Historical Biogeography & Diversification in the Tropical Forests

From left to right: Bharti Dharapuram, Jahnavi Joshi, Pooja Pawar

Research interests

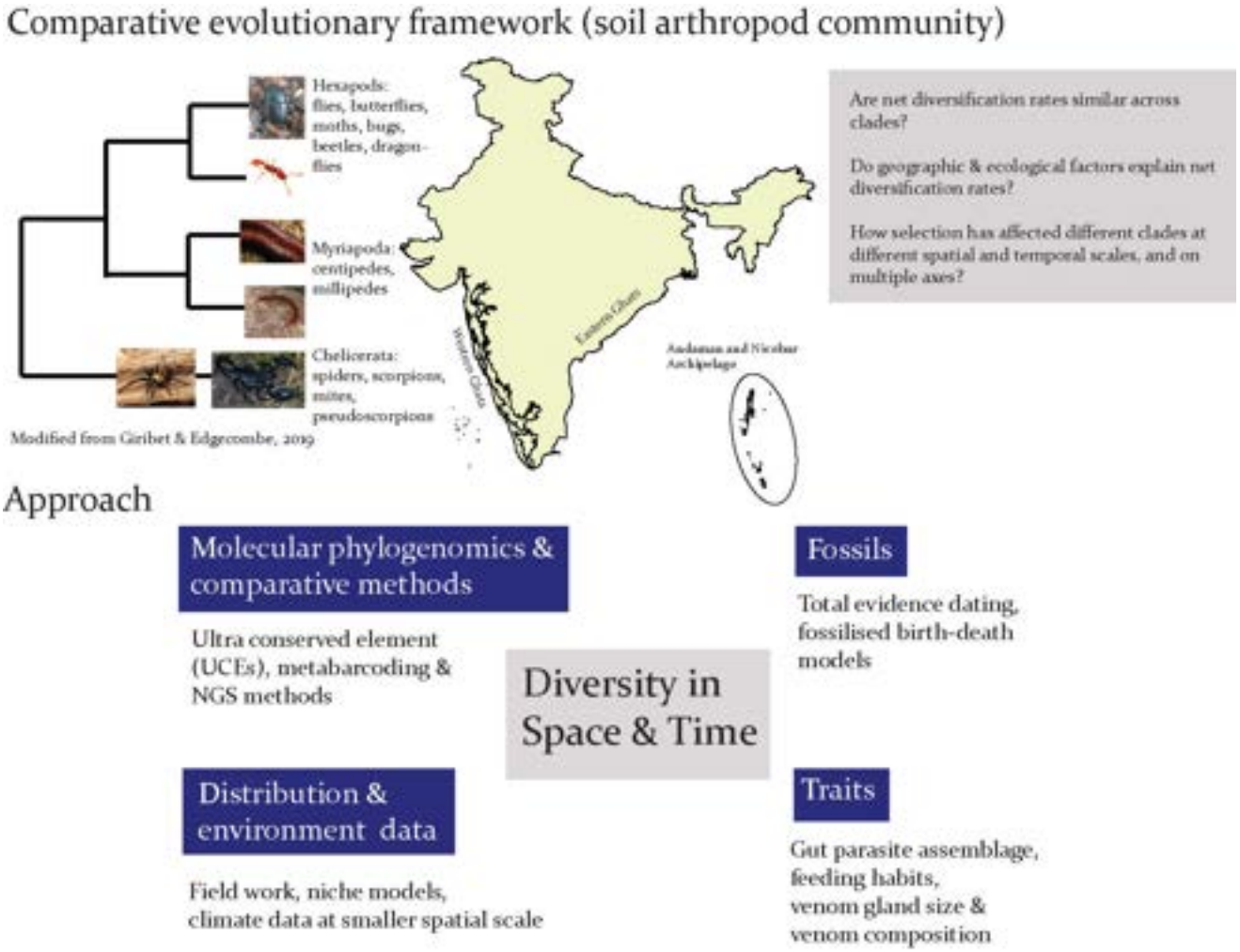
- Arthropod systematics
- Evolutionary and ecological processes that shape the arthropod diversity in the tropical forests
- Reconstructing evolutionary relationships among taxa, biogeography, diversification patterns and processes, community assembly, and trait evolution using comparative methods

Selected recent publications

- Joshi J Karanth P & Edgecombe G (2020). The Out-of-India hypothesis: Evidence from an ancient centipede genus, Rhysida (Chilopoda: Scolopendromorpha) from the Oriental Region, and systematics of Indian species. ***Zoological Journal of Linnaean Society*** (early online view).
- Joshi J and Edgecombe G (2019). Evolutionary Biogeography of the centipede genus Ethmostigmus from Peninsular India: Testing an Ancient Vicariance Hypothesis for Old World Tropical Speciation. ***BMC Evolutionary Biology*** 19: 41.

We are a new lab gearing up to start work exciting field and lab work in the forests of the Indian subcontinent to study ecology and evolution of terrestrial arthropod community. Some of our recent work led to the discovery of new centipede species from peninsular India. We also examined how they were affected by geological and climate change events in the past such as Gondwana break-up, Deccan volcanic activity sea-level changes etc. This helps us understand how diversity originated, and we are hoping we will be able to contribute towards conservation planning, especially for less explored and high biodiversity tropical areas of South Asia.

We are also part of a collaborative project on the endangered Narcondam hornbill from the Narcondam Island, which is a remote and tiny island (6.8 km2) in the Andaman Sea (India). The island is part of the Indo-Myanmar Biodiversity Hotspot and the only place where Narcondam Hornbills *Rhyticeros narcondami* are found. The project aims to study its evolution, ecology and conservation, which is vital for ensuring the long-term conservation of the species. We had a very successful field season and got the faecal samples of the Narcondam hornbill to its DNA.



JYOTSNA DHAWAN

Molecular programs of quiescence in adult stem cells and skeletal muscle regeneration

Jyotsna Dhawan, Prabhavathy Devan, Gunjan Purohit, Lamuk Zhaveri, Sujoy Deb, Debarya Saha, Swetha Sundar, A.S. Priti, Ananga Ghosh, Puja Singh, Devesh Bahety, Anviti Vashishta, Saher Chawla, Shinny Sunny, Manjit Rana, Kapila Awasti (visiting PhD student from Prof. Alok Bhattacharyya's lab, JNU)

Research interests

- Control of cellular quiescence and its relationship to stem cell function
- Adult stem cells and skeletal muscle regeneration
- Epigenetic, transcriptional and post-transcriptional mechanisms in quiescence
- Secreted and mechanical signals in control of cell fate

Selected recent publications

- Venugopal N, Ghosh A, Gala HP, Aloysius A, Vyas N and J Dhawan (2020). The primary cilium dampens proliferative signaling and represses a G2/M transcriptional network in quiescent myoblasts. ***BMC Cellular and Molecular Biology.*** doi.org/10.1186/s12860-020-00266-1.
- Purohit, G, and J Dhawan (2019). Adult muscle stem cells: Exploring the links between systemic and cellular metabolism. ***Frontiers in Cell and Developmental Biology*** (review article) Section Epigenomics and Epigenetics. DOI: 10.3389/fcell.2019.00312.

We are interested in the mechanisms that regulate cellular quiescence in adult muscle stem cells to impact their regenerative function.

Investigating the function of the primary cilium in G0

The primary cilium is a microtubule-based cell-surface organelle implicated in signaling. We perturbed the expression of a key ciliary assembly protein (IFT88), and found that the primary cilium integrates and dampens proliferative signaling, represses translation and is integral to the establishment of the quiescence program (Venugopal et al, BMC Cell and Mol Biol, 2020).

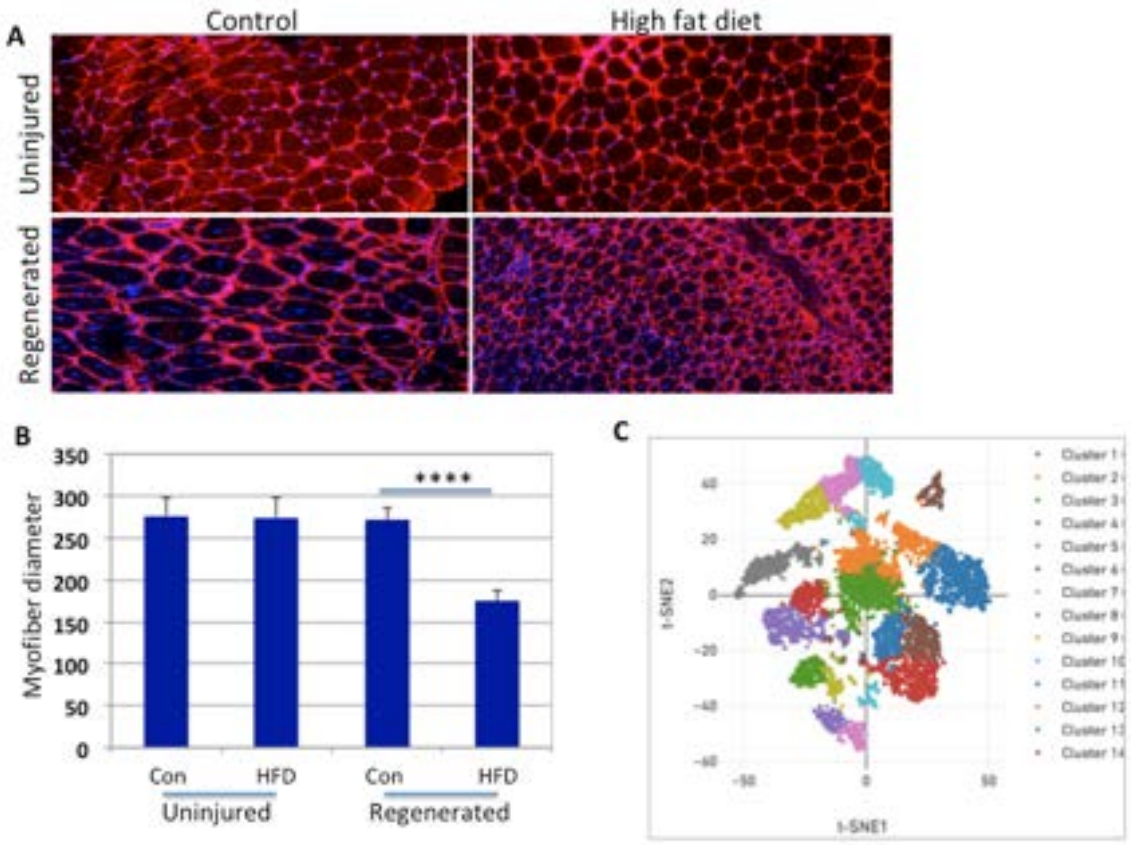
Muscle-derived exosomes

Exosomes are nano-sized vesicles of endocytic origin that are secreted from producing cells and have effects in target cells in the vicinity as well as at long range. We find that exosome secretion as well as uptake is affected by quiescence and differentiation. Our current studies are focused on perturbing exosome biogenesis to understand the phenotypic consequences of altered exosome secretion.

Impact of diet on muscle regeneration

We have been studying the effect of diet-dependent metabolic transitions on muscle stem cells *in vivo*. Mice fed with high fat diet (HFD) show diminished muscle regeneration: reduced size of regenerated myofibers (mean fiber area), accompanied by a reduced capacity of purified MuSCs to undergo self-renewal in culture. We are currently exploring how high fat diet affects molecular changes in MuSCs.

Investigating heterogeneity of muscle stem cells with scRNAseq (with Dr. Divya Tej Sowpati): Single cell RNA sequencing (scRNA-seq) has emerged as robust method for interrogating population heterogeneity. A pilot experiment showed that FACS purified MuSCs that appear homogeneous dispersed into 20 clusters based on an scRNAseq expression profile of 750 transcripts. Our efforts over the next year will be to improve the depth of sequencing in single cells and to track cells during regeneration *in vivo.*



Adult mice were fed with control (Con) or high fat diet (HFD) for 5 months and then subjected to muscle injury by barium chloride injection into the tibialis anterior (TA) muscle of one leg; the other leg served as an uninjured control. Mice were sacrificed 14 days after injury and TAs were isolated and immunostained with laminin (red) and DAPI (blue) to detect the outlines of myofibers and nuclei.

A. *Histological analysis of muscle from mice* Con and HFD for 5 months subjected to muscle injury by barium chloride injection into the TA. Uninjured muscle from control and HFD mice have evenly sized myofibers with nuclei located at the fiber periphery. After injury, both Con and HFD muscle undergoes regeneration shown by large numbers of myofibers with centrally located nuclei. However, the area of myofibers in HFD muscle after regeneration is much smaller, indicating poor maturation of newly repaired or regenerated myofibers.

B. *Quantification of muscle regeneration* by measurement of myofiber area (n=1500 myofibers from 3 mice in each group). While control mice show no difference in the myofiber caliber before and after regeneration, HFD muscle fibers are significantly smaller (p=0.0002).

C. *Single cell transcriptomics of muscle stem cells from uninjured muscle* scRNA seq analysis of 11,400 individual purified mouse MuSC using 10X Genomics platform followed by Illumina RNA sequencing. The standard visualization of this type of multi-dimensional data in two dimensions is performed using t-distributed stochastic neighbour embedding (t-SNE). The tSNE plots show the distribution of the MuSC population into sub-clusters based on the expression of gene clusters, where each dot represents one cell.

KARTHIKEYAN VASUDEVAN

Ecology and Conservation of Endangered Species

From left to right, starting from top: Anuradha Reddy, Yashvardhan Singh Sengar, Snehalatha Vaidigi, Siddharth Bhatia, K. Krishna , Karthikeyan Vasudevan, Vaishnav, Gayathri Sreedharan, K. Harika, Akshay, Ashish Jha, Afsar Soghra, Ravi Singh, Arjitha, K. Rajyalakshmi, Avni Blotra

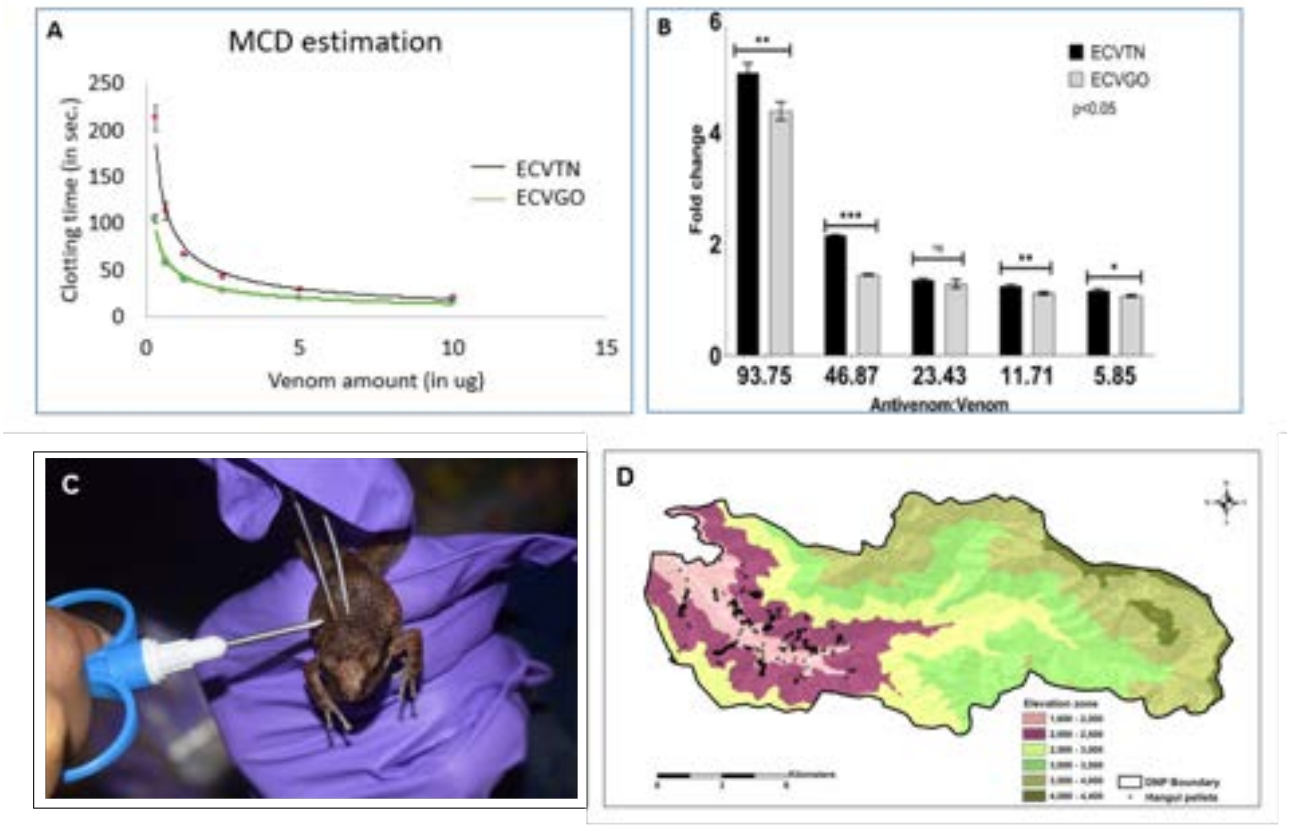
Research Interests

- Ecology, evolutionary biogeography and systematics with a focus on south Asian amphibians and reptiles.
- Endangered species, their ecology and conservation.

Polyvalent antivenom (PAV) is the most appropriate treatment available for snakebites. However, it is not effective due to intra-specific geographic variation in venom compositions. In *Echis carinatus* Saw-scaled Viper (ECV), we performed in vitro coagulation and proteolytic assays to elucidate the functional variation in venom, from Tamil nadu (ECVTN) and Goa (ECVGO). Minimum clotting dose showed significant variability between ECVTN and ECVGO. Proteolytic, fibrinolytic and PLA2 assays, are being carried out to estimate the efficacy of PAV.

Chytridiomycosis is caused by a fungal pathogen, *Batrachochytriumdendrobatidis* (Bd). It encysts on the frog skin, disrupts osmoregulation and causes death of the frog. It has caused extinctions and declines in several species globally. In India, no fatalities have been observed. It has a low prevalence, and population parameters, such as, survival could influence the disease spread. To track this, Capture-Mark-Recapture (CMR) studies were carried out for two endemic species: *Euphlyctuscyanophlyctis* and *Indiranaleithii* in Tilari Ghat, Maharashtra. Five second order streams were monitored. Swab samples were collected and 1250 Passive Integrated Transponder (PIT) tags have been inserted subcutaneously on frogs.

The Kashmir stag or hangul (*Cervus hanglu*), is critically endangered with only 220 adults surviving in Kashmir Himalaya. To develop a conservation breeding program for the hangul, we undertook an assessment of reproductive activity using hormone metabolites, and an estimation of sex ratio using faecal samples. Ten trails in Dachigam National Park, and six in Tral Wildlife Sanctuary were monitored repeatedly every month from September 2019. Around 800 samples were collected, and analyses is underway. Four capacity building workshops are being conducted to train the forest staff, PhD students and veterinarians in Kashmir.



A. Minimum clotting dose (MC); B. the antivenom-venom ratio required for fold change in clotting time compared to control in ECVTN and ECVGO; C. *Indirana leithii* being tagged with PIT for CMR studies; D. Map of Dachigam National Park showing locations where hangul fecal samples were collected.

KRISHNAN H HARSHAN

Host-Virus Interactions: Molecular Perspectives

From left to right, starting from top: Dixit, Abhirami, Vishal Sah, Krishnan H Harshan,Dhiviya Vedagiri, Amit, Haripriya, Divya, Mohan, Karthika Nivedita, Sana

Research interests

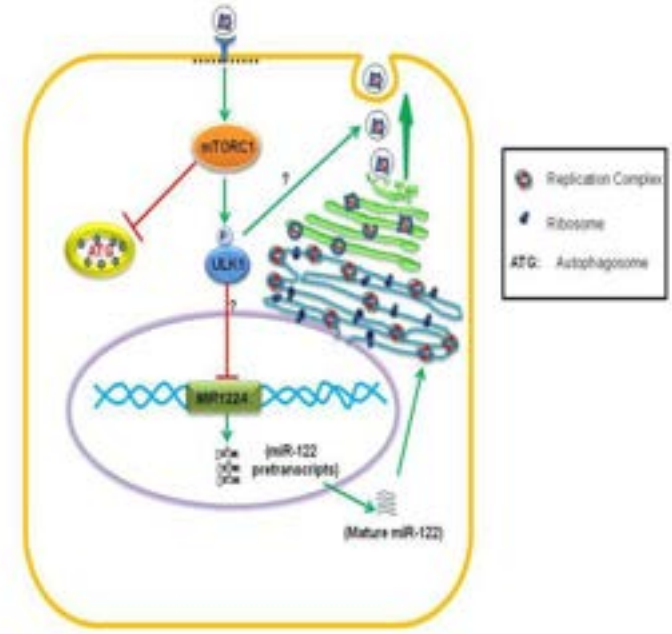
- Regulation of antiviral pathways in innate immunity against RNA viruses including SARS-CoV-2.
- Understanding the regulatory mechanisms that provide the preferential advantage to viral translation.

Selected recent publications

- Johri MK, Lashkari HV, Gupta D, Vedagiri D, and Krishnan HH (2019). mTORC1 Restricts Hepatitis C Virus RNA Replication Through ULK1-mediated Suppression of miR-122 and Facilitates Post-replication Events. ***Journal of General Virology*** DOI 10.1099/jgv.0.001356.
- Kiran U, Gokulan CG, Kuncha, SK, Vedagiri D, Chander BT, Sekhar AV, Dontamala SM, Reddy AL, Tallapaka KB, Mishra RK, and Krishnan HH (2020). Easing diagnosis and pushing the detection limits of SARS-CoV-2. ***Biology Methods and Protocols.*** (In press)

The focus of our laboratory is the host-response to infections by human viruses such as SARS-CoV-2 and dengue. Through our studies we aim to characterize novel mechanisms of antiviral responses that regulate viral replication, translation and packaging. Viruses are intracellular parasites that obligate living cells for their replication. In the process of their sustenance in the foreign host, viruses jeopardize the biological equilibrium of the host cell or organism. The outcome is the compromised survival of the infected cells that often leads to their death. On the other hand, several viruses have evolved to co-exist with the host that often results in life long relationship without causing major threats to the host. We have recently identified that mechanistic target of rapamycin (mTOR) that is well known to activate host translation machinery also functions to restrict Hepatitis C Virus (HCV) replication. Through a unique mechanism not identified before, we demonstrated that ULK1, a key substrate of mTORC1 limits the abundance of miR-122 that is critical for the replication of HCV (Fig). The major identified function of ULK1 is regulation of autophagy and we demonstrated that its restriction of HCV is independent of autophagy.

Our laboratory has isolated SARS-CoV-2 viral strains and have initiated studies pertaining to understanding host response to infection. One of the key pathways that we study keenly is the RLR pathway that detects cytosolic viral RNA leading to the production of interferons. We have been characterizing the roles of several transcription factors that play crucial roles in various cellular processes, in innate immune responses that are triggered by viral infection. We hypothesize that these transcription factors modulate viral tropism by altering the intracellular conditions that can determine the efficiency of viral replication.



mTORC1 activated by HCV infection has anti-HCV functions

KUMARASWAMY REGALLA

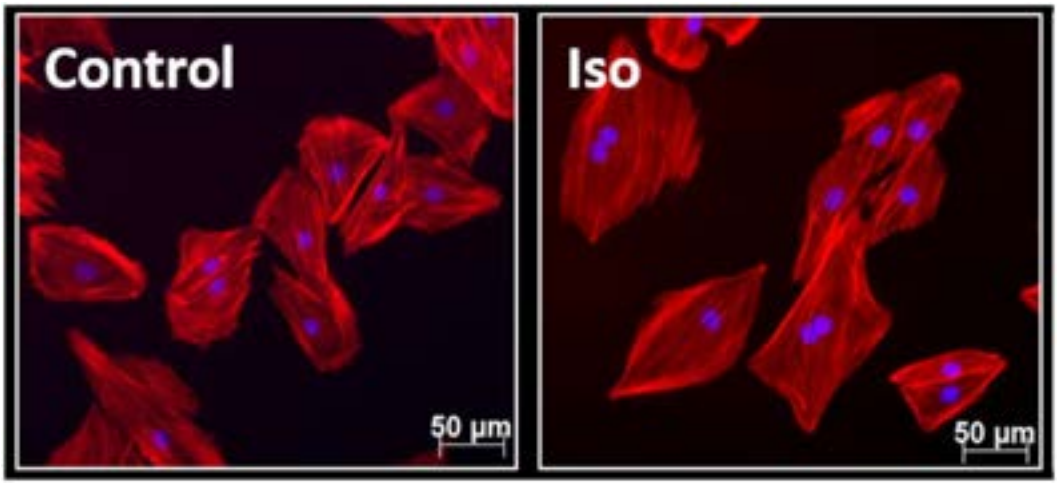
Cardiovascular Biology

From left to right: Kumaraswamy Regalla, Priyanka Pant, Disha Nanda and Abhishek Bharadwaj

Research interests

- Non-coding RNAs and their role in cardiovascular pathophysiology.

We are studying the role of specific non-coding RNAs in heart failure and aneurismal diseases. We use pressure overload or isoproterenol administration models for inducing heart failure in mice. To induce aortic aneurism in mice, we administer Angiotensin II. We found that Notch regulated lncRNA (L213, internal reference) is induced in vascular smooth muscle cells (VSMCs) upon angiotensin II stimulation. Up regulation of L213 paralleled with elevated levels of MMP2, a hall mark of aortic aneurysm. Under these conditions, Notch target genes *Hey1* and *Jagged* were also found to be up-regulated, indicating activation of Notch pathway during angiotensin II induced aortic aneurysm. Further investigations revealed that promoter of L213 lncRNA harbours binding sites for RBPJ, which is the principle effector of Notch signalling. Pharmacological inhibition of Notch signalling inhibited expression of L213 lncRNA while over-expression of Notch intracellular domain (NICD) was sufficient to induce L213 lncRNA. Overall our results suggestedthat Notch induced lncRNA L213 plays an important role in angiotensin II induced aortic aneurysm. In another study, we found that L72 lncRNA (internal reference) is up-regulated during isoproterenol induced heart failure in mice. We found that L72 promoter has binding sites for several pro-hypertrophic transcriptional factors such as Nfat and Mef2. Further experiments revealed that silencing of L72 blunted cardiac stress marker expression after treatment with isoproterenol, indicating that L72 plays an important role in isoproterenol induced cardiomyocyte hypertrophy.



Increase in cell size of rat cardiomyoblasts (H9C2) after treatment with isoproterenol for 24 hours. F-actin is stained by phalloidin conjugated with AF-594.

K THANGARAJ

Evolutionary and Medical Genetics

From left to right: Lomous Kumar, Purushotham V, Narmadha, G. Mala, Nipa Basak, Pratheusa Machha, S Deepa Selvi Rani, K Thangaraj, Rajan Kumar Jha, Jaydeep AB, Sagnik Dhar, Sudhakar, Sunil Kumar Tripathi, Haneef
Inset images, from left, top to bottom: Sunitha Kundur, Nitin Tupperwar, Agyeya Pratap, Jagamohan Chhatai, Deepak Kumar Kashyap

Research interests

- Evolutionary and medical genetics, including origin and affinities of modern humans, genetic basis of cardiovascular diseases, mitochondrial disorders and male infertility and sex determination

Selected recent publications

- Shinde V, Narasimhan VM, Rohland N, Mallick S, Mah M, Lipson M, Nakatsuka N, Adamski N, Broomandkhoshbacht N, Ferry M, Lawson AM, Michel M, Oppenheimer J, Stewardson K, Jadhav N, Kim YJ, Chatterjee M, Munshi A, Panyam A, Waghmare P, Yadav Y, Patel H, Kaushik A, Thangaraj K, Meyer M, Patterson N, Rai N, Reich D (2019) An Ancient Harappan Genome Lacks Ancestry from Steppe Pastoralists or Iranian Farmers. ***Cell*** 179: 729-735.

- Mustak MS, Rai N, Naveen MR, Prakash S, Carlus SJ, Pasupuleti N, Srivastava A, Singh PP, Babul, Dubey PK, Chaubey G, Thangaraj K (2019). The peopling of Lakshadweep Archipelago. ***Scientific Reports*** 9: 6968.

- Harney É, Nayak A, Patterson N, Joglekar P, Mushrif-Tripathy V, Mallick S, Rohland N, Sedig J, Adamski N, Bernardos R, Broomandkhoshbacht N, Culleton BJ, Ferry M, Harper TK, Michel M, Oppenheimer J, Stewardson K, Zhang Z, Harashawaradhana, Bartwal MS, Kumar S, Diyundi SC, Roberts P, Boivin N, Kennett DJ, Thangaraj K, Reich D, Rai N (2019). Ancient DNA from the skeletons of Roopkund Lake reveals Mediterranean migrants in India. ***Nature Communications*** 10: 3670.

- Paramasivam A, Venkatapathi C, Sandeep G, Meena AK, Uppin MS, Mohapatra S, Pitceathly RDS, Thangaraj K (2019). Homozygous R627W mutations in POLG cause mitochondrial DNA depletion leading to encephalopathy, seizures and stroke-like episodes. ***Mitochondrion*** 48:78-83.

- Narasimhan VM, Patterson N, Moorjani P, Rohland N, Bernardos R, Mallick S, ……., Boivin N, Thangaraj K, Kennett DJ, Frachetti M, Pinhasi R, Reich D (2019). The formation of human populations in South and Central Asia. ***Science*** 365: pii: eaat7487.

- Singh V, Bansal SK, Sudhakar DVS, Neelabh, Chakraborty A, Trivedi S, Gupta G, Thangaraj K, Rajender S, Singh K (2019). SNPs in ERCC1, ERCC2, and XRCC1 genes of the DNA repair pathway and risk of male infertility in the Asian populations: association study, meta-analysis, and trial sequential analysis. ***Journal of Assisted Reproduction:*** *Genetics* 36: 79-90.

- Rani DS, Nallari P, Rani J, Nizamuddin S, Seelamneni T, Narasimhan C, Thangaraj K (2019). A Complete Absence of Missense Mutation in Myosin Regulatory and Essential Light Chain Genes of South Indian Hypertrophic and Dilated Cardiomyopathies. ***Cardiology*** 141: 156-166.

- Rani DS, Nallari P, Narasimhan C, Thangaraj K (2019). Novel Variations in β-Myosin Heavy-Chain Gene (β-MYH7)and Its Association in South Indian Women with Cardiomyopathies. ***Indian Journal of Cardiovascular Disease in Women*** 4: 72-78.

- Thangaraj K, Rai N (2019). Peopling of India: Ancient DNA perspectives. ***Journal of Bioscience*** 44: pii: 70.

- Rani DS, Rajender S, Pavani K, Chaubey G, Rasalkar AA, Gupta NJ, Deendayal M, Chakravarty B, Thangaraj K (2019). High frequencies of Non Allelic Homologous Recombination (NAHR) events at the AZF loci and male infertility risk in Indian men. ***Scientific Reports*** 9: 6276.

- Mishra A, Sundaravadivel P, Tripathi SK, Jha RK, Badrukhiya J, Basak N, Anerao I, Sharma A, Idowu AE, Mishra A, Pandey S, Kumar U, Singh S, Nizamuddin S, Tupperwar NC, Jha AN, Thangaraj K (2019) Variations in macrophage migration inhibitory factor gene are not associated with visceral leishmaniasis in India. ***Journal of Infection and Public Health*** 12: 380-387.

- Abraham A, Thirumalairaj K, Gaikwad N, Muthukkaruppan V, Reddy AG, Thangaraj K, Kim U, Vanniarajan A (2019). Retinoblastoma discordance in families with twins. ***Indian Journal of Ophthalmology*** 67: 436-439.

- Govindaraj P, Rani B, Sundaravadivel P, Vanniarajan A, Indumathi KP, Khan NA, Dhandapany PS, Rani DS, Tamang R, Bahl A, Narasimhan C, Rakshak D, Rathinavel A, Premkumar K, Khullar M, Thangaraj K (2019). Mitochondrial genome variations in idiopathic dilated cardiomyopathy. ***Mitochondrion*** 48: 51-59.

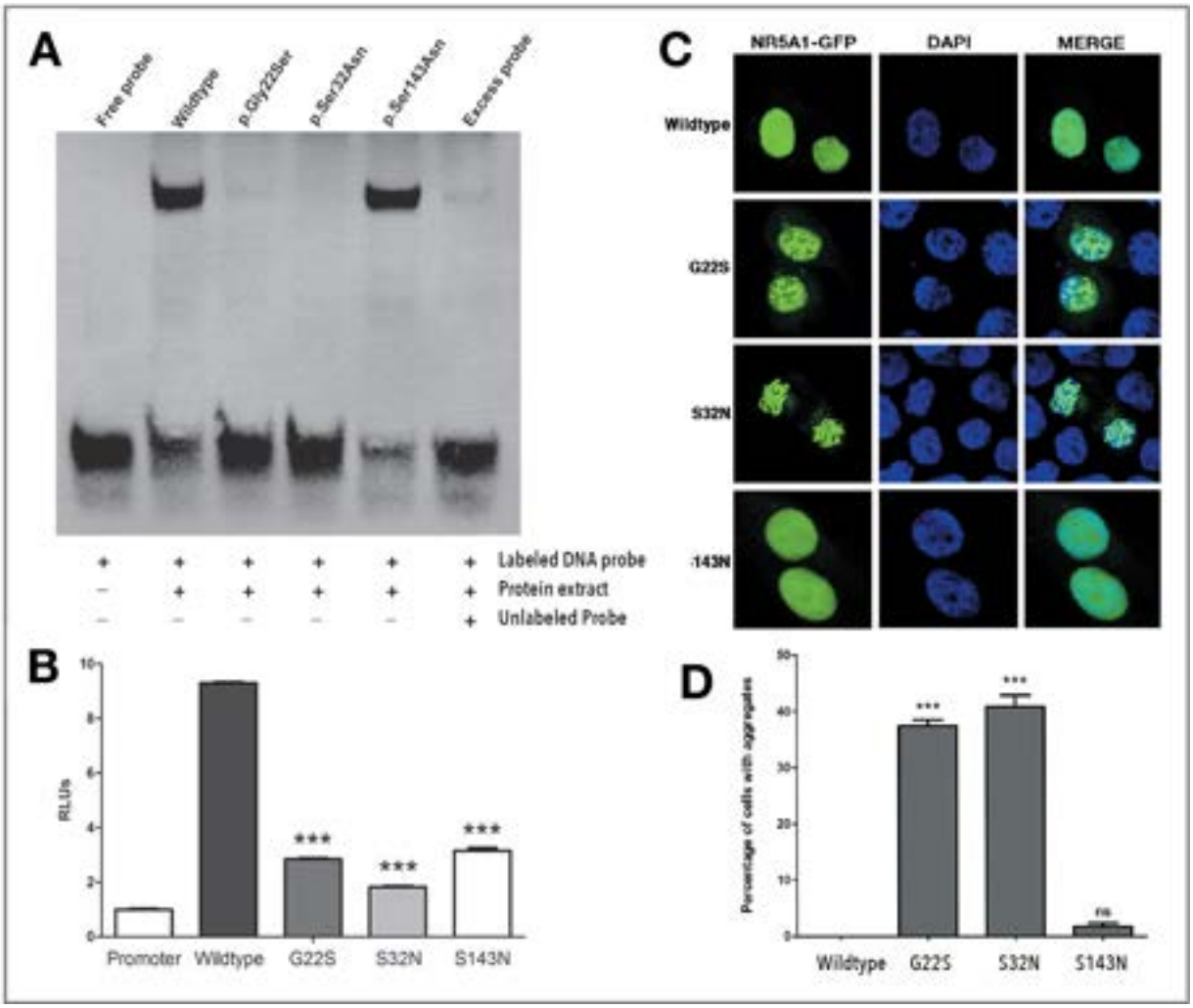
- Rai N, Verma SK, Gaur A, Iliescu FM, Thakur M, Golla TR, Chandra K, Prakash S, Tabasum W, Ara S, Singh L, Thangaraj K, Jacobs GS (2020). Ancient mtDNA from the extinct Indian cheetah supports unexpectedly deep divergence from African cheetahs. ***Scientific Reports*** 10: 4618.

- Sudhakar DVS, Jaishankar S, Regur P, Kumar U, Singh R, Kabilan U, Namduri S, Dhyani J, Gupta NJ, Chakravarthy B, Vaman K, Shabir I, Khadgawat R, Deenadayal M, Chaitanya AD, Dada R, Sharma Y, Anand A, Thangaraj K (2020). Novel NR5A1 Pathogenic Variants Cause Phenotypic Heterogeneity in 46, XY Disorders of Sex Development. ***Sexual Development*** doi: 10.1159/000505527 [Epub ahead of print].

- Danda S, Mohan S, Devaraj P, Dutta AK, Nampoothiri S, Yesodharan D, Phadke SR, Jalan AB, Thangaraj K, Verma IC, Danda D, Jebaraj I (2020). Founder effects of the homogentisate 1,2-dioxygenase (HGD) gene in a gypsy population and mutation spectrum in the gene among alkaptonuria patients from India. ***Clinical Rheumatology*** doi: 10.1007/s10067-020-05020-8 [Epub ahead of print].

During the year, we sequenced an ancient genome from the Indus Valley Civilization and found that the genome had a combination of Iranian Hunter-Gatherer and ancient Ancestral South Indian. There was no detectable ancestry from Steppe pastoralists or from Anatolian and Iranian farmers, suggesting that farming in South Asia arose from local foragers rather than from large-scale migration from the West (Cell, 2019). In a similar study, we analysed 523 ancient human genomes from Central Asia and northernmost South Asia along with the contemporary South Asian genome, and found that the primary source of ancestry for modern South Asians is a combination of early hunter-gatherers of Iran and South Asia (Science, 2019). In another study, we traced the origin of skeletal remains of the Roopkund Lake, situated over 5,000 meters above sea level in the Himalayas. We performed genome-wide studies for 38 skeletons from this lake, and found that they cluster into three groups: (1) A group of 23 individuals with ancestry that falls within the range of variation of present-day South Asians, (2) A group of 14 with ancestry typical of the eastern Mediterranean, and (3) one individual with Southeast Asian-related ancestry (Nature Communications, 2019). We have also analyzed 64 cases of 46,XY DSD for NR5A1 variants, as NR5A1 is a key transcription factor that regulates the

development of adrenal glands, gonads and involved in steroidogenesis. We found 3 pathogenic variants, of which 2 were novel (p.Gly22Ser and p.Ser143Asn), and 1 was reported earlier (p.Ser32Asn). Functional analysis revealed that p.Gly22Ser and p.Ser32Asn could significantly affect DNA binding and transactivation abilities (Sexual Development, 2020) (Fig).



DNA binding assay, transactivation assay, expression and cellular localization of NR5A1: A. Electromobility shift assay showing binding of in vitro translated wild type and 3 mutants to a labeled probe (CYP11A1) promoter. A free probe without NR5A1 protein extract (lane 1) and an excess of unlabeled probe with wildtype NR5A1 protein (lane 7) were used as controls. B. Effect of pathogenic NR5A1 variants on the transcriptional activity of hCYP11A1 minimal promoter studied using HEK293 cells (details are given in the results section, ***p < 0.001). RLUs, relative luciferase activity units. C. Subcellular localization of GFP-tagged (pEGF-N1) wild type and 3 mutant NR5A1 proteins in HEK293 cells. D. Graphical representation of the number of cells with nuclear aggregates. The experiment was performed in triplicate. Cells with visible protein expression were counted for each replicate consisting of 500 cells. Estimation of cells with aggregates was made only by visual inspection. No distinction between size and shape of aggregates was made. Students paired t-test was used. ***p <0.001.

LEKHA DINESH KUMAR

Wnt Signalling, Cancer, and Biomarker Discovery

From left to right: Varsha Durgempudi, Ashwini Tirkey, Lekha Dinesh Kumar, Aviral Kumar, Guruprasad Swaminathan

Research interests

- Role of Wnt deregulators in the initiation and progression of colon cancer
- MicroRNAs as biomarkers for detection of different subtypes of breast cancer and leukemias
- Discovery of biodrug and its targeted delivery using RNA interference and nanotechnology
- Mechanisms of drug resistance

Selected recent publications

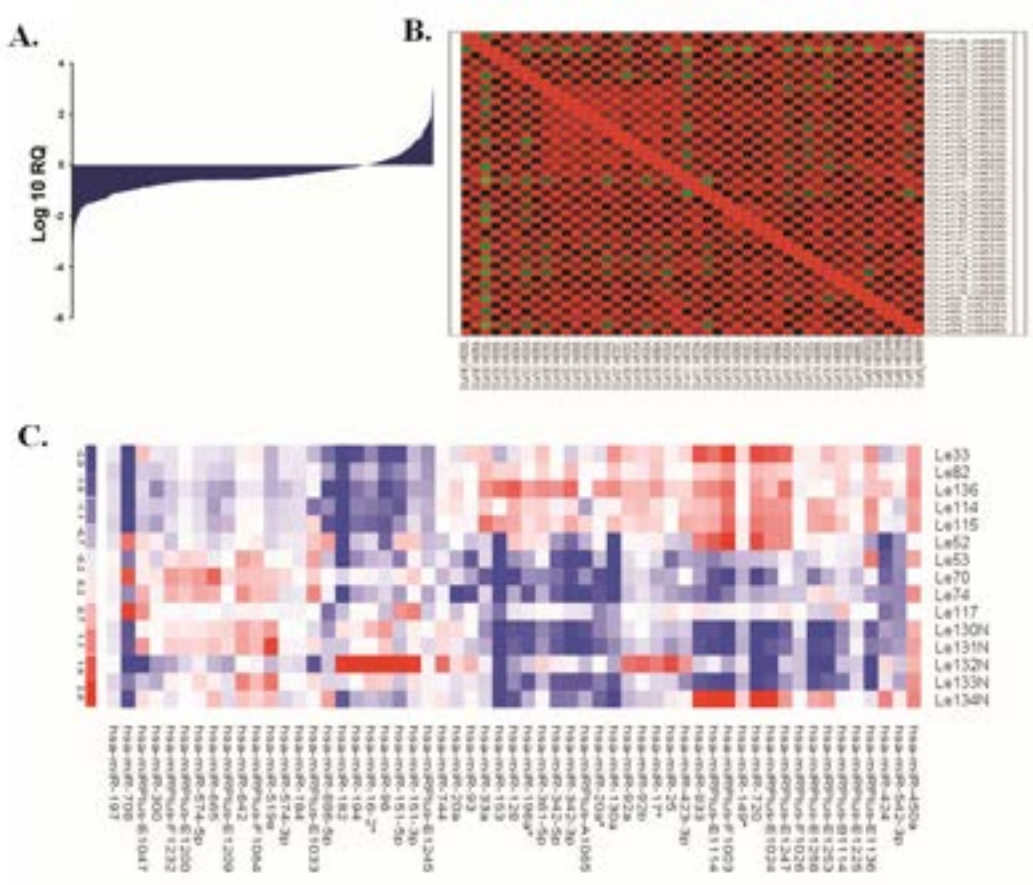
- Souneek Chakraborty, Aviral Kumar, Anmol Kumar, Debasis Nayak, Aparna Golani, Jedy Jose, ⁎Lekha Dinesh Kumar and ⁎Anindya Goswami (2019). Vimentin activation in early apoptotic cancer cells errands survival pathways during DNA damage inducer CPT treatment in colon carcinoma model. ***Cell Death and Disease*** 10: 467.
- Dinesh Kumar L (2019). (eds) In: RNA Interference and Cancer Therapy. ***Methods in Molecular Biology, Springer Protocols*** vol 1974. Humana, New York, NY. doi: https://doi.org/10.1007/978-1-4939-9220-1_193.
- Syed Sultan Beevi, Vinod Kumar Verma and Naneen Kumar Tangudu (2019). Biodrug Suppresses Breast and Colorectal Cancer in Murine Models. In: RNA Interference and Cancer Therapy. ***Methods in Molecular Biology, Springer Protocols*** (2019) vol 1974. Humana, New York, NY. Dinesh Kumar L. (eds) doi: https://doi.org/10.1007/978-1-4939-9220-1_19.
- Aviral Kumar, Aparna Golani and ⁎Lekha Dinesh Kumar (2020). EMT in breast cancer metastasis: an interplay of microRNAs, signaling pathways and circulating tumor cells. ***Frontiers in Biosciences*** : Landmark edition. 25: 979-1010.PMID: 32114421.

- Abdul Rawoof, Guruprasadh Swaminathan, Shrish Tiwari, Rekha A Nair, and *Lekha Dinesh Kumar (2020). LeukmiR: A database for miRNAs and their targets in Acute Lymphoblastic Leukemia. DATABASE (Oxford press). 2020 Jan 1; 2020:baz151. doi: 10.1093/database/baz151. PMID: 32128558.

Patents filed

- Biomarkers useful for detection of grades of human breast cancer. Lekha Dinesh Kumar, Vinod Kumar Verma, Rekha A Nair, Jem Prabhakar and Jayasree Kattoor. Indian Patent No.313602, Date of Publication, 31.05.2019

Acute Lymphoblastic Leukaemia (ALL) is one of the most common haematological malignancies in children. Recent studies suggest the involvement of multiple microRNAs in the tumorigenesis of various leukaemias. However, until now, no comprehensive database exists for miRNAs and their cognate target genes involved specifically in ALL. Therefore, we developed 'LeukmiR' - a dynamic database - comprising of *in silico* predicted microRNAs as well as experimentally validated miRNAs along with the target genes they regulate in mouse and human. LeukmiR is a user-friendly platform with search strings for ALL-associated microRNAs, their sequences, description of target genes, their location on the chromosomes and the corresponding deregulated signalling pathways. Database URL: http://tdb.ccmb.res.in/LeukmiR/. OncomiRs identified for ALL were validated in peripheral blood and bone marrow samples independently using two different high-fidelity microarray platforms. The unique and common gene signatures from both arrays were validated by TaqMan individual assays in hundred paediatric ALL samples. MicroRNA expression profile revealed characteristic signatures for distinguishing T and B lineages and identified 51 novel microRNAs in paediatric ALL. Interestingly, the present study also revealed endogenous similarities and differences between blood and bone marrow within each ALL subtype. When Cox regression analysis was carried out with these identified microRNAs, 11 of them exhibited expression levels significantly correlated with survival. Validation of significant microRNAs from our study showed that their targets are involved in key oncogenic signalling pathways. Thus, this study suggests that microRNAs have the potential to become important diagnostic and prognostic tools for identification and monitoring clinical outcomes in ALL patients.



MANDAR V DESHMUKH

Molecular Basis of Evolutionary Divergence in RNAi Initiation

From left to right, starting from top: Mandar V Deshmukh, Upasana Rai, Sneha Paturi, Jaydeep Paul, Debadutta Patra, Ramdas A Aute, Priti Chanda Behra, K Joy

Research interests

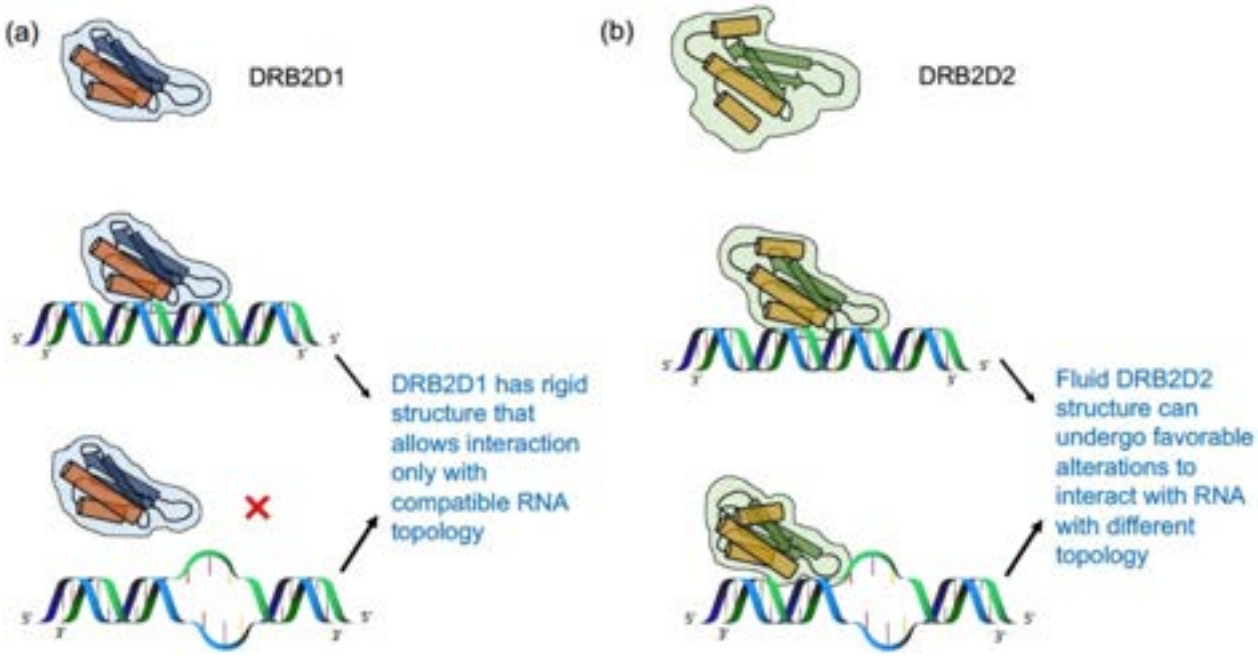
- Structural biology of RNA binding proteins
- NMR methods and applications

Selected recent publications

- Ajeet Kumar, Avishek Roy, Mandar V. Deshmukh and Ranjan Tamuli (2020). Dominant mutants of the calcineurin catalytic subunit (CNA-1) showed developmental defects, increased sensitivity to stress conditions, and CNA-1 interacts with CaM and CRZ-1 in *Neurospora crassa*. ***Archives of Microbiology*** 202: 921-934.

Our lab studies the molecular determinants of the heterogeneity in the RNAi pathway through the structure, function, and dynamics studies of proteins and nucleic acids. So far, our work has revealed that the subtle differences in structure and dynamics in highly homologous proteins incite the evolutionary divergence in one of the basic biological processes that have direct implications in infection, cancer, and development.

Initiation of the RNAi pathway involves the formation of a ternary complex between Dicer, initiator dsRNA, and a dsRNA binding protein (dsRBP). Preliminary structural studies from our lab on dsRBPs and their binding with a variety of initiators dsRNA reveal that each species has evolved a distinctive mechanism for the dsRBP:dsRNA interaction. Despite apparent conservation in sequences and domain architecture in Dicers and dsRBPs, plants and insects maintain multiple Dicers and dsRBPs specifically tuned to recognize a subset of initiator dsRNA. To understand the origin and necessity of the evolutionary divergence in RNAi, we have defined the functional roles of RDE-4 in *C. elegans* and DRB4 in *A. thaliana* in the last few years. We are currently exploring the structure-function relationship in DRB2 in *A. thaliana* and R2D2 in *D. melanogaster* using solution structure, biochemistry, and dynamics studies. We find that the first dsRBD of DRB2 maintains canonical dsRBD fold, whereas, the second dsRBD of DRB2 shows the hallmark of multiple conformers that are lowly populated as evident from broadening and NMR driven relaxation studies. The results from dsRNA binding experiments suggest that DRB2-dsRBD1 exclusively interacts with shorted dsRNA whereas DRB2-dsRBD2 recognizes a variety of dsRNA indiscriminate of the length, structure, and mismatches. Overall, our studies imply that plant's ability to induce translational suppression by sequestering the miRNA:mRNA complex is mostly driven by DRB2-dsRBD2. Currently, we are in the process of defining the mechanistic determinants for the DRB2:DCL1 complex formation for a comprehensive understanding of the miRNA biogenesis in plants.



The proposed functional model of DRB2 domains derived from the structure, backbone dynamics, and ability to recognize dsRNA of a varied topology. (a) With a well-folded rigid solution structure, DRB2 dsRBD1 is poised to recognize perfectly complementary dsRNA substrates canonically and cannot bind to the dsRNA with distinct shapes caused due to mismatch(es). (b) The presence of several low populated, higher energy conformations bequeaths plasticity to the DRB2 dsRBD2 which allows the recognition of topologically different dsRNA substrates, a process vital for the initiation of the miRNA pathway in plants.

MANJULA REDDY

Bacterial Cell Wall Synthesis and its Regulation

From left to right, starting from top: Nilanjan Som, Pavan Kumar Ch, Vaidehi M Rajguru, Balaji Venkataraman, Raj Bahadur, Shambhavi Garde, Manjula Reddy, Moneca Kaul, Richa Khanna, Suraj Kumar M, GSN Reddy, S Venugopal

Research interests

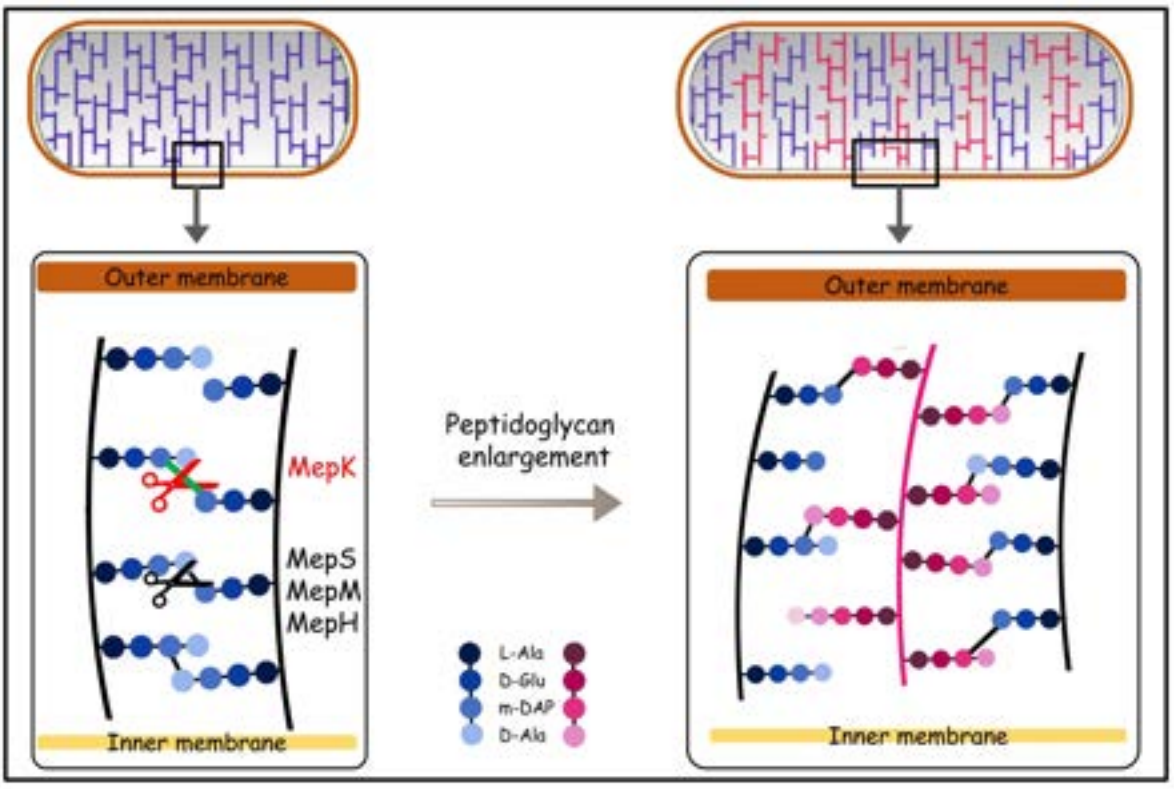
- Understanding bacterial cell wall synthesis and its regulation.

Selected recent publications

Chodisetti PK and Reddy M (2019). Peptidoglycan hydrolase of an unusual cross-link specificity contributes to bacterial cell wall synthesis. ***Proceedings of National Academy of Sciences USA.*** 116: 7825-7830.

- Chueh CK, Som N, Ke LC, Ho MR, Reddy M,Chang CI (2019). Structural basis for the differential regulatory roles of the PDZ domain in C-terminal processing proteases. ***mBio.*** doi: 10.1128/mBio.01129-19.

Research in our laboratory is focused towards understanding how bacteria elongate, divide and split their cell walls during their cell cycle to successfully generate two equal daughter cells. We take a multi-disciplinary approach including genetics, biochemistry, cell biology, and genomics to address these questions using the Gram-negative rod-shaped bacterium *Escherichia coli* as a primary model system. To protect cells against extreme environmental conditions and internal osmotic pressure, bacterial cell envelopes contain a cage-like molecular sieve called peptidoglycan (PG) sacculus. PG is made up of multiple overlapping glycan strands with short peptide chains that are cross-bridged to each other resulting in a net-like single-layered sacculus. In Gram-negative organisms, the PG sacculus is enclosed by an additional bilayered lipid membrane, the outer membrane (OM) that restricts the entry of large hydrophobic molecules into the cells. During cell cycle progression, this complex cell wall poses a challenge because all the three layers (i.e., the OM, the PG sacculus and the IM) must coordinately grow in length as cell expands in size and volume and also invaginate to form a septum during division phase for generation of daughter progeny. We earlier showed that hydrolysis of PG sacculus is an essential process for bacteria to enlarge their PG sacculi which is stringently regulated. Currently we are trying to understand the mechanistic basis of PG enlargement and how the hydrolysis and synthesis are coupled to successfully enlarge PG sacculus during growth of bacteria.



A schematic representing peptidoglycan enlargement during growth of a bacterial cell. Cell envelope of a Gram-negative bacterium contains outer membrane, peptidoglycan (PG) and inner membrane. Cell growth requires PG enlargement and this occurs by cleaving the existing peptide cross-links by space-maker PG hydrolases (MepS, M, H and K) for the insertion of new PG material (colored magenta).

MEGHA KUMAR

Cell and Developmental Biology

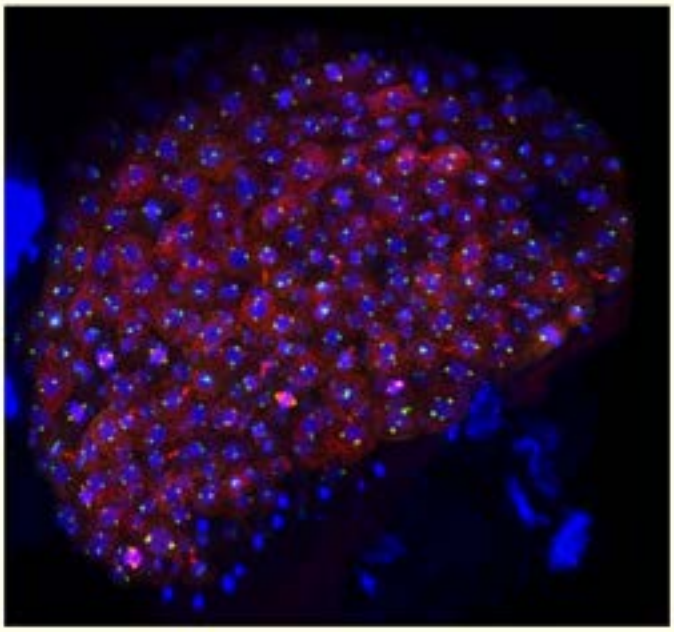
From left to right: Sonu Yadav, Sharada Iyer, K. Pavani, Megha Kumar, Sulagna Mukherjee, Chandrima

Research interests

- Mitosis during early embryonic development
- Mitotic aberrations and developmental disorders
- Zebrafish embryogenesis

Cell division is a fundamental cellular process involved in embryonic development and mitotic aberrations result in disorders such as microcephaly, aneuploidy syndromes and embryonic lethality. We study the molecular mechanisms regulating cell division to understand the basis of these developmental disorders. We use zebrafish as the model system to study cell division dynamics during embryonic development, since zebrafish embryos are amenable to live cell imaging, genetic manipulation and high throughput genetic screens. Our current studies are focussed on the mitotic machinery and the associated signalling pathways involved in various steps of cell division, resulting in faithful separation of DNA and cytoplasm during early divisions in the zebrafish embryo. As a molecular handle to the complex mitotic machinery, we are currently investigating the role of Centrosomal protein family (CEPs) during cell division. Our preliminary results indicate that CEP genes are required for proper spindle orientation, resulting in correct specification of cell fate and normal tissue architecture during early embryonic development.

In the past year, we have also initiated ecotoxicological studies using zebrafish as a model system. In this project, we are exploring the developmental toxicity and the effects of common industry effluents such as by-products of the perfume industry and washing powder industry which is routinely found in our water sources.



Surface blastomere of a 3.3hpf zebrafish embryo showing different phases of mitosis. At metaphase, the chromosomes (DAPI, blue) are tightly congressed in the centre, held by the spindle microtubules (a tubulin, red) and centrosomes (g tubulin, green). The CEP proteins also localize to the centrosomes with g tubulin.

MEGHNA KRISHNADAS

Community and Functional Ecology

Meghna Krishnadas

Research interests

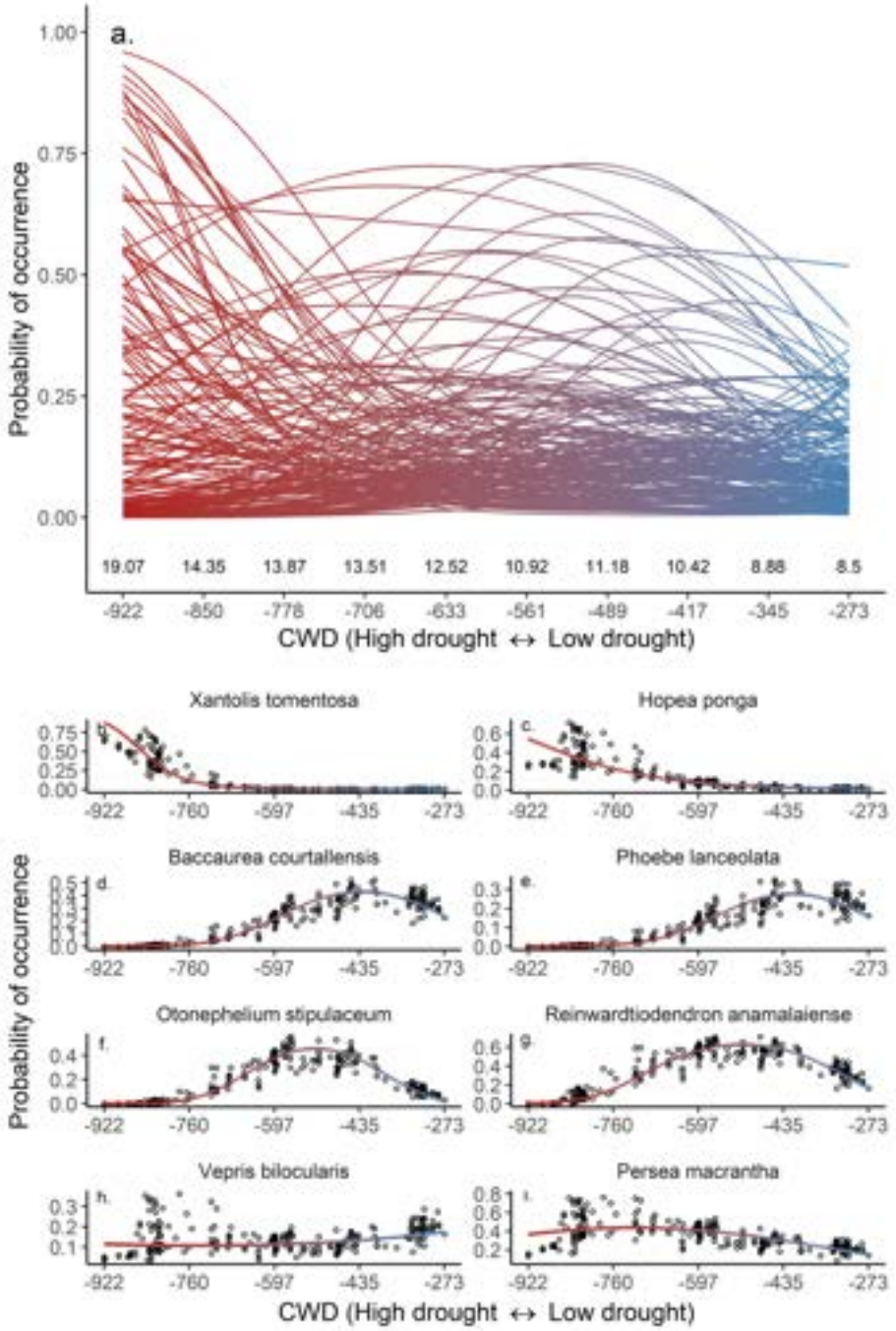
- Processes that allow species to coexist, and, thus, maintain diversity in ecological communities
- Why are some species common but most species rare?
- What factors govern the outcome of species' response to environmental stress and competition?
- Creation of 'winners' and 'losers' among species due to human-mediated environmental change

Selected recent publications

- Krishnadas M and Osuri AM (2020). Environment shapes the spatial organization of tree diversity in fragmented forests across a human-modified landscape. ***Ecological Applications*** (in press).
- Krishnadas M, Agarwal K and Comita LS (2020). Insects and fungi regulate functional composition and diversity of tree seedlings, but edge effects alter these processes in fragmented forest. ***Annals of Botany*** (in press).
- Krishnadas M and Comita LS (2019). Edge effects on seedling diversity are mediated by impacts of fungi and insects on seedling recruitment but not survival. ***Frontiers in Forests and Global Change*** 2: 00076.
- Krishnadas M, Kumar N, Comita LS (2019). Edge effects reduce α-diversity but not β-diversity during community assembly in a human-modified tropical forest. ***Ecological Applications*** 29: e01996.

During the past year, our research focused on two major themes.

First, we continued our investigation of patterns and processes of biodiversity change in human-modified forests. Second, we assessed how seasonal drought shapes tree species distributions and forest composition across 1200 km of the Western Ghats biodiversity hotspot. We complemented this landscape-level analysis with a greenhouse experiment to understand how seedlings of tree species differ in their ability to withstand drought. The study of seasonal drought has set the stage for a detailed assessment of the impacts of climate change on the regeneration of human-modified forests.



Species distributions in relation to Climatological Water Deficit (CWD). Probabilities of occurrence for a) all species and b–i) selected species that reveal different modal responses to CWD. Distributions were estimated for 166 species that occurred in at least 15 plots across the gradient, using Gaussian logistic regressions implemented as generalized linear mixed effects models in a hierarchical Bayesian framework with species-specific intercepts and slopes. Plots were included as random intercepts to account for spatial dependencies and unmeasured site-level factors. Lines show predicted distributions and points indicate estimated probabilities of occurrence per plot when all random effects are included.

M M IDRIS

Bio-mechanisms of Regeneration

M M Idris

Research interests

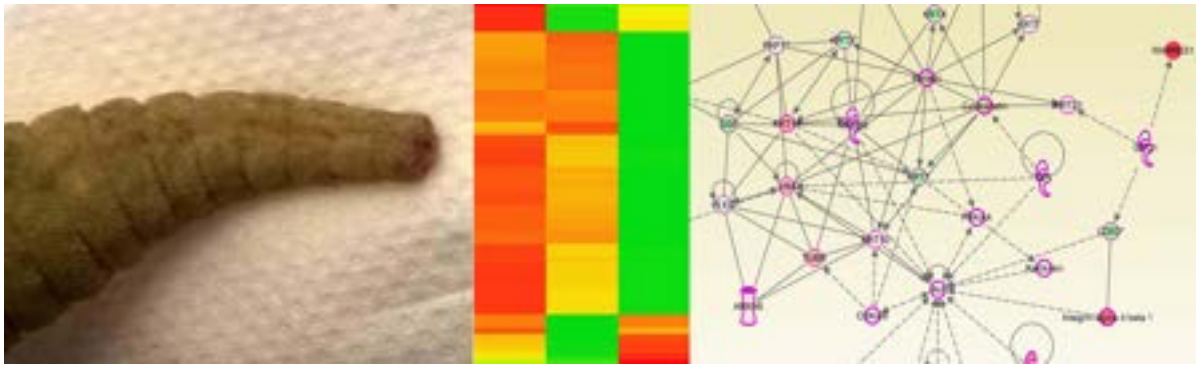
- Bio-mechanism of tissue regeneration in alternate animal models
- Molecular perspective of wound healing and regeneration in zebrafish
- Development of primary reference standard and impurities for biopharmaceuticals and DNA barcode based monograph for herbal drugs

Selected recent publications

- Pawan S, Banu S, Idris MM (2019). Transcriptome and Proteome analysis of Hemidactylusfrenatus during initial stages of tail regeneration. ***BioRixV*** 879718.
- Al-Asmari AK, Kunnathodi F, Anvarbatcha R, Tanwir Athar M, Sigmani D, Idris MM (2019). Properties and effect of Ittar in mice behavior and neurological functions. ***BioRixV*** 876581.
- Rekulapally R, Murthy Chavali LN, Idris MM, Singh S (2019) Toxicity of TiO2, SiO2, ZnO, CuO, Au and Ag engineered nanoparticles on hatching and early nauplii of *Artemia* sp. ***PeerJ*** 6: e6138. DOI10.7717/peerj.6138.

Our group works on understanding the molecular and genetic aspects involved in tissue and organ regeneration using alternate model animals like zebrafish, geckos, ascidians and echinoderms. Understanding the bio-mechanisms of regeneration and the association of various genes (or proteins) in the regenerating environment is of high significance, as it might help us engineer non-regenerating systems into regenerating systems for therapy and healing. Understanding regeneration mechanisms among different model animals might provide us an improved perspective of the underlying processes involved in this phenomenon. Our major research achievement during the past year was establishing the molecular basis for the regeneration of tail tissue among the house gecko, *Hemidactylus frenatus* and zebrafish, *Danio rerio*, for which we used expression and functional analysis. We developed transcriptome and proteome maps for these organisms and analysed their differential expression during the process of tail regeneration at various time points. We have also established a novel method of CRISPR based knockdown analysis involving electroporation, to study the functional role of genes during tissue regeneration in zebrafish.

Our group also works on the development of primary reference standards for biopharmaceuticals, monograph development of monoclonal antibodies, and DNA barcode development for medicinal plants as per the requirement of Indian Pharmacopeia Commission. This initiative for the development of reference standards and monographs for biotherapeutics will strengthen our country's program on affordable health and help to produce quality biotherapeutics drugs under Ayushman Bharat. Till date we have analyzed two therapeutic proteins and developed an assay for the analysis of protein impurities. We have also developed a DNA barcode-based monograph for 10 different herbal drugs.



Gecko tail regeneration with heat map and associated network pathway

MUKESH LODHA

Mechanism of Epigenetic Inheritance in Plants

From left to right: Mukesh Lodha, Sharmila Singh, Akanksha Garhewal, Preethi Jampala, Shraddha Lahoti, Saideep

Research interests

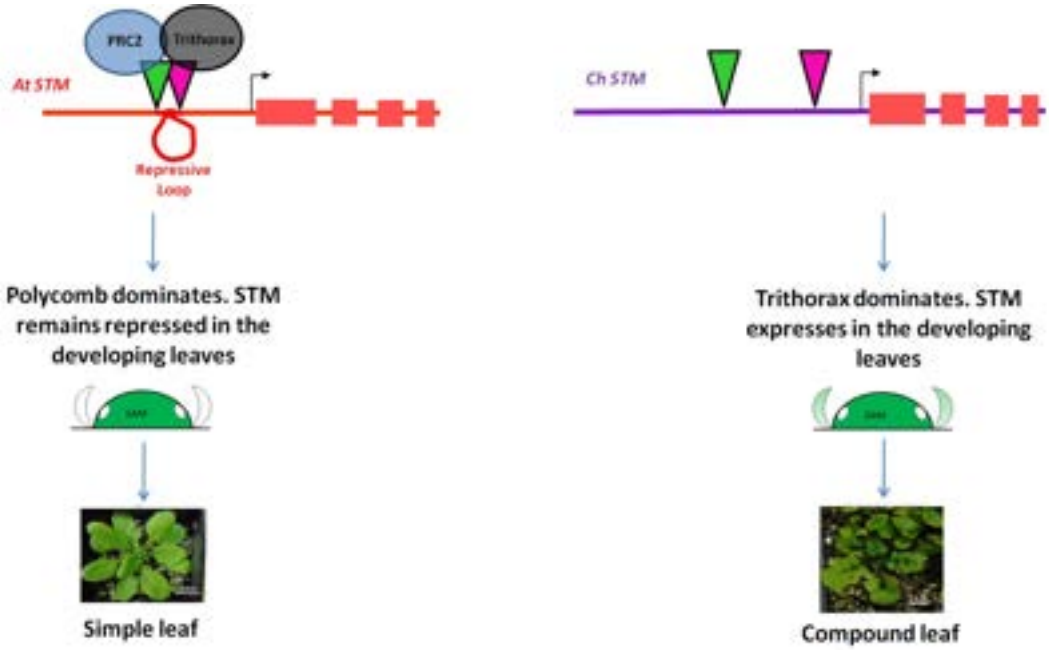
- Mechanism of epigenetic inheritance during cell division
- Epigenetic mechanisms regulating plant development

Selected recent publications

- Pallavi Sinha, Vikas K Singh, Rachit K Saxena, Sandip M Kale, Yuqi Li, Vanika Garg, Tang Meifang, Aamir W Khan, Kyung Do Kim, Annapurna Chitikineni, K B Saxena , C V Sameer Kumar, Xin Liu , Xun Xu, Scott Jackson, Wayne Powell, EviatarNevo , Iain R Searle, Mukesh Lodha, Rajeev K Varshney (2020). Genome-wide analysis of epigenetic and transcriptional changes associated with heterosis in pigeonpea. ***Plant Biotechnology Journal*** 18: 1697-1710.

Epigenetic information is heritable during mitotic and/meiotic cell divisions but it is not encoded in the genetic material. It is stable even in the absence of initial trigger and is reversible to various extents. An important question that remains under-explored is the mechanism of inheritance of epigenetic state. We have strong interest in elucidating the mechanisms of transmission of epigenetic memory from one cell to another, or one generation to the next. Using *Arabidopsis thaliana* as a model plant,we have identified the histone tail residues H3K23 and K14 to be important in the transmission of histone H3 during cell division and root development. Their acetylation appears to be important in histone H3 transmission during root development.

A large share of our understanding of epigenetics is achieved through developmental genes. Our group is using one of the important developmental regulators, SHOOT MERISTEMLESS (STM) as a tool to understand epigenetic regulation in plants. STM is an important shoot meristem stem cell regulator and determining factors in leaf complexity. In simple leaves species such as *Arabidopsis thaliana,* STM is expressed in the shoot apical meristem and is down regulated in leaf primordia. This downregulation is maintained throughout the leaf development and is required for proper simple leaf development. In compound leaf species like *Cardamine hirsuta*, tomato and pea, STM down regulation occurs in leaf primordial but is not maintained. STM reactivation in developing leaves is necessary and sufficient for compound leaf formation. We have dissected the binding sites for Polycomb and Trithorax complexes on the STM promoter. By 3C assays we determined that binding sites of these complexes come close to each other in simple leaf species, whereas in compound leaf species this repressive loop does not form. It appears that the repressive loop is critical in determining leaf complexity.



Regulation of leaf complexity in plants by differential expression of SHOOT MERISTEMLESS (STM), Polycomb and Trithorax binding sites in STM promoter form a repressive loop in the simple leaf species, preventing expression of STM in the developing leaves. In compound leaf species, absence of loop allows regaining of expression in the developing leaves. Regained STM expression is critical in compound leaf formation.

M V JAGANNADHAM

Studies on Outer Membrane Vesicles of Bacteria

From left to right: Deepika Chandra, M .V. Jagannadham

Research interests

- Structural and functional studies of bacterial membrane vesicles
- Improving the *de novo* sequencing efficiency of peptides for proteomics analysis
- Proteomics of an Antarctic bacterium *Pseudomonas syringae Lz4W*

Selected recent publications

- Karthikeyan R, Gayathri P, Gunasekaran P, Jagannadham MV and Rajendhran J (2020). Functional analysis of membrane vesicles of *Listeria monocytogenes* suggests a possible role in virulence and physiological stress response. ***Microbial Pathogenesis*** 142: 104076.
- Johny Ijaq, Neeraja Bethi and Jagannadham MV (2020). Mass spectrometry-based identification and characterization of human hypothetical proteins highlighting the inconsistency across the protein databases. ***Journal of Proteins and Proteomics*** 11: 17-25.

Patent filed

- Indole derivatives as potentiators of bioefficacy of anti-infectives. M.V. Jagannadham, CSIR-CCMB, Giasuddin Ahmed and Bina Agarwal from Gauhati University, B. Ramesh Babu from Boga R Laboratories, Peddapuram, AP. Filed on: December 12, 2019 in India. Appl No. 0207NF2019.

Sequence determination of peptides is a crucial step in mass spectrometry-based proteomics. Peptide sequences are determined either by database search or by *de novo* sequencing using tandem mass spectrometry (MS/MS). Determination of all the theoretical expected peptide fragments and eliminating false discoveries remains a challenge in proteomics. Developing standards for evaluating the performance of mass spectrometers and algorithms used for identification of proteins is important for proteomics studies. We focused on these aspects by using synthetic peptides. A total of 599 synthetic peptides were designed from *in silico* tryptic digests with one or two missed cleavages from 199 human proteins and synthetic peptides were obtained. The peptides were mixed together, and analysis was carried out using liquid chromatography-Electrospray Ionization Tandem Mass Spectrometry on a Q Exactive HF mass spectrometer. The peptides and proteins were identified with SEQUEST program. The analysis was carried out using a standard proteomics work flow. A total of 573 peptides representing 196 proteins could be identified and a spectral library was created for these peptides. Analysis parameters like no enzyme selection gave maximum number of peptides detection as compared to trypsin in the selection. False discoveries could be identified. Our study highlighted the limitations of peptide detection and the need for developing powerful algorithms along with tools to evaluate mass spectrometers and algorithms. It also showed the limitations of peptide detection even with high-end mass spectrometers.

PAVITHRA L CHAVALI

Cellular and Developmental Biology

From left to right: B.H. Muralikrishna, Balaji Prasanna Kumar, Ch. Naga Ravi Teja, Sourav Ganguli, Pavithra L. Chavali, Dhruv Kumar

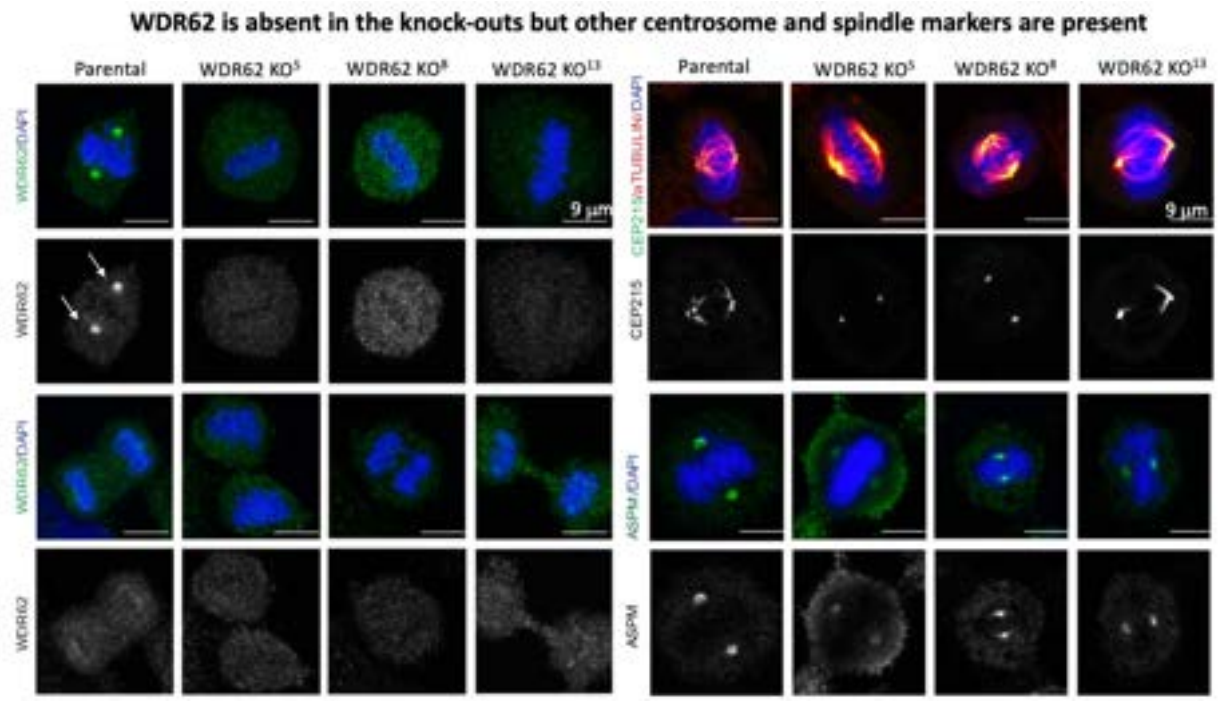
Research interests

- Convergent and divergent mechanisms underlying neurodevelopment and neural cancers
- Genes implicated in congenital neurodevelopmental disorder, Primary Microcephaly (small brain phenotype) to understand mechanisms governing normal brain development and neural cancers

Selected recent publications

- A, Khan MIK, Govindaraju G, Verma M, Awasthi S, Chavali PL, Chavali S, Rajavelu A, Dhayalan A. (2020) SET7/9 interacts and methylates the ribosomal protein, eL42 and regulates protein synthesis. ***Biochimica et Biophysica Acta Molecular Cell Research*** 867(2): 118611.
- Chavali PL*, Ramachandran R, Chavali S (2020). Functional Categories of RNA regulation in RNA based regulation in Health and Disease, 2020 (Ed: Rajesh Pandey), ***Elsevier Academic Press.***

Research in our group focusses on understanding commonalities between neurodevelopment and neural cancers, since both these share similar molecular signatures. We do this by identifying shared molecular pathogenesis implicated in Microcephaly (MCPH) and neural cancers using major MCPH genes as our targets and cell lines and organoids as models. We plan to delineate the physiological molecular processes which are disrupted in MCPH knock-out cell lines using Next-Generation Sequencing and proteome profiling approaches. In this regard, we have successfully established a robust experimental pipeline to generate knock-outs in several cell lines and have validated growth phenotype of these knock-outs. Ongoing work focusses on deciphering the molecular pathways disrupted in these knock-outs, which will provide us clues about their roles in normal neurodevelopment and how these are perturbed in diseases.



The panel on the left depicts immunofluorescence analysis of WDR62 knock out cells. During mitosis, WDR62 is present in the spindle poles (white arrowmarks) and promotes timely mitosis. In knock out cells, WDR62 protein is absent in the poles and results in delayed mitosis. The panel on the right depicts immunofluorescence analysis of other centrosome and spindle pole markers such as CEP215 and ASPM, which are not affected by the absence of WDR62 at the poles.

P CHANDRA SHEKAR

Early Embryonic Development in Mouse

From left to right, starting from top: P. Chandra Shekar, Hanuman Kale, Mansi Srivastava, Hiral Shah, Vishnu Vijay V, Purnima Sailasree, Debabrata Jana, Nelaparthi Sudheer Kumar

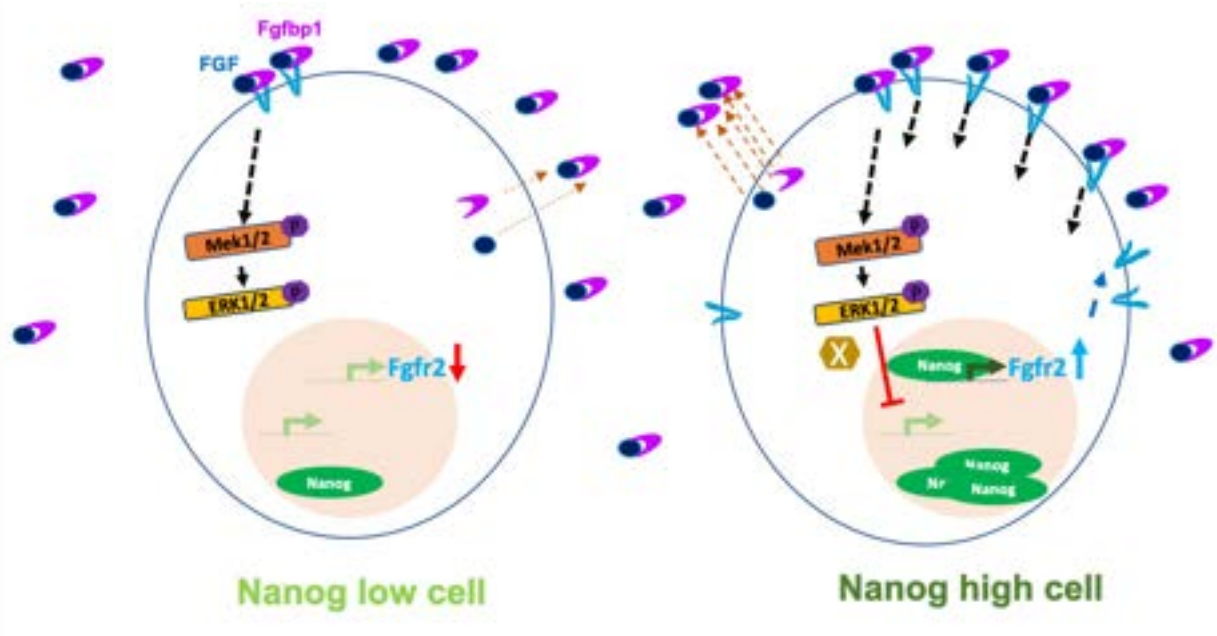
Research interests

- Cell fate choice based on transcription factor modulation in pluripotent state
- Molecular mechanisms of pluripotency state transition and self-organisation of cell types from preimplantation embryonic stages to embryo like structures

Selected recent publications

- Jana D, Kale HT, Shekar PC (2019). Generation of Cdx2-mCherry knock-in murine ES cell line to model trophectoderm and intestinal lineage differentiation. ***Stem Cell Research*** 39: 101521. doi: 10.1016/j.scr.2019.101521.

Embryonic stem cells are pluripotent and can differentiate to the three primary germ layers. Among the core factors, Nanog shows heterogeneous expression. Heterogeneous expression of Nanog is known to have a functional role in cell fate decisions. However, it is not known how the heterogeneous expression of Nanog is induced and maintained. The ectopic overexpression of Nanog in pluripotent cells resist their differentiation, thereby embryos fail to undergo normal embryogenesis. Hence, maintaining the expression of Nanog in ES cells within threshold limits is essential for retention of differentiation potential along with self-renewal. This level is maintained in ES cell by an auto feedback repression loop. In addition, it is known that this loop is also operational in serum-free '2i LiF' conditions. However, mechanistic details operating for maintaining Nanog levels in this loop are poorly understood. Nanog shows monoallelic expression when ES cells are cultured in Serum/LIF condition. Whereas when cultured in '2i LIF' it shifts to biallelic expression. We have identified an elaborate FGF signalling based autocrine/paracrine signalling loop which regulates Nanog levels.The Fgf signalling cascade activates downstream molecules like MEK1/2 and ERK1/2, which repress the activity of Nanog locus. We further show that the same Fgf signalling is essential for inducing heterogenous expression of Nanog in ES cells. We also show that MEK1/2 is essential for monoallelic expression of Nanog. We suggest that MEK1/2 acts as pivot to integrate different aspects of Nanog expression in pluripotent stem cells.



Nanog auto repression operates in ES cells with high Nanog expression and not in cells with low Nanog expression. Nanog induces expression of FGFR and makes cells more sensitive to FGF signalling in Nanog-high cells. The activation of MEK1/2 and ERK1/2 by FGF signaling in Nanog-high cells results in transcriptional repression of Nanog locus but not in Nanog-low cells.

PURAN SINGH SIJWALI

Roles of the Ubiquitin Proteasome System and Autophagy in Malaria Parasite Biology and Pathogenesis

From left to right, starting from top: Somesh, Deepak, Savita, Zeba, Srinivas, Puran, Divya, Renu, Nivya, Manish, Prajakta, Saniya

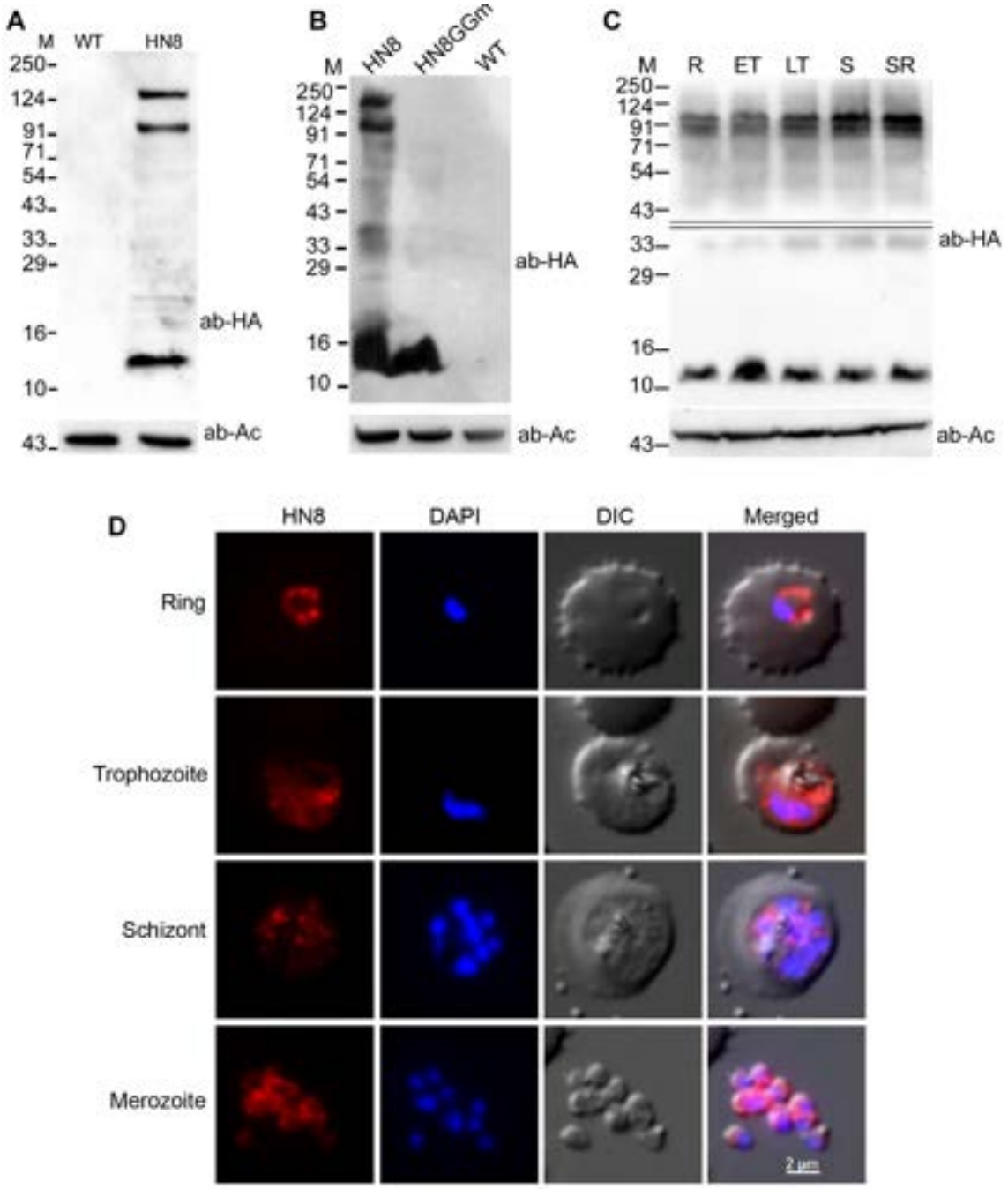
Research interests

- Proteolytic systems of malaria pathogen *Plasmodium* to determine their roles in parasite biology and disease pathogenesis
- Autophagy and the ubiquitin proteasome system (UPS), in cellular homeostasis and regulatory processes

Selected recent publications

- Govindarajalu G, Rizvi Z, Kumar D and Sijwali PS (2019). Lyse-Reseal Erythrocytes for Transfection of *Plasmodium falciparum*. ***Scientific Reports*** 29: 19952.
- Gaikwad VR, Karale UB, Govindarajalu G, Adhikari N, Krishna EV, Krishna VS, Misra S, Sriram D, Sijwali PS, Rode HB (2020). Synthesis and efficacy of pyrvinium-inspired analogs against tuberculosis and malaria pathogens. ***Bioorganic & Medicinal Chemistry Letters*** 127037.
- Rana D, Kalamuddin M, Sundriyal S, Jaiswal V, Sharma G, Das Sarma K, Sijwali PS, Mohmmed A, Malhotra P, Mahindroo N (2020). Identification of antimalarial leads with dual falcipain-2 and falcipain-3 inhibitory activity. ***Bioorganic & Medicinal Chemistry*** 28: 115155.
- Bhowmick K, Tehlan A, Verma S, Sudhakar R, Kaur I, Sijwali PS,Krishnamachari A and Dhar SK (2019). *Plasmodium falciparum* GCN5 acetyl transferase follows a novel proteolytic processing pathway essential for its function. ***Journal of Cell Science*** 236489.

E3 ligases are the selectivity determinant of UPS and comprise of three classes: HECT, RING and U-box. The largest number of E3 ligases are the Cullin RING ubiquitin ligases (CRL), which are regulated by conjugation of a ubiquitin-like modifier, the neural precursor cell expressed developmentally downregulated protein 8 (NEDD8). Towards studying the neddylation pathway in malaria parasites, we characterized *P. falciparum* NEDD8 (PfNEDD8) and identified cullins as its physiological substrates. PfNEDD8 is a 76 amino acid residue protein without the C-terminal tail, indicating that it can be readily conjugated. The wild type and mutant (Gly75Gly76 mutated to Ala75Ala76) PfNEDD8 were expressed in *P. falciparum* (Fig). Western blot of wild type PfNEDD8-expressing parasites indicated multiple high molecular weight conjugates (Fig), which were absent in the parasites expressing the mutant, indicating conjugation of NEDD8 to proteins through Gly76. Immunoprecipitation followed by mass spectrometry of wild type PfNEDD8-expressing parasites identified several proteins, including two putative cullins. Furthermore, we expressed PfNEDD8 in mutant *S. cerevisiae* strains that lacked endogenous NEDD8 (Δrub1) or NEDD8 conjugating E2 enzyme (ΔUbc12). The Western blot of complemented strains and mass spectrometry of PfNEDD8 immunoprecipitate showed conjugation of PfNEDD8 to S. cerevisiae cullin cdc53, demonstrating functional conservation and cullins as the physiological substrates of PfNEDD8. The characterization of PfNEDD8 and identification of cullins as its substrates make ground for investigation of specific roles and drug target potential of neddylation pathway in malaria parasites.



Expression, conjugation and localization of *P. falciparum* NEDD8. A. The lysates of wild type (WT) and HA-PfNEDD8-expressing (HN8). *P. falciparum* parasites were processed for western blotting using anti-HA (ab-HA) and β-actin (ab-Ac) antibodies. The blot shows bands close to the predicted size of HA-PfHANEDD8 and two high molecular species in the HN8 lane only. B. The HA-PfNEDD8-expressing (HN8), mutant HA-PfNEDD8 (HN8GGm) and wild type (WT) parasites were processed for western blotting using anti-HA (ab-HA) and β-actin (ab-Ac) antibodies. C. Ring (R), early trophozoite (ET), late trophozoite (LT) and schizont/ring (SR) stages HA-PfNEDD8-expressing *P. falciparum* parasites were processed for western blotting using anti-HA (ab-HA) and β-actin (ab-Ac) antibodies. The blot shows two prominent high molecular weight bands along with the free HA-NEDD8. Protein size markers in A, B and C are in kDa (M). D. FixedHA-NEDD8-expressing *P. falciparum* parasites of the indicated stages were evaluated for localization of HA-NEDD8 using anti-HA antibodies. The images show HA-NEDD8 specific signal (HA-NEDD8), nucleic acid staining (DAPI), the parasite and the erythrocyte boundaries (DIC), and the merged of all three images (Merged).

PURNIMA BHARGAVA

Epigenetic Mechanisms of Gene Regulation

Purnima Bhargava

Research interests

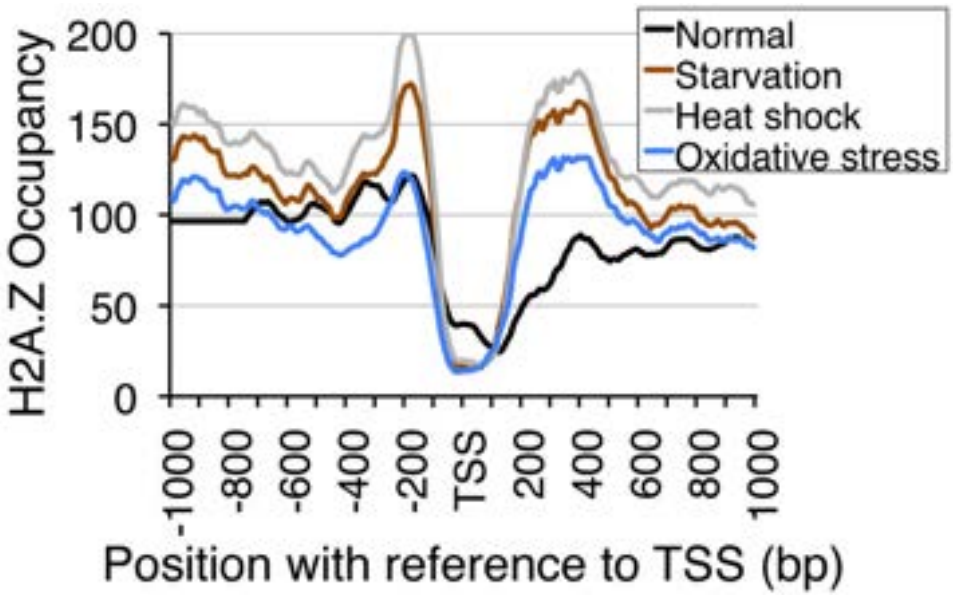
- Regulatory mechanisms of transcription in chromatin context, with special reference to the genes transcribed by RNA polymerase (pol) III

Selected recent publications

- Bhalla P, Shukla A, Vernekar DV, Arimbasseri AG, Sandhu KS and Bhargava P (2019). Yeast PAF1 complex counters the pol III accumulation and replication stress on the tRNA genes. ***Scientific Reports*** 9: 12892.

- Bhalla P, Vernekar DV, Gilquin B, Coute Y and Bhargava P. (2019). Interactome of the yeast RNA polymerase III transcription machinery constitutes several chromatin modifiers and regulators of the genes transcribed by RNA polymerase II. ***Gene*** 702: 205-214.

RNA polymerase III synthesizes short, stable, non-coding RNAs from a set of highly transcribed genes in vivo, which are repressed under several environmental stress conditions. We had earlier reported (i) a regulatory influence of the nucleosome found downstream (DS) of the tRNA gene terminator, on yeast pol III transcription. (ii) Several chromatin modifiers and transcription factors of pol II associate with the transcription complex of pol III. Our recent genome-wide mappings revealed that levels of the histone variant H2A.Z and nucleosomes on the pol III-transcribed tRNA genes are lower than the levels on the pol II-transcribed genes. The DS nucleosomes show higher instability than the bulk due to higher H2A.Z levels. Spt16 subunit of the FACT complex, which shows H2A.Z chaperone activity, is enriched in the DS nucleosome, while the Swr1 complex deposits H2A.Z in the tDNA-flanking nucleosomes. FACT complex maintains the H2A.Z levels by regulating the gene occupancy of Swr1. Spt16 and H2A.Z participate in transcription indirectly. Spt16 presence on the genes is transcription-dependent and stress-responsive as its DS enrichment is abolished when transcription is repressed under nutritional stress. As expected of a true stress-sensor, the DS nucleosomal H2A.Z levels on the tRNA genes change under different stress conditions like starvation or higher growth temperature. Thus the histone chaperone activity of Spt16 facilitates transcription by pol III and links the DS nucleosome dynamics to pol III transcription via a subtle mechanism of stress sensing. The results reveal an involvement of H2A.Z in pol III transcription under different stress conditions.



Average ccupancy profile of the histone variant H2A.Z on the tRNA genes in the budding yeast cells exposed to different stress conditions. H2A.Z levels measured by the genome-wide ChIP-seq are shown in a window of the 1kb upstream and downstream of the TSS (Transcription Start Site) of the tRNA genes.

RAGHUNAND R TIRUMALAI

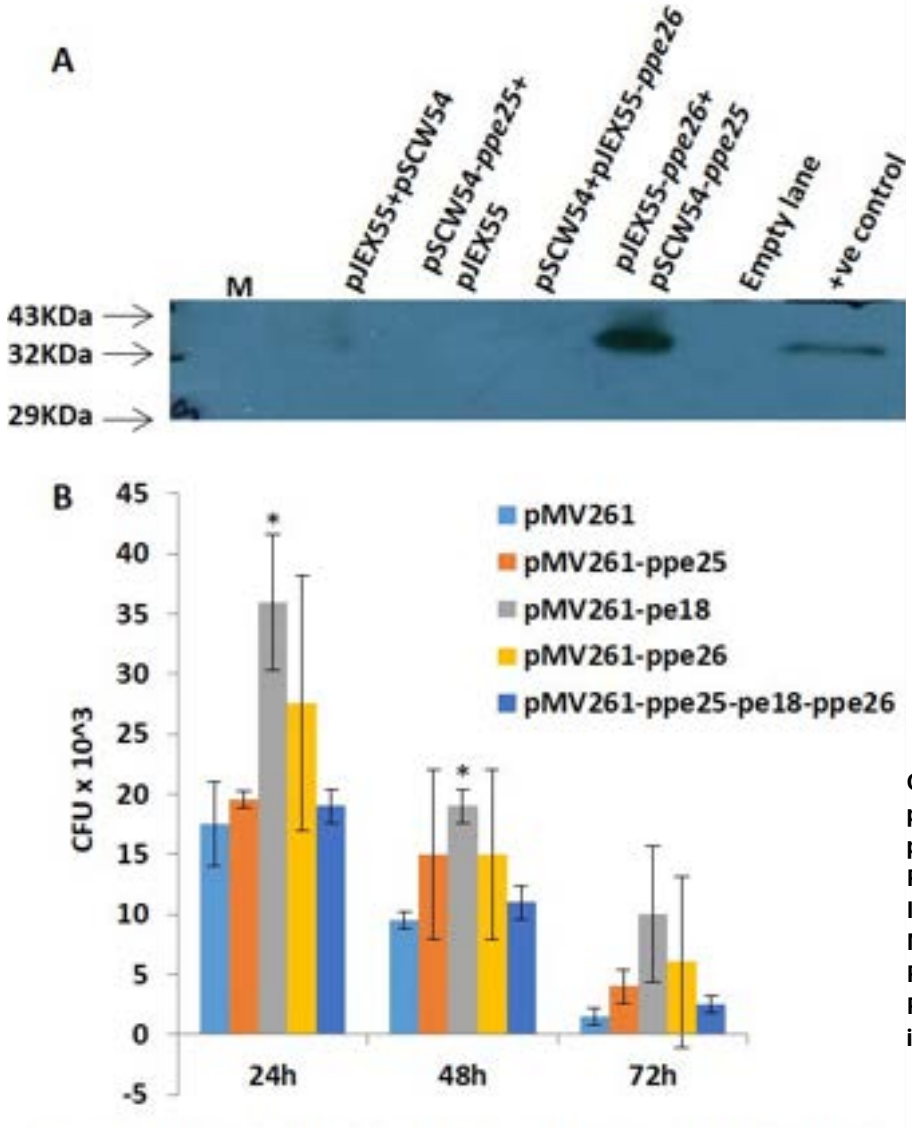
Physiology and Pathogenic Mechanisms of *Mycobacterium tuberculosis*

From left to right: Raghunand Tirumalai, Shubhangi Jaiswal, Nandhini Nagarajan, Sushma Ram, Ravi Prasad Mukku

Research interests

- Physiology and pathogenic mechanisms of *Mycobacterium tuberculosis* (*M.tb*)
- Characterizing the events at the host-pathogen interface
- Identification of bacillary virulence factors, and novel antibiotic resistance mechanisms

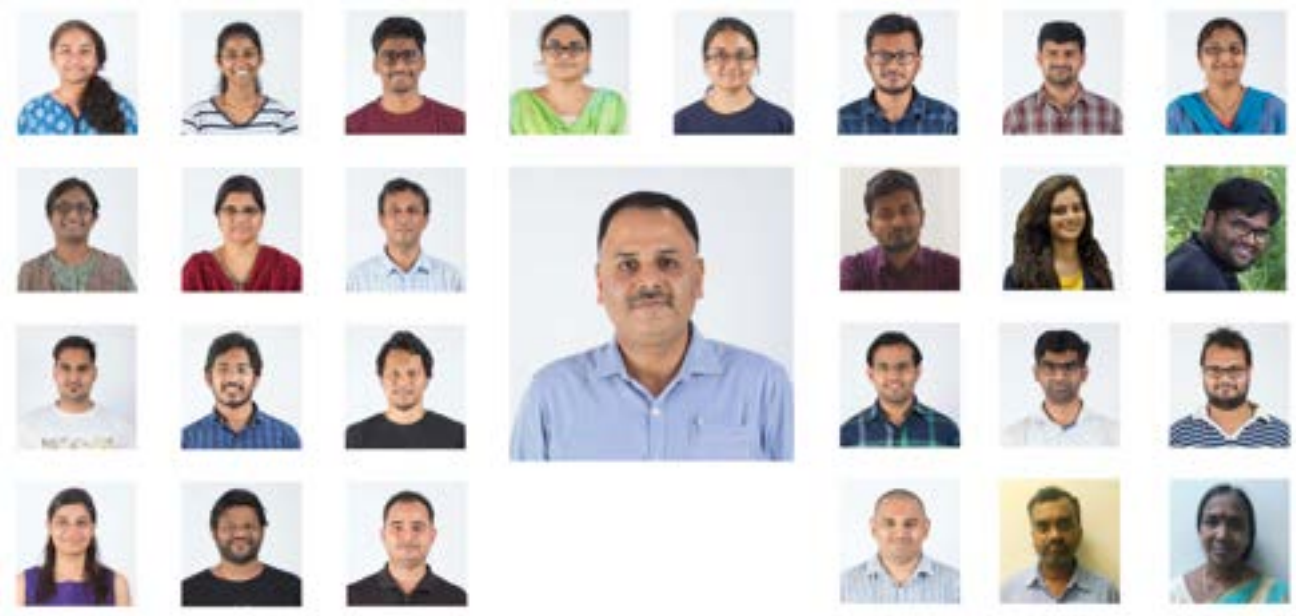
For close to a decade now, we have been investigating the physiological role of multi-gene clusters in the PE_PPE family (named after the conserved Proline-Glutamate and Proline-Proline-Glutamate residues at their N-termini), which comprise about 10% of the coding potential of *M.tb.* Our discovery of host immune modulation by novel heterodimers of the PE_PPE family signifies that the potential of PE and PPE proteins to form heterodimers represents a considerable expansion of the PE_PPE repertoire in the context of receptor engagement and immunomodulation by these proteins. It has also suggested that strategies designed to inhibit ligand-receptor interactions may be clinically relevant for the control of *M.tb* infection. As part of this effort, we set out to characterise the PPE25 (Rv1787)-PE18 (Rv1788)-PPE26 (Rv1789) gene cluster situated in the ESX-5 type-VII secretion system, the only cluster in the genome with this kind of organisation. Using RT-PCR we demonstrated that this clusteris operonic, based on which we hypothesised that they encode interacting proteins, a common feature of operons. Using Mycobacterial Protein Fragment Complementation and *in vivo* pull-downs, we observed that the PPE25::PPE26 protein pair interact (Fig. 1A). CFU counts of THP-1 macrophages infected with recombinant *M.smegmatis* strains expressing PPE25, PE18, PPE26, and the entire operon suggested that PPE18 plays a role in intracellular bacillary survival (Fig. 1B). We are now performing assays to identify the receptor(s) these proteins may be binding to, and the possible consequences of such a binding in the context of *M.tb* pathogenesis.



Characterization of the ppe25-pe18-ppe26 gene cluster of M.tb. A. In vivo pull down showing interaction of PPE25 and PPE26 in M.smegmatis. B. Intramacrophage CFU counts of M.smegmatis expressing pMV261, PPE25, PE18, PPE26, and PPE25-PE18-PPE26, 24, 48 and 72 hr post-infection. ∗p<0.01

RAJAN SANKARANARAYANAN

Structural Biology



From left to right, starting from top: Surabi, Kezia, Gurumoorthy, Vinitha, Noopur, Ankit, Mallesh, Sambavi, Rukmini, Shonha, Biswajit, R. Sankaranarayanan, Koushick, Sakshi, Santosh, Pradeep, Sudipta, Jotin, Mazeed, Gajanan, Aditya, Rajkanwar, Akshay, Raghvendra, Priyadarshan, Aravind, Lalitha

Research interests

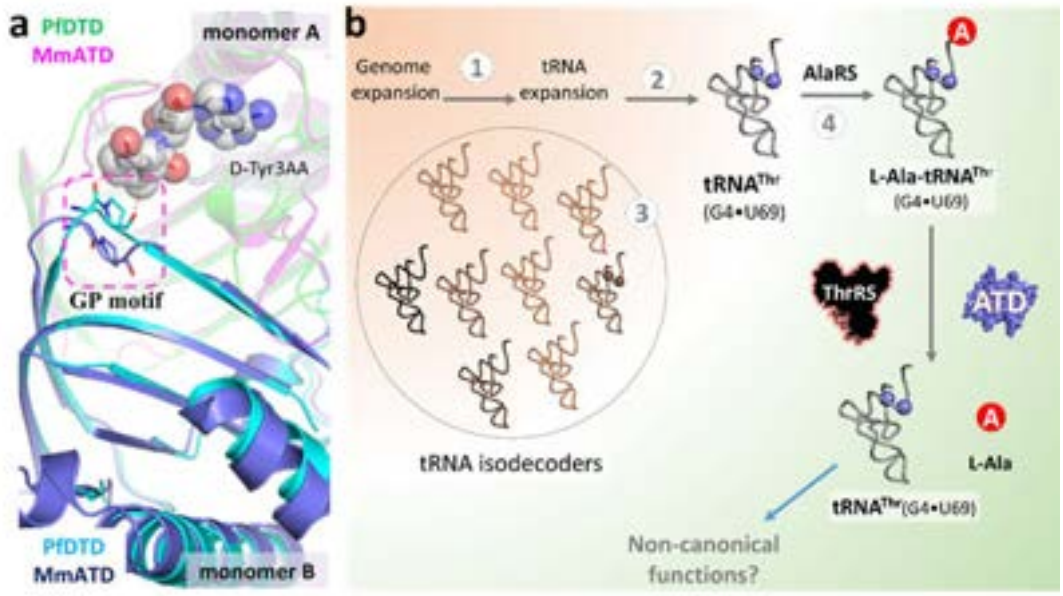
- Proofreading/editing mechanisms involved in the maintenance of quality control during translation of the genetic code and their physiological significance

Selected recent publications

- Kuncha SK, Kruparani SP, Sankaranarayanan R (2019). Chiral checkpoints during protein biosynthesis. ***Journal of Biological Chemistry*** 294: 16535–16548.

The major focus of the lab is to understand the structural and mechanistic basis of proofreading during translation of genetic code. Homochirality of the cellular proteome is essential to maintain an undisrupted flow of genetic information. D-aminoacyl-tRNA deacylase (DTD) is an enzyme which enforces proteome homochirality by decoupling erroneously charged D-amino acids from D-aminoacyl-tRNAs. Earlier, we have shown that the 'L-chiral rejection' is the *modus operandi* of DTD, and therefore acts on tRNAs charged with D-amino acids and achiral glycine. Recently, we have discovered a new variant of DTD which is specific to the Kingdom Animalia and hence named as Animalia-specific tRNA deacylase(ATD). Unlike DTD, ATD acts on smaller L-amino acids (of aa-tRNA). Using structural and biochemical data we show that ATD is recruited to proofread L-Ala-tRNAThr (G4•U69), a product of tRNA mis-selection by eukaryotic alanyl-tRNA synthetase. Co-evolution of ATD alongside G4•U69 containing tRNA isodecoder suggests a critical physiological role of the tRNA isodecoder. Our preliminary results show that threonyl-tRNA synthetase (ThrRS) is a redundant factor involved in proofreading L-Ala-tRNAThr (G4•U69). The physiological basis and relevance for recruitment of ATD and the functional redundancy in proofreading tRNA mis-selection is being probed.

DTD2 is a functional homolog of DTD and is present in Archaea and plants. Earlier work on DTD2 has shown that DTD2 knockout plants are sensitive to acetaldehyde. Our preliminary biochemical data shows that acetaldehyde reacts with D-aminoacyl-tRNA. Currently, we are in the process of testing whether DTD2 has any role in clearing this modified tRNA and its potential relevance *in vivo*.



a) Structural superimposition of *Mus musculus* ATD (MmATD) (PDB id: 5XAQ) on *Plasmodium falciparum* DTD (PfDTD) (PDB id: 4NBI) highlighting (pink box) the cross-subunit GP motif which is Gly-transPro in ATD while Gly-cisProin DTD; b) Model depicting the appearance of (1-3) tRNA isodecoders due to tRNA expansion, (4) which led to the tRNA mis-selection by AlaRS in Kingdom Animalia to form L-Ala-tRNAThr (G4•U69). L-Ala-tRNAThr (G4•U69) is proofread by both ATD and ThrRS, however, the non-canonical function of these tRNAs (if any) is yet to be probed.

RAKESH K MISHRA

Genome Organization and Epigenetic Regulation

From left to right, starting from top: Rashmi Upadhyay Pathak, Runa Hamid, Shreekant Verma, Rakesh Kumar Mishra, A Srinivasan, Shagufta Khan, K. Phanindhar, Sonu Yadav, Ashish Bihani, Ravina Saini, Avvaru Akshay Kumar, Soujanya M. S, Nikhil Hajirnis, Fathima Athar

Research interests

- Comparative and functional genomics of non-coding DNA
- Organization & regulation of Hox genes: evolutionary logic of animals body plan
- Epigenetic regulation and development

Selected recent publications

- Bisht S, Banu S, Srivastava S, Pathak RU, Kumar R, Dada R and Mishra RK (2020). Sperm methylome alterations following yoga-based lifestyle intervention in patients of primary male infertility: A pilot study. ***Andrologia*** 52: e13551.
- Khan S, Sowpati DT, Srinivasan A, Soujanya M and Mishra RK (2020). Long-Read Genome Sequencing and Assembly of *Leptopilina boulardi*: A Specialist Drosophila Parasitoid. ***G3*** (Bethesda) 10: 1485-1494.
- Srinivasan A and Mishra RK (2020). Genomic organization of Polycomb Response Elements and its functional implication in *Drosophila* and other insects. ***Journal of Biosciences*** 45.
- Srivastava A and Mishra RK (2020). Interactome of vertebrate GAF/ThPOK reveals its diverse functions in gene regulation and DNA repair. ***Journal of Biosciences*** 45.
- Tanwar VS, Ghosh S, Sati S, Ghose S, Kaur L, Kumar KA, Shamsudheen KV, Patowary A, Singh M, Jyothi V, et al. (2020). Maternal vitamin B12 deficiency in rats alters DNA methylation in metabolically important genes in their offspring. ***Molecular and Cellular Biochemistry*** 468: 83-96.
- Elizarev PV, Chetverina DA, Melnikova LS, Srivastava A, Mishra RK, Golovnin AK, Georgiev PG and Erokhin MM (2019). Activation of Su(Hw)-Controlled Genesls Associated with Increase in GAF Binding. ***Doklady Biochemistry and Biophysics*** 488: 293–295.

Patents filed

- DNA Repair Protein as Biomarker for Melanoma. Srivastava Avinash, Mishra Rakesh Kumar. Prov. NFNO: 0186NF2018/IN, Country: IN, Lab: CCMB, India. Filing Date: 24.01.2019; Application No. 201911002903, Status: PP.

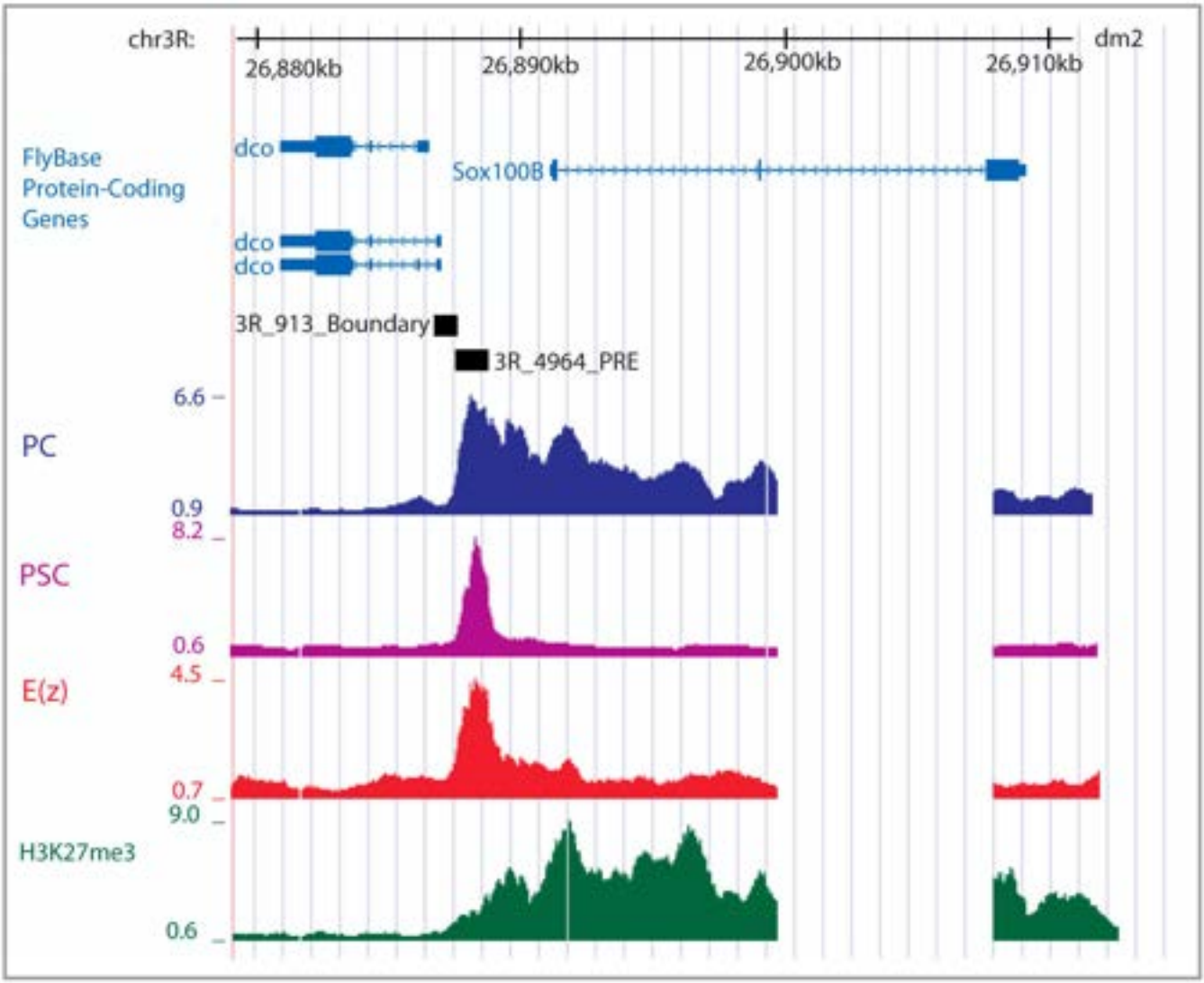
- A method for rapid detection of antibodies against SARS-CoV-2 using recombinant nucleospike fusion. N M Rao, Rakesh Mishra, Sudarshan Reddy, K Sridhar Rao. NFNO, Country: IN, Lab: CCMB, India, Prov. Filing Date: 27.05.2020; Application No.: TEMP/E-1/24380/2020-CHE, Status: Provisional

Packaging of genomic DNA has regulatory consequence on the expression of genes during development. This regulation is based on chromatin structure in which organization of coding and non-coding elements of the genome plays an important role. A good example of such regulation is provided by the Hox cluster that shows a colinearity of gene expression pattern with the arrangement of the genes in the cluster, a feature known to be conserved in all bilaterians. Chromatin domain boundary elements, the topologically independent structural unit of higher order chromatin organization, and cellular memory elements, that maintain the expression state of genes by means of chromatin structure, regulate the expression of homeotic genes. Such epigenetic regulatory mechanisms control genes at many loci in the eukaryotic genome and have been found to be conserved during evolution. Our group is interested in understanding how genetic information in the form of genomic sequence is interpreted by the developmental mechanisms, and how cell type-specific packaging of the genome in the context of nuclear architecture is achieved and maintained throughout the life of the individual.

Some of our findings during the period of this report are:

We have developed a tool to predict cellular memory elements, a.k.a., PREs (Polycomb Response Elements), PRE Mapper, and analysed the functional implications of their genomic organization, especially in the context of boundary elements as PREs are often found in their vicinity as seen on the bithorax complex.

Genome sequencing and assembly of *Leptopilina boulardi*: a specialist *Drosophila* parasitoid. This work enables epigenomic approaches accessible to this wasp and explore the host-parasite interaction in this special system.



Chromatin domain boundary elements and PREs are contiguously arranged in the genome. A UCSC genome browser screenshot of dco-Sox 100B gene loci (chr3R 26880000-26910000, dm2 genome version) showing the boundary 3R_913 and a predicted PRE, 3R_4964 that are contiguously located and overlapping at the edges are as black boxes (middle panel). The lower panel shows the enrichment of PC, PSC, E(z) and histone H3K27me3 towards the Sox100B gene, which is repressed in that cell line.

RAMESH V SONTI

Plant-Pathogen Interactions

From left to right, starting from top: Md. Jamaloddin, Vishnu Narayanan M, Donald James, Roshan M V, Niranjani, Shailaja Kanumuri, Pranali Vankore, Manideepika M, Raju Madanala, Kranthi Brahma, Komal Awalellu, Namami Gaur, Sohini Deb, Palash Gosh, Gokulan C G, Ram Chandra Panigrahi, Rajkanwar Nathawat, Kamal Kumar Malukani, Hitendra K Patel, Rennya P R, Bipin Kumar
Inset image: Ramesh Sonti

Research interests

- Bacterial virulence functions
- Induction and suppression of innate immunity in plants
- Enhancing scope of marker-assisted selection in plant breeding

Selected recent publications

- Kachewar NR, Gupta V, Ranjan A, Patel HK, Sonti RV (2019). Overexpression of OsPUB41, a Rice E3 ubiquitin ligase induced by cell wall degrading enzymes, enhances immune responses in Rice and *Arabidopsis*. ***BMC Plant Biology*** 19: 1-17.
- Pillai SE, Kumar C, Dasgupta M, Kumar BK, Vungarala S, Patel HK, and Sonti RV (2020). Ectopic Expression of a Cell-Wall-Degrading Enzyme-Induced OsAP2/ERF152 Leads to Resistance against Bacterial and Fungal Infection in Arabidopsis. Phytopathology 110:726-733.
- Deb S, Mahesh K. Gupta MK, Patel HK, Sonti RV (2019). *Xanthomonas oryzae pv. Oryzae* XopQ protein suppresses rice immune responses through interaction with two 14-3-3 proteins but its phospho-null mutant induces rice immune responses and interacts with another 14-3-3 protein. ***Molecular Plant Pathology*** 20: 976-989.
- Malukani KK, Pillai SE, Kachewar NR, Patel HK and Sonti RV (2019). Induction and suppression of rice innate immunity. ***Indian Society of Genetics & Plant Breeding.*** Issue: 79(1) Suppl. 171-180.

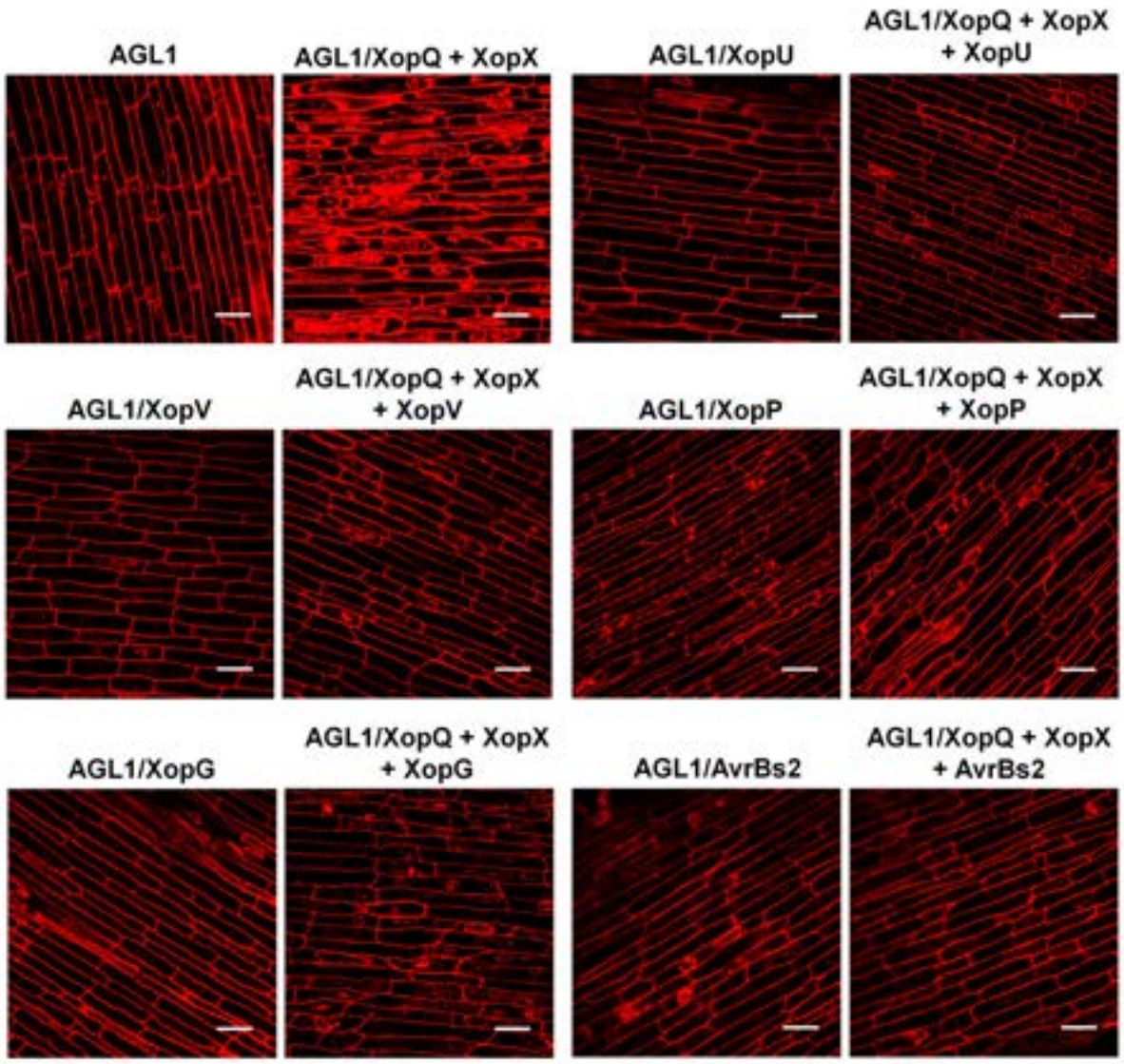
- Kaur A, Bansal K, Kumar S, Sonti RV and Patil PB (2019). Complete genome dynamics of a dominant-lineage strain of Xanthomonas oryzae pv. oryzae harbouring a novel plasmid encoding a type IV secretion system. Access Microbiology 1: 1-6.doi.org/10.1099/acmi.0.000063.

Patents filed

- Improved Samba Mahsuri rice licensed to Shree Krishna Rice Mill, Chhattisgarh as a low GI (Diabetic-friendly) rice.

Our group is studying the mechanism by which plant innate immune responses are induced and suppressed during the interaction between rice and the bacterial pathogen *Xanthomonas oryzae pv. oryzae* (Xoo). The Xoo bacterium secretes plant cell wall degrading enzymes (CWDEs) that are important for virulence but their action in damaging cell walls triggers Pathogen Triggered Immunity (PTI) in rice. We had earlier identified four Type 3 secretion system (T3SS) secreted proteins, namely Xanthomonas outer protein N (XopN), XopQ, Xopx and XopZ as being involved in suppressing PTI. The XopQ, XopX and XopZ proteins interact with unique rice 14-3-3 proteins that are key elements in eukaryotic signal transduction pathways. Point mutations in the 14-3-3 binding motifs of the Xop proteins abrogate their interaction with 14-3-3 proteins and also abolish their ability to suppress PTI.

The XopQ and XopX proteins interact with each other in *Planta* and this appears to trigger rice immune responses that are akin to Effector Triggered immunity (ETI). Five other Xoo T3SS secreted proteins, namely XopU, XopV, XopP, XopG and AvrBs2, that can individually suppress XopQ-XopX triggered immune responses. These results suggest a complex interplay of Xanthomonas T3SS effectors in suppression of both PTI and ETI to promote virulence on rice. Our group has also identified a rice Wall Associated Kinase Like protein (OsWAKL21), a helix loop helix transcription factor called OsRERJ, E3 ubiquitin ligase (OsPUB41) and a AP2/ERF (OsAP2/ERF152) transcription factor that appear to be playing key roles in elaboration of CWDE-induced immune responses. We are also working towards enhancing scope of marker-assisted selection in rice breeding.



Xoo T3SS secreted proteins; XopU, XopV, XopP, XopG and AvrBs2 individually suppress XopQ-XopX-induced immune responses. Rice roots were treated with *Agrobacterium tumefaciens* strain AGL1 alone or AGL1 harboring the gene construct expressing EGFP::XopU, EGFP::XopV, EGFP::XopP, EGFP::XopG or EGFP::AvrBs2, or pre-treatment with AGL1 alone or AGL1 harboring the gene construct expressing EGFP::XopU, EGFP::XopV, EGFP::XopP, EGFP::XopG or EGFP::AvrBs2, followed by expression of EGFP::XopQ + EGFP::XopX. Treated roots (n = 5) were subsequently stained with propidium iodide (PI) and observed under a confocal microscope using a 63 x oil immersion objectives and He-Ne laser at 543 nm excitation to detect PI internalization. Internalization of PI is indicative of defence response-associated programmed cell death (PCD) in rice roots. Scale bar: 20 µm.

R NAGARAJ

Host-defense Antimicrobial Peptides; Activity and Developing Future Therapeutic Agents

From left to right: V. Krishna Kumari, Taniya, R. Nagaraj

Research interests

- Biophysical chemistry of of short peptides that self-assemble to form hydrogels
- Biochemistry of host-defence antibacterial peptides

Selected recent publications

- Chandra D, Gayathri P, Vats M, Nagaraj R, Ray MK, Jagannadham MV (2019). Mass spectral analysis of acetylated peptides: Implications in proteomics. ***European Journal of Mass Spectrometry (Chichester).*** doi: 10.1177/1469066719857564.
- Datta D, Kumar V, Kumar S, Nagaraj R, Chaudhary N (2019). Limpid hydrogels from β-turn motif-connected tandem repeats of Aβ(16-22). ***Soft Matter*** 15(24):4827-4835.
- Datta D, Kumar V, Kumar S, Nagaraj R, Chaudhary, N (2019). Hydrogel Formation by an Aromatic Analogue of a β-Amyloid Fragment, Aβ16–22: A Scaffold for 3D Cell Culture. ***ACS Omega*** 4: 620–627.
- Datta D, Nagaraj R, Chaudhary N (2020). Water-Alcohol Bigels from Fatty Acylated Dipeptides. ***The Journal of Physical Chemistry*** *B* 124: 577-588.
- Krishnakumari V, Binny TM, Adicherla H, Nagaraj R (2020). *Escherichia coli* Lipopolysaccharide Modulates Biological Activities of Human-β-Defensin Analogues but Not Non-Ribosomally Synthesized Peptides. ***ACS Omega*** 5: 6366–6375.

Limpid hydrogels and water-alcohol bigels

The hydrogelation propensity of Ab16–22 repeats connected through β-turn-supporting dipeptide motifs was investigated. The peptides formed transparent hydrogels at ~2 mM. These gels could trap the anti-cancer drug doxorubicin and displayed its steady release in water. The gels supported the growth of mammalian cell lines. Alcohol/water bigels are formed by fatty-acylated hydrophobici peptides. Eight out of the possible twenty seven peptides formed good bigels. They are of fibrous aggregates with β-sheet conformation of the peptidic region in the gels. Entrapment and steady release of the anticancer drug, docetaxel in the gel was demonstrated. Such bigels could be attractive gelator candidates with potential application in drug delivery.

Interaction of antibacterial peptides with lipopolysaccharide (LPS)

LPS, a major constituent of the cell-wall of Gram-negative bacteria, is released during bacterial cell-division or death, on administration of therapeutic antibiotics. It is a major cause of sepsis. We have investigated, in detail, the interaction of defensins, their analogs and non-ribosomally synthesised antibacterial peptides with LPS with respect to their antibacterial and hemolytic activities.The antibacterial activity of host-defense peptides are inhibited by LPS but not non-ribosomally synthesised peptides. Hemolytic activity of some analogs were also inhibited. Defensins and their analogs neutralized LPS activity.

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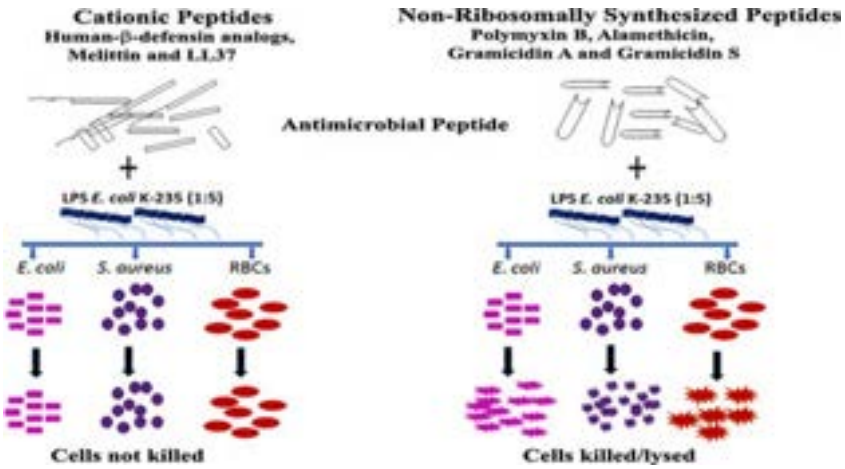
Our study suggest: (i) in nature, defensins may have evolved with twin roles of inhibiting bacterial killing and neutralizing LPS activity and (ii) evaluating interaction of antibacterial and hemolytic peptides with LPS is a compelling way of elucidating the mechanism of bacterial killing or hemolysis.



SANTOSH KUMAR

Receptor Signalling and Immune Response

From left to right: Somdutta Paul, Sitanshu Kumar Sarangi, Katherin Steffy, Santosh Kumar, Ketaki Bhagwat

Research interests

- Immunoreceptor signaling
- T cell responses in *Helicobacter pylori* infection
- Principles of immunoreceptor signaling, using the tools of *in vitro* reconstitution, fluorescence imaging, and cellular biochemistry
- T cell and NK cell responses in human diseases, using the tools of single cell sequencing, genomics, and cellular biochemistry

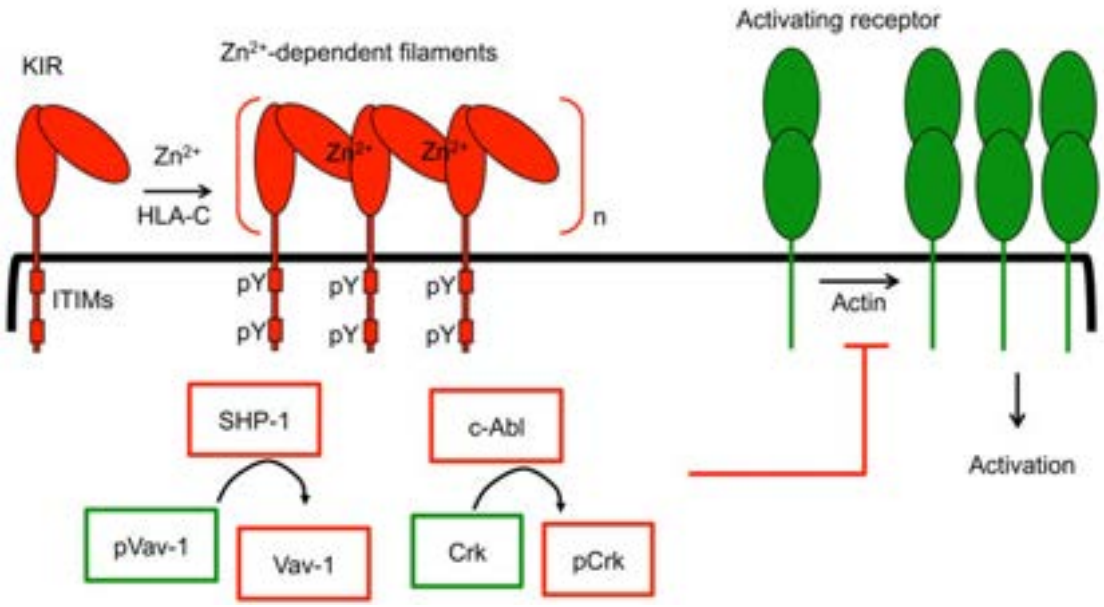
Selected recent publications

- Kumar S & Jain S (2018). Immune signaling by supramolecular assemblies. ***Immunology*** 155: 435-445.
- Kumar S (2018). Natural killer cell cytotoxicity and its regulation by inhibitory receptors. ***Immunology*** 154: 383-393.

Transmembrane immune signaling

Dimerization or oligomerization is a general principle in transmembrane receptor signaling. Human natural killer (NK) cells express HLA-C-specific inhibitory killer-cell Ig-like receptor (KIR) on their surfaces. KIR signals through its cytosolic immunoreceptor Tyr-based inhibitory motifs (ITIM) (Fig) to prevent activation of natural killer (NK) cells. KIR undergoes Zn2+-dependent polymerization into filaments. This could represent a new transmembrane signaling mode. We wish to understand the regulation and functions of the molecular events that underlie KIR signaling. KIR is the only known example so far, wherein a transmembrane receptor signals as polymers. To obtain a consolidated understanding of this new mode of transmembrane signaling, we wish to obtain and study more examples.

The region flanking ITIMs in the cytosolic tail of KIR is rich is basic amino acids. To explore whether ITIM phosphorylation in KIR is controlled by their membrane association, we expressed the cytosolic tail of KIR in bacteria and purified it. We then tested its interaction with negative or zwitterionic liposomes using intrinsic Trp fluorescence-based measurements. The results demonstrated that the cytosolic tail of KIR interacts with negative, and not zwitterionic, liposomes.



Interception of NK cell activation by KIR. At the inhibitory ynapses formed between KIR+ NK cells and HLA-C+ target cell, KIR clusters rapidly, in actin-independent manner. The Zn2+-dependent polymerization of KIR into filaments could contribute to the rapid and actin-independent KIR clustering at these synapses. The Srk family kinase Lck and Fyn are candidate kinases for ITIM phosphorylation. The protein Tyr phosphates SHP-1, recruited and activated by its interaction with phospho-ITIMs, dephosphorylates the guanine nucleotide exchange factor Vav-1. The c-Abl kinase is recruited to the inhibitory synapses through an unknown mechanism. The c-Abl kinase phosphorylates the small adaptor protein Crk, and dissociates it from a signaling complex (not shown here) formed during activation. Vav-1 dephosphorylation and Crk phosphorylation contribute to blockage of actin-dependent signals for NK cell activation, and thus could contribute to inhibition of proximal actin-dependent steps, such as LFA-1 activation (not shown here) and clustering of activating receptors.

SHASHI SINGH

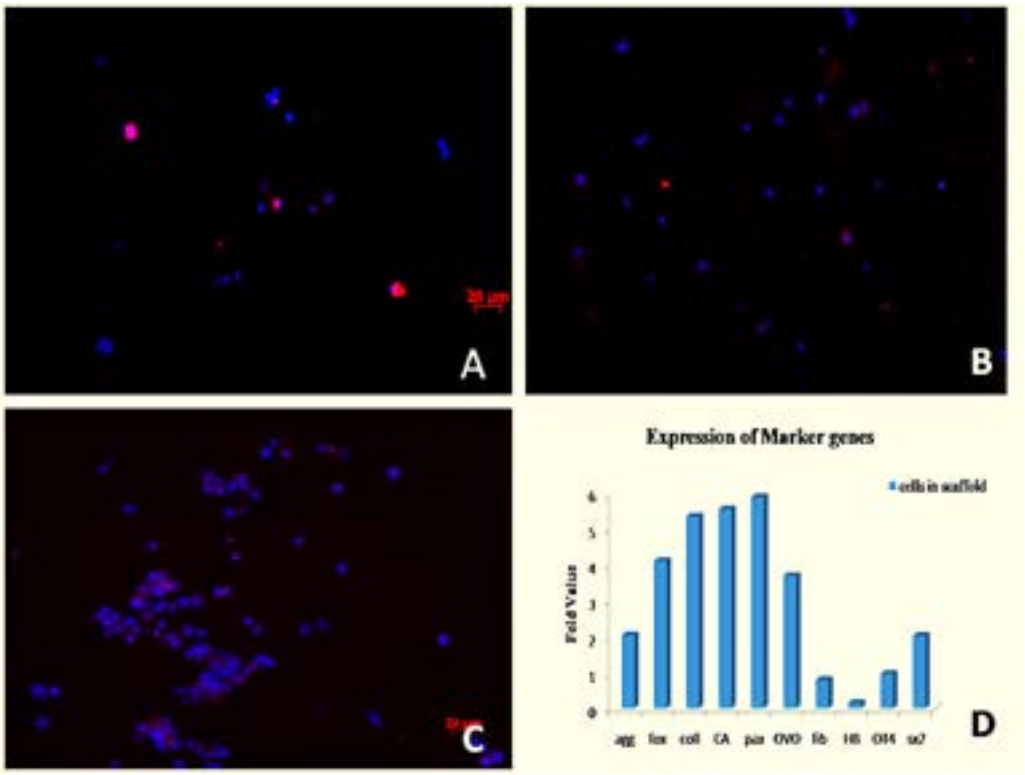
Adult Stem Cells from various Sources and Tissue Engineering

Shashi Singh

Research interests

- Cell and tissue engineering using natural matrix material as scaffolds and stem cells to create injectable cartilage inserts and artificial pancreas with functional capabilities

Mesenchymal stem cells derived from placenta and iPSC derived from fetal human fibroblast were used as a cell source to tissue engineer a cartilage like construct that could be injected at the site of injury. From the earlier studies, it was established that the collagen obtained from the rat tail can be cross-linked with glycans or sugars and make stable constructs. During the process of construct making and moulding, the cells were added into the mix before it sets. The cells not only survived the setting process but they also continued to proliferate and differentiate. Both the cell types showed differentiation into the chondrogenic phenotype. At the end of 30 days the histology of construct showed the cells to be exhibiting chondrocytic morphology and markers. The construct was injected into rats in which knee injury was created. The healing process is being followed for a period of 12 weeks. The animals do not show any reaction to the material injected. After histology, at the end of recovery period we will be sure of its preclinical efficacy. In continuation to our work in pancreatic regeneration, iPSC cells were induced to pre-beta cell lineage and allowed to form pancreatic organoids. These organoids were allowed to develop in matrigel, ECM preparation and cross-linked collagen matrix, a comparative analysis of these sets is being performed in terms of markers expression, insulin release and continuity of the constructs.



iPSC grown in scaffolds containing 1% collagen crosslinked with GAA 50% oxidized express markers for differentiation. Cells stained for aggrecan (A); lumican (B) and collagen type II (C). qPCR analysis also shows manifold increase in levels of markers and decline in iPSC markers.

SHRISH TIWARI

Sequence Analysis of Biomolecules

From left to right, starting from top: Deepti Rao, Shrish Tiwari, P. Ramesh, Tummala Nikhila Sai and Ruby Srivastava

Research interests

- NGS sequence analysis, including *de novo* assembly and variant identification
- Discovering correlation between genotype and phenotype

Selected recent publications

- Muripiti V, Mujahid TY, Boddeda VHV, Tiwari S, Marepally SK, Patri SV and Gopal V (2019). Structure-activity relationship of serotonin derived tocopherol lipids. ***International Journal of Pharmaceutics*** 554: 134-148.
- Rawoof A, Swaminathan G, Tiwari S, Nair RA and Kumar LD (2020). LeukmiR: a database for miRNAs and their targets in acute lymphoblastic leukemia. ***Database*** 2020: baz151.

We are building a reference genome for Samba Mahsuri (SM). In this regard we have generated an assembly with ~40,000 scaffolds, using short reads from Illumina sequencing. Analysis of this assembly using various parameters, including N50 value, the BUSCO score that looks at the core set of genes in the family, the fraction of rice transcripts recovered in the assembly, seems to indicate this assembly is of good quality and near complete.

We are working on an EMS mutant line of SM which has the phenotypes of early maturation and high yield. The MutMap approach is being used to identify the loci which could be responsible for these traits. In the MutMap approach stable EMS mutants, with a favourable agronomic trait, are crossed with wild-type parental line to get F1 generation. F1 is self-propagated to get F2 generation, which segregates for mutant and wild-type phenotype. The plants exhibiting the mutant phenotype are bulked and sequenced along with the parental plant. The aim is to identify a cluster of SNPs that is present in almost all the mutant plants. These loci are predicted to be responsible for the observed trait. We have generated the F2 generation for the mutant line we are working with, and are in the process of phenotyping it.

We have also sequenced a halophyte plant, *Salicornia brachiata*, that accumulates salt in its stems. This is a plant from which our sister lab CSIR-CSMCRI has been able to extract herbal salt, a low sodium salt of botanic origin. With a combination of short- and long-read sequencing we have been able to build a relatively high-quality assembly.

We have also been involved in a project to build a comprehensive database of microRNAs involved in cancer. We have published a database of miRNAs involved in leukemia, along with their target genes and the pathways they may be involved in.

SONAL NAGARKAR JAISWAL

Developmental Biology

From left to right, starting from top: Sonal Nagarkar Jaiswal, Priyanka Pandey, Aishwarya K, Reshmi Varghese, Nandan J, Brinda Palliyana

Research interests

- Regulation of neural stem cell self-renewal, differentiation and quiescence during development
- Neurodevelopmental diseases
- Development of new methods to manipulate fly genes

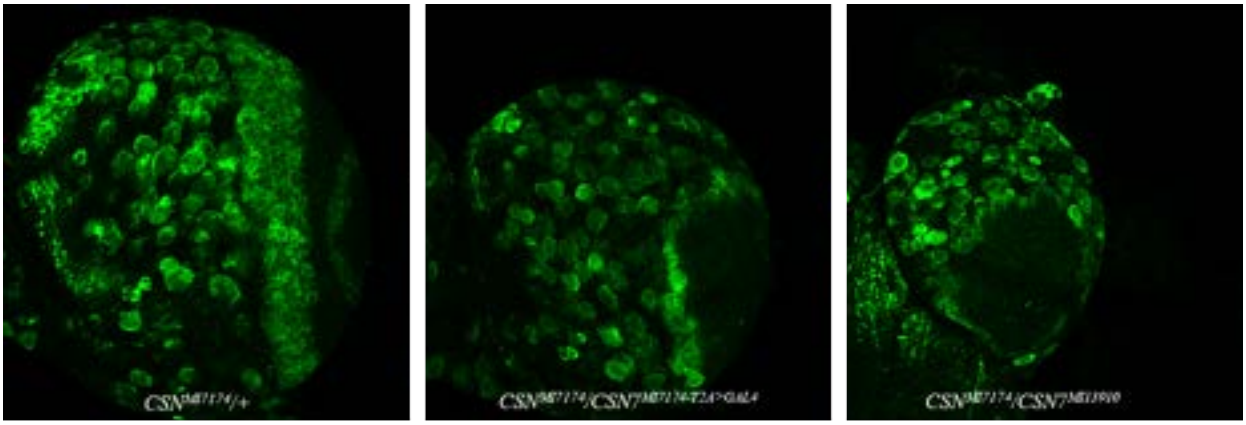
Selected recent publications

- Nandan J and Nagarkar Jaiswal S (2019). Methods for Creating Fly Models to Understand the Molecular Mechanisms Underlying Neurological Diseases. ***Insights into Human Neurodegeneration: Lessons Learnt from Drosophila,*** 37-54.

- Manivannan SN, Pandey P, Nagarkar-Jaiswal S. Flip-flop Mediated Conditional Gene Inactivation in Drosophila. ***Bio-protocol*** 9: e3157.

The presence of an intact and fully developed nervous system is essential for the survival and proper functioning of animals. Central to the development of such a complex and highly organized system are multipotent stem cells known as Neural Stem Cells (NSCs). By contrast, in adults, the vast majority of adult NSCs are relatively quiescent, and only a fraction of them divide rarely to ensure replacement of damaged cells. NSC self-renewal, quiescence and differentiation are highly regulated processes. Any defects in these processes lead to neurodevelopmental disorders such as microcephaly, autism, epilepsy and brain tumor. Therefore, to develop therapeutic approaches to these inherited or acquired disorders, it is important to understand the cellular processes underlying NSC biology.

In recent past, we performed genetic screens and isolated several genes that are enriched in NB, and whose loss leads to defects in brain development (Fig). These genes are evolutionarily conserved and have been implicated in several neurological diseases such as Down syndrome, Alzheimer's and Parkinson's diseases, but their function in brain development is unclear. Currently, we are focusing on three genes that were isolated from the screen: (1) CSN7, a subunit of COP9 Signalosome, (2) CG32069, a homologue of human Immediate Early Response 3 Interacting Protein 1 (IER3IP1) and (3) CG12050, a homologue of human WDR75. Knockdown of all three leads to a small brain phenotype indicating that these are crucial for brain development. We aim to uncover the roles of these genes in *Drosophila* NB and hNSC maintenance using a series of targeted genetic manipulations.



***Drosophila* larval brains (72 hours ALH) from control (left) and *CSN7* mutants (middle and right) exhibiting small brain phenotype. Brains are stained with anti-Miranda antibody**

SREENIVASULU YELAM

Plant Developmental Biology

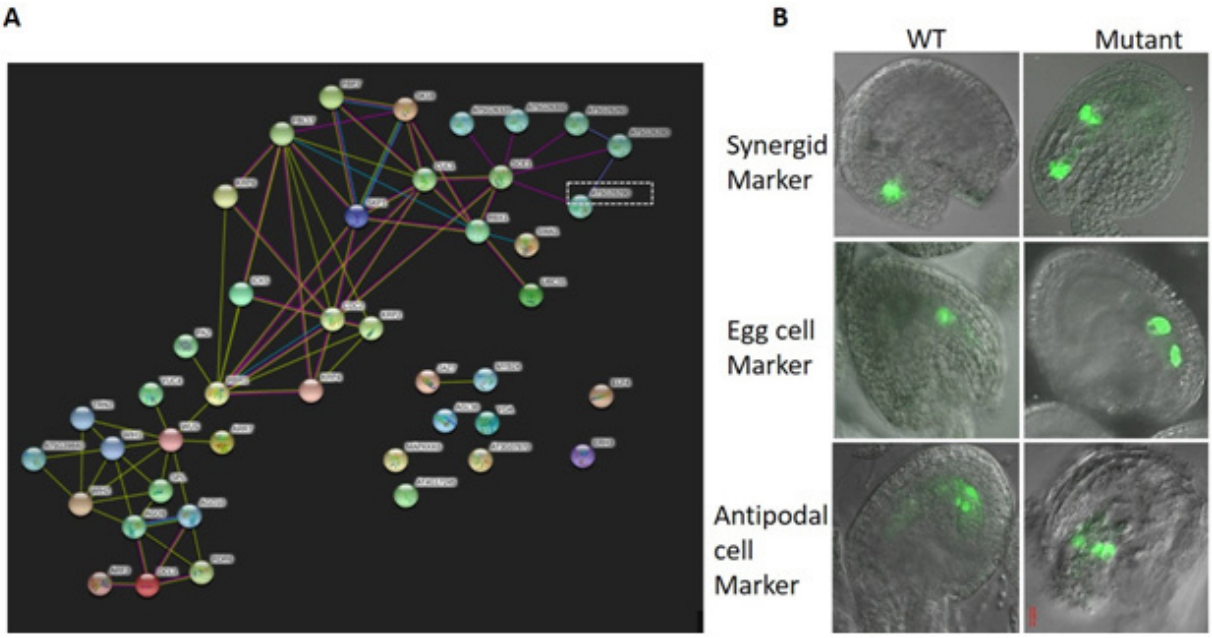
From left to right, starting from top: P. Malathi, G. Bhargavi, A. Venkateswara Rao A. Subbaiah, V. Vijaya Bhaskar, Y. Sreenivasulu

Research interests

- Sporophyte to Gametophyte Transition (SGT) in plants
- Gametogenesis and gamete specification
- Polyembryony in *Arabidopsis*

In continuation to the characterization of the role of TRAMGaP in reproductive development of *Arabidopsis*, we tried to identify its role during sporophyte cell to germ cell transition. Possible TRAMGaP interactions with different known gametophyte development related genes were assessed by using interactome analysis. It was found that this gene has interaction with RBR1, WUS, SPL, AGO9, RDR6, through SCE1, CUL1, SKP1 and other kinases (Fig. 1A). Microarray analysis of TRAMGaP showed down-regulation of reproductive development related genes including RNA-mediated development pathway genes (AGO9, RBR, MEI, AML etc.), CRL complex related, ovule and pollen development related, lipid and hormones related genes in the Attramgap mutant. Functional validation of these interactions are underway.

We also characterized the role of Pectin Methyl Esterase Inhibitor (AtPMEI) during embryo sac development in *Arabidopsis*. Mutation in this gene causes defects in female gamete specification which leads to significant seed sterility.This was also further confirmed by gamete specific marker gene expression in this mutant back ground (Fig. 1B). Functional supernumerary egg cells were observed in the embryo sacs of this *Atpmei* mutant, which resulted in polyembryony. Our results provide novel information on female gametogenesis and gamete specification in plants.



A. Interactome analysis of TRAMGaP (At5g26290) with different known gametophyte development related genes, B. Gamete specific marker genes (DD31: GFP-synergid; DD45: GFP-egg cell; DD1: GFP-antipodal) expression in AtEPMEI mutant. Supernumerary egg cell was observed in egg cell marker line expression.

SUNIL KUMAR VERMA

Molecular Biology Applications in Wildlife Conservation and Plant Forensics

From left to right: Sunil Kumar Verma, Lakshami Narayan, K. Vinoth Kumar

Research interests

- Signal transduction in human health and disease conditions
- Molecular evolution of genes and species
- Wildlife forensics and plant forensics

Selected recent publications

- Rai N, Verma SK, Gaur A, Iliescu FM, Thakur M, Golla TR, Chandra K, Prakash S, Tabasum W, Ara S, Singh L, Thangaraj K and Jacobs GS (2020). Ancient mtDNA from the extinct Indian cheetah supports unexpectedly deep divergence from African cheetahs. ***Scientific Reports*** 10: 4618.
- Verma SK and Biswas N (2020). A novel nucleic acid extraction method from aromatic herbs and dried herbal powders using cow skim milk. ***Scientific Reports*** 10: 11513.

Authenticity of dried aromatic herbs and herbal powders for ASU (Ayurvedic, Siddha, Unani) drug formulations is a key to their clinical success. The DNA based authentication is an answer; however, extraction of PCR quality DNA from such material is often problematic due to the presence of various co-extracted PCR inhibitors. In the current year, we developed a novel DNA isolation and purification method utilizing cow skim milk that successfully yields PCR quality DNA from the aromatic herbs and dried herbal powders. The improved method presented in this study could be used as an alternative to successfully extract PCR quality DNA from such plant materials. Further, we developed and verified a set of robust *matK* primers which could be used as plant barcoding resource in future studies.

In another study, we had delineated nearly complete mitochondrial (mt) DNA sequences of Indian cheetah museum specimen and two African cheetahs, one modern and one historic, imported into India at different times and based on their phylogenetic analysis. This work revealed for the first time that Indian cheetahs unexpectedly have a deep divergence from African cheetahs. Our results suggest that the most recent common ancestor of cheetah mtDNA is approximately twice as ancient as currently recognised. The Indian and Southeast African (*Acinonyx jubatus jubatus*) cheetah mtDNA diverged approximately 72 kya, while the Southeast and Northeast African (*Acinonyx jubatus soemmeringii*) cheetah mtDNA diverged around 139 kya. Additionally, the historic African cheetah sampled from India proved to have an *A. j. jubatus* haplotype, suggesting a hitherto unrecognised South African route of cheetah import into India in the 19th century. These studies provide a deeper understanding of the relationships between cheetah subspecies, and have important implications for the conservation of *A. j. venaticus* and potential reintroduction of cheetahs into India.

Dried herbs included in this study

SWASTI RAYCHAUDHURI

Proteotoxicity in Age-related Diseases

From left to right, starting from top: Swasti Raychaudhuri, Shivali Rawat, Shemin Mansuri, Harshit Vaish, Pooja Gupta, Suparna Ghosh, Richa Singh, Sravani Pollepalli

Research interests

- Coordination of the proteins towards a functional proteome
- Defence-mechanisms in the face of proteotoxic events

Selected recent publications

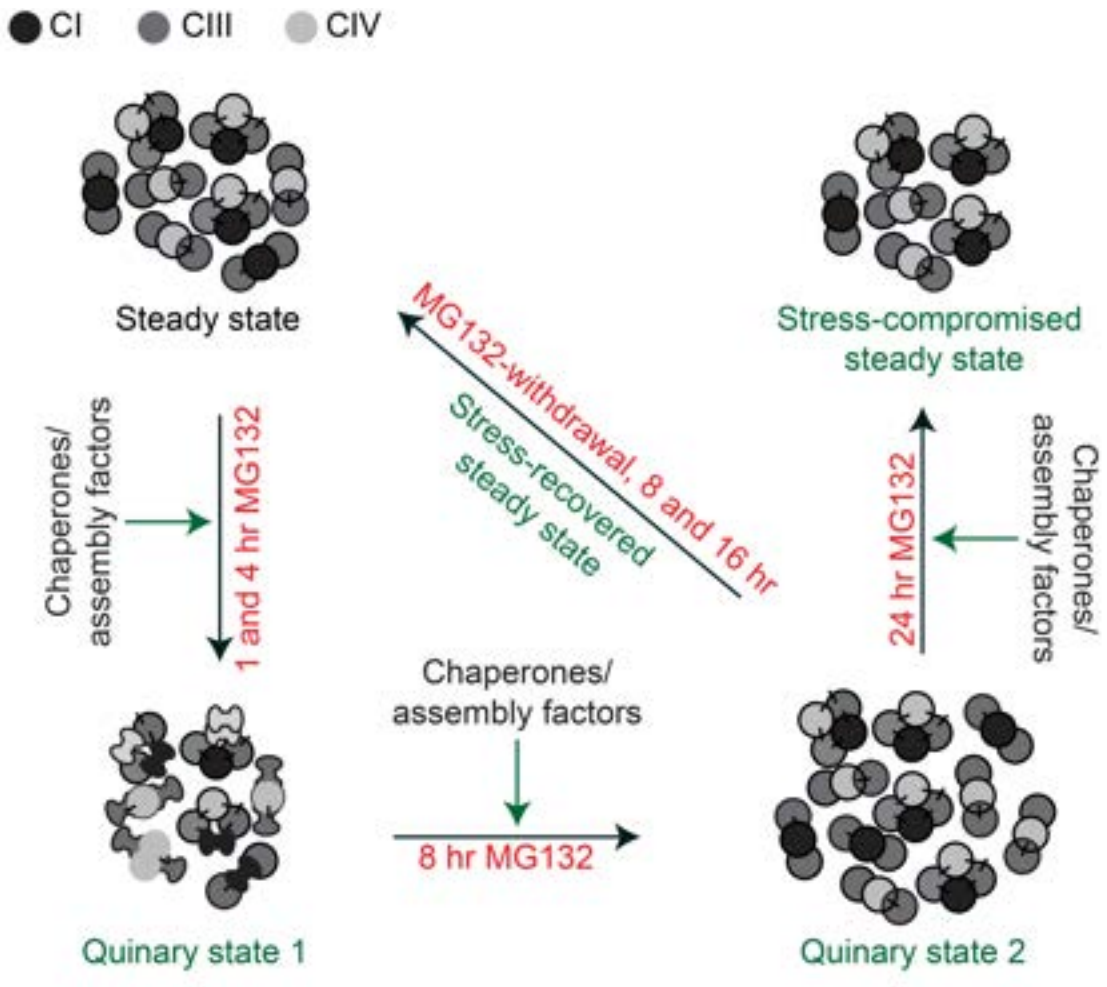
- Rawat S, Anusha V, Jha M, Sreedurgalakshmi K and Raychaudhuri S (2019). Aggregation of Respiratory Complex Subunits Marks the Onset of Proteotoxicity in Proteasome Inhibited Cells. ***Journal of Molecular Biology*** 431: 996-1015.

Proper folding and solubility are two major determinants of protein function. Any physicochemical stress that can perturb protein-conformation is capable of triggering protein aggregation. Proteostasis-damage corresponds to chronic form of stress that results in continuous accumulation of protein aggregates. It remains unknown whether widespread protein-aggregation in many age-related diseases is stochastic in occurrence or initiated by the instability of a specific group of proteins, dictated by their physicochemical signatures or cellular function.

Using quantitative proteomics and microscopy we find that nuclear-encoded Respiratory Complex (RC) subunits readily form aggregates when over-accumulated due to multiple proteostasis stresses. Intrinsic instability of these subunits is determined by diverse physicochemical-signatures including low complexity regions (LCRs) at N-termini. Further, we found that formation of diverse higher order Respiratory Complexes (RCs) is favoured over free RC-subunits and sub-complexes to achieve optimum performance in response to proteostasis-stresses. We named this dynamic post-translational

defence mechanism as 'improved Supra-organization of Respiratory Complexes' (iSRC). We find that partially unfolded quinary-state RC-ensembles at early-stress state promote consolidation of native-like interactions and steady state stoichiometry of RC-supra-organizations with time (Fig).

Simultaneously, we are using α-Synuclein (SNCA) expressing cell-culture models to understand the mechanism of proteotoxicity in protein-misfolding diseases. We have found that nuclear deformity, and thereby aggregation of nuclear proteins, is an early proteome destabilizing event in SNCA-expressing cells. Aggregation of nuclear proteins does not trigger toxicity in cell culture but reduces proliferation. Currently, we are investigating the mechanism deregulating nuclear protein homeostasis in these cells.



Model depicting different states of iSRC - five distinct states of SCs observed. Steady state: cells grown in normal culture conditions in absence of MG132 (proteasome inhibitor). SCs are attributed to literature described stoichiometry - SC (I+III2+IV), (I+III2) and (III2+IV). Quinary state 1: Partial disintegration of SCs during early-MG132 (5 μM, 1 and 4 hr) as revealed by both iBAQ and SILAC. Excess CIV in SCs indicates non-steady state stoichiometry. Conformational flexibility as probed by limited proteolysis. Optimized catalytic activity. Quinary state 2: 8 hr MG132. Increased SC-quantity as revealed by both iBAQ and SILAC. Excess CIV in SCs indicates non-steady state stoochoimetry. Optimized catalytic activity. Stress-compromised steady state: 24 hr MG132. Overall drop in SCs, HCs and SubCs as revealed by SILAC. Relative protection of SCs over SubCs as reveale by i BAQ. Re-establishment of steady state stoichiometry. Optimized catalytic activity. Stress-recovered steady state: MG132 withdrawal. Restoration of steady state abundance of SCs as per SILAC. Steady state stoichiometry as per iBAQ. Optimized catalytic activity.

TUSHAR VAIDYA

Molecular Analysis of Host-Pathogen Interactions

From left to right: Satyajeet, Tushar Vaidya, Devi Prasad, Pradyumna, Ram Prasad

Research interests

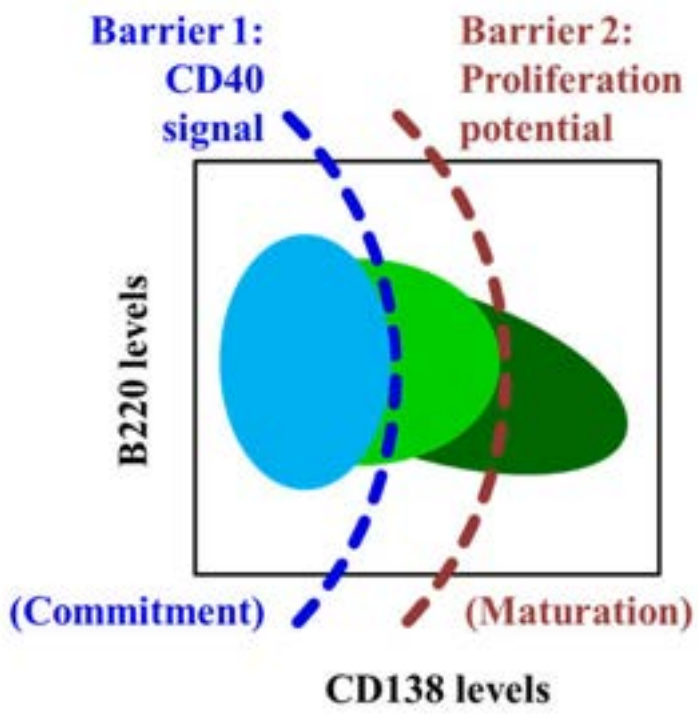
- Generation of immune memory
- Virulence mechanisms in *Leishmania*
- Regular of Gene expression in *Leishmania*
- Host immune responses to parasitic infections

Selected recent publications

- Satyajeet Salunkhe and Tushar Vaidya (2020). CD40-miRNA axis controls prospective cell fate determinants during B cell differentiation. ***Molecular Immunology Elsevier*** Manuscript accepted (In Press).

Several members of the group have been studying the generation of immune memory in B lymphocytes. Our focus has been on the role of CD40 mediated events (akin to T cell mediated help, *in vivo*) in the generation of immune memory in B lymphocytes. Previously we have described how CD40 signal moves naïve B cells into an intermediate state that is neither naïve nor plasma cell. Our analyses of this intermediate "memory-like state" suggests that both CD40 signal and the proliferative status of the B cell are key determinants of B cell differentiation. Additionally, we have investigated the CD40 mediated signals that mediate changes in naïve B cells. Our experiments have established the existence of a CD40-miRNA axis controlling determination of cell-fate in B lymphocytes.

Additionally, we are also investigating the regulation and function of key genes in *Leishmania donovani*, a significant protozoan pathogen, endemic to India. We have categorized META1 as a potential druggable target, given its involvement in virulence, secretory processes, and morphological integrity of *Leishmania*. Additionally , we have identified a pair of paralogs, DRG1 and 2 (Differentially Regulated Genes) which are evolutionarily conserved across Kinetoplastids, differing from each other at just three specific positions in their encoded proteins and yet exhibiting distinct gene expression and regulation, protein stability and cellular localisation.



Regulation of B cell differentiation. B cells undergo terminal differentiation to become plasma cells. During this process, they progressively accumulate CD138 and lose B220 from their surface. We identified that engaging CD40 signalling restricts the commitment to differentiate (light blue → light green), whereas, the proliferation potential of cells hinders the maturation of differentiation (light green → dark green).

VEGESNA RADHA

Signaling and Regulation of Cell Fate

From left to right: Ch. Ramulu, Bh. Muralikrishna, V. Radha, Divya Sriram

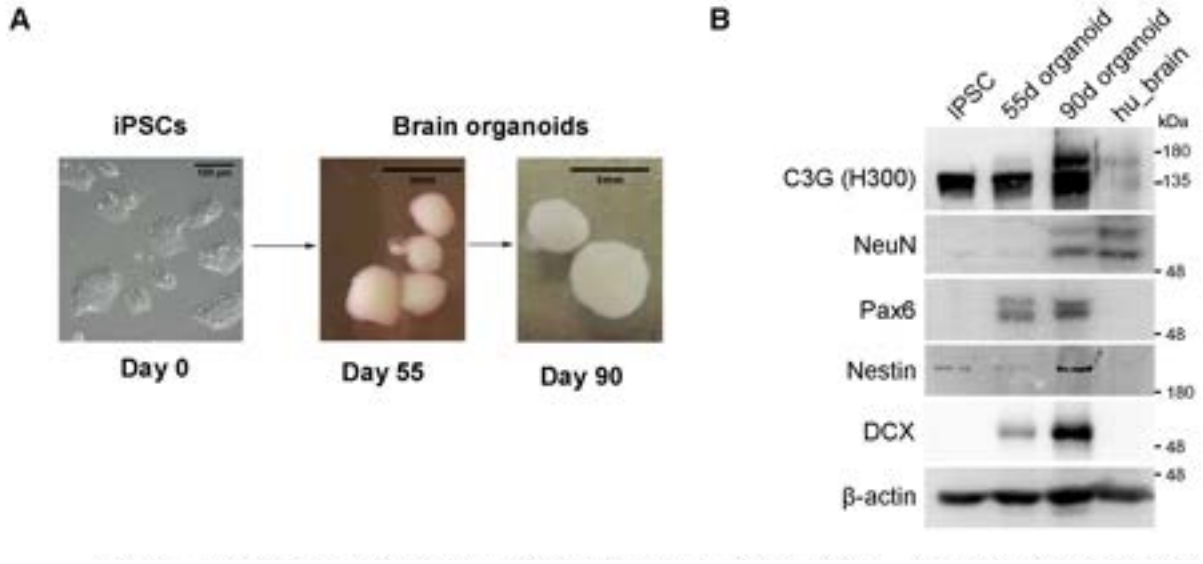
Research Interests

- Characterizing regulatory molecules of intracellular pathways leading to differentiation and cell death, to understand regulation of fundamental processes and pathological situations caused by deregulation

Selected recent publications

- Raghawan AK, Ramaswamy R, Radha V, Swarup G. (2019). HSC70 regulates cold-induced caspase-1 hyperactivation by an autoinflammation-causing mutant of cytoplasmic immune receptor NLRC4. ***Proceedings of the National Academy of Sciences of USA*** 116: 21694-21703.

During the year, our focus was on the Guanine nucleotide Exchange Factor, RapGEF1 (C3G), which is essential for mammalian embryonic development and many cellular functions in adult tissues. We identified novel properties that explain the essential role of RapGEF1 in regulating cell fate decisions. Significantly, we showed that RapGEF1 interacts with cenexin, an appendage protein of the mother centriole, and shows dynamic centrosomal localization. It functions to maintain centriole number and cilia length. These functions depend on the catalytic activity of RapGEF1. We demonstrated that in the adult human and mouse brain, an alternate longer isoform of RapGEF1 is predominantly expressed, and the form expressed in other tissues is lost during brain development. Cerebral organoids grown from iPSCs, showed switch in C3G isoform expression during development of the human brain. We identified a novel function of RapGEF1 as a negative regulator of GSK3β, a property important forits ability to induce tissue differentiation. A GSK3b interaction domain (GID) was identified in RapGEF1. Multiple GSK3b phosphorylation sites (primed as well as unprimed) were identified in RapGEF1. Our findings explain why loss of RapGEF1 causes early embryonic lethality, and suggest that mutations in RapGEF1 may cause developmental defects called ciliopathies in humans. We have identified heat shock proteins as regulators of inflammasome activity in response to sub-normal temperatures, and elucidated the molecular mechanism of cold induced auto-inflammation caused by NLRC4 mutations. These findings enhance our understanding of normal cell functions at a molecular level and how deregulation causes pathology.



Generation of human brain organoids from iPSCs, and demonstration of differentiation-dependent expresssion of a novel C3G isoform. A. Organoids grown from iPSCs (Day 0) to form cerebral tissue (days 55 & 90) B. Expression of C3G in human cerebral organoids. A higher molecular weight isoform is expressed as organoids mature. Adult human brain tissue was used for comparison. Expression of neuronal precursor markers (Pax6, Nestin and DCX), and marker of mature neurons (NeuN) is shown.

VENKAT CHALAMCHARLA

Transcription and Chromatin Regulation

From left to right, starting from top: Venkat Chalamcharla, Anubhav Bhardwaj, Harsh Kapoor, Annapoorna KP, Mamta Nirmal, Shreya

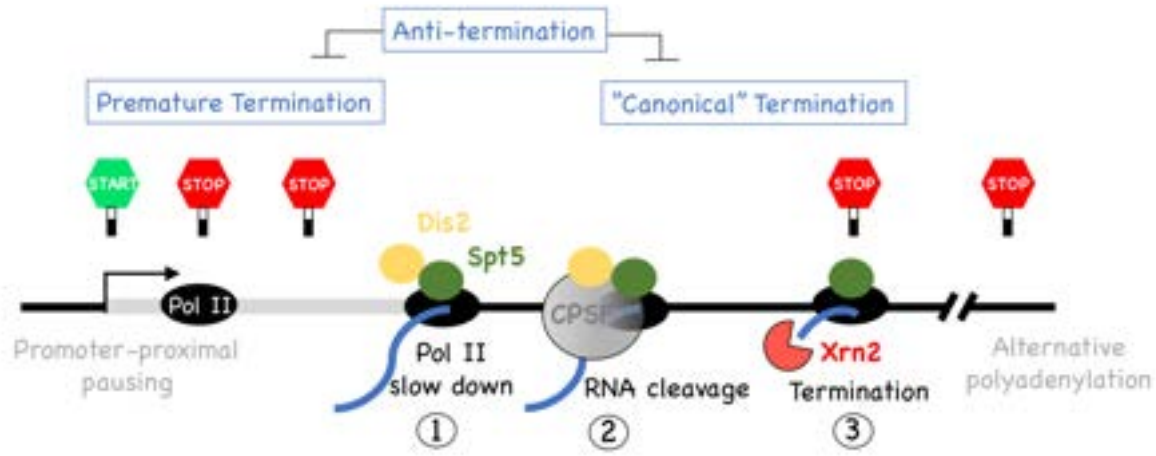
Research interests

- Regulation of transcriptional elongation and termination for gene control in non-dividing and dividing eukaryotic cells, using the fission yeast *Schizosaccharomyces pombe* as a model organism

Gene regulation is a fundamental problem in biology. Cells respond to a wide-range of developmental and environmental signals by reprogramming transcription and gene expression. In eukaryotes, transcription by RNA Polymerase II (Pol II) is a discontinuous and a highly regulated process, determining both gene output and gene isoforms. Promoter-proximal Pol II pausing and premature termination is a widespread phenomenon, although the underlying mechanisms are poorly understood. Likewise, Pol II pausing and termination at gene ends are of paramount importance to generate functional mRNAs, but are somehow regulated to either produce different mRNA isoforms in a process called alternative polyadenylation (APA) or to interfere with the neighboring gene expression. Termination defects and transcriptional mis-regulation are observed in a broad range of human genetic diseases, including cancer, neurodegenerative disorders and cardiac hypertrophy.

Using the yeast *Schizosaccharomyces pombe* (a simple eukaryote) as a model organism, our current objectives are to understand (1) how transcriptional exit (elongation-termination transition) is signaled at gene ends with canonical polyadenylation signals, and (2) the fundamental conflict between the termination and anti-termination mechanisms, which determines where to terminate Pol II.

In addition to studying the proliferating cells, we are also investigating the transcriptional control mechanisms in the 'quiescent' non-dividing cells (also called the G0 phase of the cell cycle). Active maintenance of the quiescence gene-expression program, and transcriptional reprogramming to prioritize cell growth in response to a wide-range of mitogenic signals, governs the remarkable longevity of quiescent G0 cells. Advances in fundamental understanding of cellular quiescence will benefit several fields relevant to human health, such as stem cell biology and cancer biology.



Schematic on the mechanism and regulation of transcription termination by RNA Polymerase II for gene control in non-dividing and dividing eukaryotic cells

YOGENDRA SHARMA

Calcium Signaling via Calcium-binding Proteins

From left to right, starting from top: Yogendra Sharma, Syed Sayeed, Phanindra, Venu, Aditya, Asmita, Radhika, Amrutha, Uday Kiran

Research interests

Calcium signaling via calcium-binding proteins:βγ-Crystallin superfold and Ca2+-binding, Secretagogin, and pathophysiology.

Selected recent publications

- Chidananda AH, Sharma AK, Khandelwal R and Sharma Y (2019). Secretagogin binding prevents α-Synuclein fibrillation. ***Biochemistry*** 58: 4585-4589.
- Sharma AK, Khandelwal R, Mahesh Kumar MJ, Sai Ram N, Amrutha HC, Raj TA and Sharma Y (2019). Secretagogin regulates insulin signaling by direct insulin binding. ***iScience*** 21: 736-753.
- Krishnan B, Srivastava SS, Sankeshi V, Garg R, Srivastava S, Sankaranarayanan S and Sharma Y (2019). βγ-Crystallination endows a novel bacterial glycoside hydrolase 64 with Ca2+-dependent activity modulation. ***Journal of Bacteriology*** 201: e00392-19.
- Pawar AD, Kiran U, Raman R, Chandani S, Sharma Y (2019). Abundant Perithecial Protein (APP) from Neurospora is a primitive functional analog of ocular crystallins. ***Biochemical and Biophysical Research Communications*** 516: 796-800.
- Kiran U, Kreutz MR, Sharma Y, Chakraborty A (2019). Tryptophan Scanning Mutagenesis of EF-Hand Motifs. ***Methods in Molecular Biology*** 1929: 567-581.
- Sharma AK, Khandelwal R and Sharma Y (2019). Veiled Potential of Secretagogin in Diabetes: Correlation or Coincidence? ***Trends in Endocrinology and Metabolism*** 30: 234-243.
- Sharma AK, Khandelwal R and Sharma Y (2019). Secretagogin Purification and Quality Control Strategies for Biophysical and Cell Biological Studies. ***Methods in Molecular Biology*** 1929: 551-566.

My group focuses on understanding the properties of Ca2+ binding proteins from different domains of life. In the bacterial systems, we were instrumental in the discovery and establishment of a novel Ca2+ binding protein super family, i.e., βγ-crystallins. In collaboration with Dr. Sankaranarayanan's group, we have elucidated the functional significance of association βγ-crystallin domain with a predicted enzyme, belonging to the Glycoside Hydrolase 64 family from *Clostridium beijerinckii*. Ca2+ binding to βγ-crystallin domain modulates the glycolytic activity of this protein. In all likelihood, the interface between the βγ-crystallin and the glycosyl hydrolase domains is responsible for bringing about Ca2+ sensitivity to the enzyme. Under the broad interest of regulation of Ca2+ functions in eukaryotes, we have been studying the roles of Secretagogin (SCGN), which is a β-cell enriched, moderate affinity Ca2+ sensor, and has emerged a multifunctional protein of neuroendocrine cells. We have shown that SCGN binds insulin physically and potentiates insulin's action in vivo, which prompted us to explore the potential therapeutic use of SCGN as an insulin sensitizer. The administration of exogenous SCGN preserves insulin sensitivity in diabetic mice and reduces fat accumulation, deciphering a function of extracellular SCGN. We have shown that SCGN physically binds α-Synuclein and rescues it from detrimental fibrillation. SCGN treatment significantly reduces the cytotoxicity of α-Synuclein fibrils in neuronal cell lines correlating with reduced hippocampal SCGN expression in Alzheimer's disease mouse model and postmortem brains of Alzheimer's patients. SCGN appears to impart broader neuroprotection via proficient chaperone action.

1.1B Research Facilities

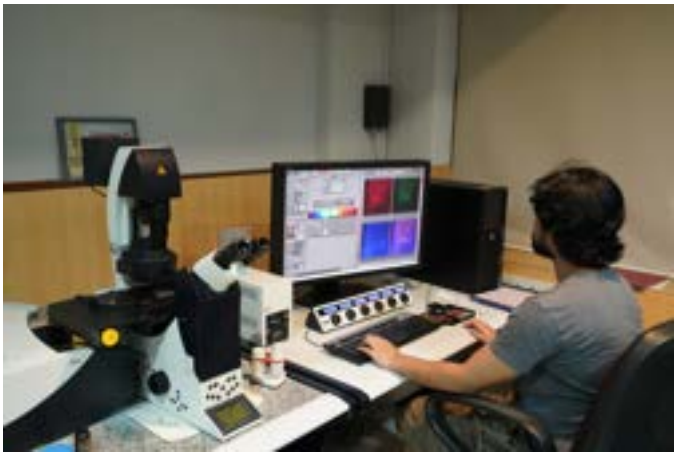
Advanced Microscopy and Imaging Facility (AMIF)

Confocal Microscopes

Models: Leica TCS SP8, Zeiss LSM 880, Olympus FV 3000

Confocal microscope scans specimens in the XY-plane alongwith the Z-plane thus allowing data collection in 3D. The users are provided with additional computers and suitable software for data analysis while the main systems are being used for data acquisition. This facility uses inverted microscopes with various objectives and receives illumination from various laser lines (405, 458, 477, 488, 514, 532, 543, 561, 594 and 633 nm). The systems are provided with facilities for scanning and analysis of single and multi- labeled samples combined with DIC, 3D reconstruction, kinetic analysis, ratio analysis, spectral analysis, Fluorescence Recovery after Photo bleaching (FRAP) and Fluorescence Resonance Energy Transfer (FRET).

- The Leica SP8 has three PMT detectors and additional two hybrid detectors which can scan weak samples and perform photon counting.
- The Zeiss LSM 880 is a high resolution confocal microscope having both PMT and GaAsP detectors. In a classical confocal microscope, the pinhole is set at 1 AU which improves resolution by a factor of 1.06. The resolution can be further increased by making the pinhole smaller but the signal to noise ratio drops significantly.



- The Zeiss Airy Scan LSM880 microscope is a high resolution confocal microscope which has a hexagonal microlens array that connects to a linear GaAsP detector which collects all light of an airy disk simultaneously. Each detector element functions as a single very small pinhole of 0.2 AU. This enables highly efficient maging by making use of all the photons collected by the objective. This gives a resolution of 140 nm laterally and 400 nm axially even in thicker and denser samples i.e. a 1.7x higher resolution in all three spatial dimensions (compared to normal confocal imaging which gives about 250 nm lateral and ~500 nm axial resolution).
- The Olympus FV 3000 is a live cell Laser Scanning Confocal microscope for real-time imaging with solid state lasers and GaAsP detectors. It also has an additional thermostated chamber for maintaining samples at temperatures ranging from ambient to 40°C with continuous supply of CO2 attachment for live cell imaging for long periods.

Atomic Force Microscope (AFM)

Model: Nanonics Imaging Ltd (Multiview 1000)

Atomic force microscope (AFM) is a high-resolution scanning probe microscope which measures the forces between the tip of a probe and the sample surface with piconewton sensitivity and a topographic image of the sample surface is obtained.

Samples that can be analyzed by AFM: Biological assemblies as diverse as multi subunit enzymes, viral capsids, bacteria, biofilms, molecular nets, ribosomes, nucleosomes, biological membrane components, protein aggregates, amyloids and organic/inorganic nanomaterials.

Scanning Electron Microscope

Model: Hitachi S3400N

Scanning electron microscopy (SEM) uses a finely focused beam of electrons in order to produce a high resolution image of the surface structure of a sample by detecting the secondary electrons resulting from interactions of the electron beam with atoms at various depths within the sample.

Samples that can be analyzed using SEM: Nanomaterials, bacteria, normal and tumor cells, organic and inorganic materials, dental and bone implants among others.

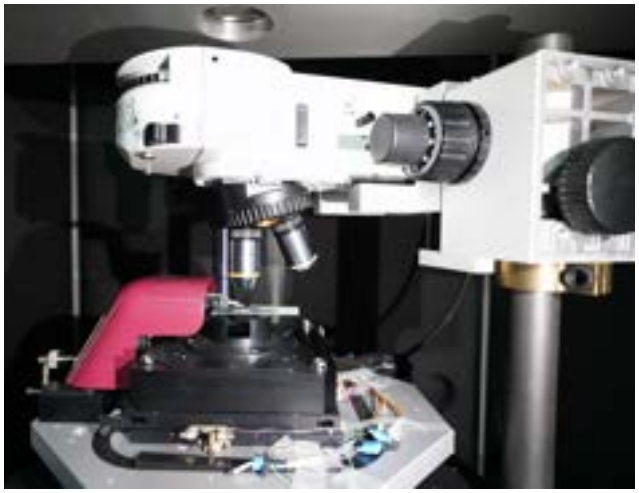
Raman Spectroscopy and Raman Rapid Imaging

Model: RENISHAW InVia Raman Microscope

In Raman spectroscopy, the sample is illuminated with a monochromatic laser beam (532 nm, 633 nm and 780 nm) and the Raman spectrum is obtained from the resultant inelastic scattered light intensity, as a function of frequency shifts. From the characteristic Raman frequencies the chemical composition of a sample can be obtained.

Raman rapid imaging is done using Stream Line technique by acquiring data from different points on the sample to generate maps based on parameters of resulting spectra.

Samples that can be analyzed using Raman Microscope: Biofluids, fixed and live cells, thick tissue specimens, bacteria, plant materials, drugs, semiconductors, nanomaterials, polymers, proteins, organic and inorganic compounds.



From left to right: A Harikrishna, Suman Bhandari, A Ramesh, N.R. Chakravarthi, C. Subbalakshmi and Nandini Rangaraj

Bitplane Imaris 8.4.2, Zen Black and Marianas Light Sheet Software for Image Analysis

The softwares allow one to do deconvoluton, 3D volume or mixed model rendering of the optical sections acquired from the different microscopes and can also generate movies. It can perform 3D counting and measurements as well.

Apart from above advanced microscopes, the facility also has the following fluorescence microscopes.

Universal Research Microscope Model Axioplan 2 Imaging with Film and Digital Cameras

This is an excellent manual microscope suitable for fluorescence, bright field, phase, DIC, dark field applications. The AxioVision software for capturing images with CCD camera has a number of facilities like capturing images both in black & white and colour, image export or import, enhancement, annotations, archiving and multi-channel acquisitions.

Axioimager Z2: Fluorescence Imaging System with Fully Motorized Microscope

This is an advanced system with fully motorized microscope for imaging both, black and white and color images and also acquire Z-sections. A color camera for unstained samples and a monochrome digital camera for capturing images of fluorescent samples are the attachments which are also controlled by the inbuilt software.

Apotome Fluorescence Imaging system with Fully Motorized Axioimager. Z1 Microscope and Monochrome Digital Camera

This is a highly sophisticated and motorized fluorescence microscope with DIC attachment. The system is used to observe the biological specimens with fluorescence technique and acquire Z-sections at good resolution. The system works on structured illumination principle to get high quality images and is capable of acquiring images on both DIC and fluorescence. The optical tomography technique uses optical grid for structured illumination. The images are analyzed using Zen software.

Live Cell-Imaging System

This system is capable of acquiring images of live cells (fluorescence and bright field) in petri-dishes or 96-well plates over a period of time. It also has a temperature controller, mini-CO incubator to keep the cells in live conditions for long time intervals. The system has been used for multi-channel acquisition and time-lapse imaging.

Advanced Fluorescence Zeiss AxioZoom V16 Stereo Microscope with Apotome

This is a high resolution stereo microscope with optical sectioning using the structured illumination principle having a color camera and a monochrome camera for fluorescent samples. The system can be used for fluoroscence, bright field and DIC imaging with a zoom ratio of 16. It can be used to scan *Drosophila*, zebrafish, plant samples and 96-well plates. Tile scans can also be done on the system. 3D reconstruction is a part of the Zen analysis software.

Animal House

The CCMB Animal House (AH) has been registered under CPCSEA [Committee for the Purpose of Control and Supervision of Experimental Animals], Ministry of Animal Husbandry & Dairying, Government of India in the year 1999 (Registration number is 20/GO/RBi/S/99/CPCSEA) for the purpose breeding of mice, rats, rabbits, hamsters and guinea pigs for research (both in-house and external).

Main objective of animal house is to supply genetically defined strains of mice, rats and rabbits to CCMB's scientific community as per strict regulation from CPCSEA, Government of India. All animal house activities are regulated by ONTEXA [Online Indenting System for Experimental Animals] software in which PI can raise the online animal request as per Institutional Animal Ethical Committee (IAEC)-approved project for supply of animals. ONTEXA serves as a inventory platform to regulate animal census, mortality, animal production and supply details and also is a monitoring platform to generate the data of microbial, genetic monitoring with micro-environmental parameters in the animal rooms such as temperature and relative humidity. CCMB AH also provides orientation and training programmes to authorized animal house users (students & project staff) to maintain high standards of humane, ethical and responsible use of animals in their research. Animal facility maintains 56 strains of various inbred, outbred mice including different transgenic & knockout mouse models, immuno-compromised (nude & SCID) mice, two strains of rats, one strain of hamster and one strain of rabbit. All the mice and rat colonies are housed in individually ventilated caging system (IVCs) where air supply is filtered through a HEPA filter system. All animal rooms are environmentally controlled and monitored for temperature, humidity and automatic lighting system to control 12 hr light and dark cycle. The AH team comprises of 2 trained veterinarians and 12 trained staff members who are involved in breeding, in management of various lab animals and in providing technical support to various approved research projects. The total number projects approved for animal experimentation under IAEC in this year are 154. Two of our permanent staff Mr. Alliah, Technician and Mr. Yadagiri, Lab Attendant retired from their service on September 30, 2019.

During this year the following Knockout mice were procured from Jackson laboratory, USA.

Strain Name	Animal Model	Sources
B6,129-Mavstm1Zjc/J https://www.jax.org/strain/008634	Loss of MAVS (mitochondrial antiviral signaling) protein expression in this knock-out strain abolishes viral induction of interferons and prevents the activation of NFKB and IRF3 in multiple cell types, except plasmacytoid dendritic cells. Mice lacking the protein fail to induce interferons in response to poly(I:C) stimulation and are severely compromised in immune defense against viral infection	Jackson Laboratory, USA

Number of animals supplied during this year are as follows:

Mice: 6247 **Rats: 48** **Rabbits: 28**

Cell Culture Facility

The centralized Cell Culture Facility of CCMB caters to the need of all groups in CCMB using cells for their research. The facility maintains a variety of cells for experimental purpose, and provides cell lines, media, serum, plastic-ware and other specific solutions for more than 100 users in CCMB. Experts help in training CCMB staff, students and researchers in cell culture techniques. The facility also serves as a repository for cells, and provides cell lines to various scientific organizations, educational institutions and industries in the country.

The facility is well-equipped with laminar flow hoods, CO2 incubators, inverted microscopes, freezers, cold storage, liquid nitrogen storage facility, FLoid cell imaging system, electroporator & nucleofector, automated cell counters, photo-dynamic therapy instrument, hypoxia chamber among others. A dedicated BSL2 facility is available that permits use of reagents/viruses/human primary cells requiring biosafety measures. The staff is well-trained in maintenance of cell lines, stem cells, organ explant and primary cultures, cell fusion to produce monoclonal antibodies, DNA transfection to establish stable clones and cryopreservation of cells. More recently, platforms for generation of brain organoids have been established. Staff also provides technical help to facility users from various groups in CCMB, as and when required. Around 150 different cell lines are at present being maintained in the facility and are validated to be free of contamination. A short-term training course on Animal Cell Culture for students/faculty members/researchers from universities/ institutes/ industry interested in learning cell culture techniques has been introduced, this year on.

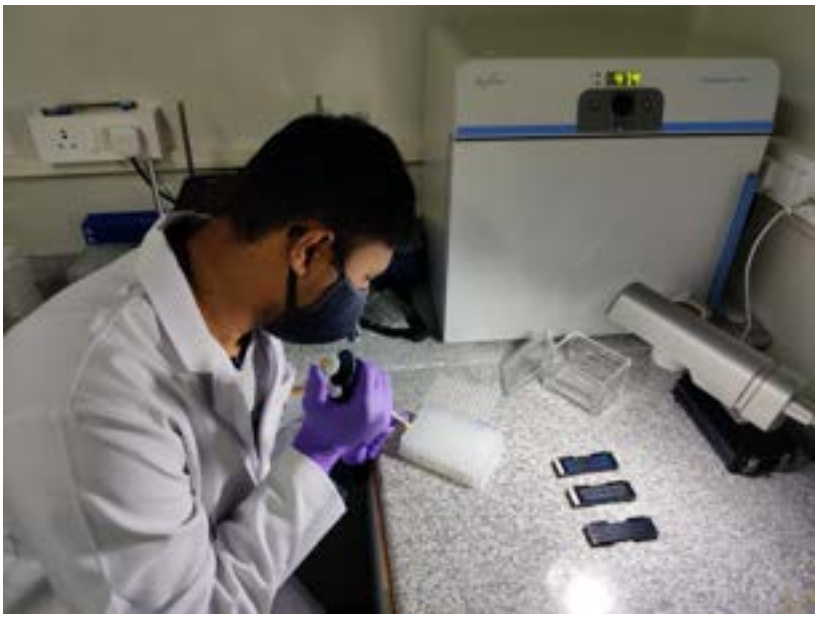
Facility staff:

Ch.Varalakshmi, Zareena Begum, BVV Pardhasaradhi, S Easra, T Dayakar, G. Vidyasagar

DNA Microarray Facility

Microarray is a high-throughput technique for analyzing expression levels of thousands of genes or genotyping large numbers of SNPs in a single experiment. The microarray facility is equipped to do genome wide analysis with applications in basic research as well as in biomedicine and agro-biotechnology. Microarrays (also known as DNA/gene chips) are generated by a technology that integrates molecular biology and information technology.

The facility combines dedicated cubicles for wet lab experiments, data generation and data analysis using high-end computing systems. It houses the Illumina HiScan System for sensitive and accurate imaging of Illumina Bead Arrays for Gene Expression, high throughput Genotyping & DNA Methylation and the Affymetrix Gene Chip System for analyzing Affymetrix Chips related to generating similar kind of data. The entire microarray facility is housed in a dust-free room at CCMB main building. The applications that have been used are largely in the areas of gene expression analysis, microRNA profiling, and genotyping. Gene expression studies have been done with mammalian (Mouse, Rat and Human), plants (Rice and *Arabidopsis*), and insects (*Drosophila*) systems. Similarly, the genotyping studies have been carried out in the area of human population genetics and disease association studies.



Fly Lab

Drosophila melanogaster, the fruit fly is one of the most studied and highly tractable genetic model organisms due to its short life-cycle, low maintenance costs, conserved biology, and available powerful genetic toolbox. About 60% of the protein coding genes of *Drosophila* is conserved in human and from these genes about 75% are implicated in various diseases. Therefore, fly is effectively being used for studying basic biology as well as understanding molecular mechanisms underlying human diseases.

In CCMB, we have a well-established fly lab. We maintain about 1500 different fly strains. Among these, we have strains for ongoing research activities that include studies of body patterning, neural development, behavior, stress, longevity, etc. We also have fly stains for *in-vivo* genome editing (CRISPR and MiMIC) and about 100 different tissue specific GAL4 driver lines. In addition, we maintain fly models for various human diseases including cancer, Parkinson's disease, Alzheimer's disease and neurodevelopmental disorders such as microcephaly. These strains can very well be used for drug screening. The main fly lab is equipped with several stereo microscopes for fly pushing, a fluorescent stereo microscope for transgenic larva/fly sorting, and an Axioplan microscope.

In addition, we have a well-established micro-injection facility, which is being used extensively by the research groups from CCMB and CDFD. We also have a fully equipped behavior room with *Drosophila* Activity Monitoring (DAM) system, T-maze, an equipment used to study learning and memory, and set up for tracking larval locomotory behavior.

We have supporting facilities - Nectar and embryo collection lab. Nectar supplies fly food in vials, bottles and embryo collection plates. This facility is equipped with an automatic fly food preparation and dispensing machine, hot plate with magnetic stirrers, cold cabinets, hot air oven and RO water system for fly food preparation. This facility also helps in cleaning and sterilizing the bottles & aluminum trays to prevent contamination. The embryo collection room is a small nonstop fly reproduction center, which is designed for constant supply of fly embryos. This facility is equipped with large fly cages and collection plates to collect embryos for high throughput experiments.

From left to right, starting from top: Rakesh K Mishra, Rashmi Upadhyay Pathak, Bharathi, Ramachandra, Sabitha, Sreekanth

We also provide services to other universities/ institutes. Students and teaching staff from different national and international universities visit fly lab to get a hands on experience of *Drosophila melanogaster* culture and maintenance. Fly lab also provides flies to different colleges in the city for teaching purposes and various strains to other research institutes in India for research purposes.

This year we have procured seven new microscopes with fiber optics lamps attached with high clearance area. Also, fly lab has undergone a major renovation this year to increase the work benches and space to keep more *Drosophila* culture incubators.

Histology Facility

The Histology Facility at CCMB provides the equipment and technical support for producing high quality tissue sections and staining for microscopy. All histological procedures from tissue acquisition, processing, sectioning, and standard histological, and immuno staining is carried out. Our equipment supports both paraffin-embedded and frozen cryo-sectioning. This facility is equipped with the following instruments:

- Cryomicrotome,
- Rotatory Microtome, and
- Wax embedding station

All other small equipments like water bath, centrifuge, and rotatorque are also available in the facility. The facilities cover the preparation and processing of tissues, their cutting/sectioning and staining. The services offered are:

- Tissue processing for paraffin/frozen blocks
- Sectioning of paraffin/frozen blocks
- H and E, Masson trichome, van Gieson, Toluidine blue, oil red and Alcian blue staining of paraffin sections
- Training in general tissue processing and histology study methodologies

This facility supports a wide range of projects of the research groups at CCMB.

Facility staff: T. Avinash Raj

NMR Facility

Structural Biology

The 600 MHz narrow bore NMR facility was setup in 2009 to study biomolecular structure and function at the physiological condition in the solution. The facility consists of a 600 MHz narrow bore NMR spectrometer equipped with a cryogenically cooled probe. The enhanced sensitivity of the cryoprobe allows *de novo* 3D structure determination of relatively large proteins (MW > 25 kDa) and nucleic acids as well as their ligand-bound complexes at the physiological condition. During 2018-19, we have upgraded the old AVII console with the latest Avance Neo console. The new console allows us to utilize many state-of-the-art NMR experiments including parallel detection of multiple nuclei and non-uniform sampling. The facility is useful to perform structural studies of dynamic biomolecules that are difficult to crystallize (e.g., multi-domain proteins, majorly disordered proteins). The spectrometer is routinely used to derive biologically relevant conformational flexibility of proteins and nucleic acids *in situ*. Some of the important findings derived from the data generated by the facility are:

- The solution structure of RDE-4 (*C. elegans*) elucidated structural modifications in both dsRBDs that were responsible for selecting the trigger dsRNA
- Understanding the RNAi initiation in plants through the solution structure complemented with the structure-based activity assays of DRB4 (*A. thaliana*)
- The solution structure of Crc (~32 kDa and presumably the largest solution structure derived by NMR from India) revealed its non-canonical RNA binding surface responsible for regulating the carbon catabolite repression process
- Understanding the process of enantioselection to elucidate the mechanism of chiral proofreading during protein translation

Over the years, the 600 MHz NMR has become an integral part of CCMB's research activities and has immensely contributed to numerous projects, including studies and design of thermostable lipases, studies on antimicrobial peptides, to study the interaction of intracellular loops of GPCRs with membranes, structure-function relationship of key proteins in *P. falciparum* etc. The data generated by the 600 MHz NMR facility has been used in research articles published from CCMB in several internationally acclaimed scientific journals such as Proc. Natl. Acad. Sci. USA (2010), J. Mol. Biol. (2011), eLife (2013), Biochem. J. (2014), PLoS Biol. (2016), Nucl. Acids Res. (2017).

Micro-imaging and Spectroscopy

The 600 MHz Avance III HD Microimager and Spectrometer is interfaced with a wide bore (89 mm) 14.1 T magnet system. It is equipped with actively shielded micro and mini probes with maximum gradient strength of 150 Gauss/cm, wh ich provides *in vivo* images at micron resolution. The system is equipped with volume coils for *in vivo* imaging and spectroscopic studies with mice and rats. The localized *in vivo* NMR spectroscopy could be carried out from a very small voxel (2X2X2 mm3) in mice brain. Additionally, the spectrometer is equipped with high resolution triple resonance and broadband probes for detection of X-nuclei (13C, 31P, etc) in solution. The current setup is use to study subtle changes in brain atrophy, and understanding neurometabolites, homeostasis and energetics of excitatory and inhibitory neurotransmitters in different
neurological and psychiatric disorders like amyotrophic sclerosis, Alzheimer' disease, Parkinson's disease, depression and addictions. Additionally, the setup is used for the characterization and development of MRI contrast agents.

The microimager/spectrometer caters the requirement of following Groups/users: Dr. Anant B. Patel, Dr. Arvind Kumar, Dr. Jyotsna Dhawan and Dr. A. S. Sreedhar.


AVANCE NEO

Proteomics Facility

The Proteomics Facility at the CCMB provides infrastructure for the identification and characterization of proteins. Mass spectrometry (MS) based proteomics is fast becoming an essential analytical tool for biological scientists. Modern instrumentation and data analysis software can identify and quantify hundreds or thousands of proteins from complex biological mixtures such as cell lysates or body fluids. At CCMB, we are equipped with state-of-the-art chromatography systems and mass spectrometers for LC-MS and LC-MS/MS, along with a wide range of bioinformatic tools for data interpretation and evaluation. The facility provides a range of services, including:

- Intact molecular weight measurement of proteins
- Protein identification from gel bands
- Protein identification from complex mixtures
- Identification of post-translational modifications
- SILAC, iTRAQ, and label-free quantification of peptides and proteins

Our instrument platforms include cutting-edge Q-Exactive-HF, Q-Exactive, Orbitrap Velos, and MALDI TOF/TOF mass spectrometers, coupled to ultra-high performance EASY-nLC 1200 Systems.

We also have multiple High Performance Liquid Chromatography (HPLC) instruments. These analytical instruments are routinely used for separation and quantification of mixture of proteins/chemical compounds derived either from natural products or synthetic processes. HPLC-facility offers viable solutions due to vast choice of stationary phases and mobile phase options. The different modes and choice of detectors allows analysis of a wide range of samples.

In addition to catering internal users in CCMB, we provide mass spectrometry-based proteomics services to external users including many government-funded or private research labs and the biotech industry.

From left to right, starting from top: Swasti Raychaudhuri, C. Sivakama Sundari, V Krishna Kumari, Y Kameshwari, B. Raman, K. Ranjith Kumar

Central Radio Isotope Facility (CRIF)

In India, radioisotopes are produced only in Bhabha Atomic Research Centre (BARC), Mumbai. CCMB procures radio isotopes from BARC and other companies from Europe and US for research work. The radio isotopes can be procured and handled only by the users authorised by Radiological Safety Division (RSD) under Atomic Energy Regulatory Board (AERB). This authorisation is based on the radiological safety status of the institution intending to establish a radio isotope laboratory. For this purpose, it is mandatory that the plan of the radio isotope laboratory is approved by RSD from a radiation safety standpoint. The planning of the radio isotope laboratory depends upon the type of the radioactive materials to be used, its physical from, activity and the type of experiments to be carried out using the radioactive materials.

Based on the above condition, CCMB is accredited by AERB and classified as a Type II radio isotope laboratory. CCMB is authorized to use the following radio isotopes for labeling bio-molecules for research.

In order to handle the radioactivity, special facilities are required to shield the radiation emitted from the radioactive source, and to prevent contamination of the environment by the radioactive materials released during handling and processing. In the Type II research laboratories, the processed activities are medium to high and therefore, the requirements of shielded facilities and personnel monitoring systems are mandatory.

Layout and structure of the radioisotope facility

The facility contains 17 research labs and one radio-iodination lab to handle low level radiation. The facility has one storage room having dedicated lockable freezers. The facility is also equipped with the preparation room, handling room, counting room, dilution and distribution room, auto-radiography room, separate low medium and high activity labs. The floors are covered with linoleum and the walls with strippable paint. Work surface of the laboratory bench is covered with smooth lining.

Based on the above condition, CCMB is accredited by AERB and classified as a Type II radio isotope laboratory.

The radio isotope laboratory is equipped with remote handling tongs, foot-operated dustbins, Pro-pipettes/Remote pipettes (Micro pipettes), Stainless steel sink, Fume hood, Fume hood with filter, Glove box, Face mask, Surgical gloves; the monitoring instruments like G.M. Survey Meter, Contamination monitor, Foot-hand and clothing monitor.

Major activities of the radioisotope facility:

1) Procuring and maintaining the regulatory documents from AERB

2) TLD service

3) Procuring, storage and distribution of radio-isotope chemicals

4) Radio-isotope waste disposal and management-
a) Radioactive waste disposal through sink
b) Through isolated pits
c) Through delay tanks
d) Through incinerator

CCMB is authorized to use the following radio isotopes for labeling bio-molecules for research:

Sl. No.	Isotope	Radioactivity Group	Max. Activity to be handled (mCi/MBq)	Physical form	Type of operation with this isotope
1.	^{3}H	Group IV	50/1850	Simple, organic biomolecule	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation
2.	^{14}C	Group III	5/185	Simple, organic biomolecule	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation
3.	^{45}Ca	Group II	5/185	Inorganic salt	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation
4.	^{51}Cr	Group III	10/370	Inorganic salt	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation
5.	^{125}I	Group III	10/370	Inorganic salt	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation
6.	^{32}P	Group III	100/3700	Simple, organic biomolecule	Simple, wet enzymatic or non-enzymatic chemical reaction; no dry operation

X-Ray Crystallography

Structural biology X-Ray facility provides state-of-the-art resources to elucidate three dimensional structures of macromolecules and their complexes at atomic level. It is equipped with powerful microfocus rotating anode generators: 1) MicroMax™ 007 HF (Rigaku) Cu anode generator with Mar345-dtb image plate detector and Oxford cryosystem 2) FR-E+ SuperBright (Rigaku) dual wavelength Cu/Cr anode generators with R-axis IV++ image plate detector and X-stream cryosystem. FR-E+ system is the most intense home lab source available today for macromolecular crystallography, with focusing optics that can deliver a flux comparable to second generation synchrotron beamlines. Data collected from single crystal diffraction is processed using crystallographic computational software. Molecular-modeling studies are performed using Intel Quad-Core windows and Linux-based workstations, Silicon Graphics (SGI-Fuel) workstations and software that are installed on CCMB server.

High Throughput (HT) Crystallization

A state-of-the-art HT-crystallization facility provides automation of the complete crystallization set-up. Three major components operational are: (i) Alchemist for liquid handling, (ii) Crystallization robotic systems: Mosquito, Oryx 4 and Hydra II-eDrop for crystallization drop setting and (iii) Minstrel III along with two incubators (4°C and 20°C) automated for incubation, storage and inspection of plates for crystal growth. It is supported by dynamic light scattering (DLS), which is a useful tool to diagnose size distribution, stability, and aggregation state of macromolecules in solution prior to crystallization.

For details:
http://www.ccmb.res.in/index.php?view=crystallography&mid=154&id=41

Small Angle X-ray Scattering (SAXS)

X-Ray facility is also equipped with in-house Small Angle X-Ray Scattering (SAXS) System for deciphering physical and structural features of macromolecules in solution. SAXS allows to probe size, shape, quaternary structure and complex formation of molecules without crystallization. It helps in understanding (i) structural parameters [radius of gyration (Rg), maximum Dimension (Dmax), partial-specific volume (Vp) etc], (ii) dynamics of molecules, and (iii) generation of low-resolution shapes of macromolecules.

SAXS facility houses two systems: 1) S3-MICRO Point-Focus system (Hecus X-ray systems, GmbH) with a 50W X-ray source and a Pilatus-100K detector covering a SAXS range between 2000Å and 10Å. 2) BioSAXS-2000 (Rigaku) with 2-D Kratky collimation, mounted on the existing left port of MicroMax™ 007 HF (Rigaku) Cu anode X-ray generator. It is equipped with OptiSAXS Confocal Max-Flux (CMF) for higher brilliance at the sample position and data collection times in the range of minutes. The configuration incorporates an Automatic Sample Changer for unattended overnight operation and an Automatic Analysis Pipeline based on ATSAS package from EMBL, Hamburg.

For details:
http://www.ccmb.res.in/index.php?view=x-rayfacility&mid=154&id=43

Several structural biology projects that are carried out at CCMB and other research institutes / universities outside CCMB are handled at these facilities.


Rigaku
BioSAXS-2000

Zebrafish Facility

State-of-the-art zebrafish facility is equipped with large scale breeding & embryo collection capacities, live feed (artemia) hatching facility and centralized air facility. Advanced automated standalone systems maintain transgenic lines for developmental biology, cell biology and behavioural studies. The facility also houses a high resolution microscopy and imaging system (Model M205 FA) that has motorized advanced stereofluorescence for multichannel fluorescence and bright-field imaging of entire zebrafish. The facility is also equipped with a micromanipulation system and trained staff to help researchers generate transgenic fishes and perform genetic manipulations. A computer aided tracking system (Danio vision with ethovision software) is available to carry research on behavioural aspects of this vertebrate model.

Zebrafish facility caters to the needs of different research groups of CCMB and collaborative projects of institutes such as CDFD and LVPEI. Apart from providing staged embryos and adult fishes for research, we also help users with micromanipulation to generate and maintain desired transgenic fish lines. Recently, an industry collaboration has been initiated with SSS, Sweden and its Indian counterpart to determine the ecotoxicological impact of industrial byproducts which are disposed off in the industrial waste water.

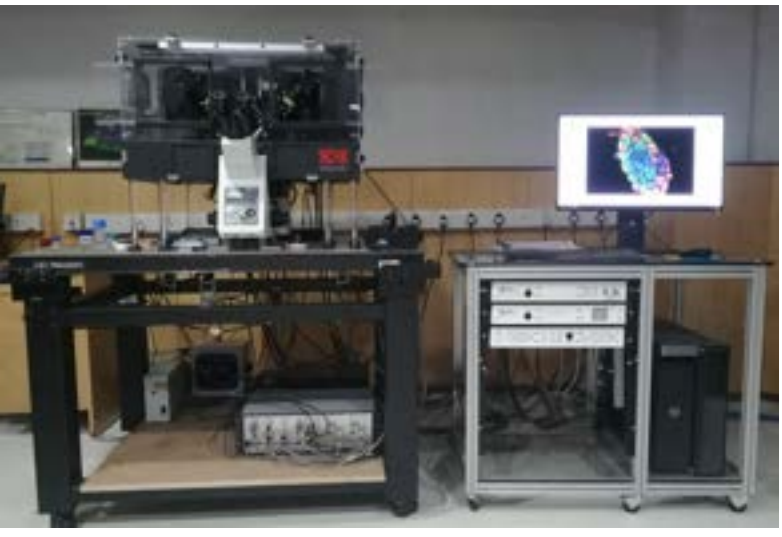
Zebrafish facility provides training and logical support to students from different universities of India and abroad. Facility also offers medium scale testing of various biological potential drug molecules / bioactive agents and developing transgenic fishes. The two week hands- on workshop titled 'CRISPR as gene editing tool using zebrafish' was conducted in March 2020 as part of the Skill Development Program (SDP) conducted by CCMB.

The stock room has been reorganized to house all the stock transgenic lines and wild type strains of the facility. The molecular biology room has been remodelled into light/ dark and temperature controlled room to house adult zebrafish. Each of these housing rooms are equipped with aeration and pump systems.

1.1C
Research Resources

Instrumentation

CCMB has a strong and highly supportive Instrumentation Group which takes care of the installation maintenance and repairs of instruments in house without any maintenance contracts. The group provides technical help to the PI's for the procurement of equipment by way of framing technical specifications and making technical comparisons of bids. Maintenance of UPS and audio-video projection systems is also taken care by the group. The group conducts training programs, on the usage of Instruments with safety instructions, for the new research students during August every year, for the summer students in May and for the other research staff throughout the year. The state-of-the-art facilities are managed, maintained and run without much down-time due to the support and services provided by the group. Further, the group carries out in-house design, development, modification and fabrication of instruments as and when needed and also provides technical advice to other institutes in the procurement and usage of scientific instruments. The group is also involved in the Young Innovators Program where young school children are taught designing small experiments in Electronic and Physics. The group's contribution to symposia, seminars, workshops and other events are multifarious, particularly for audio-video and exhibition arrangements.



Major equipments installed during the year:

- 3i's Marianas Light Sheet Microscope
- Jeol MALDI TOF MS system model JMS-53000
- Ultra-High Performance Liquid Chromatography (UHPLC) system
- Small Angle X-Ray Scattering (SAX) system model BioSAXS-2000
- Extracellular flux analyzer model XFp
- Computer-Assisted Semen Analysis System (CASA)
- Protein purification systems model AKTA Pure 150 M3
- High-end motorized upright research grade fluorescence microscope with optical tomography Model Axio Imager Z2 with Axiocam 503 camera
- Olympus Model IX83 research grade fully Motorized Inverted Microscope with Fluorescence & DIC Attachment
- High speed floor model centrifuge model AVANTI JXN -26
- Olympus model IX-73 inverted fluorescence microscope
- 3 CO_2 incubators
- Stack ble refrigerated Incubator shaker
- 3 refrigerated incubator shakers
- 2 water purification systems
- Semi-automatic front loading horizontal high pressure steam sterilizer
- Carl Zeiss stereo microscope Stemi 508 with Axiocam 305 color camera
- *In vitro* and *in vivo* electroporator

From left to right, starting from top: Nagaraj, Ramesh, B Janardhan Rao, D Chithari, D Thirumal Rao, Syam, Venkat, Sudatt, Mahesh, Asha Ramesh, Dev S, Lora, Chetan, Dattatreya, Chakravarthi, B Mesan, Bala A, Bapi Raju, Amol Mandalik

Fine Biochemicals

CCMB's Fine Biochemicals facility maintains and stocks large number of biochemicals for the ongoing research activities of the laboratory. The facility has a walk-in freezer (-18°C to -20°C) and a cold room and, two deep freezers (-20°C & -80°C), for storage of chemicals as per the recommended storage conditions. However, the chemicals stable at room temperature are kept in a room (72 sq.mtrs plinth area) where temperature is maintained at 26-28°C. The stocks of fine biochemicals include amino acids, proteins, enzymes, purification kits and buffer reagents. In addition, stocks of restriction enzymes, antibodies, reagents necessary for purification and detection of recombinant proteins, reagents for DNA/protein gel electrophoresis, PCR, RT-PCR, DNA sequencing and synthesis and buffers, and gel electrophoresis. The requirement for these chemicals is monitored such that procurement is carried out on a regular basis, so as to maintain a constant level of supply. Requirement for these chemicals/enzymes is monitored with a help of software developed by CCMB IT Group such that procurement is carried out on regular basis so as to maintain a constant level of supply. Availability of various chemicals can be seen on CCMB intranet.

The fine biochemicals indented by all the scientists is first received by the facility, and issued to the corresponding groups, in addition, to the general chemicals maintained by this facility.

Over the last year, 1800 consignments were received and 1468 invoices were received (the monthly breakup is given below), checked and forwarded to the CCMB Stores for further action. 3900 items were issued to researchers during 2019-20 from the facility. In addition, it maintained the inventory of materials from 1720 consignments ordered by individual scientists.

Month	Consignments Received	Invoices Processed
April - 19	168	126
May- 19	126	84
June - 19	135	106
July - 19	128	130
August - 19	107	80
September - 19	206	164
October - 19	124	132
November -19	172	113
December - 19	200	102
January - 20	123	200
February - 20	156	96
March - 20	155	136
Total	1800	1468

From left to right: M.C. Joseph, Y. Ramadasu, Kishore Joshi

Information Technology Group

The Information Technology group plays a major role in designing, implementing and managing IT infrastructure & services in-house. The group facilitates scientific collaborations by providing secure and faster data transfers, assisting scientists in the creation of computing facilities required for R&D projects, protects the organization's network and research data from cyber-attacks.

IT group creates and manages CCMB website, intranet site, and other websites as and when required for various national and international events/conferences organized by CCMB. The team also develops many online applications and tools to automate and manage R&D facilities and administrative works.

CCMB is connected by a dedicated 1 Gigabit leased line connection from NKN and a redundant 10 Mbps leased line connection. LAN is built with a high-speed 10 Gbps network backbone and switched 1 Gbps connection to systems. Secured wireless connectivity is implemented in the student's hostel and all the buildings on the campus.

IT group manages Cluster that has a compute capacity of 5.525 Tera Flops used for Next-Generation Sequencing and a centralized Network Access Storage with 400 TB storage capacity mounted to research facilities, servers, and desktops. Other facilities like surveillance camera, biometric system, fire alarm system, telephone, and closed-circuit TV are also managed by the group.

Sponsored Project

The project proposal 'Network infrastructure upgrade' with the objective of 'Accelerating Science, Genome research and collaborations at CCMB through implementation of core network infrastructure upgrades' from IT Group was selected from India by TEIN*CC – (Trans-Eurasia Information Network-star Corporation Centre). IT Group received a budget of Rs. 1.23 cr and a major network infrastructure revamping will be executed this year.

From left to right, starting from top: Geetha Thanu, Sublari Balaraju, Aparna Kumari, Biswajit Roy, P Radhakrishna Murthy, P Nagalinga Chary, K Sambasiva Rao, N Siva Rama Prasad, S Mahalingam, A Padmavathi, K Rama Chary, Y Padmavathi, K Gopichand, M Srinivas Rao, Sreekanth M, Shiva Kumar M, K Harinath, B Shiva Kumar, G Sai Krishna, G Praveen

Laboratory Technical Services

The Lab Technical Services (LTS) in CCMB, CRF (CCMB Annexe 2), Uppal, and LaCONES, Attapur (CCMB Annexe 1), acts as a bridge beetween the scientific staff and the engineering services. Thus it is the single contact point for scientific staff for all their needs that require involvement of engineers.

This section is headed by an engineer, and some of the major services for which LTS is responsible are: (i) Housekeeping, (ii) Manpower supply, (iii) general maintenance like civil, electrical, etc., of laboratory buildings, (iv) maintenance of lifts, (v) Pest control services, (vi) Horticulture, (vii) maintenance of fire extinguishers, (viii) arrangements for scientific and other conventions.

The LTS team headed by YV Rama Rao

Rajbhasha Unit

This unit helps the institute mainly in complying with various provisions of Official Language envisage by the GoI. It provides training to the officials in Hindi, Hindi typing & stenography and also conducts Hindi workshops for its employees at regular intervals. This unit helps scientists in preparing papers, articles, reports in Hindi. This unit also ensures issue of official documents in Hindi as per the OL Act Provisions. This unit also facilitates issuing of press releases in Hindi.

For the past 21 years, Rajbhasha unit has been bringing out a popular science magazine in Hindi viz., Jigyasa dedicating every issue to a special topic of Life Sciences. English is being used internationally, for the spread of science extensively for a long time. But in India, use of regional language is must to reach out to the common public to make them aware of scientific developments taking place around them. The main aim of publishing Jigyasa is to popularize and disseminate science among the common public and students in their own language. The latest issue comprised of recent articles in the field of Environmental Sciences. The latest edition will be on Climatic Changes and the Living Planet.

We have a reason to be proud that the articles published in these issues are written in Hindi by the scientists and students of CCMB. This act of contributing articles to Jigyasa helped in inculcating a habit of writing regularly in Hindi among our scientists, thus, enabling them to fulfill their responsibility towards the society.

This Rajbhasha Unit conducts 'Hindi Day' on 14th September every year. Various Hindi competitions and programmes are organized on the occasion. This year Hindi Fortnight was conducted from 03 Sep 2019, concluding with the valedictory function on 14th September, 2019. The winners of the competitions and the officials who do their official work in Hindi were awarded. Former IFS Shri PK Sharma, presently working as an advisor and Course Director in Marrichanna Reddy Institute, Hyderabad was invited as Chief Guest for the occasion. Every year, we invite some eminent writer, poet or expert of a subject of general interest to deliver a popular lecture in Hindi. This helps our staff and students to interact with such personalities and get benefited by listening to their valuable views.

The unit provides opportunity to students and staff to showcase their cultural and literary talents by organising a programme named 'Pratibha'. The main aim of the programme is to provide a platform to the inherent talents of research students and staff of CCMB. The programme is held annually, usually in the month of June. The programme mainly includes literary and cultural activities.

The Unit also conducts other activities, viz., inviting eminent speakers of various fields to deliver popular talks in Hindi for the benefit of staff and research students. The spectrum of topics includes personality development, space technology, geology, management skills, classical music, etc., and they have proved very useful for the staff to gain some basic knowledge in these areas.

The Rajbhasha unit has a very good library consisting 2879 Hindi books on various subjects viz., classic works of Hindi literature, science, translations and books of general interest, personality development, etc. This year 107 books have been added to this collection. Thus, the Rajbhasha unit takes care of CCMB in respect of implementation of Official Language as prescribed by GoI from time to time.

वार्षिक वैज्ञानिक पत्रिका

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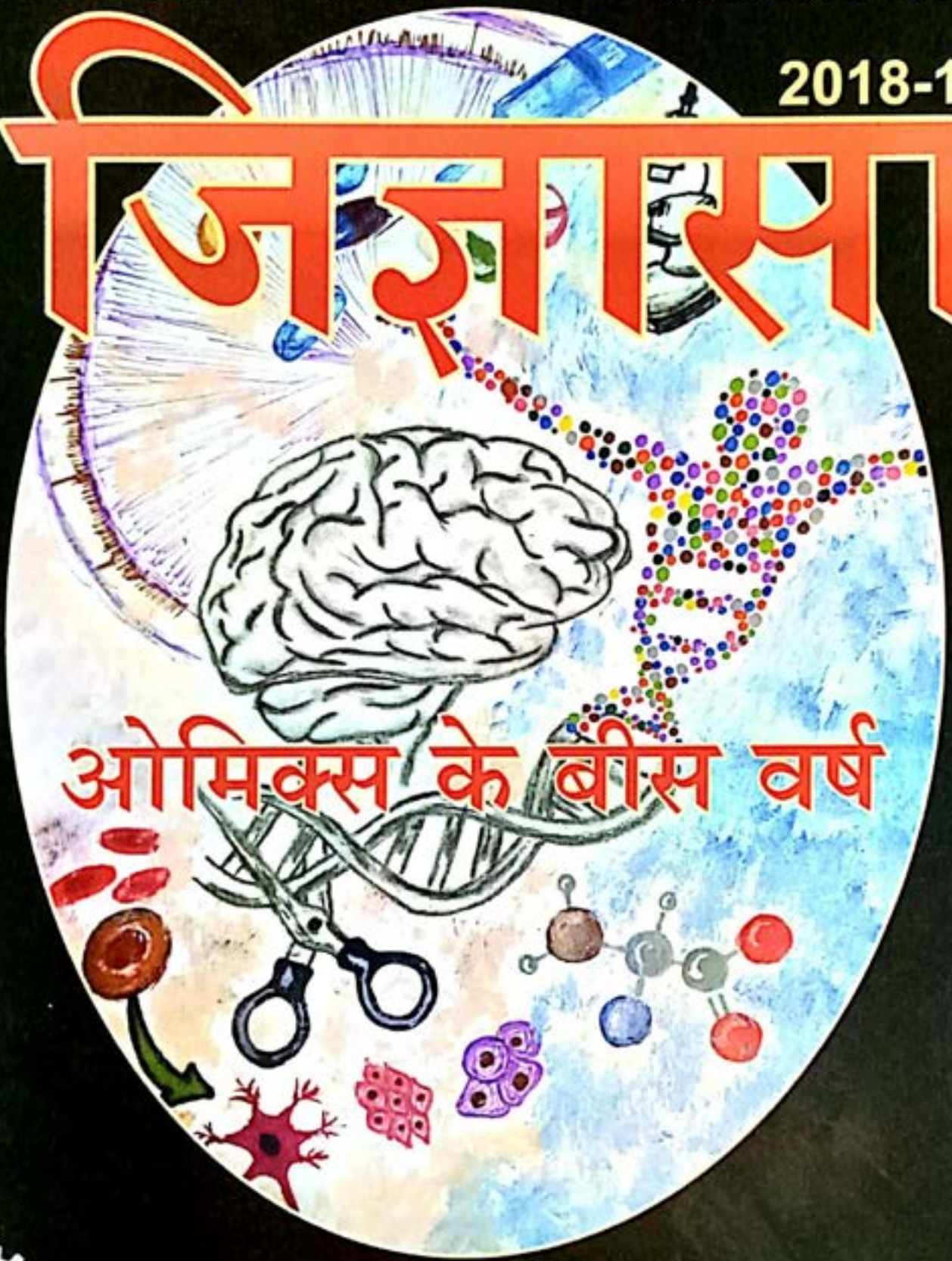
जिज्ञासा



ओमिक्स के बीस वर्ष

सीएसआईआर- कोशिकीय एवं आणविक जीव विज्ञान के लिए केंद्र
उप्पल रोड, हैदराबाद-500007

अंक 17

1.2
Academics

1.2 A Academic Cell & PhD Program

CCMB imparts training to doctoral students in an academic program linked either to Jawaharlal Nehru University (JNU), New Delhi or Academy of Scientific and Innovative Research (AcSIR). The PhD program is run by an Academic Cell, which consists of two academic co-ordinators and an assistant. This cell handles almost all the academic activities related to PhD students, including selection and recruitment of students, course work, lab allotment, Doctoral Advisory Committee (DAC) meetings, Comprehensive Exam, and PhD thesis submission. The Academic Cell keeps records of the performance in course work, progress reports of the PhD work, and all AcSIR related documents. All administrative matters of the JNU-CCMB PhD program are dealt by a separate JNU-CCMB committee.

CCMB's PhD program targets students who intend to pursue research-oriented careers in interdisciplinary areas within or outside academic. Our main goal is to provide students a strong technical background, enhance their capacity for analytical thinking, and address new kinds of problems for the advancement of science and society.

CCMB selects candidates for the PhD program in August and January. Eligible candidates are invited to apply and selected based on performance in a written test, followed by two rounds of interviews at CCMB. The students can apply through CCMB-JNU, CCMB-AcSIR and CCMB-JGEEBILS streams. 15 students joined for August 2019 and 7 students joined for January 2020 PhD programs. 16 students gave their PhD colloquia and 15 students submitted PhD thesis during April 2019 to March 2020. 11 students have been awarded PhD degree from JNU/AcSIR during this academic year.

1.2 B PhDs Awarded

List of students awarded with PhD degrees during April 2019 to March 2020

Rahul Sureka

Role of nuclear matrix in genome packaging and regulation (03.04.2019)

Guide: ***Dr. Rakesh K. Mishra & Dr. Suman Thakur***

Kamal Kumar Malukani

Characterization of rice functions that are potentially involved in DAMP induced innate immune responses (06.05.2019)

Guide: ***Dr. Rameh V. Sonti***

Shakuntala E Pillai

Understanding DAMP inducd innate immune responses in rice: Characterizing early induced transcription factor (06.05.2019)

Guide: ***Dr. Ramesh V. Sonti***

Avinash Srivastava

Role of Vertebrate GAF in Chromatin Structure and Gene Regulation (27.05.2019)

Guide: ***Dr. Rakesh K. Mishra***

G. Aditya Kumar

Cholesterol-dependent Organization and Dynamics of Membrane Receptors in Health and Disease (05.07.2019)

Guide: ***Prof. Amitabha Chattopadhyay & Dr. Raghunand Tirumalai***

Aditya A. Jamkhindikar

Discerning the structural and biophysical characteristics of metal ion-binding proteins and their implications (24.07.2019)

Guide: ***Dr. Yogendra Sharma & Dr. R. Sankaranarayanan***

Saurabh Pandey

Molecular analysis of meiosis and gametogenesis in Arabidopsis thaliana: The role of the SHUKR (SKR) gene (05.08.2019)

Guide: ***Dr. Imran Siddiqi & Dr. Mukesh Lodha***

Unis Ahmad Bhat

Investigations into the role of histone arginine methylation in alcohol-induced neuroglial and behavioural changes in mice (16.09.2019)

Guide: ***Dr. Arvind Kumar***

Aswan Nalli

Control of Plant Meiosis and Germ Cell Development: Characterization of the Duet Gene as a Transcriptional Regulator (11.12.2019)

Guide: ***Dr. Imran Siddiqi & Dr. Mukesh Lodha***

Rajkanwar Nathawat

Structure-function analysis of novel virulence factors in Xanthomonas oryzae pv. oryzae the bacterial blight pathogen of rice (18.12.2019)

Guide: ***Dr. Ramesh V. Sonti &***
Dr. R. Sankaranarayanan

Alok Kumar

Functional analysis of lactation through genetic approaches (11.03.2020)

Guide: ***Dr. Satish Kumar***

1.2 C Training Programs

Dissertation Research Training Program

The Dissertation Research Training Program (DRTP) is an interdisciplinary research training program for students from any field of life sciences to do a six months to one-year research project at CCMB under the supervision of a scientist towards their partial fulfillment of Bachelor's (B.Tech, B. Pharm, BDS, and MBBS) or Master's (M.Sc, M.Tech, M.Pharm, and MD) degree. In this program, in addition to routine laboratory training, candidates are exposed to recent research developments, scientific ethics, good laboratory practices, and career opportunities in life sciences. At the end of the training, candidates present their work in the form of posters to the scientific community at CCMB. On successful completion of their research work and submission of the dissertation report, students receive a certificate. The program was formalized under the Skill Initiative in June 2017. In 2019-2020, there have been 74 students who enrolled and carried out their Dissertation Research Training.

Summer Training Program

Summer training at the CCMB, one of the best-equipped biomedical research institutes in the country involved in basic and applied molecular biology research, is a sought after academic activity. We received 856 applications and after an extensive and rigorous selection process, 58 students could make it to the programme. In addition, 13 students selected through Indian Academy of Sciences (IAS) programme did summer internship at various CCMB labs. There were 11 other students from IISERs, IITs and few other institutes/universities that underwent training this period, making a total 83 students this summer at the CCMB.

We make lots of efforts to run this program wherein our main intention is to provide students a real time working opportunity in an active research lab. We also select students from state universities to those students who never had a research laboratory exposure. To make this programme more vibrant and exciting, talks by CCMB faculty members on popular bioscience subjects were organized. The students were given orientation sessions by the instrumentation engineers at the beginning of the programme. In the end, a visit was organized to CCMB Annexe I LaCONES (Laboratory for the Conservation of Endangered Species), which is an exciting component of the summer training.

Project-based Research Training

Project-based training programme, initiated in October 2017 caters to students (rather interested individuals), who wish to carry out research-based training in specific areas, based on research expertise of the various PIs at CCMB. In 2019-20, 30 students enrolled for either a 6-month or 1-year duration. Presently, there are 22 project-based trainees associated with various PI labs at CCMB.

Skill/Training Development Program

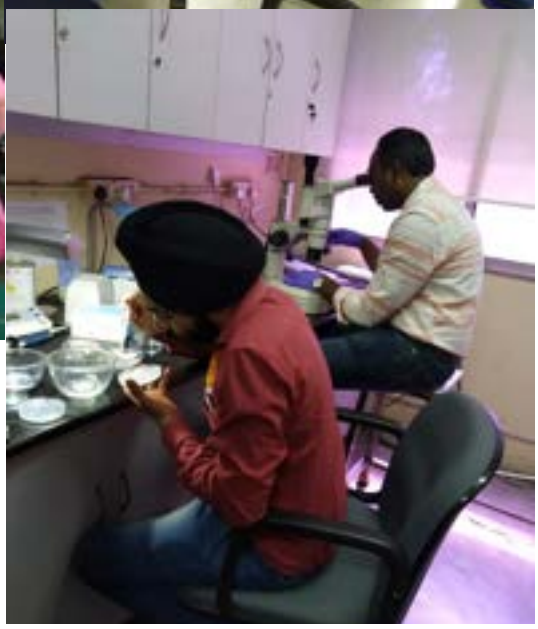
For the past two academic years CCMB has been conducting its Skilling/Training Programs under the CSIR-Integrated Skill Initiative. This year as well, various Skilling Programs were conducted with a view to cater to both academia and industry needs.

The training program for medical students-Medical Student Research Training Program (MedSRT) was held in May 2019 and 24 medical students had participated . The purpose of MedSRT has been to create an orientation of medical students (mostly in their 2nd and 3rd

years) towards clinical research through lectures and hands-on trainings. The Winter Research Observership Program was also organized for MBBS students, where they spend 2-weeks in a lab at CCMB to acquaint themselves with the research life. 23 students from medical colleges across India attended this course this year.

About 6 different trainings spanning from 3 days to 4 weeks benefiting around 74 candidates were held - in various advanced areas of CCMB expertise namely, Wildlife Forensics, Animal Cell Culture, CRISPR Technology, Recombinant DNA Technology, Proteomics, and Stem Cell Biology during 2019-20.

The ultimate aim of these programs is to improve employability and career advancement (through reskilling/ upskilling) in life sciences. Several entry-level skilling courses in Instrumentation, Laboratory Attendants, Animal Attendants, etc. are in the pipeline as well. Apart from these training programs 'Orientation workshop on Biologics' for Nektar Therapeutics (India) Pvt Ltd and Communication Conservation Research (CCS) and a workshop for college students, 'What makes a Scientist' were organized. 20 candidates in Biologics workshop , 6 candidates in CCS workshop and 34 for workshop on 'What makes a Scientist' had participated.



Glimpses of the training programs at CCMB

1.3 Innovation Hub (iHUB)

1.3 A Services

Centralized Diagnostics Facility at iHUB

The molecular and chromosomal diagnostic activities are now running in a centralized facility at CCMB, Annexe-II - iHUB. Last year witnessed the addition of several new diagnostic tests into our armamentarium. NGS services are now being offered to various hospitals across the country. Utility of diagnostic exome sequencing has been expanded by the addition of CNV detection pipelines in analysis of raw data. Whole genome analysis is now offered for diagnostic purposes as well. Genetic counseling services are provided to more than 50 patients and families every month. Dr. Surya Prabha, a medical geneticist has joined the team and additional technical staff, Harichandan, Lakshmi Priyanka and Sri Krishna have been recruited for further expansion. A total of 1836 patients have been tested in molecular diagnsotics, along with significant contributions to the COVID-19 testing activity of CCMB.

Molecular Diagnostics

Advances in molecular and cell biology have provided an understanding of the mechanisms of disease at molecular and genetic levels, which can now be translated into diagnostic, prognostic, and therapeutic applications in modern medicine. A number of genetic disorders are known to result from the defects in a single gene. Although rare in comparison to the infectious diseases, genetic disorders cause enormous misery since they are largely incurable and result in many cases, severe morbidity and mortality. In the absence of specific treatments, molecular diagnosis, genetic screening for carrier detection, genetic counseling, pre-pregnancy testing, pre-implantation genetic diagnosis and prenatal diagnosis for these disorders becomes the best approach to prevent their transmission to the next generation. The Molecular Diagnostics Facility, CCMB provides diagnostic services for about 30 such monogenic disorders. The facility provides DNA-based testing for a number of inherited and acquired genetic diseases including hemoglobinopathies, musculopathies, bleeding and clotting disorders and neurodegenerative diseases. The strategy is to identify the causal genetic defect in an individual, screen, at risk members for carrier status, tracking inheritance of the genetic defect in the fetus by performing prenatal diagnosis on fetal samples (procured at appropriate stage of pregnancy through hospitals) and providing appropriate and timely genetic counseling. The major thrust of these diagnostic services is to provide reliable genetic testing services to the common man within a rapid turnaround time and at affordable rates.

The advent of Next-Generation Sequencing (NGS) into clinical practice has tremendously increased our potential to identify the molecular defect in a wide spectrum of genetic diseases. Exome sequencing enables us to screen ~20,000 genes at a go for pathogenic variants. The initiation of NGS diagnostic services is in line with our motto to provide quality, low cost genetic diagnostics to the people of our country, and at the same time aid in generation of data important for research and public health care.

Chromosomal Diagnostics

Chromosomal abnormalities are a group of genetic disorders due to microscopically detectable defects at the level of chromosomes. They are commonly implicated in mental retardation, congenital malformations, dysmorphic features, primary and secondary amenorrhea, bad obstetric history, infertility and neoplastic diseases. Cytogenetic evaluation of patients is helpful in the counseling and management affected individuals and families. Prenatal diagnosis of chromosomal abnormalities in high-risk pregnancies helps in detecting chromosomal abnormalities in fetuses,

and aids in their genetic counseling and reproductive decision-making. The state-of-the-art facility offers cytogenetic tests such as karyotyping (conventional-G banding techniques) and FISH (fluorescence in situ hybridization, which includes probes using WCP and LSI, mFISH, mBAND, SKY), which involves investigation of genetic defects at the chromosome level.

Wildlife Diagnostics

At LaCONES, DNA-based wildlife diagnostics services are provided to the nation for species identification, individual identification, sexing, disease detection and rehabilitation of live species. The technique developed and patented by CCMB allows identification of a biological specimen of unknown origin and delineates its utility to the level of family, genus and species. We receive biological specimens confiscated in wildlife-related crime forwarded by the state forest, judiciary, police and customs departments.

During the period April 2019 - March 2020, a total of 298 wildlife crime cases were forwarded to LaCONES. This included 491 biological samples such as meat, cooked meat, bones, dried chemically treated skin, ivory, hair, nails, blood stains, saliva and swabs, etc. Of these,180 cases have been successfully reported to the forwarding authorities.

A revenue of more than Rs. 24 lacs was generated during the financial year 2019-20. Wildlife diagnostics brings awareness and speeds up reporting of crime involving poaching, illegal hunting and trade, thereby, expediting the justice process directly contributing to conservation of the endangered Indian species.

Forensic samples received at CCMB

1.3 B Common Research and Technology Development Hub (CRTDH) & Atal Incubation Centre-CCMB

#StartupLife

Incubation at CCMB

Atal Incubation Centre-Centre for Cellular and Molecular Biology (AIC-CCMB) & CRTDH are dedicated to contributing towards Atmanirbhar Bharat through its efforts in promoting home-grown life science-based enterprises. Established at CCMB, under the Atal Innovation Mission of NITI Aayog, GoI, AIC-CCMB has been voted No 5 in the list of top ten life sciences incubators ranked by BioSpectrum India, a B2B media platform in life sciences. It is no surprise as this incubation centre has become a hub for life sciences and biotechnology startups and MSMEs.

Creating enterprises in life sciences is an uphill task - one that AIC-CCMB has successfully demonstrated that with the right infrastructure, support system and team. An incubation centre can play a pivotal role in helping startups to have stable foundations and grow into sustainable businesses. AIC-CCMB has been actively working with its host institution, CCMB to create a physical space for startups to work and creating a high impact ecosystem with policy makers, mentors, alumni, fund providers, experts, consultants and industry. We have incubated twenty five startups, with two graduations. Over thirteen patents have been filed by our startups.

At AIC-CCMB we urge our startups to create a goal-oriented roadmap for themselves. It is necessary to have a focused time-based schedule as most of the startups are either bootstrapped or operate through limited grants for developing the Proof of Concept (PoC).

Only when a founder can develop a scalable and replicable PoC, can they move forward to validation, prototyping and so on. Our core thrust is to ensure that startups achieve this at the soonest by providing them with equipment, scientific and technical guidance as well as mentoring. Additionally, the startups get exposed to monthly workshops/trainings, startup gatherings through effective networking and handholding mechanisms.

SNAPSHOT OF ONE YEAR

- Ranked #5 **Top Biotech Incubators** in India by BioSpectrum Magazine
- Incubated 25 startups till date with 2 successful graduations
- Became a #World Class Incubator wtih a vibrant co-working space with swanky meeting pods and deskspaces for startups successfully
- Launched 2 fellowship programs with other government agencies for

1. IT enabled startups with the support of MIETY Startup Hub to financially aid technology based startups specially in Genomics & Precision Medicine
2. BIRAC Social Innovation Fellowship Program (SIIP)- SPARSH

- Established a think-tank for developing human-centric toxicology models in India with Humane Society International, India
- Supporting 8 startups and innovators for Accelerated Deployment to combat COVID-19
- Signed 11 strategic partnerships to promote social and technology entrepreneurs

Centre for Predictive Human Model Systems

CPHMS was established AIC-CCMB as a think-tank and policy centre to enable human-relevant research in India. Towards this objective, our efforts were directed towards four directions:

(1) Writing white papers

Three white papers, each on microphysiological systems, adverse outcome pathways, and systems/computational biology were written. These white papers documented the research in various research institutes, colleges, and private companies across the country. Personal communication with several scientists were used to analyse the challenges in this area and, recommendations were provided to overcome the challenges currently being faced in the field.

(2) *Conducting adverse outcome pathway (AOP) workshops*

Four adverse outcome pathway workshops were conducted in Indian Institute of Science Education and Research (IISER, Kolkata), University of Hyderabad (Hyderabad), Central Drug Research Institute (CDRI), Jamia Hamdard (Delhi), and one workshop was conducted as a pre-conference workshop to the National Conference on Alternatives to Animal Experimentation (NCAAE, Mumbai). We also conducted an AOP webinar. Around 200+ people were reached via these physical and online AOP workshops.

(3) Reviews, popular science articles, and webinars

We submitted one perspectives paper and a viewpoint article to journals (both these are currently undergoing the process of peer-review). We also wrote two popular science articles to increase the awareness among the general population.

(4) Announcing and co-ordinating the Adverse Outcome Pathway Grant to two scientists to submit an AOP to AOP Wiki

During these various initiatives of CPHMS, more than 500 people, including scientists, regulators, and general population were reached. We hope to continue to build on this momentum and collaborate with government, funding, regulatory, and private bodies to address the challenges currently present in the space.

Social Innovation for Products – Affordable and Relevant to Societal Health (SPARSH)

AIC-CCMB proposed to BIRAC to act as a SPARSH Centre for the implementation of BIRAC's SPARSH Fellowship Program aimed at promoting the development of innovative solutions to society's most pressing social problems through biotechnological interventions. The SPARSH Fellowship Program is an 18-months program to create a pool of biotech social innovators who could identify the needs and gaps within their communities, and then bridge the gap through innovative products and services.

We conducted roadshows in various academic institutions such as Mallareddy Medical College, IIIT-Hyderabad, IIT-Hyderabad, Osmania University, MNR Medical College, VNR VJIET, etc. and incubation centres such as AIC-IIIT Hyderabad and also hosted Café Mandala - SPARSH to evangelize about the SPARSH Fellowship Program at AIC-CCMB and invite applications for the Fellowship Program in the first week of December 2019. We received a whopping 90 plus applications as on January 15, 2020. We had a rigorous selection process to select the best candidates for the fellowship program. Due to the lockdown declared by the end of March 2020, we have had to postpone the selection and launch of SPARSH fellowship to a later date .

Immersion is a very crucial component of the SPARSH Program as one needs to go in the field, looking out for real problems faced by the elderly and come up with a solution that is of high social impact. We partnered with august organizations as our clinical and rural immersion partners for the Fellowship Program. Access Health International collaborates with AIC-CCMB for the SPARSH Program to support the SPARSH Fellows in healthcare. We also have SHARE India, Public Health Foundation of India (PHFI), Social Alpha, Access Livelihood Consultants, Apollo Hospitals, NIMS as our immersion partners for the SPARSH Fellowship Program.

MeitY TIDE 2.0 Centre

Technology Incubation and Development of Entrepreneurship (TIDE 2.0) is a program supported under MeitY Statup Hub (MSH) by Ministry of Electronics and Information Technology (MeitY), GoI. AIC-CCMB was granted TIDE centre in October 2019. MeitY intends to promote entrepreneurship and innovation in emerging technologies field. Through TIDE 2.0, we aim to support innovations that are addressing healthcare challenges using Information and Communications Technology(ICT). Under this program, support is providing to start-ups' and individuals in multiple forms. Funding to develop a PoC, mentoring to create a robust business case, access to investor network are some

Inauguration of MeitY Tide 2.0 Centre

of the examples.

At AIC-CCMB, we are focused on fostering innovations' that leverage ICT and other emerging technologies to address healthcare challenges. AIC-CCMB is also committed to provide these startups with connects from both Industry and academia. Some of the key highlights of the program are given below:

1. Funding of INR 4 lakhs & INR 7 lakhs to Entrepreneur in Residence and Grant in Aid respectively over a period of 1 year for 8 projects.
2. Corporate connects.
3. Mentorship from various domain experts.

Through November 2019, we have setup a fully furnished dedicated co-working space for all the innovators. Along with physical infrastructure we also worked towards establishing a strong network of mentors. From December 2019, we have aligned our efforts to bring together industry leaders, corporates into our list of partners in order to leverage their expertise in the areas of computation and hardware.As a result of these efforts we have managed to onboard Industry leaders like Amazon and Intel to support us in our endeavor.

Strategic Partnerships

In January 2020, Government of Telangana has declared 2020 as Year of AI. Under this initiative, the government has rolled out plans to support organisations working on development of AI-related solutions for societal problems. AIC-CCMB, a key stakeholder in Telangana's innovation ecosystem is a partner in this initiative. AIC-CCMB believes that a sustainable ecosystem for innovation is only possible through collaboration. Therefore, we have been at the forefront of reach out to various stakeholders of the ecosystem to work with us in an initiative to transform the life sciences space. Some of our partnerships with academia, industry and government are mentioned below:

Government of Telangana: AIC-CCMB is actively taking part in various initiatives of the government. Year of AI, an initiative by emerging technologies division of Telangana. We are working under this initiative to identify & support potential solutions involving emerging technologies to address issues related to healthcare.

International Institute of Information Technology (IIIT), Hyderabad: AIC-CCMB is closely working with IIIT-H to integrate technology into life sciences in order to address current day's challenges.

DSIR-CRTDH conclave

Amazon Web Services (AWS): AIC-CCMB has partnered with AWS to leverage its expertise in the area of cloud computing. We are also providing our startups with credits to utilize their cloud services.

Boston India Limited: AIC-CCMB is aiming for strategic training & mentorship to assist startups in deploying ML, AI to address healthcare challenges.

CoCreations: Promote co-operation in productizing scientific research and undertaking of entrepreneurial interventions for scientists & support for startups within AIC-CCMB across acceleration models.

Smart Bridge: We are working with Smart Bridge in engaging student community in healthcare innovation practices through various outreach activities.

Share India: As rural immersion partner, they facilitate in acquiring ground level information to strengthen innovative ideas towards developing a product / service in healthcare.

Asia Inc500: Our marketing partner in spearheading thought leadership activities and ensure global outreach for the products and services developed by our startups.

SoftVan: Innovation partner to run a program named '90 days to PoC' to support startups deploying ICT in healthcare to validate their ideas in a real time environment.

AIC-CCMB TIDE 2.0 Ideathon 2020

AIC-CCMB announced its call for applications for support under the TIDE 2.0 program on March 9, 2020. The call was opened for the four positions of Entrepreneur-in-residence and startup support. We have invited applications from innovators working on healthcare related solutions using ICT, emerging technologies.Under this call, we reached out to a student community of about 10,000 in and around Telangana. We also managed to reach out to about 500 startups in our ecosystem.

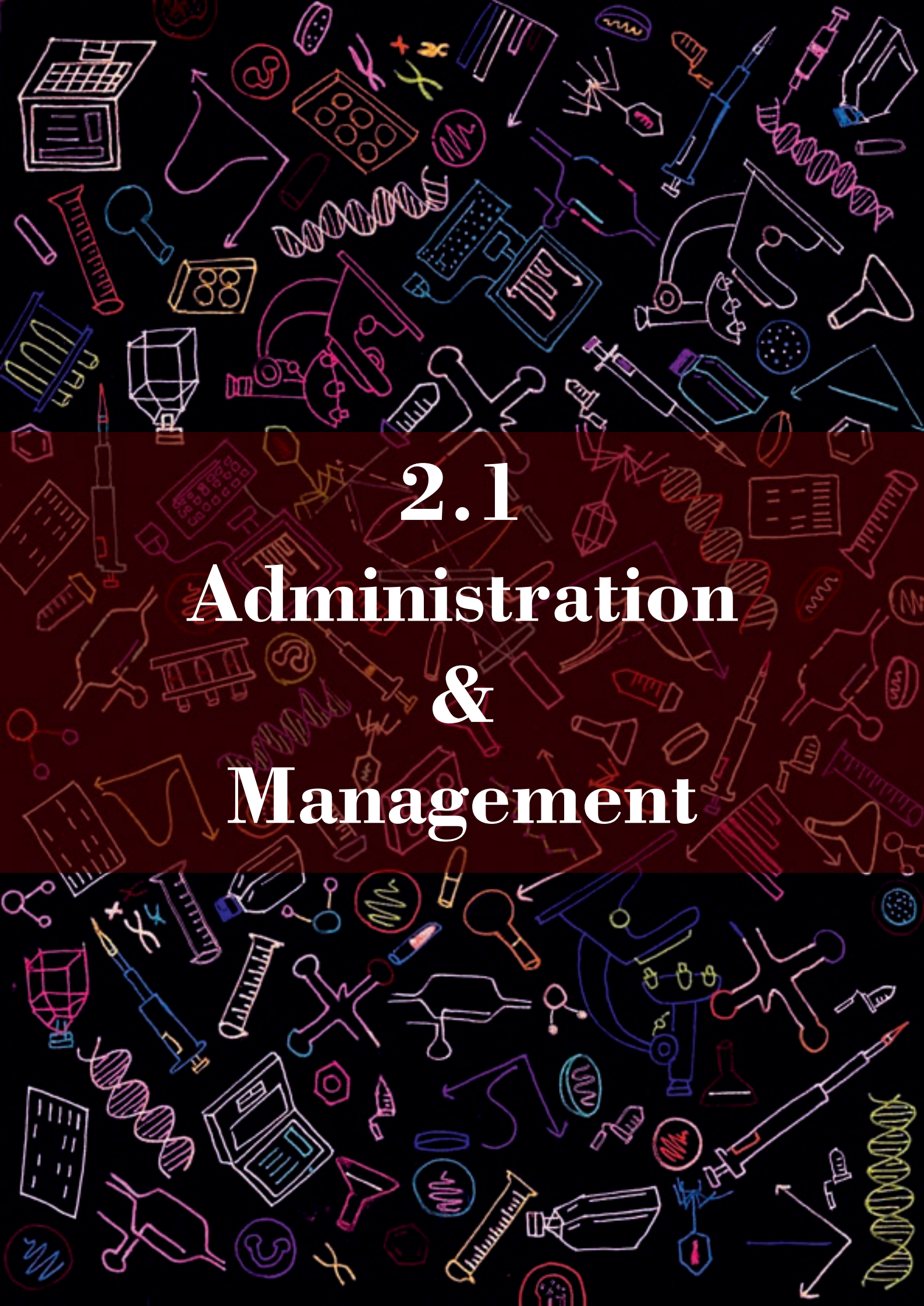
Launch of AIC-CCMB TIDE 2.0 Ideathon

Notable events By CRTDH – AIC-CCMB

13-Apr-19	Pride and Prejudice - Maiden Year Celebration of AIC-CCMB On the occasion of the visit by DG CSIR, we hosted an event called 'Pride and Prejudice', with a large assembly of prominent life scientists,partners in the new revolution of home-grown innovations. A panel discussion on 'Overcoming Apprehensions of Life Science Industries in Institutional Innovations' which was attended by prominent life scientists and Indian Lifesciences Industry. Director General, CSIR, Dr Shekhar Mande, chief guest at the occasion remarked that it is the age of life sciences, and CSIR-CCMB is ideally poised to help the emerging life science start-ups with technical and intellectual expertise.The event was attended by a number of industry doyens like Dr Krishna Ella, Dr Deepanwita, Dr A.V. Ramarao, Dr. Satya Prakash Dash, Mr.Ram Kaundinya and many others. The panelists consisted of those with long experience with start-up incubators housed in educational and research institutes of India. The discussion focused on the key reasons why industries do not engage with prestigious Indian Institutions like CSIR labs and startups incubated by them, the challenges in translation and how they can be done to mitigate these issues.
24-May-19	Workshop on Industrial Design of Medical Devices - Workshop was organised by Tata Trust PATH Impact Lab (TPIL), Hyderabad for Med Tech start-ups where they covered a breadth of topics that are relevant to both early and advanced stages of Med Tech startups which was attended by 50 participants.
19-Jul-19	Sensitization workshop - 25 participants from International Training Program MANAGE who are from different countries visited CRTDH and had an interaction with the entrepreneurs and team members.
12-Sep-19	Café Mandala - Sparking Technology Transfer within Government Institutes. - Dr.Premanth Venugopalan, Venture center, Pune and Dr. Deepanwitha, IKP, Hyderabad addressed the importance of technology transfer from academic institutions to industries
4-Sep-19	Sensitization worshop - Visit by delegates of DST training program by RICH
10-Oct-19	BIRAC Funding Workshop - Leveraging funding opportunities for Biotech innovators in collaboration with BIRAC
5-Nov-19	Café Mandala - DERBI-EMERGE - The program was organized to "focus on late stage tech startups that are into Health Care" who are ready for trials in progress or Startups in advanced stage of completion of their product/service/solution.
8-9-Nov-19	DSIR — CRTDH Conclave - DSIR—CRTDH Conclave was organized in which all the CRTDHs across the country participated and shared their experience with presentations.
14/15-Nov-19	City camp and R clinic City camp by BRBC - Workshop was held on raising money, tech transfer, company formation, inventive problem solving, IP, networking and pitching and it also focussed on understanding the relevant Acts/ Laws/ Rules and standards applicable to medical devices and diagnostics.
11-13-Dec-19	Indian Women Scientist Association Conference at NIN - Incubated Stall at National Institute of Nutrition to showcase the activites of CRTDH

16-Dec-19	Mentoring meet by Sunita Jones (Business Mentor) - Mentoring meetings were conducted to advise the start-ups on risk assessment.
17-Dec-19	Talk by Palamuru Biosciences - Services to start-ups in in-vitro and in-vivo Studies
18-Dec-19	Visit by Indo-Brazil Agri tech - Participants of Indo-Brazil Agri tech visited incubation centre to understand the start-up ecosystem in India.
21st, 22nd December	National Academy of Sciences, India - Attended 89th annual session of NASI and Symposium on Science and Technology based Entrepreneurship Development
2.01.2020	Launch of Telangana Year of AI2020 – AIC-CCMB has become a partner with the state to promote AI & other emerging technologies in life-sciences.
22.01.2020	Dagar Workshop on writing BIG grant by a-IDEA NAARMAgri-BioNest PPT on
23.01.2020	Interaction of Startup founders with Pasteur delegates
27.01.2020	Presentation by AIC team to his excellency Vice President of India, Venkaiah Naidu
30.01.2020	Presentation by White Apron - E commerce platform for medical devices
31.01.2020	Talk by Dr.Ramjee at TiEhyderabad open mic on Enablers and their role in lifesciences innovation ecosystem
12.02.2020	Breakfast meet - Indian Women Scientists Association- Ritika represented AIC-CCMB, "Building bonds to create future leaders" with a focus on leadership development.
17.02.2020	BioAsia 2020 – This is a major industry focused trade show organized by the Govt. of Telangana. CCMB had a major footprint at this event as a scientific and incubation partner as well as exhibit cum networking space for its works in CRTDH & AIC-CCMB

Delegates at DSIR-CRTDH conclave



2.1 Administration & Management

Research Council

Research Council of a laboratory under CSIR provides direction and vision and helps it to formulate R&D programmes keeping in view the national priorities and opportunity niches and facilitates to design a road map to achieve it. The following are the constituent members of the Research Council of CCMB:

Prof G Padmanabhan **Chairman**
Emeritus Professor,
Department of Biochemistry,
Indian Institute of Science
Bengaluru

Dr R Varadarajan **Member**
Molecular Biophysics Unit
Indian Institute of Science
Bengaluru

Prof Jitendra P Khurana **Member**
Head, Department of Plant
Molecular Biology
Delhi University, South Campus
New Delhi

Prof Umesh Varshney **Member**
Department of Microbiology &
Cell Biology
Indian Institute of Science
Bengaluru

Prof Subrata Sinha **Member**
Director
National Brain Research Centre
Gurgaon

Dr Vijay Chandru **Member**
Chairman & Managing Director
Strand Life Sciences Private Limited
Bengaluru

Dr Krishna Ella **Member**
Chairman & Managing Director
Bharat Biotech International Limited
Hyderabad

Dr Anurag Agrawal **Member**
Director
CSIR-Institute of Genomics
and Integrative Biology
Delhi

Dr Samit Chattopadhyay **Member**
Director
CSIR-Indian Institute of Chemical Biology
Kolkata

Dr S Chandrasekhar **Member**
Director
CSIR-Indian Institute of Chemical
Technology
Hyderabad

Dr Rakesh K Mishra **Member**
Director
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr K Thangaraj **Secretary**
Chief Scientist
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Management Council

Following is the composition of the Management Council of CCMB for the period 01.01.2019 to 31.12.2021 as approved under Rule-65 of the CSIR Rules 7 Regulations:

Dr Rakesh K Mishra **Chairman**
Director
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr N. Nagesh **Member**
Chief Scientist
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr A. Vijaya Lakshmi **Member**
Senior Principal Scientist
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr B. Kiran Kumar **Member**
Senior Scientist
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr C.B. Tripura Sundari **Member**
Senior Scientist
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Ms Seema Bhaskar **Member**
Principal Technical Officer
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Dr V.M. Tiwari **Member**
Director
CSIR-National Geophysical Research Institute
Hyderabad

Dr Archana B. Siva **Member**
Senior Principal Scientist & Head-BDG
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Finance & Accounts Officer **Member**
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Controller of Administration **Member-Secretary**
CSIR-Centre for Cellular and Molecular Biology
Hyderabad

Director's Office

The Director's office is responsible for central planning, co-ordination and execution of all activities at the Centre. This includes maintaining relationships with stakeholders interested in the Centre's development and collaborating with them.

From left to right, starting from top: S Madhuri, Rakesh K Mishra, Lakshmi Rao, Lavanya, Naveen Kumar, Surabhi Srivastava, Somdatta Karak

Administration

The overall administration of the Centre and the supervision of ancillary services such as transport and telecommunications are under the purview of the administration. In addition, secretarial assistance is provided to the staff for the preparation of the reports, manuscripts and correspondence.

From left to right - Pic 1: Noopur Rani Prasad, P.Sudha Rani, Padmaja, Savita Kumari, Kanchana mala, Manju Singh, Ch Sridevi, inset image: Naveen Kumar; Pic 2: Sunil Kumar, S Ashok Kumar, Ram Gopal, Krishnamacharyulu, inset image: Sharada; Pic 3: Rajani, B Venkateshwarlu, Mahendra, J Venu, Y Srinivasa Rao, K Satyanarayana, B Srinivas, Mohd Gazanfar Ali Khan, Abdul Raheem Qureshi, Mahender Vynala, Mohd Pasha, inset images: Vivek Khare, Devendranath

Finance & Accounts

All financial matters pertaining to CSIR-CCMB, including budget planning, allocation and expenditure are taken care of by the Finance and Accounts section.

From left to right: Imran Khan, T Sudhakar, M V Subba Rao, M Vishnu, Yadav, M S Murthy, M Ashok Kumar, W Sudhakar, K Venkateshwarlu, K Ramakrishna, S K Roy, Ch Vijaya, Vimala Prakash, K Sujatha, A K Nagamani, V V L Prasanna, M Madhavi, G Anuradha

Stores & Purchase

CCMB has a modern stores building with a cold storage facility and separate rooms for the storage of solvents and acids. The Stores and Purchase section maintains an exhaustive inventory of inorganic chemicals, stationery, glassware, plastic ware and other items. The staff of this section carries out the processing of orders and the procurement of materials for the Centre.

The Stores and Purchase team led by Dharmendra Kumar

Planning Monitoring and Evaluation Group

The primary responsibility is to assist the Director, CCMB in project management activities and act as a liaison between the Director and other research groups, CSIR-HQ and other organizations. The PME takes care of various in-house, sponsor, collaborative, grant-in-aid and NMITLI projects and provides inputs related to projects. In addition, PME provides information to project audit agencies agencies and RTI queries.

PME assists the Director in preparation and collating institutional data for onward transmission to CSIR head quarters, survey agencies. PME also conducts various institutional programs as advised by the Director from time to time.

From left to right: Charan Kumar, Satyanarayana, VishnuPriya, Gulzar Khan, BV Ramakrishna

Business Development Group

Business Development Group of CCMB carries out various activities related to technical services, IPs, technology transfers, etc. Technical services include diagnostics services (Molecular Diagnostics, Wildlife Forensics & Chromosomal Diagnostics) and various analytical services. BDG coordinates with CSIR HQ for facilitating the research leads from CCMB for patenting. The group also facilitates CCMB's connect with industry for contract & collaborative research projects, technical services, tech transfers, and trainings.

From left to right: Azmath, Subbalakshmi, Archana B Siva, Divya Singh, K Anitha, Leela Kumari

Security

The Security services are outsourced to a professional security agency and is under supervision of trained security officers of CCMB.

The security team led by Tirumala Rao

Medical Services

CCMB shares a well-equipped clinic and dispensary with the CSIR-Indian Institute of Chemical Technology. Medical care is available round the clock for staff and their families.

Guest House

The Guest House is an important service facility of CCMB. It is well-equipped and ultramodern with pantry facilities with skilled and trained professionals as staff. It has 28 rooms and 2 suites. It is used by visiting scientists, faculty members and foreign dignitaries.

It also serves special breakfast, lunch and dinner during seminars and symposia.

It is just at walking distance from the main lab of CCMB.

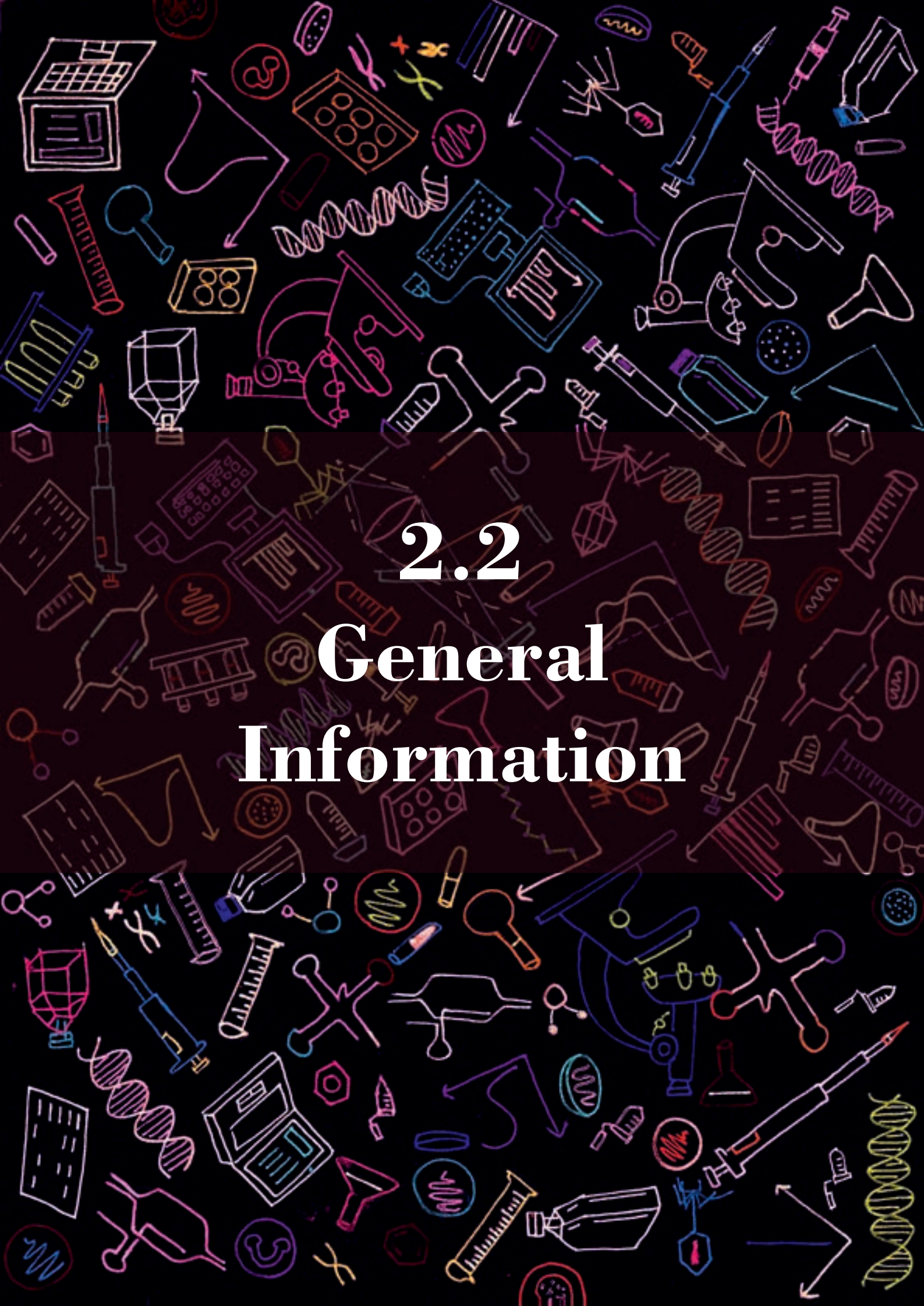
Canteen Services

The CCMB Canteen provides food for CCMB staff, students, contract staff and visitors. We serve breakfast, lunch, dinner and high tea. We have Canteens at three different campuses - CCMB, LaCONES, CCMB Annexe-I and iHUB, CCMB Annexe-II. All canteens are operated with Canteen Smart Card System making it the first canteen in CSIR labs to operate in cashless mode.

There are four food outlets in CCMB Canteen, these are Baithak, Ahlaad, Samvaad and Kiosk. We serve North Indian, South Indian, Continental and Chinese food. We serve 1000 people during the day and through various meals. Apart from regular dinner, we also cater to conferences, seminars, and symposia conducted by CCMB.

We serve breakfast, lunch, dinner and high tea everyday for around fifty people in LaCONES Canteen, CCMB Annexe I. This runs through a contractor.

We serve lunch and high tea for 100 people in iHUB Canteen, CCMB Annexe II daily.



2.2 General Information

2.2 A List of Publications

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  ⁎Equal contribution.
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2.2 B Awards & Honors

Research Staff

Amitabha Chattopadhyay

- Awarded Prof. G.N. Ramachandran Gold Medal
- Delivered lecture at the 20th IUPAB Congress in Foz do Iguaçu, Brazil
- Invited to be Visiting Professor, Paul Sabatier Universite Toulouse III
- Associate Editor for Journal of Membrane Biology

G R Chandak

- Elected Fellow, Indian Academy of Sciences, Bangalore, India
- Elected Fellow, The National Academy of Sciences India, Allahabad, India
- Invited to be Adjunct Faculty, JSS Medical College, Hospital and Research Centre, Mysuru, India

G Umapathy

- Elected Fellow, Telangana Academy of Sciences, Telangana, India

Jyotsna Dhawan

- President, Indian Society for Cell Biology 2019-2021
- President, Indian Society of Developmental Biologists 2017-2020
- Member, Governing Board, Centre for Human Genetics, Bangalore
- Member, Scientific Advisory Committee, Institute for Life Sciences, Bhubhaneshwar

K Thangaraj

- Awarded J C Bose Fellowship

Mandar V Deshmukh

- Professor S. Subramanian's 60th Birthday Award 2019 given by the National Magnetic Resonance Society, India (NMRS)

Manjula Reddy

- Infosys Prize in Biological Sciences-2019.
- Elected Fellow, Indian Academy of Sciences, Bangalore, India

Pavithra L Chavali

- SERB Women in Science Excellence Award, 2020

Ramesh V Sonti

- Dr. B. P. Pal Memorial Lecture Award 2019. National Academy of Sciences, India
- Professor Panchanan Maheshwari Memorial Lecture Award 2019. Department of Botany, University of Delhi
- Prof. K. K. Nanda Memorial Lecture Award 2019 of the Indian Society of Plant Physiology for outstanding contributions in the field of Plant Physiology & Cognate Sciences

R Sankaranarayanan

- Member of the Board of Reviewing Editors (BRE) of the journal Elife

Swasti Raychaudhuri

- Elected as Treasurer, Proteomics Society of India

Students

Sreetama Pal

- Awarded ACS Poster Prize at the 12th International Symposium on Cell Surface Macromolecules (ISCSM), IISER Pune,India

Parijat Sarkar

- Best poster award at Hy-Sci 2019

G. Aditya Kumar

- International Travel Grant from the Science and Engineering Research Board, Department of Science and Technology (Govt. of India) to participate in the Molecular Membrane Biology Gordon Research Conference, New Hampshire, U.S.A

Prachand Issarapu

- Runner-up Award at K. V. Rao Young Scientist award for Biological Sciences (India)
- Young Scientist Award at 44th Annual Conference of The Indian Society of Human Genetics

Hanuman T Kale

- ISSCR Travel award for presenting poster in ISSCR-2020 held at Boston USA

Debabrata Jana

- ISSCR Travel award for presenting poster in ISSCR-2020 held at Boston USA

Akhouri Kishore Raghawan

- Awarded "Prof. SRV Rao-Best Paper Presentation Award" at 43rd All India Cell Biology Conference held at IISER, Mohali, India (December 19-21, 2019)

Zuberwasim Sayyad

- Travel grant by SERB, DST to attend Association of Research in Vision and Ophthalmology (ARVO) 2019 Annual Meeting, Vancouver, Canada (April 28 April-May 02, 2019)

Shivranjani Moharir

- Travel grant by SERB, DST to attend a conference "Ubiquitin, autophagy and disease" at Cold Spring Harbor Laboratory, New York, USA (April 23-27, 2019)
- Travel grant by CSIR to attend the International Symposium on Autophagy, at Academia Sinica, Taipei, Taiwan (November 3-7, 2019.

Sohini Deb

- "Ko Shimomoto Travel Award" from the International Society of Molecular Plant Microbe Interactions (IS-MPMI) to attend the XVIII Congress of IS- MPMI at Glasgow, Scotland (July 14 -18, 2019)

Kamal Kumar Malukani

- "Ko Shimomoto Travel Award" from the International Society of Molecular Plant Microbe Interactions (IS-MPMI) to attend the XVIII Congress of IS-MPMI at Glasgow, Scotland (July 14 -18, 2019)

Debarya Saha

- IUSSTF GET in Fellowship for Genome Editing in the lab of Dr. Charles Keller, Childrens' Cancer Therapy Development Institute, Oregon USA from June –Dec 2019

Upasana Rai

- Best poster award at 10th RNA Group Meeting Thiruvananthapuram, 2019

Akanksha Garhewal

- EMBO Travel Grant and DBT Travel Grant (DBT/CTEP/02/20190348835) to attend EMBO Workshop: Chromatin and Epigenetics at EMBL, Heidelberg, Germany (May 1-4 , 2019)

Preethi Jampala

- Travel Grant by DST-SERB under International Travel Support (ITS) Scheme File No.ITS/2019/003703 to attend Mechanisms of Eukaryotic Transcription, Cold Spring Harbor, NY, USA (August 27-31, 2019)

Manish Bhattacharjee

- 1st prize for best oral presentation in the 30th National Congress of Parasitology & Global Summit on Malaria Elimination at JNU, New Delhi (September 26-28, 2019)

Divya Das

- 1st prize for best poster presentation in the 30th National Congress of Parasitology & Global Summit on Malaria Elimination at JNU, New Delhi (September 26-28, 2019)

Divya Sriram

- Best poster presentation award at HySci-2019, CCMB, Hyderabad, for presenting poster titled "RapGEF1 (C3G) interacts with and negatively regulates GSK3beta activity to promote myogenic differentiation

- Finalist at National Bio Entrepreneurship Competition 2019 (start-up innovation contest by C-CAMP and BIRAC, Govt of India)

- Awarded 2nd prize at start-up idea competition, IGNITE (2019) at Professor Jayashankar Telangana State Agricultural University (PJTSAU) conducted by NAARM TBI, a-IDEA

Ravi Prasad Mukku

- 'Global Health Travel Award from the Bill and Melinda Gates Foundation' to participate in the Keystone meeting on 'Tuberculosis: Immunity and Immune Evasion' at Santa Fe New Mexico USA (January 16 -21, 2020)

Nikhil Hajirnis

- DBT Travel Grant Award for the Allied Genetics Conference 2020, organised by the Genetics Society of America, Washington DC

Runa Hamid

- Inspiring Women Scientist under the 'Capture Success Stories' program of DST

Binita Ghosh

- Selected as Moderator for 3 sessions in an online international webinar by Dr Shyama Prasad Mukherjee University, Ranchi, on the topic 'Protection of heart, kidney, liver and maintaining psychology amidst COVID-19 lifestyle change'

Majeed Mohd

- Outstanding Oral Presentation award at Hy-Sci 2019, at Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad, India (August 28 2019)

Santosh Kumar Kuncha

- Sun Pharma Science Scholar Award for Young Scientists, 2019, in the field of Bio-Medical Sciences, Sun Pharma Science Foundation, Sun Pharmaceutical Industries Ltd., India

- Outstanding Poster Presentation award at Hy-Sci 2019, at Centre for Cellular and Molecular Biology (CSIR-CCMB), Hyderabad, India (August 28 2019)

- Best Oral Presentation award at 10th RNA group meeting-2019, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, India

Sudipta Mondal

- EMBO Bursary award for Travel & accommodation to attend EMBO Practical Course: CEM3DIP 2020- Single Particle cryo-EM of macromolecular assemblies and cellular tomography, Kolkata, (January 19-30, 2020)

S Manu

- Best Student Seminar Award, CCMB (November 26, 2019)

2.2 C Conferences & Symposia

Hy-Sci - 2019

Hy-Sci was conceptualised by CCMB Student Council and organised by a group of CCMB students. The first event of Hy-Sci Biology was held on 29th August 2019 in CCMB with the aim of initiating discussions between the young researchers of different institutes of Hyderabad. This was attended by over 250 students and 50 principal investigators from different institutions and universities in Hyderabad.

It included flash talks, oral and poster presentations by graduate students and postdocs. There were also two panel discussions to deliberate on points relevant to research students. The first discussion, titled 'Ten years down the line' was aimed at discussing the research areas that demand attention in the near future. The second panel, 'Life beyond PhD' touched upon post-PhD careers and the taboo of 'alternate careers'. In addition, Dr D P Kasbekar gave a plenary talk titled 'Brenner's elegant nonsense' as an ode to late researcher Dr Sydney Brenner. All the talks, posters and the panel discussions were well received and applauded. Details of panels and abstracts of talks can be found on Hy-Sci's website (http://e-portal.ccmb.res.in/hysci2019/index.php).

Hy-Sci was set in motion with the anticipation that it will become an annual event, and with support from the director and others in CCMB, we wish to continue the trend.

International Conference on Advancements in Veterinary Sciences for Wildlife Conservation

About two hundred veterinarians including ten speakers representing six different countries participated in the international conference on 'Advancements in Veterinary Sciences for Wildlife Conservation' and 13th Annual Meeting of Association of Indian Zoo and Wildlife Veterinarians hosted by CCMB from November 13 to 15, 2019. Latest research advances made in the area of conservation breeding and management of endangered wildlife species were discussed through sixty six posters and twenty five oral presentations.

Indo-US Workshop on "Human Diversity and Health Disparities"

The aim of this workshop was to bring together researchers to understand and address the genetic basis of health disparities in different ethnic populations in South Asia, USA and other parts of the world. The workshop also provided opportunities to formally develop disease-specific working groups. We believe understanding the genetics underlying diversity and health disparities in Indian population will aid to India's quest for developing "precision or personalized medicine".

CCMB organized the Indo-US Workshop on "Human Diversity and Health Disparity" during 16 - 18 January 2020.

Inauguration of Next-Generation Sequencing (NGS) Facility by Dr Harsh Vardhan, Hon'ble Minister for Science & Technology, Health & Family Welfare, Earth Sciences, Govt. of India

On July 20, 2019, Dr Harsh Vardhan, Hon'ble Minister for Science & Technology, Health & Family Welfare, Earth Sciences, initiated the inaugural run on the NovaSeq and was guided through the details of the samples and the problem being addressed by the study. The Minister expressed his immense happiness n inaugurating the state-of-the-art NGS facility activity for human genome sequencing. He said it will be of great help to patients with rate genetic disorder and meets the pressing need for prevention of diseases and counseling.

Later, the Hon'ble Minister laid the Foundation stone for the CCMB Auditorium.

CSIR - Pasteur Networking Workshop: Inherited and Acquired Diseases

CCMB organized the CSIR-Pasteur Workshop during January 16 - 18, 2020. Keeping up with the global research, the networking workshop by CSIR with the Institut Pasteur was designed to promote exchange of research ideas and develop a framework for setting up an Institut Pasteur network in India under the aegis of CSIR. The focus of the workshop was on inherited and acquired diseases, keeping in mind the current global need as well as expertise of both institutions. Boosting collaborations between the CSIR labs and Institut Pasteur will propel cutting edge research in India and promote advances in the areas of shared interest.

This was a one of a kind meeting where, in addition to the scientific talks, specific brainstorming sessions were held to develop the theme of a long-term collaborative network between CSIR and Institut Pasteur. There was ample networking among scientists to facilitate discussions on common research interests and aid in emergence of impactful concepts in the field of Inherited and Acquired diseases. The workshop included interactive sessions with the students at CCMB, keeping an eye on developing future exchange programs and inter-lab collaborations towards their doctoral research work. A special entrepreneurship session also focused on the startup space and discussions were held with the incubatees at AIC-CCMB to assess the needs and requirements of entrepreneurs in the context of the future collaborative vision.

2.2 D Deputations

- **Dr K Thangaraj**

To attend the launch of International Center of Genomic Medicine in Neuromuscular Diseases at the House of Lords in London, UK and participate and deliver lecture in the special session of the 12th UK Neuromuscular Translational Research Conference at Center for Life Newcastle, UK
April 3-5, 2019

To deliver a talk in the 15th Indo-Australian Biotechnology Conference entitled 'Contemporary Strategies for the Prevention and Management of Disease in the 2020s' at the University of Adelaide Medical School, South Australia
November 16-18, 2019

- **Dr Manjula Reddy**

To participate in the 6th Molecular Biology Meeting in the Center for Bacterial Cell Biology, Newcastle University, UK
June 17-18, 2019

- **Dr Mandar V Deshmukh**

To attend the 8th Asia-Pacific NMR Symposium at Nanyong Technological University, Singapore
July 3-6, 2019

- **Dr G Umapathy**

To attend the 7th Conference of the International Society of Wildlife Endocrinology at Kruger National Park, South Africa
October 12-19, 2019

- **Dr Deepa Selvi Rani**

To attend the American Society of Human Genetics (ASHG) 2019 Annual Meeting at Houston, USA
October 15-19, 2019

- **Dr G R Chandak**

For Quennial Review of MRC Life Course Epidermiology Unit and collaborative work on EMPHASIS Project at University of Southampton and to visit the London School of Hygiene and Tropical Medicine
October 29 - November 9, 2019

- **Dr R Sankaranarayanan**

To deliver lecture and interact with the scientist of Structural Biology Laboratory of Tshinghwa University , China

Attend and deliver lecture in 12th International Symposium on Aminoacyl-Trna Synthesis at Institute of Genetics, Zhejiang
University, China

Deliver a lecture about his recent research work and discuss with the Scientists of Shanghai Institute of Biochemistry and Cell Biology
October 31 - November 12, 2019

- **Dr Somdatta Karak**

To attend the Antimicrobial Resistance Summit Asia organized by The Economist in Singapore as an invited speaker to deliver a talk on 'Superheroes against Superbugs' - a public engagement initiative on AMR
December 5, 2019

- **M Sanjeev Chavan Nayak**

For pursuing PhD in Molecular Biology at University of Manchester, UK
February 12, 2020 to February 11, 2023

2.2 E MoUs & Agreements

- 'Development of cost effective Biosimilars using novel recombinant DNA technology' Lease agreement between AIC-CCMB and Laxai Biopharma Pvt. Ltd.

- 'Characterization and Pharmacological Evaluation of Bioactives of A Novel Phytopharmaceutical Compound for malaria and Scale-Up to NCE'
  Lease agreement between AIC-CCMB and Consytel Life Sciences Pvt. Ltd.

- 'Encouraging Innovations in Alternative Animal Models', by establishing a Centre for Predective Human Model Systems
  MoU between AIC-CCMB and Humane Society International, India

- 'Automatic Nucleic Acid Isolation Device'
  Lease agreement between CRTDH-CCMB and Sirf Bio Private Ltd.

- 'Development of a Screening Platform for Pane Reactive Antibodies (PRA) using Artificial Intelligence'
  Lease agreement between AIC-CCMB and Acrannolife Genomics Pvt. Ltd.

- 'Life Sciences startup acceleration and global partnerships'
  MoU between AIC-CCMB and Ignite Innovators, Seoul, South Korea

- 'Development of CRISPR-Cas9 assisted diagnostic chip for detection of nucleic acid implicated in human diseases'
  Lease agreement between AIC-CCMB and Albot Technologies Pvt. Ltd.

- 'Fabric-based Electrochemical Sensing Platform: Point-of-care and Continuous Testing'
  Lease agreement between AIC-CCMB and Achira Labs Pvt. Ltd.

- 'Early Identification of Sepsis Causing Pathogens from Whole Blood'
  Lease agreement between AIC-CCMB and CubeDx India Pvt. Ltd.

- 'To create an Expert Group to develop and promote NGS base diagnostics & data'
  MoU between CCMB and Centre for DNA Fingerprinting and Diagnostics (CDFD)

- 'To develop Factor 8 protein, a blood based protein to meet the regulatory compliance'
  MoU between CCMB and AVRA Life Sciences

- 'Collaboration of Entrepreneurship'
  MoU between AIC-CCMB and AIC-IIIT Kottayam Foundation, Kerala

- 'Carbonated Natural Ingredient Soft Drink (Sap Drink)'
  Lease agreement between AIC-CCMB and Sri Jaitra Associates Pvt. Ltd.

- 'Smart Active Vaccine Carrier Device'
  Lease agreement between AIC-CCMB and Zedblox Logitech Pvt. Ltd.

- 'Implementation of Technology Incubation and Development of Entrepreneurs (TIDE 2.0 Scheme)'
  MoU between AIC-CCMB and Ministry of Electronics & Information Technology (MeitY), Govt. of India

- 'Partnership in the areas of Outreach for mutually agreed collaborative events, Branding, Cross-Promotions, Recognizing, Media, Thought leadership'
  MoU between AIC-CCMB and Asia Inc. 500

- 'To jointly work towards help and foster entrepreneurship through programs and initiatives'
  MoU between AIC-CCMB and SoftVan

- 'Engaging student community in healthcare innovation practices through various outreach activities'
  MoU between AIC-CCMB and SmartBridge Educational Services Pvt. Ltd.

- 'To jointly work towards strategic training & mentorship to assist startups in deploying ML, AI to address healthcare challenges
  MoU between AIC-CCMB and Boston It Solutions(India) Pvt. Ltd.

- 'To jointly work towards supporting start-ups', researchers and students for social and rural immersion and ensure in acquiring ground level information to strengthen innovative ideas towards developing a product / service in healthcare'
  MoU between AIC-CCMB and Public Health Foundation of India (PHFI)

- 'Identify & support potential solutions involving emerging technologies to address issues related to Healthcare
  MoU between AIC-CCMB and ITE&C, Govt. of Telangana

- 'Promote co-operation in productizing scientific research and undertaking of entrepreneurial interventions for scientists & support for startups within AIC-CCMB across acceleration models'
  MoU between AIC-CCMB and Co-Creation Consulting India Pvt. Ltd.

- 'Rural Immersion partners to facilitate in acquiring ground level information to strengthen innovative ideas towards developing a product / service in healthcare
  MoU between AIC-CCMB and Share India

- 'Develpoment of primary reference standards for biotherapeutics,monographs for monoclonal antibodies and DNA barcode for medical plants as perrequirement of India Pharmacopoeia Commission'
  MoU between CCMB and Indian Pharmacopoeia Commission ,Ghaziabad

- 'Optimizing the Processes for Isolation,Preservation,Transportation and Delivery of human Limbus-derived Stromal/Mesenchymal Stem Cells for Clinical Use in a cGMP fcacility'
  MoA between CCMB and Hyderabad Eye Research Foundation, LV Prasad Eye Institute

- 'Ancient DNA anlysis of adichanallur human and animal skeletal remains'
  MoU between CCMB and Archaeological Society of India (ASI), Chennai

- 'SARS-CoV2 and COVID-19 Research and Diagnostics'
  MoU between CCMB and Osmania Medical College, Hyderabad

2.2 F Visitors & Invited Talks

DG-CSIR's visit to CCMB

The AIC-CCMB, completed its first year in April 2019. Dr Shekhar C Mande, DG-CSIR, was the Chief Guest. Before heading to the AIC-first year celebrations, Dr Mande visited all the major facilities in CCMB and addressed the scientific and technical staff, interacted with PhD students and postdoctoral fellows and talked to the administrative staff.

Visit of Hon'ble Vice-President of India to CCMB

Hon'ble Vice President of India, Shri M Venkaiah Naidu, visited CCMB on January 27, 2020. CCMB students explained their work through exhibits on structural biology, plant research, wildlife conservation, developmental biology and incubation centre. This was followed by visit to Advanced Imaging facility and Next-Generation Sequencing facility. Dr Rakesh Mishra, Director, CCMB, made a presentation on the mission and vision of CCMB and how the offshoots of basic research led to important game changing technologies in life sciences. Hon'ble VPI addressed the staff, students and other invited guests followed by release of CCMB's 'Societal Impact report' prepared by Administrative Staff College of India (ASCI).

Visit of national and international dignitaries

A delegation of IFS officers, Ms Vani Rao, Shri V Subbarayudu and Shri Sevala Naik, who serve as Ambassadors of India to European and South American countries visited CCMB on Nov 11th 2019. The delegates expressed their interest in working towards building faculty exchange programs and collaborations between Indian institutes such as CCMB and academic institutes in Finland, Estonia and Peru.

Delegates from the Niti Aayog Mr Ratan Watal, Member Secretary to Economic Advisory Council of PM and Mr. K. Rajeshwar Rao, Senior Advisor, Economic Advisory Council of PM on 17th Feb 2020. They discussed the scope of Foreign Direct Investment in Indian research, especially in medical research.

They had an at-length discussion with the startups incubated at AIC-CCMB to understand the various problems that they face in procuring investments, supply chain and logistics and scaling up of ideas. They also discussed the need for a different yardstick to measure the success of life sciences-based startups.

2.2 G Invited Talks

Dr Martin Stewart
Lecturer in Medical Technologies, University of Technology, Sydney
"Analyzing Cell Behaviour: From Mitotic Cell Shape to Intracellular Delivery"
16 April 2019

Dr Murali Krishna Cherukuri
Head, Biophysics Section, National Cancer Institute, NIH, Bethesda, USA
"Metabolic Imaging of Cancer using Hyperpolarized 13C MRI: Pre-clinical and Clinical Studies"
16 April 2019

Dr Shravanti Rampalli
Centre for Inflammation and Tissue Homeostasis,inStem, Bangalore
"Expanding the Repertoire of Histone Lysine Methyltransferases Beyond Gene Regulation in Reprogramming and Aging"
22 May 2019

Dr Amit K Bhattacharya
Business Development Manager, Premas Life Sciences Pvt Ltd
"Deep Interrogation in Tissue Biology and Disease: a CyTOF Approach"
28 May 2019

Dr Anand T Vaidya
Yale University & Howard Hughes Medical Institute, New Haven, USA
"Redox Biology in Health and Disease: Photoreception in the Biological Clock and the Dynamics of Mitochondrial Cristae"
21 June 2019

Dr Deepak K. Saini
Indian Institute of Science, Bangalore
"Targeting GPCR, CXCR4 for counteracting DNA damage response associated Inflammation"
5 July 2019

Prof Somdatta Sinha
Department of Biological Sciences, IISER, Mohali
"Modelling Infectious Diseases: Genomes to Populations"
15 July 2019

Dr Steve Xiaofeng Yu
Vice President of Technology, Cyagen US
"Turbo Knockout® & CRISPR: Technologies for Rapid Generation of Gene Targeted Mouse / Rat Models"
30 July 2019

Dr Yashpal Rawal
Yale University, New Haven, USA
"Chromatin remodelers SWI/SNF and RSC are versatile regulators of different stages of transcription initiation"
5 August 2019

Dr Binay Panda
Ganit Labs Foundation, Bangalore
"The Role of Data in Biology: Utility of Machine Learning and Artificial Intelligence-based methods in Biology"
6 August 2019

Dr Satyaki Prasad
Gehring Lab, Whitehead Institute for Biomedical Research, USA
"RNA Pol4 mediates divergent maternal and paternal impacts on the endosperm"
7 August 2019

Dr Ashutosh Srivastava
Institute of Transformative
bio-Molecules, Nagoya University, Japan
"Structural and dynamical insights into mammalian circadian clock proteins"
22 August 2019

Dr Sandip Basak
Case Western Reserve University, Cleveland, USA
"Gating and drug modulation in ligand-gated ion channels: Insights from X-ray crystallography and Cryo-EM"
26 August 2019

Dr Soumyashree Das
Red-Horse Laboratory, Department of Biology, Stanford University, USA
"Paving the Road to Regeneration with Collateral Arteries"
30 August 2019

Dr Koushik Roy
University of California, Los Angeles, USA
"A step towards predicting the immune response"
6 September 2019

Dr Debabrata Laha
MRC Laboratory for Molecular Cell Biology, University College London, London, UK
"Control of plant immunity and hormone perception by inositol pyrophosphates"
12 September 2019

Dr Avinash Sharma
National Centre for Cell Science, Pune
"Alteration of river microbiome during Mass Gathering Events"
13 September 2019

Dr Mahmood M. Alam
Wellcome Centre for Integrative Parasitology, University of Glasgow, UK
"Understanding of phospho-signalling pathways in regulation of malaria parasite survival"
17 September 2019

Prof Henry Houlden
University College of London, UK
"Neurogenetics, techniques and gene identification with neuromuscular examples"
4 October 2019

Prof Mike Hanna
University College of London, UK
"Neuromuscular diseases- understanding molecular mechanisms and developing treatments"
4 October 2019

Dr T Pavankumar
Dept. of Microbiology and Molecular Genetics, University of California Davis, USA
"Watching `3R`s of life`(DNA replication, repair, and recombination) at single-molecule level"
17 October 2019

Dr Shantanu Shukla
Department of Entomology, Max Planck Institute for Chemical Ecology, Germany
"Microbiome-mediated dietary adaptations in insects"
23 October 2019

Prof A.K. Chaudhary
ACRHEM, South Campus, University of Hyderabad
"Development of Efficient Terahertz Sources and Its Interdisciplinary Applications"
24 October 2019

Prof Ruchi Anand
Department of Chemistry, Indian Institute of Technology Bombay, Mumbai
"Strategies to Combat Antibiotic Resistance"
4 November 2019

Dr Saravanan Palani
Center for Mechanochemical Cell Biology, Warwick Medical School, University of Warwick, UK
"A spatio-temporal kinase gradient ensures sequential events of cell division"
5 November 2019

Mr Argha Manna
Journalist & Comics Artist, The Telegraph, Kolkata
"DRAWING KNOWLEDGE: Reconstructing the visual culture in science and history of science through comics"
11 November 2019

Dr Sambasivam Periyannan
Research Scientist, Agriculture & Food, CSIRO, Canberra, Australia
"Protecting the global wheat cultivation through rapid detection of resistance to the deadly rust disease"
13 November 2019

Dr Samrat Mukhopadhyay
Department of Biological Sciences, IISER, Mohali
"Liquid-Liquid Phase Separation of Intrinsically Disordered Proteins"
19 November 2019

Dr Subbaya Subramanian
Associate Professor, Department of Surgery, University of Minnesota, Minneapolis, USA
"Antitumor Immune Regulation in Colorectal Cancer"
25 November 2019

Prof Vikram Patel *(Foundation Day Lecture)*
Honorary Professor, The Public Health Foundation of India
"Transforming Mental Health Globally through Science and Action"
26 November 2019

Dr C.B. Gurumurthy
Director, Mouse Genome Engineering Core Facility, University of Nebraska Medical Center, USA
"Easi-CRISPR and GONAD: CRISPRing Mouse Genome Made Easy"
28 November 2019

Dr Siyaram Pandey
University of Windsor, Canada
"Anticancer natural extracts and their interaction with standard chemotherapies; mechanism of action and scientific validation"
2 December 2019

Dr Arunabha Majumdaar
Dept of Pathology and Laboratory Medicine, University of California, Los Angeles, USA
"Leveraging eQTLs to identify individual-level tissue of interest for a complex trait"
3 December 2019

Dr Roberta Faedda
Scientific Support Specialist, Abcam plc, UK
"Optimization techniques for Chip, IHC & Immunocytochemistry / IF"
5 December 2019

Dr Karthik Subramanian
Department of Microbiology, Tumor and Cell Biology, Karolinska Institute
"Host-pathogen interactions in invasive pneumococcal disease"
17 December 2019

Dr Kesavardana Sannula
St. Jude Children's Research Hospital, Memphis, USA
"Decoding intracellular mechanisms of innate stress sensing and inflammatory cell death"
30 December 2019

Dr Kathleen Vandiver
MIT Edgerton Center, MIT Center for Environmental Health Sciences. USA
"Using Hands-on Molecular Models to Teach Key Concepts in Science to Diverse Audiences"
2 January 2020

Dr Yelagandula Ramesh
IMBA - Institute of Molecular Biotechnology, Vienna Biocentre, Austria
"Epigenetic mechanisms of cell fate control in mammals"
07 January 2020

Dr Srikanth Ravichandran
Luxembourg Centre for Systems Biomedicine, Luxembourg
"Big Omics Data-Driven Computational Approaches for Stem Cell Systems Biology"
24 January 2020

Dr Shovmayee Maharana
Max Planck Institute of Molecular Cell Biology & Genetics, Dresden, Germany
"Role of RNA interactions in phase separation driven cellular compartmentalization and neurodegeneration"
29 January 2020

Dr Keiichi Namba
Graduate School of Frontier Biosciences, Osaka University, Japan
"Common mechanisms by skeletal muscle actomyosin and bacterial flagellar motor revealed by electron cryomicroscopy and optical nanophotometry"
4 February 2020

Dr Deepak Veerappan
Scientific Associate, Department of Life Sciences, Natural History Museum, London, UK
"Ecomorphological Diversity in Natricine Snakes"
11 February 2020

Dr Mahipal Ganji
Ludwig-Maximillian-University, Munich & Max-Planck Institute of Biochemistry, Germany
"Biophysical approaches for unraveling the spatial organization of chromosomes"
20 February 2020

Prof Manoj Puthenveedu
Department of Pharmacology, University of Michigan, Ann Arbor, USA
"Spatiotemporal regulation of GPCR signaling by membrane trafficking"
24 February 2020

Dr Manoj Hariharan
Genomic Analysis Laboratory,Salk Institute for Biological Studies, La Jolla, USA
"Mitochondrial Biology at Single-cell Resolution and Multi-omic Medicine in India"
13 March 2020

Dr Basudeb Maji
Harvard Medical School, USA
"Synthetic Small Molecule Mediated Precision Control of CRISPR/Cas9 and β-Cell-specific Drug Delivery"
16 March 2020

2.2 H Events & Popular Talks

Independence Day (August 2019)

As part of the 73rd Independence Day celebrations, various competitions in outdoor games, indoor games, quiz were conducted. Winners were awarded on 15th of August after flag hoisting and address to staff by the Director, CCMB.

- Two superannuated staff (Shri Nanjappa and Smt N Shyamala Rao) were invited as the guests and were felicitated on the occasion.

Hindi Week (September 2019)

For Hindi Day celebrations, CCMB invited Mr Paresh Kumar Sharma, Chief Advisor, Marichanna Reddy Institute, to give a popular talk followed by prize distribution to staff who won in various competitions conducted as part of Hindi day celebrations. This was followed by cultural event and a skit by staff & students – *Aapadaa-e-Anusandhan.*

CCMB Foundation Day (November 2019)

CCMB celebrates November 26th every year as its Foundation Day reminiscing the day when its laboratory complex in Habsiguda was officially dedicated to the nation and cause of science in 1987. On the 32nd Foundation Day, Prof Vikram Patel was the Chief Guest and distinguished invited speaker. He delivered a lecture on "Transforming Mental Health Globally through Science and Action". His lecture described how science has generated significant knowledge to understand the nature of, and how to respond to, the sufferings caused by mental ill-health. On this occasion, Prof Patel released CCMB Annual Report 2019-2020 and Jigyasa 2019 (Hindi science magazine). This was followed by dinner for CCMB staff and their families, well-wishers, invited guests and the retired staff.

Release of Annual Report 2018-19 (image above), and Jigyasa 2019 (image below)

Republic Day (January 2020)

On the occasion of 70th Republic Day, CCMB invited Dr Jayaprakash Narayan, Former IAS, as Chief Guest. Dr Jayprakash talked about the uniqueness of India despite its cultural and linguistic diversity. He also interacted with the staff and students on various socioeconomic and political issues in the country.

Founders Day (February 2020)

Birthday of Dr P M Bhargava, Founder Director of CCMB, is being celebrated as Founder's Day since February 2017. For the occasion, CCMB invites two of its alumni members on this day to talk of their career trajectories. The invitees for this year were Dr Thomas Pucadyil, Associate Professor, IISER Pune and Dr Gayatri Saberwal, Dean of Academics, IBAB, Bengaluru. This was followed by a public debate on "Genome editing, genetic modification and the future of agriculture in India" with Drs Imran Siddiqi, Rakesh Mishra, Pooja Bhatnagar (ICRISAT) and Amitabh Mohanty (NIPGR) as panelists. This was followed by cultural program, live band by Ashwin and Benji .

CCMB Students' Council (CSC)

The CCMB Students' Council (CSC) is a group of PhD student representatives created with the objective of coordinating and communicating students' matters as well as facilitating various engaging activities. Regular activities coordinated by CSC include the monthly Scientific Group Meeting and the informal discussion forum 'Chalk the Talk'. In addition, in 2019 a unique student-led conference 'Hy-Sci' was organised. Here is a brief recap of activities conducted in the past year.

Scientific Group Meeting

SGM is a platform for CCMB researchers to discuss interesting new ideas and studies outside of their

SGM Speakers - April 2019 to March 2020

April 2019	**Dr. Krishnan Harshan** - Regulation of Gene Expression by Ribosome: Decoding the Decoder	**Radhika Khandelwal** - Cellular trans-differentiation and reprogramming: way ahead to alleviate insulin deficiency?
May 2019	**Nikhil Hajirnis** - CELL-OR-ON - world's first CRISPR based Dual-core Processor	**Kamakshi Dandu** - Metabolic targeting of cancer stem cells: A promising therapeutic approach
June 2019	**Dr. Sonal Nagarkar Jaiswal** - Infectious and Genetic causes of Microcephaly	**Hanuman Kale** - A Transmissible RNA pathway in Honey Bees
July 2019	**Dr. Swasti Raychaudhuri** - Double Edged - Infection and amyloids	**Manish Bhattacharjee** - The science of things that aren't so
August 2019	**Dr. Santosh Kumar** - Supramolecular assemblies in immune signaling	**Jotin Gogoi** - Evolutionary adaptations that transformed the ancestral RAG transposase into the RAG recombinase for V(D)J recombination
October 2019	**Dr. Mandar V Deshmukh** - Probing low-populated excited conformational states by NMR	**Swetha Sundar** - Single 'celled' steps towards multicellularity
November 2019	**Dr. Meghna Krishnadas** - Invisible forces: how cryptic fungi maintain plant diversity in natural ecosystems	**Debabrata Jana** - Every time things don't need breaking to change
December 2019	**Dr. Jahnavi Joshi** - Community ecology from a phylogenetic perspective	**Umesh Kumar** - Mitochondria: The powerhouse of ATP to pluripotency
March 2020	**Dr. Rakesh Mishra** - Genomics presenting new approaches to uncover biology	**Haripriya Parthasarathy** - Not just an Xist-ential crisis – unravelling novel players in X-chromosome inactivation

field of research. The meeting happens once a month and has two talks, usually by a Principal Investigator and a student, followed by a quiz on science trivia and recent science news. In a nutshell, one hour per month is dedicated to amazing new studies, insightful discussions as well as a competition of recurring and emerging trivia champions!

Chalk the Talk

It is an open forum for scientific discussions on anything under the Sun, and beyond. There are zero restrictions on who can opt to speak, their topic of discussion and even the length of the session. The sole rule is we collectively say no to PowerPoint presentations! Speakers can go totally old school with a chalk and duster (now evolved to a marker and eraser) or get creative and hone their digital sketching skills. The objective is to have a highly interactive and organic dialogue without the need to tailor the talk. Previous speakers of this forum have given testimony of the benefits of casual unrestricted discussions. The discussion is usually scheduled on Friday nights at 9 PM.

'Chalk the Talk' Speakers - April 2019 to March 2020

Date	Speaker	Title of the talk
22nd March 2019	Kamal Kumar Malukani	The Watcher on the Wall
3rd May 2019	Suraj Singh Nongmaithem	Metabolic Thrifty- An evolutionary perspective of modern day diseases
21st June 2019	Nikhil Hajirnis	Blackhole: discovering the sweet spot of galactic space-time
26th July 2019	Pavan Kumar Ch	Quirky tale of the bacterial cell wall
20th September 2019	Umesh Kumar	Germ cell: the Soul of Life
18th October 2019	Annapoorna P K	The mental illness spectrum
27th December 2019	Narayan Datt Soni	Alzheimer's Disease: let's not 'forget' the sex!
7th February 2020	Sai Uday Kiran	The Critical Four Hours and Magic of Cognitive Flexibility that Rules 4x10^5

CSC members as of 31/03/2020:

Manish Bhattacherjee (Jan 2015)
Siddharth Bhatia (Jan 2015)
Preethi Jampala (Aug 2015)
Ashish Bihani (Jan 2016)
Shambhavi Garde (Aug 2016)
Divyaa Gupta (Aug 2016)
Annapoorna PK (Aug 2017)
Shraddha Lahoti (Aug 2017)
Soujanya M (Jan 2018)
Sai Uday Kiran (Aug 2018)
Sakshi Shambhavi (Aug 2018)
Aishwarya Arun (Jan 2019)
Harsh Kapoor (Aug 2019)
Pooja Gupta (Aug 2019)

2.2 I Science Outreach & Popularization Programs

Study tours

CCMB receives a number of requests from universities, colleges and schools every year for guided tours to the various facilities. CCMB has taken up this activity since its inception with an objective of keeping the young minds informed about the ongoing activities in the institute, in general and advances in frontier areas of modern biology in particular which they might not read in their textbooks in graduate and post-graduate studies. For this, a guided tour is organized for the visiting student groups. During the year 2019-20, 2829 students visited the Centre from several colleges and universities.

- Modern College, Pune
- Trainees from National Institute of Nutrition, Hyderabad
- Prof Jayashankar Telengana State Agricultural University, Hyderabad
- Govt College for Women, Thiruvananthapuram
- Sree Narayana Guru College, Coimbatore
- Yashoda College of Nursing, Hyderabad
- Ahmadhiyya International School, Male', Republic of Maldives
- Kendriya Vidyalaya, Air Force Academy, Hyderabad
- Delhi Public School, Hyderabad
- Sri Bhavishyaa Educational Society, Hyderabad
- Abhaya School, Hyderabad
- Mount Litera Zee School, Manikonda, Hyderabad
- Zilla Parishad High School, NTR Nagar, Hyderabad
- Zilla Parishad High School, Budvel, Hyderabad
- Zilla Parishad High School, Vattinagulapally, Hyderabad
- Zilla Parishad High School, Kismatpur, Hyderabad
- Bharathidasan University, Tiruchirappalli
- Sagar Public School, Bhopal
- Johnson Grammer School, Nacharam
- St Joseph's College, Tiruchirapalli
- Talla Padmavathi School, Warangal
- Farmers of Sankarapuram, Tamil Nadu
- St Xavier's College, Goa
- Young Inventors selected by Network of Organisations for S & T Communication, New Delhi
- University of Mysore, Mysore
- Faculty Members of Telengana Pharmacy Association, Khammam
- Rajiv Gandhi Institute of IT & Biotechnology, Pune
- College of Veterinary and Animal Sciences, Wayanad, Kerala
- Shivaji University, Kolhapur
- St Francis College for Women, Microbiology Department, Hyderabad
- Tamil Nadu Agricultural University, Coimbatore
- Focus High School, Hyderabad
- Kuvempu University, Shimoga, Karnataka
- Traineees from National Institute of Plant Health Management, Hyderabad
- College of Agriculture, Punjab Agricultural University, Ludhiana
- Shivchhatrapati College, Aurangabad
- Sri Chandra Techno School, Nizamabad
- Kerala Agricultural University, Thiruvananthapuram
- Govt School students of Nirmal District, Telengana
- Sri Tripura International Junior College, Latur
- St Francis College for Women, Zoology Department, Hyderabad
- N S S College, Mamppuram, Kerala
- Mecy College, Palakkad, Kerala
- Providence Women's College, Calicut, Kerala
- College of Agricultural Biotechnology, Ratnagiri, Maharashtra
- The Cochin College, Cochin, Kerala
- Savitribai Phule Pune University, Pune
- Dantuluri Narayana Raju (DNR) College, Bhimavaram, Andhra Pradesh
- Government Degree College for Women, Nalgonda
- CMS College, Kottayam, Kerala

- Hislop College, Nagpur
- Adarsha Science, J.B Arts & Birla Commerce Mahavidyalaya, Dhamangaon, Amravati
- Telengana Social Welfare Residential Degree College for Women, Armoor,Nizamabad
- Telengana Social Welfare Residential Degree College for Women, Budvel, Hyderabad
- Kerala Police Academy, Thrissur, Kerala
- Sahyadri Science College, Shimoga, Karnataka
- VES College of Arts, Science & Commerce (Microbiology), Chembur,Mumbai
- Bajaj College of Science, Wardha, Maharashtra
- VES College of Arts, Science and Commerce (Biotechnology), Chembur, Mumbai
- Trainees from National Institute of Nutrition, Hyderabad
- Palamur University, Mahabubnagar, Telengana

CCMB Open Day

Celebrated on September 26th to mark CSIR's Foundation Day, CCMB opens up its gates for public to come and interact with its scientists, see the facilities, and contextualize the research that we do. Last year, it was visited by around 9000 people – most of them were students and educators. The exhibits and posters presented on this day covered the breadth of our research focus spanning cell and molecular biology, genetics & genomics, organismal development, structure-function relationship of proteins to technology development and nature conservation. In addition, there were special booths focusing on entrepreneurship and urging problems of climate change and antibiotic resistance.

CCMB Young Innovators Program (YIP)

CCMB conducted the Young Innovators' Program (YIP) for the 7th straight year. This program provides a platform for school students to spend an extended amount of time with scientists. Around 200 interested students from schools of Hyderabad as well as nearby districts had applied for the program. The program began with a public talk by Dr VM Tiwari, Director, CSIR-National Geophysical Research Institute on Sustaining Water Availability. This was followed by a screening test for the students. Based on their performance, the top 10% are selected for the 2-week program.

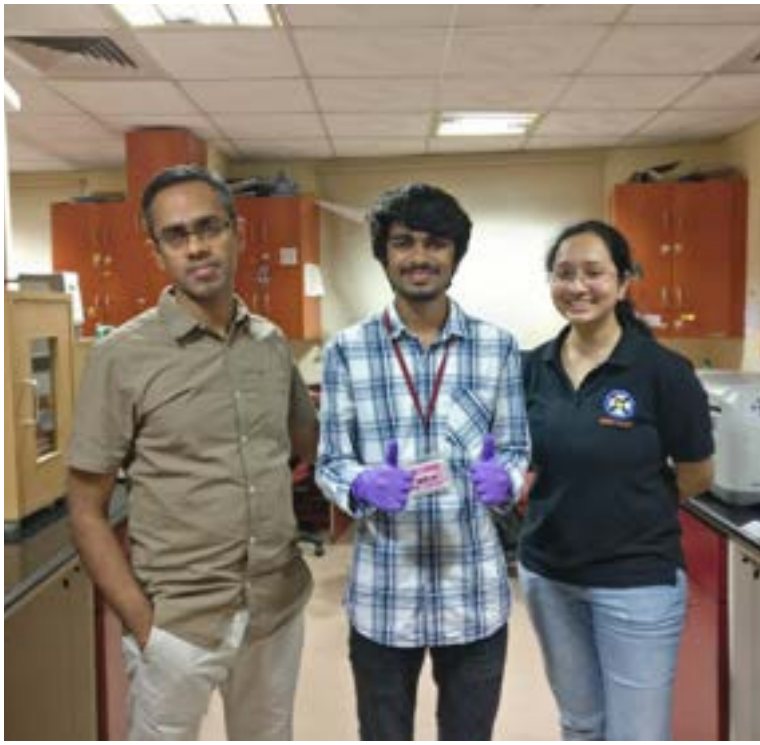
During this period, these students interacted with young and senior scientists at CCMB. The sessions were designed to encourage discussions on the motivations of scientists, and include activities explaining scientific methodology. They also carried out experiments and built instruments to feel the excitement of doing hands-on science. We also encouraged them to think of science in novel ways such as while writing fiction, and engage with global concerns of climate change and antibiotic resistance through their interactions with ecologists and wildlife biologists, and microbiologists respectively at CCMB.

What makes a Scientist

We started this workshop to inculcate the habit of questioning among college students. Young college students often think of science only in terms of the modern techniques, and not on the question one addresses. We used art to make them observe and question things around them. We introduced them to scientific methodology, scientific literature to enable them to ask more relevant questions – that can potentially become their research proposals. The sessions were led by a science artist and a CCMB scientist - to strike a balance between exploration and critical thinking. This program received an overwhelming response from Hyderabad and other cities, suggesting a lack of such a program for the country's undergraduate students.

Shadow a Scientist

Through this program we provide a platform for motivated (high school onward) students to choose a lab of their choice at CCMB, and spend a day with the scientists working in that lab.



Project Abhilasha

Second year in running, CCMB's PhD students have mentored undergraduate students of the colleges in the city through this program. This year, we have worked with three of the Telangana Social Welfare Residential Degree Colleges in the city. Five of our students have mentored thirty of their students and five teachers to learn how to access scientific literature as well as critique it, roughly over five months.

The participants of Project Abhilasha have taken these learnings to their peers in their classrooms.

YouTube videos and Zines

CCMB has started a series of videos called What the Science on its YouTube channel. The PhD students of the institute have scripted and produced several videos based on questions that visitors at CCMB often leave for us. The videos cover topics such as heredity, development of organisms, and structure-function relationship of proteins.

Our zines are our efforts to take our science to public, and raise curious and pertinent questions among them.

Science and Art

This year, we did workshops in Maker Faire, a huge public gathering in Hyderabad. We integrated talks by scientists at CCMB with workshops by science artists on zines and comics-making. Conducting workshops in public spaces helped us take our work out of the walls of the institute.

This activity also enabled the participants to engage with the scientific discussion in a novel way. Instead of being passive listeners, they became story-tellers, and became our partners in taking our message to their circles.

We also engaged with amateur and aspiring writers at the Hyderabad Literature Festival. We discussed how a better understanding of science can improve their fiction writing. We informed them on various ways they can access scientific literature (reviews and popular science articles from reliable sources). The participants utilized these to write stories with aspects of science portrayed from their perspectives.

Superheroes against Superbugs

Through the Superheroes against Superbugs initiative we have developed lesson plans with Wellcome DBT India Alliance, for conducting workshops on antibiotic resistance with secondary school students of the country. We conducted workshops with students in Hyderabad and Chennai. We trained trainers in NCBS, Bangalore.

Celebrating Wildlife

We experimented with puppetry to talk about environmental issues with primary and middle school students. This mode of discussion makes the content much more relatable for young children. These sessions were done in a public space with hundreds of children on Save the Frogs Day on 25th April as well as in a school in the city.

In October, we celebrated the Wildlife Week. We engaged with school students and educators across the city to discuss and appreciate wildlife, in and beyond the urban spaces. We conducted art and quiz competitions for the participants followed by a public lecture. The Friends of Snakes Society in Hyderabad delivered a public lecture and demonstration for the participants. Around sixty students engaged with us this year discussing various facets of wildlife.

Climate Change Challenge

We initiated a challenge for high school students (grades 9-12) to identify impacts of climate change in their local surroundings, and devise solutions to combat them. We partnered with KV Rao Scientific Society's SPARK Innovation Awards, an NGO of repute working in science popuarization in Hyderabad. They helped us widen the reach of the challenge to the five states of southern India. Of the fifty plus entries that we received, ten were invited to Hyderabad to present their ideas to judges from different institutes of Hyderabad, in addition to our scientists – Tata Institute of Fundamental Research, Jawaharlal Nehru Technological University, and Suno India podcast makers.

2.2 J Media coverage

रीक्षण किट विकसित करे सीसीएमबी

महामारी का प्रकोप हमारे समक्ष चुनौती : वेंकैया नायुडू

YOGA IMPROVES SPERM QUALITY, SHOWS CCMB STUDY

TIMES CITY

Hair strand can show stress: LaCONES

THE SECRETS THAT HAIR CAN REVEAL

Cow Hair Can Help Check Stress Levels

The Rahnuma

April 29 2019

CSIR-CCMB and IPC join hands to facilitate regula

For a better understanding of genetic disorders

Centre for Cellular and Molecular Biology (CCMB), Hyde

THE HIN

CCMB scientist gets gold medal

SPECIAL CORRESPONDENT

HYDERABAD

Telangana Today

CCMB holds 'Hy-Sci-2019'

Research finds origins of

Central Asia

Protein that fights plant bacteria identifie

CCMB SCIENTISTS BREAKTHROUGH

CCMB discovers n to inhibit bacterial

HYDERA

Mystery mutation: CCMB study h

1008 మంది భారతీయుల జన్యుక్రమం ఆవిష్కరణ

కుంగుబాటుకు చికిత్సలో ముందడుగు!

ఆంధ్రజ్యోతి

అస్థి పంజరాల గుట్టు రట్టు

Enzyme to curb bacteria cell growth discovered

It opens up fresh ways to target microbes, leading to new antibiotic drugs

Y. GEETANATH

HYDERABAD

Scientists at the Centre for Cellular & Molecular Biology (CCMB) have discovered an enzyme which helps in breaking cell walls of bacteria and hence, offers potential for a new drug delivery

cell regulates growth of its wall. Other bacteria, too, have the same enzyme working on cell division as the cell wall is fundamental for bacterial growth and division. Therefore, by blocking this 'scissors enzyme'

GULF NEWS

ASIA

India's 'Skeleton lake' contains bones of mediterranean migrants: Study

August 21, 2019

Hyderabad: A study by an inte
scientists has revealed that ar
mysterious skeletons found ir
Lake show there were Medite
Himalayas.
The study involving 28 resear
India, the US and Europe reve
belonged to three genetically
The study, published in popul
Communications', covered 38
Roopkund Lake and once thou
single catastrophic event. Hov
that they died in multiple per
1,000 years.

Genome-wide ancient DNA reveals that 23 of the individuals had ancestry that falls
variation of present-day South Asians. A further 14 had ancestry typical of the easte

LIFELINE FOR RED PANDA

CCMB completes genetic diversity assessment of the elusive mammal

THE ELUSIVE HIMALAYAN BEAR

- CCMB researchers complete genetic assessment of Red Panda
- They are endangered species and are at high risk of extinction
- Only 10,000 mature animals are present in the wild
- CCMB part of captive breeding of Red Panda in Darjeeling
- Numbers increase from 2 to 38 in the last two years
- Captive breeding of Red Panda under way in Darjeeling

PROCESSIONS CAUSE STR
POOR HEALTH IN ELEPHAN

THE TIMES OF INDIA

Stress lessens fertility in jumbos, finds CCMI

THE HINDU

CCMB to sequence 30 genomes a day

ove sea level, Roopkun
undred ancient huma

have never been subj
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these skeletons. Local
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it they were the victims of an epidemic."
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osteological analysis.
cting DNA from powder drilled from long bone
them for approximately 1.2 million single

Name of the Publicati
Date of the Publicatio

INFOSYS PRIZE 2019
LIFE SCIENCES
Manjula Reddy

Animals need space of their own

THE HINDU

Prestigious fellowship for scientist

THE HINDU

Clean meat research at CCMB gets a shot

APRIL 25, 2019

NEW APPROACH

DBT to give 4.5 crore for tw
initial grant

The country's first project t
meat, also called cl
Centre for C
the

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cultured meat
with th

THE HINDU

Study of ancient DNA throws light on origin of farming, languages

THE INDIAN EXPRESS HYDERA

CCMB RESEARCH SOLV
THE ROOPKUND MYST

Its ancient-gene study on skeletons discovered around
Himalayan lake has found remains of Mediterranean

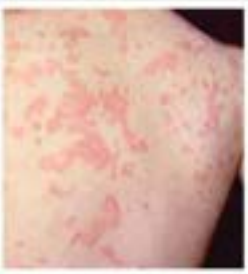
హరప్పా గుట్టు వీడింది

నూతన పరిశోధనలు @ సీసీఎం

HANS INDIA

CITY HANS SATURDAY 12 OCTOBER 2019 4

CCMB study throws light on auto inflammation



A study led by Dr Ghanshyam Swarup and Dr Vegesna Radha at Centre for Cellular and Molecular Biology (CCMB) provides mechani insights into how the FCAS-causing mutant of NLRC4, H443P, causes temperature depender caspase-1 hyper activation and cytokine

genetic alterations in mala
help in the control of malaria.

abad: A team of scientists at the Hyderabad ba
a novel and economic way of gene delivery system w
Reseal method. The new method to make genetic alterations in malaria parasite is expected to help scientist

CCMB studies DNA of Asian, African cheetah

Evolutionary divide
African, Asian cheet

CCMB analysed DNA samples to track evolutionary history of the two sub species

ఆసియా, ఆఫ్రికా చిరుతలది ఒకే జాతి కాదు

చిరుత.. గుట్టు రట్టు.

2.2 K Staff, Research Students, Project Staff

SCIENTIFIC RESEARCH GROUPS

Amit Asthana Group

Amit Asthana	Principal Scientist
Ira Bhatnagar	Principal Scientist

A S Sreedhar Group

A S Sreedhar	Sr Principal Scientist
A Vijaya Lakshmi	Sr Principal Scientist
K R Paithankar	Principal Technical Officer
Akhil Kotwal	Ph.D. student
Pankaj Kumar	Ph.D. student
Shrikant Dharaskar	Ph.D. student

Karthik Bharadwaj Group

Karthik Bharadwaj	Scientist

Purnima Bhargava Group

Purnima Bhargava	Emeritus Scientist
Pooja K Potdar	Project Sr Research Fellow

Venkata R Aditya Chalamcharla Group

Venkata R Chalamcharla	Senior Scientist
Anubhav Bhardwaj	Technical Officer
Harsh Kapoor	Ph.D. student
Annapoorna K P	Ph.D. student
Mamta Barku Nirmal	Project JRF

G R Chandak Group

G R Chandak	Chief Scientist
Seema Bhaskar	Principal Technical Officer
Inder Deo Mali	Lab Assistant
P Ashok	Lab Assistant
Ashutosh Singh Tomar	Ph.D. student
Prachand Issarapu	Ph.D. student
Sara Sajjadi	Ph.D. student
Swathi Bayyana	Ph.D. student
Sohail Rafik Mansuri	Ph.D. student
Amitabh Biswas	Project Consultant
Ajay Deepak Verma	Project Research Associate-I
Venkateshwarlu Bandi	Senior Project Associate
Arumalla Manisha	Project Associate-I
Mobeen Shaik	Project Associate-I
Shoma Kumaresh Naskar	Project Associate-I
Sravani Polepalli	Project Associate-I
Punya Sri PSKDB	Project Assistant
Shagufta Tasneem	Project Assistant
Varsha Kolaria	Project Assistant
Alagu Sankareswaran	Project JRF

Amitabha Chattopadhyay Group

Amitabha Chattopadhyay	SERB Distinguished Fellow
Parijat Sarkar	Ph.D. student
Ashwani Sharma	Ph.D. student
Subhashree S Sahu	PhD student
Amrita Samanta	Research Associate-I
Aditya Kumar G	Sr Project Associate-I
Bhagyashree D Rao	Project Associate-II
Abhishek Kumar	Project Associate-I
Sreetama Pal	Project Associate-I
Sarosh Noshir Fatakia	Visiting Scientist

Ch Mohan Rao Group

Ch Mohan Rao	CSIR-Distinguished Scientist
Kranthi Kiran Akula	Ph.D. student
Budnar Prashanth	Ph.D. student
Kamakshi Dandu	Ph.D. student

Mandar V Deshmukh Group

Mandar V Deshmukh	Principal Scientist
Upasana Rai	Ph.D. student
Sneha Paturi	Ph.D. student
Jaydeep Paul	Ph.D. student
Aute Ramdas Annasaheb	Ph.D. student
Debadutta Patra	Ph.D. student
Priti Chanda Behera	Ph.D. student

Jyotsna Dhawan Group

Jyotsna Dhawan	Emeritus Scientist
Sujoy Deb	Ph.D. student
Debarya Saha	Ph.D. student
Swetha S	Ph.D. student
Priti A S	Ph.D. student
Ananga Ghosh	Ph.D. student
Gunjan Purohit	Project Research Associate-I
Prabhavathy Devan	Project Research Associate-I
Lamuk Zaveri	Senior Project Associate

G Umapathy Group

G Umapathy	Sr Principal Scientist
Vinod Kumar	Technical Officer
Mihir Trivedi	Ph.D. student
Manu S	Ph.D. student
Krupa Vinay Teja P	Ph.D. student
G Anusha	Ph.D. student
Gopikrishnan P	Ph.D. student
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Manisha Ray	Project JRF
Karne Divya Sree	Project Field Assistant

Ajay Gaur Group

Ajay Gaur	Sr Principal Scientist
A Sreenivas	Senior Tech Officer (1)

H H Krishnan Group

H H Krishnan	Principal Scientist
M Mohan Singh	Technical Officer
Amit Kumar	Technical Officer
Dhiviya V	Ph.D. student
Haripriya Parthasarathy	Ph.D. student
Divya Gupta	Ph.D. student
Vishal Sah	Ph.D. student
Dixitkumar N Tandel	Ph.D. student
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Karthika S Nair	Project Associate-I
Neelam	Project Associate-I
Abhirami P S	Project Associate-I

K Thangaraj Group

K Thangaraj	Chief Scientist
Nitin C Tupperwar	Principal Scientist
G Mala	Principal Tech Officer
S Deepa Selvi Rani	Senior Tech Officer (3)
Jagamohan Chhatai	Technical Officer
Ch Viswanatham	Lab Assistant
Sunil Kumar Tripathi	Ph.D. student
Rajan Kumar Jha	Ph.D. student
Nipa Basak	Ph.D. student
Jaydeep A Badarukhiya	Ph.D. student
Lomous Kumar	Ph.D. student
Umesh Kumar	Ph.D. student
Deepak Kumar Kashyap	Ph.D. student
Sagnik Dhar	Ph.D. student
Partheusa Machha	Ph.D. student
Rajesh V Iyer	Ph.D. student
Agyeya Pratap	Ph.D. student
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Sunitha Reddy Kundur	Project Investigator
Narmadha Ganapathy	Post-Doctoral Fellow
Anurupa Moitra	Project JRF

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Arvind Kumar	Senior Principal Scientist
Sachin Singh	Seior Scientist
Shams Ul-Haq Talee	Ph.D. student
Annapoorna P Karthyayani	Ph.D. student
Niharika Awasthi	Ph.D. student
Aditya Undru	Ph.D. student
Bhanu Pranav N S	Ph.D. student
Gajendra Reddy	Post-Doctoral Fellow
Unis Ahmad Bhatt	Project Sr Research Fellow

Lekha Dinesh Kumar Group

Lekha Dinesh Kumar	Senior Principal Scientist
Rohitesh Gupta	Senior Research Associate

Megha Kumar Group

Megha Kumar	DST-INSPIRE Faculty
Sharda Ravi Iyer	Ph.D. student
Sulagna Mukherjee	Project Assistant

Santosh Kumar Group

Santosh Kumar	Senior Scientist
Sitanshu Kumar Sarangi	Ph.D. student
Ketaki Bhagwat	Ph.D. student
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Somdutta Paul	Project JRF

Mukesh Lodha Group

Mukesh Lodha	Principal Scientist
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Shraddha Vijay Lahoti	Ph.D. student
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M Mohammed Idris	Sr Principal Scientist

Rakesh Kumar Mishra Group

Rakesh Kumar Mishra	Director
Rashmi Upadhyay Pathak	Senior Principal Scientist
A Srinivasan	Senior Tech Officer (2)
Shagufta Khan	Ph.D. student
Phanindhar K	Ph.D. student

Nikhil Hajirnis	Ph.D. student
Ashish Bihani	Ph.D. student
Ravina Saini	Ph.D. student
Avvaru Akshay Kumar	Ph.D. student
Soujanya M S	Ph.D. student
Sonu Yadav	Ph.D. student
Saketh Murthy	Ph.D. student
Shreekant Verma	Project Scientist
Puja Singh	DST-INSPIRE Faculty
Runa Hamid	DST-Project Investigator
Titus S Ponrathnam	Post-Doctoral Fellow
Sankara Rao Kola	Project Research Associate-I
Shivranjani C Moharir	Senior Project Associate
Saher Chawla	Project Associate-I
Devesh Bahety	Project JRF
Binita Ghosh	Project Trainee
Sharath Chandra T	Project Trainee
Vaibhav Tiwary	Project Trainee
Kaladhar Bethoju	Job Contract

P Chandra Shekar Group

P Chandra Shekar	Principal Scientist
Kale Hanuman T	Ph.D. student
Debabrata Jana	Ph.D. student
Vishnu Vijay	Ph.D. student
Mansi Srivastava	Ph.D. student

Anant B Patel Group

Anant B Patel	Sr Principal Scientist
K S Vardarajan	Senior Tech Officer (1)
Narayan Datt Soni	Ph.D. student
Dipak Roy	Ph.D. student
Bedaballi Dey	Ph.D. student
Kamal Saba	Ph.D. student
Ajay Sarawagi	Ph.D. student
Simran Gothwal	Project JRF

Hitendra Kumar Patel Group

Hitendra Kumar Patel	Principal Scientist
Raju Madanala	Senior Tech Officer (2)
B Kranthi	Technical Officer
Vishnu Narayanan M	Ph.D. student
Komal Ashok Awalellu	Ph.D. student
Gokulan C G	Ph.D. student
Donald James	Post-Doctoral Fellow
Rajkanwar Nathawat	Senior Project Associate
Kamal Kumar M	Senior Project Associate
Jamaloddin	Senior Project Associate
Sohini Deb	Project Associate-I
Palash Ghosh	Project Associate-I
Bipin Kumar K	Project Associate-I
Rennya P R	Project Associate-I
Vutukuri Rani	Project Field Worker

R Nagaraj Group

R Nagaraj	J C Bose Fellow
Taniya Mary Binny	Project JRF

Swasti Raychaudhuri Group

Swasti Raychaudhuri	Principal Scientist
Shivali Rawat	Ph.D. student
Shemin Mansuri	Ph.D. student
Harshit Vaish	Ph.D. student
Pooja Ramesh Gupta	Ph.D. student
Richa Singh	Project Associate-I
D Varsha Reddy	Project Associate-I
Suparna Ghosh	Project JRF

Manjula Reddy Group

Manjula Reddy	Chief Scientist
G S N Reddy	Principal Tech Officer
M B Madhavi	Senior Tech Officer (1)
S Venugopal	Senior Technician (2)
Nilanjan Som	Ph.D. student
Pavan Kumar Ch	Ph.D. student
Raj Bahadur	Ph.D. student
Shambhavi Garde	Ph.D. student
Ashis Kumar Pradhan	Ph.D. student
Moneca Kaul	Ph.D. student
G Bhargavi Krishnasree	Ph.D. student
Suraj Kumar Meher	Ph.D. student
Vaidehi Mihir Rajguru	Ph.D. student
Richa Khanna	Post-Doctoral Fellow
Ganapathi Kandasamy	Post-Doctoral Fellow
Balaji V	Principal Project Associate

Kumaraswamy Regalla Group

Kumaraswamy Regalla	Senior Scientist
Abishek Bharadwaj	Ph.D. student
Priyanka Pant	Ph.D. student
Disha Nanda	Ph.D. student
Truptimayee Barik	Project Associate-I
Sindhoora P	Project JRF

Rajan Sankaranarayanan Group

Rajan Sankaranarayanan	Chief Scientist

P Shobha Krupa Rani	Sr Principal Scientist
Biswajit Pal	Principal Scientist
R Rukmini	Principal Tech Officer
P Sambhavi	Technical Officer
K Mallesham	Technical Officer
Mazeed Mohammad	Ph.D. student
Patil Gajanan Shrikant	Ph.D. student
Santosh Kumar K	Ph.D. student
Jotin Gogoi	Ph.D. student
Sudipta Mondal	Ph.D. student
Pradeep Kumar	Ph.D. student
Sakshi Shambhavi	Ph.D. student
Koushick S	Ph.D. student
K Priyadarshan	Project Research Associate-I
Raghvendra Singh	Principal Project Associate
Akshay Bhatnagar	Senior Project Associate-I
Kezia J Ann	Project Associate-I
Vinitha Lakshmi V	Project Associate-I
Ankit Roy	Project Associate-I
Gurumoorthy Amudhan	Project Associate-I
Noopur Dubey	Project Associate-I
Aman Ansari	Project JRF

Yogendra Sharma Group

Yogendra Sharma	J C Bose Fellow
Syed Sayeed Abdul	Lab Attendant (2)
Asmita Dhansing Pawar	Trainee Technician
Radhika Khandelwal	Ph.D. student
Amrutha H C	Ph.D. student
Sai Uday Kiran P	Ph.D. student
Venu Sankeshi	Post-Doctoral Fellow

Imran Siddiqi Group

Imran Siddiqi	J C Bose Fellow
A V Pardha Sardhi	Ph.D. student
Frank Keith Max	Ph.D. student
Survi Mahesh	Ph.D. student
Sivakumar P	Ph.D. student
Sebastien Andreuzza	DBT Fellow
Aswan Nalli	Project Research Associate-I
Jayesh Kumar N Davda	Project Research Associate-I
Vishakha Bhardwaj	Project Assistant-II
Avinash Kumar Singh	Project Assistant-II
Chandan Kumar	Project JRF
Arkasarathi Gope	Project JRF

Puran Singh Sijwali Group

Puran Singh Sijwali	Sr Principal Scientist
Renu Sudhakar	Ph.D. student
Manish Bhattacharjee	Ph.D. student
Deepak Kumar	Ph.D. student
Zeba Rizvi	Ph.D. student
Srinivas Reddy G	Ph.D. student
Chhavi Dhawar	Ph.D. student
Somesh Machhindra G	Ph.D. student
Prajakta Pramod Biyani	Ph.D. student
Angel Nivya M	Project Research Associate-I
Savita Kaswan	Project Associate

Ramesh V Sonti Group

Ramesh V Sonti	J C Bose Fellow

Divya Tej Sowpati Group

Divya Tej Sowpati	Scientist
Nitesh Kumar Singh	Senior Tech Officer (1)

Ghanshyam Swarup Group

Ghanshyam Swarup	J C Bose Fellow
Sayyad Zuber W Q	Ph.D. student
A Kishore Raghawan	Sr Project Associate
Rajashri Ramaswamy	Project JRF

Raghunand R Tirumalai Group

Raghunand R Tirumalai	Principal Scientist
Ravi Prasad Mukku	Ph.D. student

Shrish Tiwari Group

ShrishTiwari	Principal Scientist
Prachi Singh	Sr Scientist
P Ramesh	Principal Tech Officer
Deepti Rao	Ph.D. student
Ruby Srivastava	Project Investigator

Tushar Vaidya Group

Tushar Vaidya	Senior Principal Scientist
Sanjay Kumar Suman	Technical Officer
Loka Ram Prasad	Ph.D. student
Pradyumna Swanand P	Ph.D. student
Devi Prasad V	Ph.D. student
Salunkhe Satyajeet Sunil	Ph.D. student

Karthikeyan Vasudevan Group

Karthikeyan Vasudevan	Senior Principal Scientist
B Sambasiva Rao	Principal Scientist
P Anuradha Reddy	Senior Scientist
S Harika	Technical Officer

K Rajya Lakshmi	Technical Officer
Afsar Sogra	Lab Assistant
Snehalatha Vadigi	DST Inspire Faculty
Ashish Jha	Ph.D. student
Siddharth Bhatia	Ph.D. student
Gayathri Sreedharan	Ph.D. student
Ravi Kumar Singh	Ph.D. student
Avni Blotra	Ph.D. studentA
lka Sahu	Ph.D. student
Tanushree Srivastava	Project Research Associate-I
Mridula A Srinivas	Project Assistant-II
Javaid Hameed	Project Associate-I
Moomin John	Project Associate-I
Sneha N	Project Associate-I
B Nagarjun	Project Tech Field Assistant

V Radha Group

V Radha	Emeritus Scientist
Divya S	Ph.D. student
Aswathy G Krishnan	Project Assistant-II
Bharathi Venkat	Project Assistant-II

Sunil Kumar Verma Group

Sunil Kumar Verma	Principal Scientist

Sonal N Jaiswal Group

Sonal N Jaiswal	Senior Scientist
J Nandan	Ph.D. student
K Aishwarya Arun	Ph.D. student
Priyanka Pandey	Ph.D. student
Brinda Palliyana	Project Associate-I
Reshmi Varghese	Project Associate-I

Pavithra Chavali Group

Pavithra Chavali	Senior Scientist
Sourav Ganguli	Ph.D. student
Dhruv Kumar S	Project Research Associate-I
Balaji Prasanna Kumar	Project Assistant-II
C Naga Ravi Teja	Project JRF

Meghna Krishnadas Group

Meghna Krishna Das	Senior Scientist
Lakshmipriya Jayaraj C	Project Assistant II

Jahnavi Joshi Group

Jahnavi Joshi	Senior Scientist
Bharti K Dharapuram	Project Research Associate-I
Pooja Pawar	Project Associate-I

PhD Students on Lab Rotation

Aditi
Aanchal
Mukul J S
P. Sai Poojitha
Devika Dnyanraj Mahimkar
Tuhina Prasad
Chaynita Dashora
Soumya Bunk
Etikala Apoorva
Kanika Saxena
Gayatri Pratyusha M
Korak Chakraborty
Santhosh K
Vinayak Prakash Saini
Sauvik Dasnaskar
Justus Francis
N Krishna Chaitanya
Jas Ranjan Podh

S&T Resource Group

K Lakshmi Rao	Senior Principal Scientist
P Kavin Kennedy	Senior Principal Scientist
V Vijaya Bhaskar	Principal Scientist
Manoj Balyan	Senior Scientist
Suman Siddharth Thakur	Senior Scientist
A Sharada Devi	Principal Tech Officer
Bh Muralikrishna	Principal Tech Officer
S Thanumalayan	Senior Tech Officer (3)
Sandeep Shrivastava	Senior Tech Officer (1)
R Phanindranath	Senior Tech Officer (1)
M Sanjeev Chavan Nayak	Technical Officer
G Vidyasagar	Lab Attendant (2)
Venkateswara Rao A	Research Associate-I
Maheshwaran Nagaraj	Project Assistant-II*
Malathi Pinninti	Project Research Associate-I
Jayasree S Rama Devi S	SERB Post-Doctoral Fellow

Innovation Cell

N Nagesh	Chief Scientist
Jomini Liza Stephen	Principal Scientist
C B Tripura Sundari	Senior Scientist
B Kiran Kumar	Senior Scientist
V Srinivas	Principal Tech Officer
Y V Subba Lakshmi	Senior Tech Officer (2)
Hemalatha	Senior Steno
K Srinath	Lab Attendant (2)

Afna Safia	Project Senior Research Fellow
Tushar Ranjan Moharana	Project Research Associate-I
Mohammed Ghalib	Project Associate-I
Parekh Yash Rajendra	Project JRF
Rohit Sorkhel	Project JRF

Diagnostics Facility

M K Kanakavalli	Senior Tech Officer (1)
O V Padmalatha	Senior Tech Officer (1)
Raghavendra Babu	Technician (1)
V Jyothi	Project Assistant
M Pallavi	Project Assistant

CCMB-Atal Incubation Centre

N Madhusudhana Rao	Chief Executive Officer
Ramjee Pallela	Chief Operating Officer
Ritika Marrampalli	Communications Manager
Caroline K	Project Assistant-II
Saniya Pamnani	Project Assistant-II

TECHNICAL GROUPS

RESEARCH FACILITIES

Animal House

M J Mahesh Kumar	Sr Principal Scientist
Jayashree C Phukon	Scientist
A Rajasekharan	Principal Tech Officer
Jedy Jose	Senior Tech Officer (2)
N Sairam	Technical Officer
S Prashanth	Technician (1)
P Ravi	Lab Assistant
R Ellesh	Lab Assistant
M Nageswara Rao	Lab Assistant
K Raju	Lab Attendant (2)
M Rajeshwari	Multitask Staff

Bioinformatics

Sofia Banu	Project Associate-I
Archana Verma	Project Associate-I
Satuluri Sri Harsha	Project Associate-I
Deepak Sharma	Project Associate-I
Priya Singh	Project Assistant-II
Onkar V Kulkarni	Project Associate-I
Abhijeet Karan	Project Associate-I
Tanya Aggarwal	Project Assistant-II
Tummala Nikhila Sai	Project Associate-I
Priya Singh	Project Associate-I
Tanya Aggarwal	Project Associate-I

Drosophila Facility

V Bharathi	Senior Tech Officer (2)
K Ramachandra Rao	Senior Tech Officer (1)

Imaging Facility

Nandini Rangaraj	Chief Scientist
C Subbalakshmi	Principal Tech Officer
G Srinivas	Senior Tech Officer (2)
Harikrishna Adicherla	Senior Tech Officer (2)
T Avinash Raj	Senior Tech Officer (1)
Suman Bhandari	Technical Officer

Next Generation Sequencing Facility

Mohammad Jafurulla	Senior Tech Officer (2)
V Purushotham	Technical Officer

Proteomics Facility

V Krishna Kumari	Principal Tech Officer
C Sivakama Sundari	Principal Tech Officer
B Raman	Principal Tech Officer
Y Kameshwari	Principal Tech Officer
K Ranjith Kumar	Technical Assistant

Tissue Culture Facility

Avtar Singh Meena	Scientist
Ch Varalakshmi	Principal Tech Officer
V R Sundereswaran	Principal Tech Officer
Zareena Begum	Principal Tech Officer
B V V Pardhasaradhi	Principal Tech Officer
D Partha Sarathi	Senior Tech Officer (2)
S Easra	Senior Technician (2)
T Dayakar	Lab Attendant (2)

Transgenic Knockout Facility

B Jyothi Lakshmi	Senior Tech Officer (2)
S Purnima Sailasree	Senior Tech Officer (1)
Asha Kumari	Technical Officer

Zebrafish Facility

M L Arvinda Swamy	Sr Tech Officer (1)

SUPPORT FACILITIES

Planning, Monitoring and Evaluation (PME)

M R Vishnu Priya	Senior Principal Scientist
B V Ramakrishna	Public Relations Officer
Gulzar Khan	Lab Attendant (2)

Business Development, Human Resources & Documentation Group

Archana B Siva	Sr Principal Scientist
R Leela Kumari	Principal Tech Officer
Divya Singh	Sr Tech Officer (2)
K Anitha	Technician (1)

Fine Biochemicals

Y Rama Dasu	Principal Tech Officer
Kishore Joshi	Principal Tech Officer

Instrumentation Group

I Asha Ramesh	Principal Technical Officer
Lora B Narayana	Principal Technical Officer
Mahesh Prasad	Principal Technical Officer
U S T R B Bapi Raju	Principal Technical Officer
B Venkata Narayana	Senior Technical Officer (3)
N R Chakravarthi	Senior Technical Officer (2)
Dattatrya N Gurkhel	Senior Technical Officer (2)
K Sanjeev Kumar	Senior Technical Officer (2)
A Syam Kumar	Senior Technical Officer (2)
A Bala Murugan	Senior Technical Officer (1)
Sudatt T Tambe	Senior Technical Officer (1)
Devender Sundi	Senior Technical Officer (1)
Chetan R Khapekar	Technical Officer
Amol Mandlik	Technical Assistant
Angothu Ramesh	Technical Assistant

Information Technology (IT) Group

Geetha Thanu	Principal Scientist
Sublari Balaraju	Senior Scientist
Aparna Kumari	Scientist
Biswajit Roy	Scientist
P Nagalinga Chary	Principal Technical Officer
P Radhakrishna Murthy	Principal Technical Officer
K Sambasiva Rao	Senior Technical Officer (3)
N Siva Rama Prasad	Senior Technical Officer (3)
A Padmavathi Devi	Senior Technical Officer (2)
S Mahalingam	Senior Technical Officer (2)
K Rama Chary	Senior Technical Officer (2)
Sreekanth Mamidala	Senior Technical Officer (1)
Y Padmavathi	Private Secretary
K Gopichand	Senior Technician (2)
M Srinivasa Rao	Lab Attendant (2)
Shiva Kumar M	Project Associate-I

Laboratory Technical Services & Horticulture

Y V Rama Rao	Principal Tech Officer
Mani Ramana Rao	Senior Steno
P Gyaneshwar	Lab Assistant
L Laxman Dora	Lab Assistant
M A Jaleel	Lab Assistant
B Sanjeeva Rao	Lab Assistant

Engineering Services

G C Thanu	Senior Suptd Engineer
Ch Bikshamaiah	Senior Suptd Engineer
Ashok Baswa	Senior Suptd Engineer
G Rajendra Prasad	Senior Suptd Engineer
Sheelwantayya	Senior Suptd Engineer
Devidas M Nikhar	Assistant Exe Engineer
B Vijaya Kumar	Assistant Exe Engineer
K Nagendrababu	Assistant Exe Engineer
A Varaprasada Rao	Assistant Exe Engineer
V Prabhakar	Senior Technician (2)
Ch Ravindra Babu	Senior Technician (2)
K Mohan	Senior Technician (2)
A Prem Kumar	Senior Technician (2)
M Tirumala Rao	Senior Technician (2)
Ananda S Pahurkar	Senior Technician (2)
A J Narsing Rao	Senior Technician (2)
K Shankar	Senior Technician (1)
D Vinod Kumar	Technician (1)
L Kumar	Technician (1)
Anirban Adhikari	Technician (1)
Mallikanti Srinu	Technician (1)
Suresh Babu Mareedu	Technician (1)
G Ramesh	Asst Section Officer (G)
S Venkata Sastry	Lab Assistant
P Venkatarama Rao	Lab Assistant
A V Ramakrishna Reddy	Lab Assistant
T Venkateswar Rao	Lab Assistant
M Mazhar Ali	Lab Assistant
K Sreeram	Lab Assistant
K Nagabhushanam	Lab Assistant
B Balakrishna Reddy	Lab Assistant
N Narasinga Rao	Lab Assistant
Syed Khundmier	Lab Assistant
C Rosaiah	Lab Assistant
V Shankar Rao	Lab Assistant
B Satyanarayana	Lab Assistant

T Sambasiva Rao	Lab Attendant (2)
P Srinivas	Lab Attendant (2)

ADMINISTRATION & MANAGEMENT

Director's Office

D Lavanya	Senior Tech Officer (2)
B V N Naveen Kumar	Technical Officer
S Madhuri	Staff Officer & I/c Academic Cell
[illegible]ndatta Karak	Science Communications & Public Outreach Officer
[illegible]abhi Srivastava	Research Manager

Administration

P Sudha Rani	Administrative Officer
Y Srinivasa Rao	Administrative Officer
Noopur Rani Prasad	Hindi Officer
Sunil Kumar	Section Officer (G)
J Venu	Senior Tech Officer (2)
S Kanchanamala	Asst Section Officer (G)
R Gopal	Asst Section Officer (G)
Vivek Khare	Asst Section Officer (G)
Manju Singh	Sr Secretariat Assistant (G)
T Rajani	Sr Secretariat Assistant (G)
Ch Sridevi	Sr Secretariat Assistant (G)
Ashok Kumar Swasani	Jr Secretariat Assistant (G)
Abdul Raheem Qureshi	Jr Secretariat Assistant (G)
Savita Kumari	Jr Hindi Translator
K Madhavi	Receptionist
Mahendra	Sr Technician (2)
B Srinivas	Sr Technician (2)
K Satyanarayana	Sr Technician (2)
G Anand	Sr Technician (2)
Mohd Pasha	Sr Technician (2)
M Devendra Nath	Sr Technician (2)
D Ramesh	Sr Technician (2)
B Sadanandam	Sr Technician (2)
Mahender Vynala	Technician (1)
Mohd Gazanfar Ali	Lab Assistant
K Krishnamacharyulu	Lab Assistant
Ravindranath	Lab Assistant
B Venkateswarulu	Lab Assistant
Ch Chandrashekar	Lab Assistant
M Sharadha	Bearer
C V S Padmaja	Bearer
Ambe Naveen Kumar	Multitask Staff

Finance & Accounts

S K Roy	Finance & Accounts Officer
Ch Vijaya	Section Officer (F&A)
K Rama Krishna	Asst Section Officer (F&A)
Vimala Prakash	Asst Section Officer (F&A)
K Sujatha	Sr Secretariat Assistant (F&A)
V V L Prasanna	Sr Secretariat Assistant (G)
M V Subba Rao	Senior Steno
G Anuradha	Junior Secretarial Assistant
W Sudhakar	Senior Technician (2)
M Vishnu Yadav	Technician (1)
K Venkateswarulu	Lab Assistant

Stores & Purchase

Dharmendra Kumar	Stores & Purchase Officer
B Rajender Kumar	Section Officer (S&P)
Govind Kumar Jha	Asst Section Officer (S&P)
S Aruna	Asst Section Officer (S&P)
S S Lakshmi	Sr Secretariat Assistant (S&P)
N S Sandeep Kumar	Jr Secretariat Assistant (S&P)
D Balaji Prasad	Senior Technician (2)
S Riyasat Ali	Senior Technician (1)
Maqsood Ali	Junior Steno
Mohd Yakub Akheel	Lab Attendant (1)

Medical Services

V Venugopal Rao	Medical Officer
T Nagalakshmi	Sr Technical Officer (1)
A Mahesh	Technical Officer
U V Sitaramamma	Senior Technician (2)
R Palnitkar	Consultant
G Sujatha	Consultant
Ravinder Reddy D	Project Fellow

Security

C V Tirumala Rao	Senior Security Officer

Guest House

Anil Kumar Sahu	Principal Tech Officer
G Christy Wilson	Senior Technician (2)
A Selvam	Senior Technician (2)
Benedict	Senior Technician (2)
Mohd Jaffer	Lab Assistant

Canteen Group

Vikram Kumar	Technical Officer
M Venkatesan	Senior Technician (2)
P M Mani Maran	Senior Technician (2)

K Ramesh Babu	Senior Technician (2)
Mohd Athar Ali	Lab Assistant
N Aruna	Lab Assistant
R Suresh Kumar	Lab Assistant
S Yadaiah	Lab Attendant (2)
Savitri Luhura	Lab Attendant (2)

2.3 JONAKI-BRIT/DAE ^{32}P Labelled Biomolecules Laboratory

The Labelled Biomolecules Laboratory, Regional Centre (RC), Jonaki, Board of Radiation & Isotope Technology (BRIT), Department of Atomic Energy, situated in the Centre for Cellular & Molecular Biology (CCMB) campus is serving the various national laboratories, universities, industrial research centres, and hospitals involved in biotechnology, agriculture, life sciences & medical research by providing ^{32}P labelled nucleotides since 1988.

We supply ^{35}S labelled amino acids and a range of 99m Tc-radiopharmaceutical cold kits produced at Radiopharmaceutical laboratory of BRIT in Mumbai. Cold kits are for use in conjunction with 99m Tc-Pertechnatate, in imaging of human organs for diagnosis and treatment, to the nuclear medicine centres of the hospitals and diagnostic centres in and around Andhra Pradesh. In order to expand the service we will soon begin supply of 99m Tc sodium pertechnetate from radio-pharmacy laboratory at RC, JONAKI.

RC, JONAKI, BRIT has a patented FRET based qPCR chemistry which has been validated. Real time M.tb detection kit based on the above FRET technology have been developed and clinically evaluated in collaboration with Nizam's Institute of Medical Sciences (NIMS), Hyderabad. Proto type kits are under evaluation before they are introduced as regular products. We supply Taq DNA polymerase, PCR master mix, and DNA Isolation kits across the country on a regular basis.

LIST OF PRODUCTS

RADIOACTIVE BIOCHEMICALS

1. P Nucleotides:

CODE	PRODUCT
101	[g P] ATP
102	[a P] dCTP
103	[a ^{32}P] dATP
104	[a ^{32}P] dGTP
106	[a ^{32}P] ATP
107	[a ^{32}P] GTP
108	[a ^{32}P] UTP
109	[a ^{32}P] CTP
1010	[3'5'- a ^{32}P] pCP
1011	[g ^{32}P] GTP
LCP 32	[^{32}P]-Orthophosphoric Acid

The above products are available in two formulations (dry ice and ambient temperature shipments) fortnightly.

2. ^{35}S Amino Acids

CODE	PRODUCT
LCS 1/LCS 2	S Methionine
LCS 3	^{35}S Cysteine
LCS 7	^{35}S Methionine-Cysteine mix Eleg mix
LCS 6	^{35}S Glutathione
LCS 8	^{35}S Protein *in vivo* twin label mix

NON-RADIOACTIVE

BIOCHEMICALS

CODE	PRODUCT
LCK-1	Nick Translation Kit
LCK-2	Random Primer Kit
LCK-1601	dNTP mix for PCR (1 set of 4 dNTPs in 4 x 25 µl)
LCK-1602	dNTP mix for PCR (3 set of 4 dNTPs in 4 x 25 µl)
LCK-1603	dNTP mix for PCR (5 set of 4 dNTPs in 4 x 25 µl)
LCK-1604	dNTP mix for PCR (10 set of 4 dNTPs in 4 x 25 µl)
LCE-101	Taq DNA Polymerase Enzyme (100 Units)
LCE-102	Taq DNA Polymerase Enzyme (250 & 500 Units)
LCE-103	Taq DNA Polymerase Enzyme (1000-4000 Units)

LCE 104	Taq DNA Polymerase Enzyme (5000-50000 Units)
LCE 105	Taq DNA Polymerase Enzyme (60000 up to 90000 Units)
LCE 1000	Bulk packs more than 100000 units on enquiry
PMX 01	PCR Master Mix [100 Rxn (2 x 50)]
PMX 02	PCR Master Mix [250 Rxn (5 x 50)]
PMX 05	PCR Master Mix [500 Rxn (5 x 100)]
PMX 10	PCR Master Mix [1000 Rxn (5 x 200)]
PMX 1000	PCR Master Mix (On enquiry)
LCK1701	*M.tuberculosis* PCR detection kit (25 reaction kit)
LCK 1702	*M.tuberculosis* PCR detection kit (50 reaction kit)
LCK 20	Genomic DNA Isolation kit (50 reaction kit)
LCK 21	Genomic DNA Isolation kit (100 reaction kit)
LCK 22	DNA Isolation kit (Plasmid) (50 reaction kit)
LCK 23	DNA Isolation kit (Plasmid) (100 reaction kit)
LCK 24	DNA Gel Purification kit (50 reaction kit)
LCK 25	DNA Gel Purification kit (100 reaction kit)
LCK 26	PCR Product Purification kit (50 reaction kit)
LCK 27	PCR Product Purification kit (100 reaction kit)

Staff of JONAKI (as on 31-03-2020)

1. Ms Papia Hazra, OIC, RC HYDERABAD
2. Dr B.R. Varma, Manager
3. DR. T.K. Sankaranarayan, Manager
4. Mr N. Ambedkar
5. Mr M. Srineevasulu
6. Mr S. Srikanth
7. Mr T.K. Sudhir
8. Ms T. Raja Rajeswari
9. Mr M.B. Kumbhar
10. Mr P.B. Morey
11. Mr Jagdish Chandra
12. Mr S. Venkatesh
13. Mr Yakub Ali

Order for all products can be directly placed with:
OFFICER-IN-CHARGE,
REGIONAL CENTRE, JONAKI,
BRIT, CCMB CAMPUS, UPPAL ROAD,
HYDERABAD-500 007

E mail: rcrhyderabad@britatom.gov.in