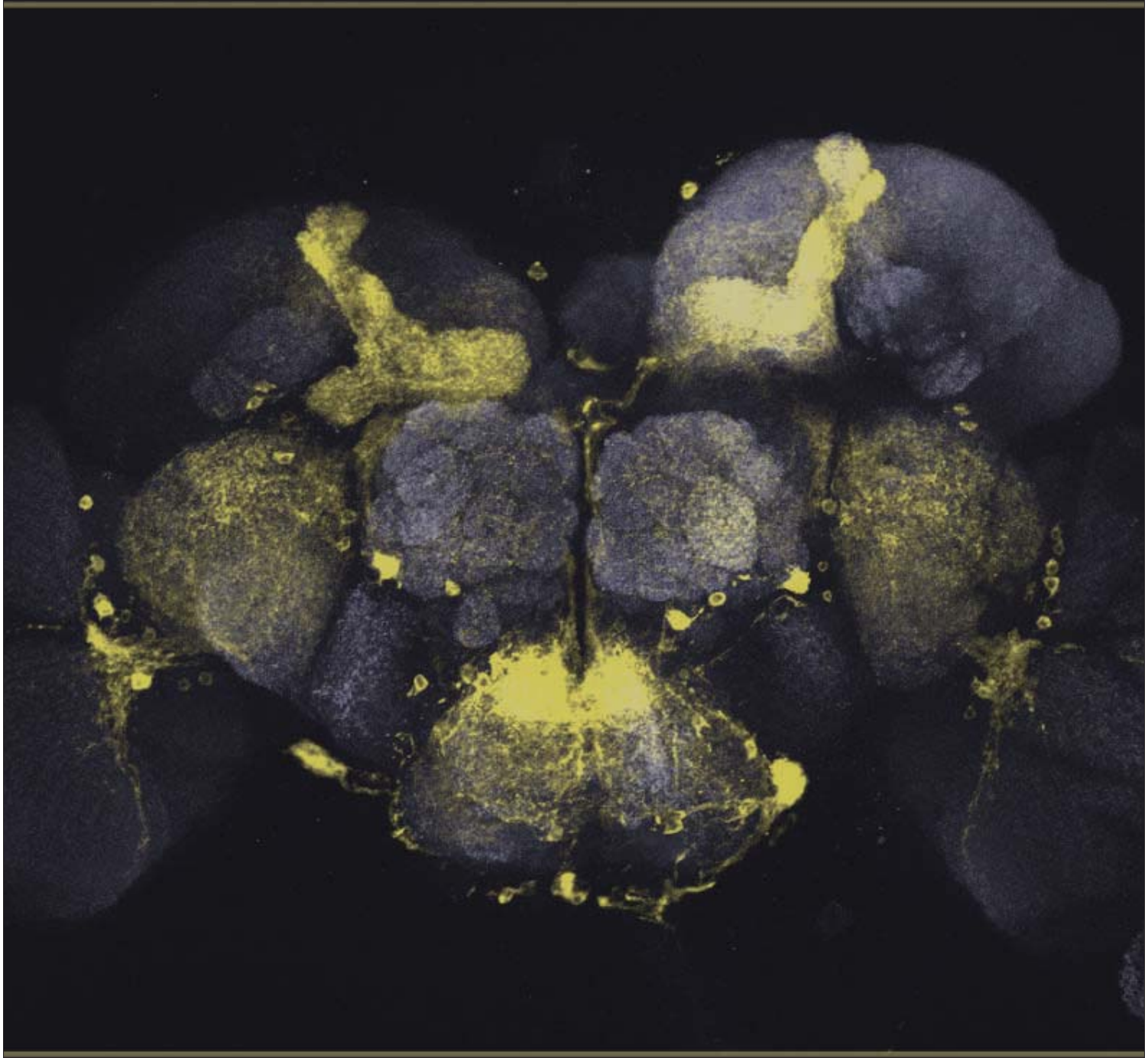
NCCS

National Centre for Cell Science



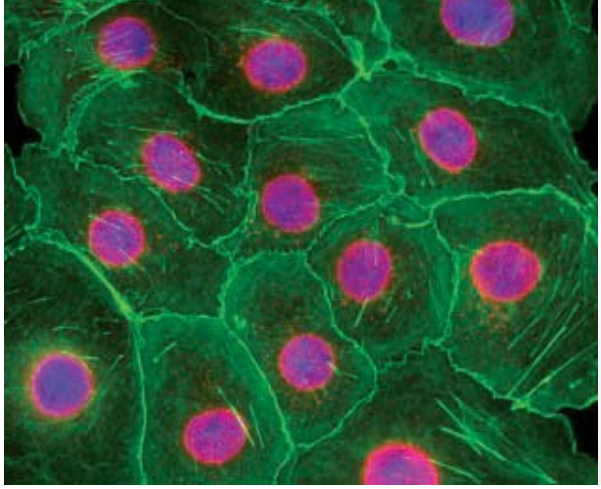
Annual Report
2020-2021

Cover page image:
Fluorescently labelled neurons in a *Drosophila* brain, including the so-called 'mushroom body' neuropils (superior half of the brain). Mushroom bodies store memories.

(Image courtesy of Dr. Gaurav Das, Ms. Prerana Choudhary and the personnel from the NCCS bioimaging facility)

National Centre for Cell Science

Annual Report 2020-2021



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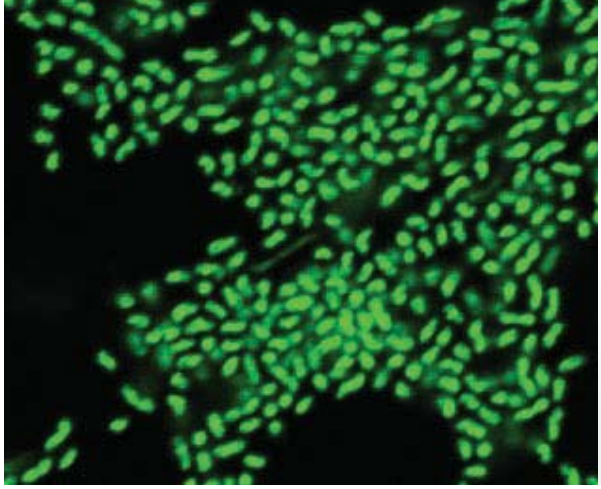


Mission, Vision and Mandate of NCCS

VISION OF NCCS

To carry out cutting-edge research in cell biology and contribute to national development through capacity-building and value-added services that facilitate cell biology research across India.

MISSION OF NCCS

- To carry out basic research in the area of cell biology.
- To serve as a national cell repository.
- Human resource development through training and teaching.

MANDATE OF NCCS

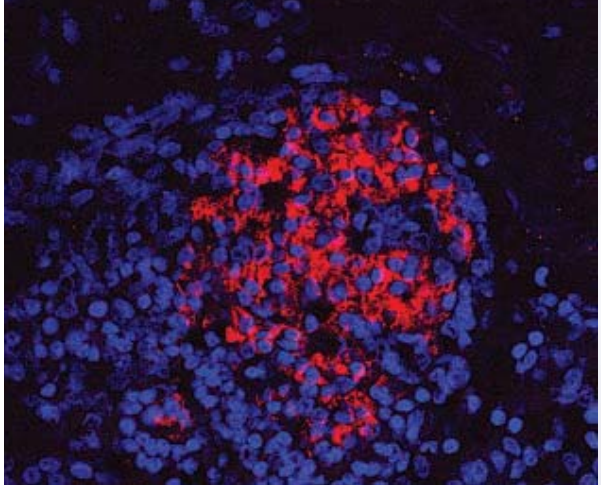
1. To receive, identify, maintain, store, grow and supply:

a) Animal and human cells/cell cultures & cell lines: currently existing (typed) as well as newly developed at NCCS.

b) Hybrid cells including hybridomas.

c) Unicellular obligate pathogens and parasites, plasmids, genes and genomic libraries.

2. Research & development in the area of cell biology, and cell culture & cell line-related materials and products.
3. To establish and conduct courses, workshops, seminars, symposia and training programmes in related fields.
4. To serve as a National Reference Centre for tissue culture in the country.
5. To provide and promote effective linkages between various scientific and research agencies/laboratories and other organisations, including industries working in the country.
6. To collaborate with foreign research institutions & laboratories, and other international organisations working in the areas relevant to the objectives of NCCS.
7. To participate in such programmes as required for the betterment of society in the country and advancement of science and technology.



Summary of NCCS Activities for the Unacquainted

NCCS carries out research in cell biology, which involves the study of cells, the 'basic unit of life'. The bodies of all animals, including humans, are composed of trillions of different types of microscopic cells. These cells, in turn, are composed of a variety of molecules, including DNA, RNA, proteins, and several others, which determine the structure, properties and biological activities of the cell. Cellular activities are also influenced by other determinants, including interactions between these molecules, as well as interactions of the cells with the environment and molecules outside the cell, with each other, and with microorganisms that they encounter. All these molecules, interactions and other factors that influence the functioning of cells, collectively determine the functioning of the animal as a whole. Consequently, to gain essential insights into how the body functions under conditions of health and disease, it is necessary to study the nuances of how cellular activities operate at the molecular level and decipher all the determinants involved. We carry out such studies at NCCS to address challenging questions about human health, especially those related to cancer, diabetes, infectious diseases, functioning of the immune system, regeneration of bone and other tissues, gut microorganisms in health and disease, stem cell biology, etc. Through achieving the proximal goal of understanding the basic biology of cells, we aspire to eventually contribute towards improvements in methods for diagnosis, and treatment regimens / therapeutics for management of diseases. Our studies hold special relevance for this purpose, since they are mainly focused on the Indian population. While engaging in basic research, we also explore possibilities for translating our promising breakthroughs into tangible benefits for the people through collaborations with clinicians. The details of the research carried out at NCCS over the past year are described in the research reports of the individual scientists in the annual report that follows.

NCCS also has service-oriented components which play a big role in facilitating high quality research not only at NCCS, but also at other organizations. One of the aims of NCCS is to function as a national cell repository for animal cell cultures, which are essential to study the biology of cells. Cell cultures are different types of cells obtained from animals, including humans, which are grown and maintained under laboratory conditions. This cell repository provides these cell cultures to cell biologists from academic and research institutions across the country. Therefore, a significant proportion of cell biology research in India is dependent on the cell repository at NCCS, and is also supported by the training and guidance provided by NCCS to develop the skills required to handle cell lines.

The NCCS Centre of Excellence, National Centre for Microbial Resource (NCMR), National Centre for Microbial Resource (NCMR) project, plays a big role in preserving the nation's microbial biodiversity, by serving as a national depository for microorganisms. It has successfully undertaken the enormous task of obtaining several different microorganisms from a variety of environments across India, preserving them in the laboratory in the form of microbial 'cultures', and characterizing them to identify them and to explore their potential for application in biotechnology. The NCMR is the largest individual collection of microorganisms in the world and is instrumental in India being internationally ranked among the top few countries with the largest collections of microbial cultures. It also facilitates high-quality research in microbiology in universities, colleges, other research institutions, and industries all over the country, by supplying authentic microbial cultures and providing related services, such as identifying microorganisms using cutting-edge techniques. Further, NCMR has been recognized by the World Intellectual Property Organization (WIPO) in Switzerland, as an International Depository Authority (IDA) for the deposit of

microorganisms to fulfill the requirements of the patent procedure in 55 countries.

In addition to carrying out research and extending services as mentioned above, NCCS also contributes immensely to capacity building of the nation and human resource development through several teaching, training & outreach activities that benefit students, researchers & academicians from various organizations across the country, as well as the general public. NCCS conducts the Ph.D. (biotechnology) coursework for students registered with the S. P. Pune University. The NCCS scientists also deliver lectures and provide hands-on training for students at various educational organizations. For example, 'Edu-Bridge', was initiated by NCCS as an extramural teaching programme wherein the scientists teach fundamental concepts of science through lectures & hands-on activities to students and faculty of the Jankidevi Bajaj College of Science (JBCS), Wardha. Students and faculty members from educational institutions across India also visit NCCS, which provides them the opportunity to learn about cutting-edge approaches and tools used in biology, which they may not have exposure to at their own institutions. Furthermore, the scientists at NCCS provide valuable mentorship and training in research to Ph.D. students and other students who carry out short-term research projects at NCCS every year as summer trainees (selected from among the Indian Science Academies' Summer Research Fellows) and project trainees (from various academic institutions).

NCCS serves to educate the general public and students about diverse topics in science through various outreach activities. These include public talks by eminent scientists, including Nobel laureates; open days at NCCS on the National Science Day and on other occasions (including public talks by eminent speakers); display of exhibits at various science exhibitions like the India International Science Festival, 'Kutuhal', 'Vigyan Rail' (the science exhibition on wheels initiated by the Government of India); articles published in newspapers and magazines in English as well as Indian languages; science-themed talks & discussions broadcast through All India Radio, podcasts and TEDx talks; participation in science documentaries for telecast on channels like the BBC Marathi, DD National channel, DD Bharati, Lok Sabha TV & Rajya Sabha TV; etc.

From the Director's Desk

I am pleased to welcome you and present here the Annual Report of the National Centre for Cell Science (NCCS), Pune, for the year 2020-21. This has been a year like none other in our experience, and one that has tested us all in multiple ways.

When the entire world was thrown into an unprecedented crisis by COVID-19 last year, NCCS swiftly rose to the challenge, and joined hands with other members of the scientific community to collectively help fight the pandemic. We are honoured that we could offer our expertise and resources to facilitate the national efforts against the pandemic. This journey began early in 2020, when Maharashtra was the worst hit state. In response to the urgent need for surveillance, NCCS set up a COVID-19 diagnostic testing laboratory with swift, determined & diligent efforts, soon after being approved as a diagnostics facility by the Department of Biotechnology, the Indian Council of Medical Research and the Maharashtra State Government. In the midst of the first lockdown, we focussed all our efforts into setting up special laboratories, procuring PPEs and other consumables, and getting our teams trained at ICMR-NIV for this purpose. The scientific & technical staff members were grouped into teams to work in coordinated shifts and manage all aspects of conducting the RT-PCR tests, as well as documentation & reporting. We were also happy to provide guidance and assistance to other organizations in Pune.

To contribute further by leveraging our research expertise, we also began exploring potential therapeutic and vaccine targets using multiple approaches. We are happy to have facilitated COVID-related research at other organizations as well, by sharing biological resources like cell cultures from our cell repository, and blood cells and plasma from our ICMR-approved biobank. Further, NCCS has been involved in sequencing the genome of the SARS-CoV-2 virus from clinical samples to help track the variants & facilitate the national surveillance efforts. We participated in DBT's pan-India 1000 genome consortium last year, and are currently participating in the Indian SARS-CoV-2 Genomics Consortium (INSACOG).

Towards the end of the 2020-21 year, we had the opportunity to add another facet to our COVID-related initiatives. We were bestowed with the Government's confidence to serve as a Central Drugs Laboratory to test COVID-19 vaccines. Once again, we initiated the process to construct a state-of-the-art facility on a war footing, with generous support from the PM CARES Trust Fund, and invaluable guidance from the Secretary, Department of Biotechnology, Government of India, CDSCO and CDL-Kasauli. This facility will help towards meeting the national demand for COVID-19 vaccines.

The pandemic has highlighted the need for public engagement in science. To help spread awareness, dispel myths and address concerns about COVID-19, precautionary measures, vaccines, etc., our scientists routinely engaged in outreach through Hindi, Marathi and English, over the last year. They reached out to the public through various media like webinars, discussions, television, radio, magazines and newspapers, to reach a wider audience.

Unfazed by the interruptions during the lockdowns, we continued with our research, training and other activities as best as possible, duly following COVID-appropriate precautionary measures and all the directives of the Government of India. Technology has proven to be a boon, allowing us to manage many aspects through virtual platforms. I am happy to state that we were able to publish almost 150 papers and file fourteen patent applications nationally as well as internationally, during the year under report. We also mentored seventeen research trainees and conducted the Ph.D. coursework for forty-three students. Seventeen of our research scholars received their

Ph.D. degrees as well. This year has taught us all valuable lessons in resourcefulness and persistence.

In the future, while we revel in our triumph over this pandemic, we will also remember 2020 as the year when we sadly lost a brilliant scientist, and a pioneer in the field of non-coding RNA, Dr. Anjali Shiras, to COVID-19. Her unprecedented findings that noncoding RNAs could play a regulatory role in cell growth were initially met with scepticism. Yet, she persisted with her explorations, and after over a decade, succeeded in establishing that 'Ginir', a noncoding RNA that she had identified earlier, acts like a cancer-causing oncogene. Her determination to chase unconventional ideas with conviction and scientific vigour will continue to inspire young researchers in the coming years.

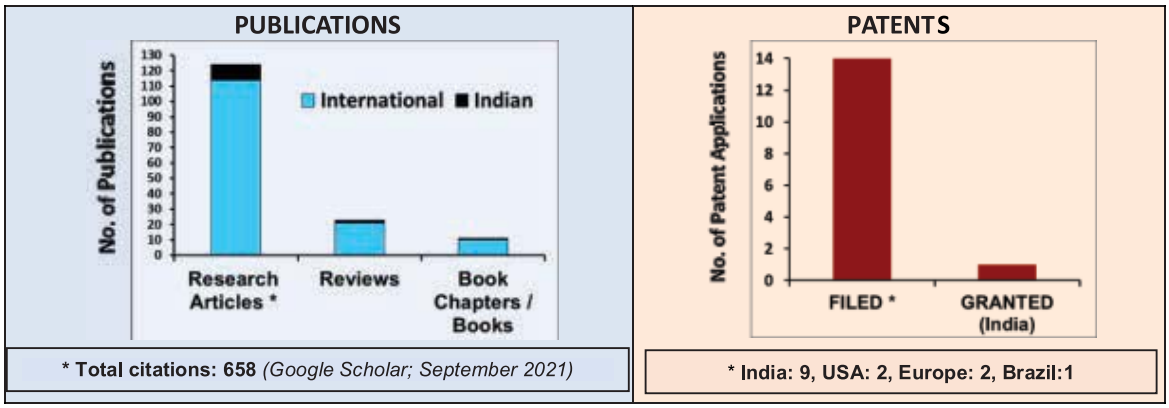
I would like to take this opportunity to express our gratitude to ICMR-NIV, the Armed Forces Medical College, and the B. J. Medical college in Pune, and the Directorate of Medical Education and Research, in Mumbai, for their timely and much-needed help, which have been invaluable in successfully initiating and implementing the COVID-related activities at NCCS. I would also like to sincerely thank everyone at NCCS involved in the COVID-related initiatives, as well as their families, for their unwavering support. Their cooperation and tireless efforts throughout the year have been instrumental in offering our services to the country in its time of need.

The recognition received from the international scientific community for our research brought a welcome change during these testing times. A paper that we published in Nature Structural and Molecular Biology recently was selected as one of the most exciting subjects investigated at the European Synchrotron Radiation Facility (ESRF) in 2020, and was featured in 'ESRF Highlights 2020'. We aspire to continue serving the nation through value-added cutting-edge science, taking forward the successful teamwork that saw us through 2020-21.

I invite you to learn more about all our activities over the year 2020-21, which are covered in the annual report that follows.

Dr. Manoj Kumar Bhat
Director, NCCS

MAJOR HIGHLIGHTS (2020-21)



OTHER MAJOR SCIENTIFIC OUTCOMES

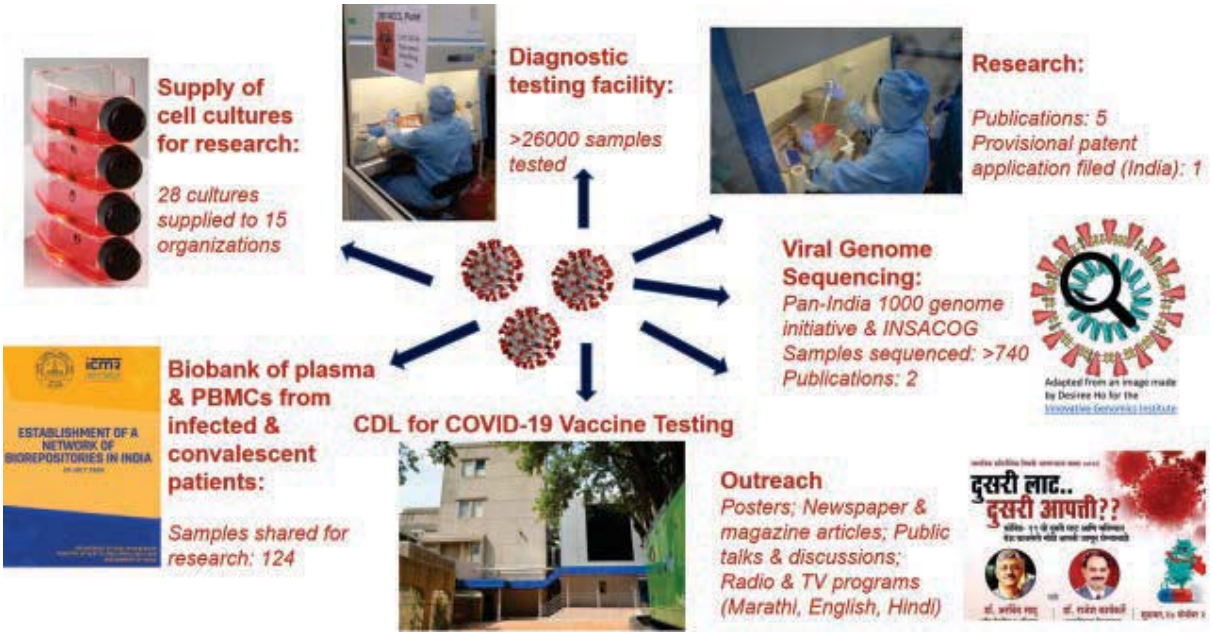
Putting Indian research on the world map :

The research published in Nature Structural and Molecular Biology was selected as one of the most exciting subjects investigated at the European Synchrotron Radiation Facility (ESRF) in 2020, and featured in 'ESRF Highlights 2020'.

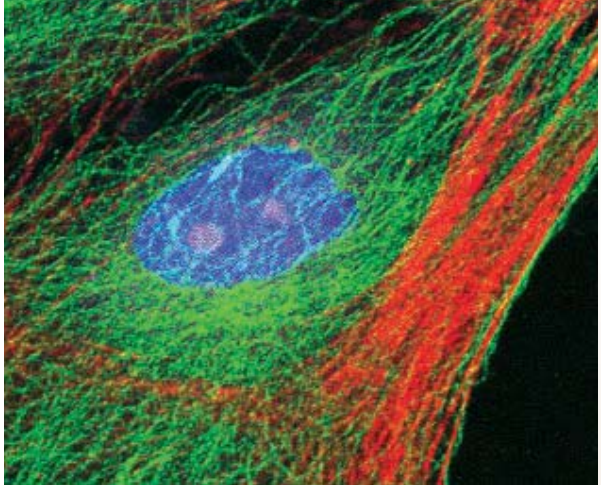
Partnerships with the industry :

- A cell line developed by NCCS was licensed to a biotechnology company in Canada.
- Clones secreting human monoclonal antibodies that showed specific binding to the SARS-CoV2 receptor-binding domain were transferred to collaborators from the industry for further testing and development.

CONTRIBUTIONS TO THE NATIONAL EFFORTS AGAINST COVID-19



BENEFICIARIES OF THE ACADEMIC PROGRAMMES	
Students awarded with a Ph.D. degree	17
Science Academies' Summer Research Fellows & Project Trainees	17
Students enrolled in the S.P. Pune University Biotechnology PhD coursework at NCCS	43



Human Resource Development

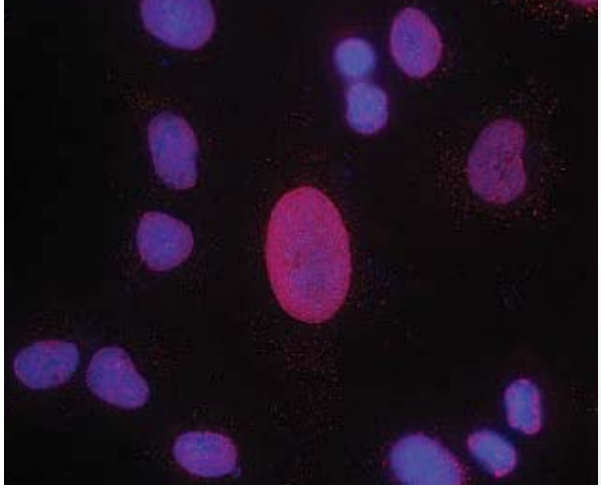
The beneficiaries of the NCCS academic programmes during the year 2020-21 are as follows:
Eleven Research Fellows joined NCCS, and four research scholars registered for a Ph.D. with the university during this year, taking the total number of registered Ph.D. students to 116, as on 31st March, 2021. Fifteen students submitted their theses to the University for evaluation, and seventeen students were awarded with a Ph.D. degree during the said year.

NCCS also conducts training programmes for students every year, as given below:

a) Project training is imparted either over 6-months' twice a year (during January-June and July-December), or over one year.

b) Summer training is conducted for 2 months during May-June. The summer trainees are selected from among the Indian Academy of Sciences Summer Research Fellows of the respective year.

The number of students who received training under these programmes during 2020-21 is as follows:
Project Trainees: 16
Summer Trainees: 01



Cell Repository

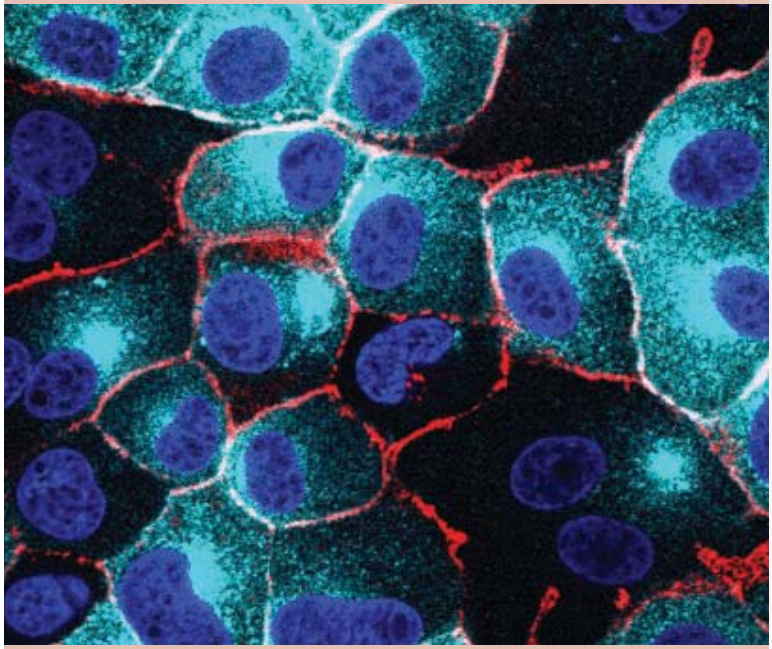
The Team

Dr. Punam Nagvenkar, Scientist D
Dr. Rahul Patil, Scientist C
Mrs. Tanuja Bankar, Technical Officer C
Mrs. Medha Gode, Technical Officer C
Mrs. Nivedita Bhave, Technical Officer C
Mrs. Anjali Patekar, Technical Officer B
Mr. Dharmendra Bulbule, Technical Officer B
Mr. Bhimashankar Utage, Technical Officer A
Mr. Nitin Sonawane, Technician C
Mr. Vikas Mallav, Technician C
Mr. Yogesh Kumbhar, Assistant Technician

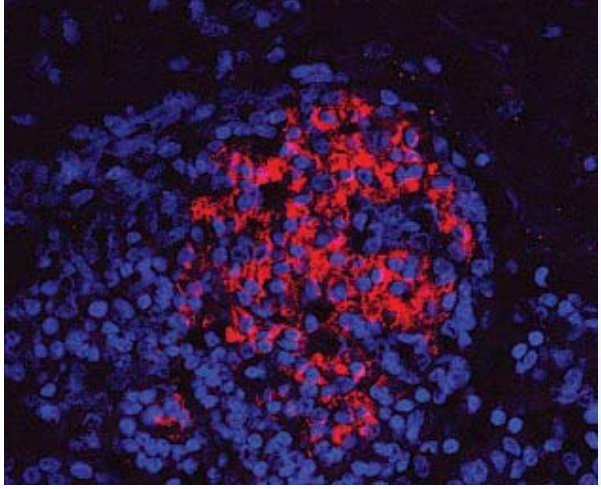
NCCS has been serving as a National Cell Repository for cell lines in India. The cell Repository carries out the expansion, cryopreservation and distribution of cell lines to researchers in academia and government as well as private research institutions and industry in India. In the year 2020-21, one thousand nine hundred and twenty-six cell cultures have been provided to 983 users in the country across three hundred eighty-six organizations. In addition, we have also supplied one hundred and twenty-seven cell cultures (including NCI cell lines) to scientists in NCCS. Furthermore, we cater towards making available an array of cell culture media to in-house scientists and have supplied almost 245 litres in the year 2020-21. Additionally, cell line authentication by Short Tandem Repeat (STR) analysis and Mycoplasma testing services have been given to both in-house scientists and external users.

In order to facilitate COVID-related research, 28 cell cultures have been supplied to 15 organizations, despite of the limitations arising due to COVID-19 pandemic situation. Efforts were undertaken to encourage scientists from NCCS and other organizations to deposit their indigenously developed or modified cell lines in Cell Repository. We have received 34 cell lines for deposition from NCCS scientists in the reporting year.

Among the outreach programs organized on a virtual platform, we actively participated in the India International Science Festival (IISF 2020) from 22nd-25th December, 2020 and Global Bio-India 2021 from 1st -3rd March, 2021. In both the events, information was provided regarding the importance and usage of cell lines in research along with the services of Cell Repository.



Research Reports



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Dr. Sharmila Bapat

sabapat@nccs.res.in

Chimeric Transcripts Generate a Diverse Non-Canonical Molecular Landscape in High-Grade Serous Ovarian Cancer

Objectives of the study

- Determination of the coding potential of chimeric transcripts identified in ovarian cancer RNA-sequencing datasets and prediction of possible antigenecity of the novel proteins and /or peptides generated by these CTs

Summary

Background

We had earlier identified chimeric transcripts (CTs; defined as RNA sequences which contains the nucleotide sequences derived from two distinct parental genes) within the TCGA ovarian cancer RNA-seq data through development of a customized cloud based analytical pipeline. While several of these CTs are novel, a few are previously reported in cancer, and some occasionally in normal tissues suggesting such transcriptional plasticity to be a global phenomenon that increases the diversity of transcripts produced within a cell, while the constancy of structural features suggests non-randomness in their generation. It appears that generation of chimeric moleculeS through relaxed transcription and translation processes may be a novel cellular mechanism for generating striking molecular diversity in a cell either in parallel / cross-talk / competition with canonical expression of the parental genes. We further probed if these CTs have any protein coding capabilities that would lead to the identification of novel proteins. This is significant since some of the CTs are expressed only in tumors, which could further be evaluated for potential applications in immunotherapy.

Lab Members

Madhuri More, SRF
Pavan Kumar Mysuru Shivalingappa, SRF
Divya Kumari Singh, SRF
Ankita More, SRF
Amruta Jadhav, JRF
Aravindan Narayanan, JRF
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Avinash Mali, Technical Officer A

Collaborator(s) – International

Prof. David Fenyo, NYULangone, NY, USA

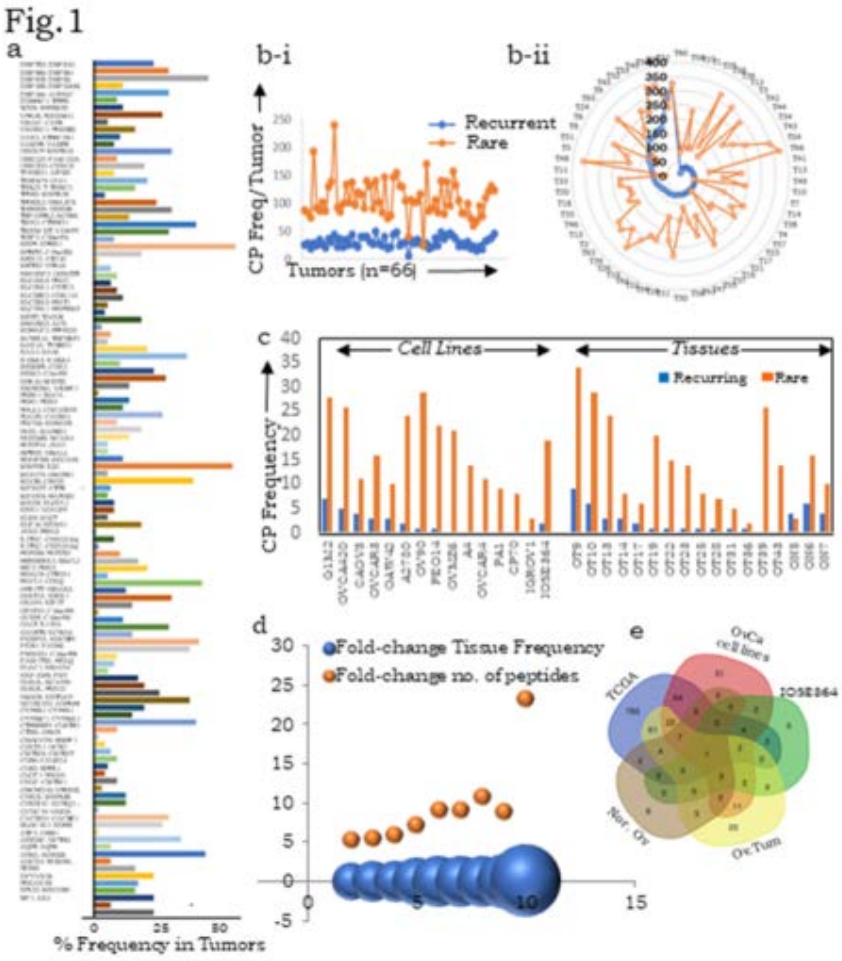

Fig. legend:

CT-derived peptides (CTdPs) in the CPTAC database for ovarian tumors (n=66), a. Expression frequencies of 116 of 120 recurrent CTdPs (at least 2 unique peptides/sample,FDR<0.05, see S.Table 5 for Y-axis details); b. Frequencies of recurrent CTdPs and their canonical parental peptides; c-i. Comparative frequencies of rare vs. recurrent CTdPs in each tumor; c-ii. Radar chart representing differential expression of recurrent and rare CTdPs per tumor (2 unique peptides/sample, Isolation Interference<50%, Xcorr>2, FDR<0.05); d. Differential expression and enrichment of CTdPs in normal and transformed cell lines and tissues; e. Differential expression of tumor-associated CTdPs in normal and transformed cells.

Main findings & Significance

Majority of CTs generate peptides, some of which are also expressed in normal cells

As a first step, we interrogated the translation of CTs using a customized database compiled from in silico translation of the transcript sequences for detection of their encoded protein as specific peptides in mass spectrometry data. This database served as a backend reference for probing ovarian tumor mass spectra datasets (n=66 generated by the National Cancer Institute Clinical Proteomic Tumor Analysis Consortium, CPTAC; https://proteomics.cancer.gov/data-portal), thereby facilitating identification of CT-derived peptides (CTdPs) as well as parental peptides derived from transcript sequences deleted during CT formation. Preliminary screening affirmed translation of 116 of 120 CTdPs in all tumors ranging from 6-39 per tumor (Figs.1a, 1b). Most tumors co-expressed parental peptides albeit at a lower level of expression than that of the CTdPs (Fig.1c). Further probing CTdP expression across a panel of tissues (normal and tumors), and cell lines (derived from normal surface ovarian epithelium and tumors) revealed expression of 39 recurrent CTdPs, 11 of which are likely to be tumor associated while the rest could be tumor-specific (Fig.1d). Cell lines expressed fewer

CTdPs over those in tissues. Expression of HSPE1-MOBKL3 derived peptides in the Indian patient tumor OT36 was unique, these were not identified in CPTAC database. The overall fewer CTdPs also could be due to fewer replicates per sample (1-6) as compared with ~24 replicates for each tumor in CPTAC datasets (Fig.1e), and is suggestive of inter-tumor heterogeneity. More importantly, the expression of CTdPs in normal tissues justifies a detailed annotation of CTs in transcript databases.

Prediction of tumor specific neoantigenecity

We further initiated an in silico prediction to probe if the the proteins / peptides derived from the chimeric transcripts are antigenic. Thus, we developed a pipeline at the following levels to predict –

(i) The peptides generated by constitutive proteasomal degradation / bound to the immunoproteasome
(ii) Antigenicity of peptides generated from the longest reads harboring the junction point of the CTs to CD8+ T cells across a set of 769 alleles across the Caucasian and Indian populations. Further docking of the shortlisted peptides with the allele(s) restricted has provided novel physic-chemical insights. Currently, we are moving ahead to dock these pMHC complexes with specific TCRs.

We believe that such a proteogenomics approach that has identified the protein coding capability of some of the CTs can now be explored in tumorigenesis, and are likely to be strikingly distinct from the well-established mutational associations with cancer. Together, these may well provide new opportunities in cancer immunotherapy by identifying neoantigens, which is an exciting field and is concurrently being developed.

Dr. Manoj Kumar Bhat

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Lab members

Mahesh Patil, RA (September 2020)
Mr. Pranay L. Ramteke, SRF (submitted thesis in October 2020)
Mr. Shyamananda Singh Mayengbam, SRF
Ms. Ankita Deb, SRF
Mr. Abhijeet Singh, SRF
Mrs. Bhavana Deshmukh, SRF
Ms. Himanshi, SRF
Mr. Firoz Khan Bhati, SRF
Dr. Varsha Shepal, Technical officer B

Collaborator(s) - National

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Dr. Mahesh J. Kulkarni, National Chemical Laboratory, NCL, Pune
Dr. Rajashekar Mohan, Dr. Praveen K. Shetty, and Shri Dharmasthala Manjunateshwara College of Medical Science and Hospital, Dharwad, Karnataka
Dr. Jeetender Chugh, Indian Institute of Science Education and Research, IISER, Pune
Dr. Amit Agarwal, Chest Research Foundation, CRF, Pune
Dr. Mohan R. Wani, National Centre for Cell Science, NCCS, Pune
Dr. Gyan Chandra Mishra, National Centre for Cell Science, NCCS, Pune
Dr. Vasudevan Sheshadri, National Centre for Cell Science, NCCS, Pune
Dr. Jomon Joseph, National Centre for Cell Science NCCS, Pune

Collaborator(s) - Industry

Dr. Ankur Kumar Upadhyay, Basic Ayurveda, Ghaziabad, India

Metabolic Regulation in Cancer Chemotherapy

Objectives of the study

- The effect of Metformin induced lactic acidosis on chemotherapeutic outcome in cancer.
- The role of MCT-4 on the therapeutic efficacy of chemotherapeutic drugs in breast and lung cancer.

Summary

Aerobic glycolysis confers cancer cells selective growth and proliferation advantage. It enhances lactate secretion that causes extracellular acidification of the tumor microenvironment. Low extracellular pH (pHe) has been shown to facilitate tumor metastasis, cell survival, and drugs resistance. Notably, the pHe of malignant solid tumor microenvironment typically ranges from 6.5 to 6.9, compared to the pHe of the normal tissues, which lies from 7.2 to 7.5, and therefore is significantly more acidic than normal tissues. Tumor acidity is correlated with its aggressive phenotype. Moreover, in vitro and in vivo studies have shown that tumor cell invasion, metastasis, and migration hugely depend upon the acidic environment.

Metformin is an anti-diabetic drug widely used for the treatment of type 2 diabetes mellitus. Beyond its anti-diabetic activity, metformin has also been shown to exhibit anti-cancer properties in various cancer models. In vitro studies suggest that metformin inhibits the proliferation of multiple cancer cells and synergistically affects many chemotherapeutic drugs to induce cytotoxicity in cancer cells. However, various studies have reported that metformin neither improves patient survival nor affects the risk of developing cancer in diabetic patients. Moreover, preclinical studies also suggest that metformin either has

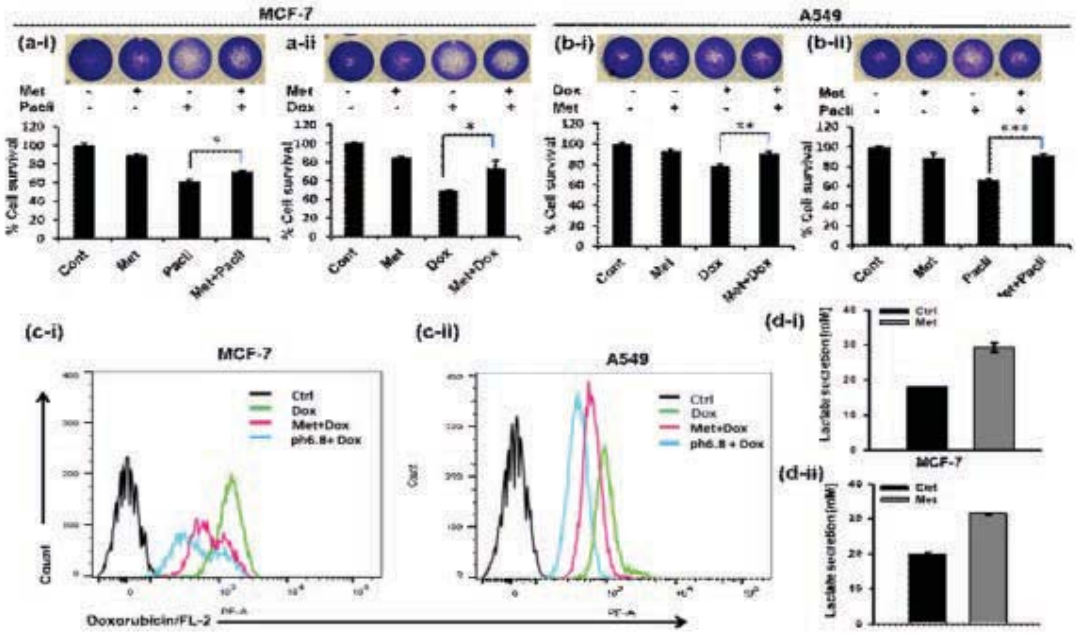


Fig. 1: Metformin limits chemotherapeutic drug-induced cytotoxicity.
(a) MCF-7 and A549 (2 × 104) cells were seeded in 48-well plates and treated with 5mM metformin for 12h. After that, 100nM paclitaxel or 10μM doxorubicin was added in the same medium for an additional 24h. Survival in MCF-7 (a-i and a-ii) and A549 (b-i and b-ii) cells were evaluated by crystal violet staining. (c) Cells were treated with 5mM metformin for 12h. After that, doxorubicin (10μM) was added in the same medium for an additional 24h. Retention of doxorubicin in MCF-7 (c-i) and A549 (c-ii) cells was determined by flow cytometry. (d) MCF-7 and A549 (7 × 103) cells were seeded in 6-well plates and treated with 5mM metformin for 12h. The medium was collected for determining the lactate secretion. Lactate secretion in MCF-7 cells and A549 cells (d-i and d-ii, respectively).

no effect on tumor growth or, in some cases, even promotes tumor growth. Nonetheless, although metformin has been reported to exhibit both pro and anti-cancer activities depending upon the nutrient availability in the tumor microenvironment, its exact function is still unclear.

Impairment in the efficacy of chemotherapeutic drugs is a primary concern in cancer treatment. One of the mechanisms by which tumor cells impair drugs is by changing their microenvironment because of altered glucose metabolism, which eventually changes the pH gradient between the extracellular environment and cytoplasm. Specific transporters mainly export the excess lactate to maintain a sustained rate of glycolysis. Glycolytic tumors specifically overexpress mono-carboxylate transporters (MCTs; MCT1-MCT4), which are often correlated with invasiveness, metastasis, and poor prognosis in many cancers. MCT1 primarily facilitates the uptake of lactate in cancer cells, while MCT4 is mainly involved in the efflux of lactate along with a proton that causes extracellular acidification of the tumor microenvironment.

Based on the information stated above, we hypothesized that lactate transporters might play an essential role in modulating the response of cancer cells towards chemotherapy. By performing inquisitive in vitro and in vivo experiments, we explored the involvement of altered pH homeostasis mediated by MCTs on the outcome of chemotherapy in breast and lung cancer models. We report that metformin impairs the cytotoxic effect of chemotherapeutic drugs by decreasing pHe via membrane translocation of MCT4.

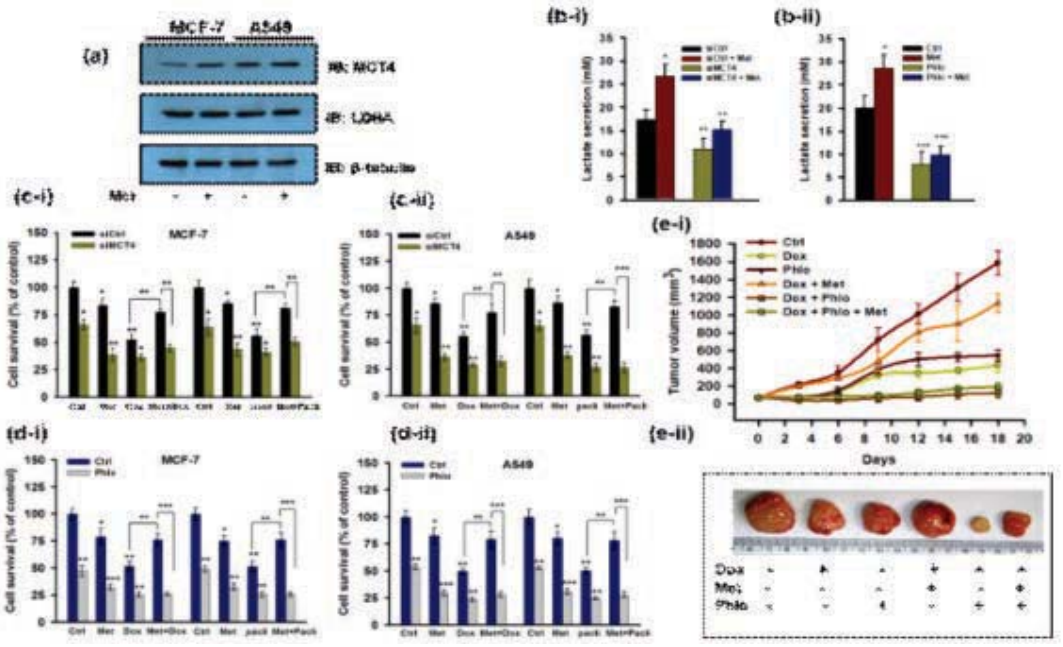
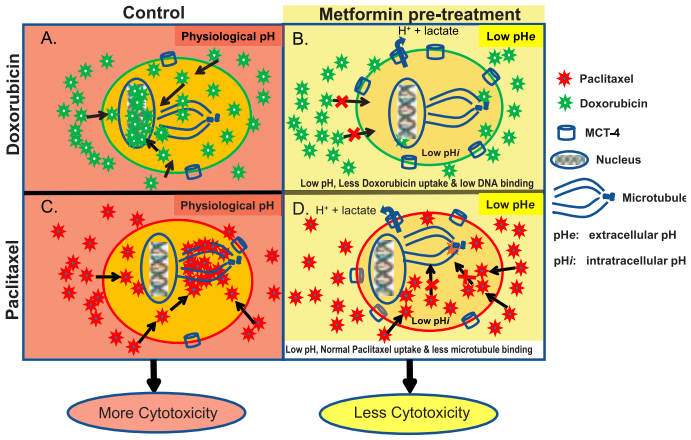


Fig. 2. MCT-4 mediates metformin-induced lactic acidosis and impairs the sensitivity of cancer cells towards doxorubicin and paclitaxel.

(a) Representative immunoblots showing the protein levels of MCT4 and LDHA in the whole cell lysate of MCF-7 and A549 cells treated or untreated with 5mM metformin for 24h. (b-i) Lactate level in the culture medium of MCF-7 cells transfected with either control or MCT4 siRNA. (b-ii) Level of lactate in the culture medium of MCF-7 cells treated with 100μM phloretin for 48h. (c-i &ii) MCF-7 and A549 (7 × 103) cells were seeded in 96-well plates and transfected with siRNA specific to MCT4. After 48h of the transfection, cells were treated with metformin, doxorubicin, and paclitaxel either alone or in combination for an additional 48h. Survival in MCF-7 (c-i) and A549 (c-ii) cells was evaluated by MTT assay. (d) Survival in MCF-7 (d-i) and A549 (d-ii) cells treated with or without phloretin (MCT-4 inhibitor) and metformin either alone or in a combination of doxorubicin (10μM) or paclitaxel (100nM) for 48h. (e) MCF-7 cells (1 × 106 in 100μl HBSS and 50μl Matrigel) were injected on the mammary fat pad of female mice to form tumors. Tumor-bearing mice were treated with either doxorubicin (1mg/kg, every 2nd day) or phloretin (5mg/kg, every 2nd day) or in the combination of doxorubicin along with phloretin, doxorubicin along with metformin or doxorubicin, phloretin, and metformin (100mg/kg day-1) together. Control mice were administered with an equal volume of the vehicle on the same treatment day. (e-i) Progression of MCF-7 induced orthotopic xenograft in mice. (e-ii) Photographs are representing the tumors excised from each treatment group. (Ctrl- control, Met- metformin, Dox- doxorubicin, Phlo- phloretin, NS- nonsignificant).



Our study shows that metformin-induced metabolic reprogramming causes lactic acidosis via activation of MCT-4, which causes impairment in the efficacy of doxorubicin and paclitaxel towards breast and lung cancer cells. Metformin, by decreasing uptake and reducing the effectiveness of drugs, diminishes their effect on cancer cells. Also, we remark that drugs being protonated in low extracellular pH may potentially be rendered ineffective when administered along with metformin.

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Understanding B Cell Responses in Health and Disease

Objectives of the study

- To understand the humoral immune response upon pathogen encounter
- To generate neutralizing antibodies against the SARS-CoV2

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Summary

Background

Antibody responses are initiated by B cells that recognize and respond to foreign antigens through antigen-specific B cell receptors (BCRs). In addition to the BCRs, B cells also express various germline encoded innate immune system receptors. For example, Toll like receptors (TLRs) that recognize highly conserved motifs present in microorganisms, called pathogen associated molecular motifs (PAMPs). This dual expression allows B cells to not only sense antigen but also survey their environment for danger signals associated with the presence of pathogens. How the BCR and TLRs function independently of one another is known in considerable molecular details. We know little about the mechanisms that integrate BCR and TLRs signaling at subcellular and molecular levels. Although both BCR and TLRs initiate signal independently, in response to antigens and PAMPs, B cells are able to integrate both antigen-specific and danger signals into a qualitatively and quantitatively unique molecular response. The goal of my lab is to determine the cellular and molecular mechanisms by which BCR signaling regulates cross-talk with intracellular TLRs to modulate B cell responses, and how intracellular BCR signaling fine-tunes B cell activation in particular B cell metabolic pathways. In addition, we are also trying to determine how antibody responses are matured

in humans upon pathogen encounter. Moreover, we are also interested in isolating pathogen specific antibodies that can be utilised for the diagnostics or therapeutics. by TLR ligands potentially results in autoimmunity and tumorigenesis.

Background

Over the last year our focus has shifted to the SARS-CoV2 as the pandemic has been the huge health and economic burdon across the globe. In our efforts to understand the antibody response in COVID-19 patients, we have generated human monoclonal antibodies that are able to neutralise the SARS-CoV2. We have generated approximately 100 human monoclonal antibodies out of which 25 clones neutralize the WT SARS-CoV2. We are now testing their ability to neutralise the delta variant. Most potent clones will be transferred to Bharat Biotech for further development. Numerous specific antibodies are generated following pathogen encounters that neutralize the pathogen and result in its eventual removal. In all recent virus outbreaks, broadly neutralizing human monoclonal antibodies have been found to be most effective and timely for both prophylactic and therapeutic use.

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Structural and Functional Studies on Components of the Nuclear Pore Complex

Objectives of the study

- Reconstitution of minimally interacting regions of Nup93 subcomplex to understand their roles in assembly of the NPC.
- X-ray crystallographic and/or cryo-EM studies on reconstituted complexes of Nups.
- Analysis of the Nups in regulating transport activity and NPC assembly.

Summary

We earlier demonstrated that the nuclear pore complex (NPC) composition is very species specific and thus may vary in architecture among the species. The mammalian NPC is comprised of ~30 different proteins called nucleoporins (Nups) that are arranged in multiple copies to yield a size of 65 MDa (yeast) or 125 MDa (vertebrate). In order to understand the molecular mechanisms of NPC assembly formed by these ~30 Nups and its versatile functions, the high-resolution structures are highly desired but complexity and the size of the NPCs pose tremendous challenges. atht etechnical level, there are two major challenges: deciphering the crosstalk of Nups and biochemical isolation of them and their complexes for structural studies.

We developed several tools to decipher protein-protein interactions of NPC, such as a novel computational pipeline for the prediction of protein-protein interaction interfaces from the amino acid sequence information named CoRNeA. We employed this tool to human Nup93 subcomplex that consists of the five proteins viz., Nup93, Nup188, Nup205, Nup35, and Nup155. In a nutshell, we could established precise boundaries of the interacting regions of

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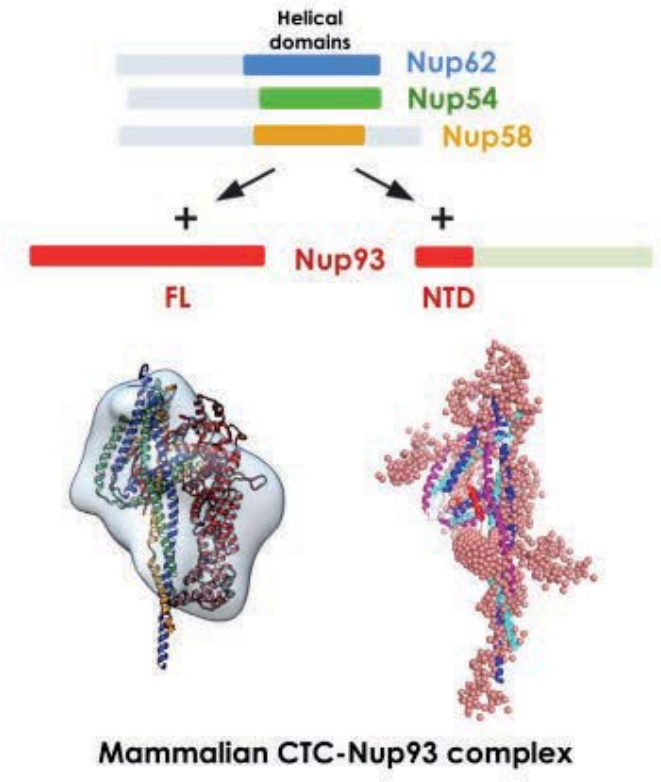

Fig. legend: Reconstitution and structural analysis of mammalian Nup93•Nup62•Nup54•Nup58 complex: A. The helical regions of Nup62, Nup54 and Nup58 were copurifed either with full length Nup93 or its minimal interacting domain (1-150). the reconstituted complexes were then subjected to electron microscopy studies and small angle light scattering analysis, which revealed the dynamic nature of the complex

binary complexes among these 5 proteins which were further confirmed by coimminoprecipitation experiments. This led us to further reconstitute the binary complexes such as Nup188•Nup93, Nup205•Nup93, Nup35•Nup93.

We also published a study where we could reconstitute the quaternary complex: Nup93•Nup54•Nup58•Nup62 for its biochemical analysis revealed how intrinsic plasticity of the Nups contribute to the dynamic nature of the complex (Figure 1). Our studies on reconstituted CTC complex with either full length Nup93 or its N-terminal domain utilizing Small Angle X-ray scattering and electron microscopy revealed the dynamic and flexible nature of CTC•Nup93 complex. Overall, we observed evolutionarily conserved plasticity and stoichiometric diversity in CTC Nups.

Significance

Our work has led to undertake comprehensive biochemical and structural studies of human Nup93 subcomplex. This complex has a major role in various diseases such as cardiovascular, kidney, neuronal disorders, etc and hence mechanistic insights would further fascilitate efforts for therapeutic interventions in future.

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Neurobiology of Nutrient Specific Memories and Feeding Behaviour in Drosophila

Objectives of the study

- To study food memories and how they influence food choices.
- To investigate how high-fat or high-sugar diets affect the brain and influence feeding behaviour.

Summary

Memories of past feeding experiences are critical in making food choices. Such memories can guide choice towards a particular food source that redresses current nutrient deficiencies. Our ability to study these memory phenomenons depend on our ability to quantify learned behaviours. Fruit flies are powerful genetic model organisms for studying brain function. Remarkably, they share most of the genes and molecular pathways that are required for proper brain development and function. Flies also exhibit robust behaviours that can be measured in behavioural assays. Hence flies have been used in learning and memory research for almost 50 years. We have recently developed an improved setup to assay food and odour relevant memories in flies. This assay allows us to measure memory at time -points where it was not possible with earlier assays. Hence it opens up the possibility to study novel memory phenomenons.

High-fat or high-sugar diets now tend to occupy a significant part of our dietary space and this has profound implications for our health and well being. Studies suggest that such diets may bias the brain to shift our food preference to more of the same. To test such phenomenon, robust feeding measurement is needed. In flies, most assay to quantify feeding are either indirect or with liquid

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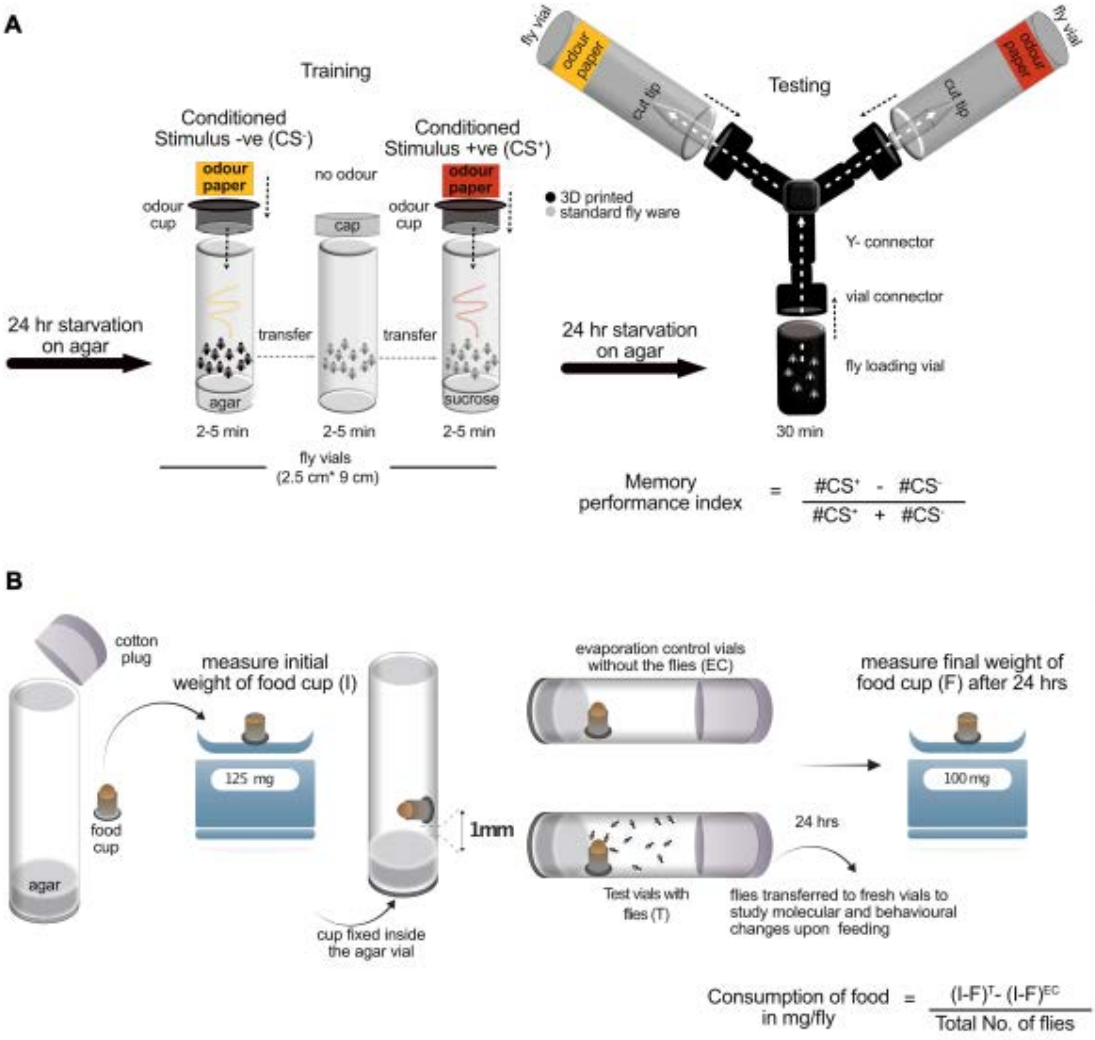

Fig. legend : a) improved memory assay in flies and b) novel solid food consumption assay in flies

food. We have developed an assay to directly measure solid food consumption in flies over extended period of time (see graphical abstract). We are now using this to assess how various signaling molecules in the brain is affected by different diets.

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Acute Necrotizing Encephalopathy-Linked Mutations in Nup358 Impair miRNA-Mediated Gene Silencing

Objectives of the study

- Characterizing the interaction between GW182 and Nup358
- Studying the effect of ANE1-associated mutations of Nup358 on its interaction with GW182
- Understanding the functional relevance of GW182 and Nup358 interaction

Summary

Acute necrotizing encephalopathy-1 (ANE-1) is a neurological disorder commonly developed in children upon infection by viruses. Recently, a nuclear pore protein (Nup358) that is important for shuttling of protiens and RNA between the nucleus and the cytoplasm has been shown to be mutated in ANE-1 patients. However, the mechansims underlying the development of this disease is unknown. In our laboratory, we found that Nup358 mutations impair the ability of the cells to fine-tune the expression of different proteins, which may contribute to the development of ANE-1. The mutations in Nup358 showed impairment in its interaction with another protein (GW182) involved in small RNA mediated suppression of gene expression. These findings provide a framework for looking into strategies that can help manage the disease.

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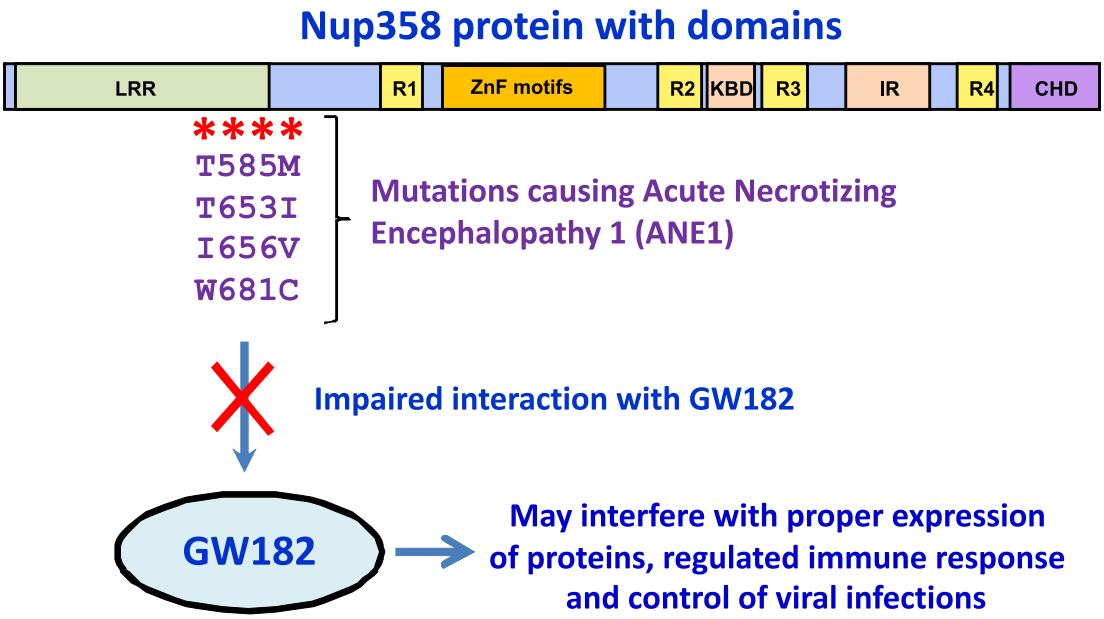

Figure : Mutations in Nup358 affect its interaction with GW182 and may interfere with gene expression in ANE-1 patients. Our studies suggest that ANE-1 patients harbouring Nup358 mutations may have comporimised control on protein synthesis due to impaired interaction with GW182, a key player in miRNA-mediated suppression of mRNA translation, leading to inappropriate immune response upon viral infections. This may trigger the pathogeneis of ANE-1. However, these findings need to be validated in ANE-1 patients.

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Evolution of Cooperation in Mycobacteria: Exploration of Public Good and Drug Resistance

Objectives of the study

- To trace the path the populations followed during the selection route by examining resultant population at 'select' selection step. The path the WT populations tend to choose to gain resistance, when triggered by sub-lethal concentration of antibiotic

Background

Metaphorically, bacteria can be imagined like a turtle that its response to a drug in its external environment can behave like a turtle that sensed danger in its outside environment. The picture in Fig. 1 is a turtle which we all know that has a hard shell and its legs and head protrude out of it. For the sake of imagination, each of its legs is susceptible to an antibiotic (akin to incubating the bacteria in a medium containing an antibiotic). The option for the turtle is to deal with the danger: that is to retract that leg (sensitive to the antibiotic). Similarly, if we add more antibiotics sensitive each of its legs and head, the turtle is anticipated to retract itself into the shell, leading to exhibition of "multi drug resistant" form. By retracting itself, the turtle is resisting many dangers outside its environment.

Summary of the work

In principle, danger to one leg of a turtle is a danger to all its legs, head and tail, not just the one targeted. A similar analogy in case of bacteria is to understand against which single antibiotic when exposed, a given bacterium chooses to be resistant will result in resistance to many other antibiotics whether or not exposed to them.

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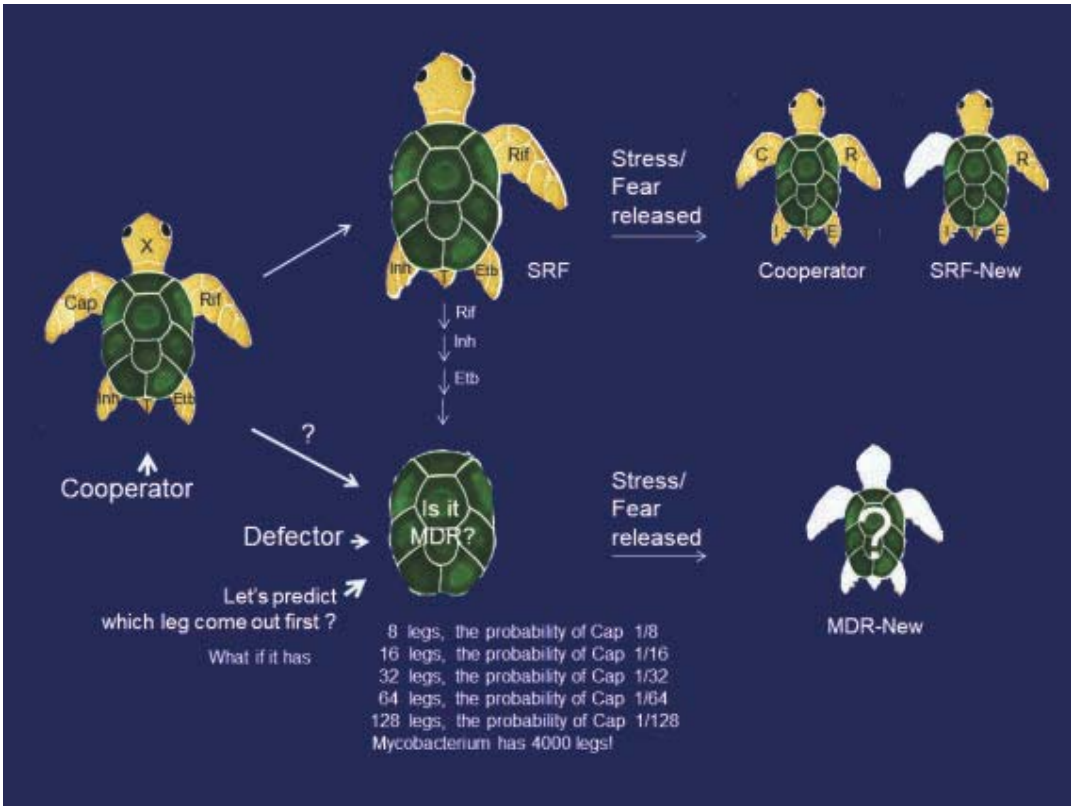

Fig. legend: The cooperator turtle, incurs the costing being hit an antibiotic labeled on each of its legs, tail and head eg. Cap: Capreomycin, Rif: Rifampicin, Inh: Isoniazid, Etb: Ethambutol. Upon hit on the Cap labeled leg, it retracts that leg leaving the others outside. This SRF (single resistant form) is resistant to Capreomycin. If this form is further hit on other legs (treated with the labeled antibiotics, downward arrow), it can completely retract itself into the shell. This is the "Defector" form. Upon release of the stress or withdrawal of antibiotic, the turtle either can puts its sensitive leg outside (back to cooperator) or it can be replaced with a new one (SRF-New). The question mark arrow indicates a short route in which it can directly attain the MDR form by sensing danger to any of its legs. Even after releasing the stress (withdrawal of antibiotics), the bacterium can completely different based on the possibility of choices (i.e. legs).

In other words, the question is whether bacteria do the same i.e. by choosing pathways that are easy to deal with the external environment to evolve in such a way that they can resist the antibiotics making the bacterium similar to a turtle that retracted itself into the shell.

Using the above analogy, we have attempted to identify the drugs, normally used for treatment, against which Mycobacterium can evolve and at the same time, the resultant population's ability to survive in vivo is an aspect our laboratory has investigated. It is observed that the Mycobacterium marinum, an organism that evokes nearly identical pathophysiology like the human pathogen in fish. It is widely used to circumvent the highly containing environments needed to investigate the human pathogen. It shares greaten than 85% homology with the human pathogen. The results of the study are not only interesting but also applicable to treatment regimen.

The first line of drugs such as Isoniazid, Ethambutol do not kill the bacterium but arrest the growth of certain population members while resistant populations multiply. This is because, Isoniazid is a pro-drug. After its entry, it is process by the bacterium aka activation leads to arrest of the growth. It is easy to understand that if the processing is not done by the bacterium, the drug has no utility. In order to grow in the presence of Isoniazid, the bacterium can "choose to not process" it since non-processing of the Isoniazid in no way prevents the bacterium from growing in its presence leading to multiplication of the population. This mechanism can be called in evolutionary biology as "Defection", choosing to not perform

a given function by an entity does not incur any cost, hence, defection is an evolutionarily stable strategy that organisms may choose due to its lowest cost to evolve drug resistance. The turtle's ability to retract into the shell is the cheapest in terms of all other options it has.

In order to get going in life, the turtle must extend its legs back to outside environment. What if the turtle has 8 legs? What if another leg is present in the place of the original leg that was hit? As shown in Fig. 1, as the number of legs increases (alternatives increases), the resistance to the environment increases. Can the same be true in case of bacteria is the question one must answer to counter the bacterial resistance. As the options for bacteria increase with cost of those options being low, the bacteria can evoke such options and multiply those populations resulting in severity of the infection. Hence, it is highly relevant to understand the progress of infection through the cost of options the bacteria have for their multiplication not only helps in treatment but also allows us to choose wise approaches to deal with it.

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Mechanisms of Kainate Receptor Modulation by auxiliary Neto proteins

Objectives of the study

- Cloning, expression, purification and characterization of Neto1-ECD.
- SAXS analysis of purified Neto1-ECD and estimation of its binding affinity with GluK2 kainate receptors via surface plasmon resonance.
- Electrophysiological investigations to understand the role of receptor domains responsible for Neto1-ECD and GluK2 receptor interactions.

Summary

Background

Kainate receptors belong to the family of ionotropic glutamate receptors and play critical roles in modulating synaptic function in the central nervous system. Neuropilin and tolloid-like proteins 1 and 2 (Neto) are auxiliary subunits that modulate the gating properties and the availability of cognate kainate receptors at the synapse. Thus, Neto proteins play an essential role in maintaining synaptic plasticity and function. While electrophysiology-based insights into functions of Neto protein are known, biophysical and biochemical insights into Neto proteins have been largely missing till-date. We conducted biochemical, biophysical, structural, and functional characterization of the purified extracellular domain (ECD) of Neto1 protein.

Main findings & significance

Our results show that Neto1-ECD exists as monomers in solution and has micromolar affinity for GluK2 kainate receptors in apo state or trapped in closed state. The affinity is ~2.8 fold lower for receptors trapped in desensitized state highlighting conformation dependent interaction of Neto proteins with kainate receptors. Furthermore, SAXS analysis of the purified Neto1-ECD reveals that

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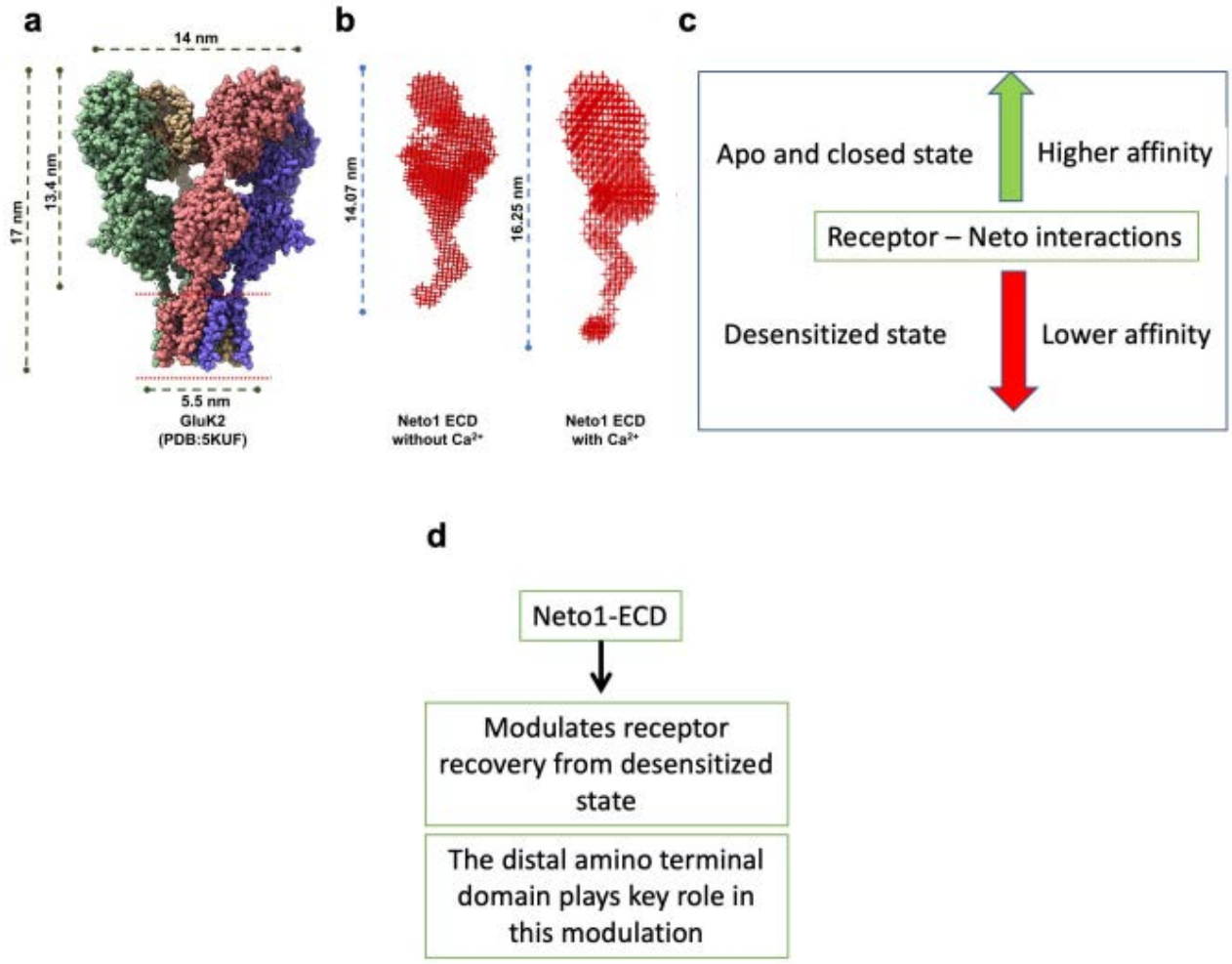

Fig. legend: Kainate receptor GluK2 is modulated by auxiliary Neto proteins. Side by side presentation of (a) GluK2 receptor structure (PDB ID 5KUF) and (b), ab initio model of Neto1-ECD in single orientation in the absence and presence calcium ions. The dimensions are labeled for comparison. Predominant solution shape of SAXS based model of Neto1 extracellular domain is shown. Calcium ion binding to Neto proteins led to an extension in their length and increased thermal stability. (c), GluK2 and Neto interact with high affinity. However, this interaction is state dependant. (d), Further, Neto1-ECD could regulate receptor function. Our experiments also show that the distal most domain of receptor plays key roles in this interaction.

their dimensions are long enough to span the entire extracellular domain of kainate receptors. We also show that calcium ions impart rigidity and extend the protein length in solution. Additionally, our experiments evaluating the gating properties of GluK2 reveal a differential role of various Neto1 domains in modulating GluK2 functions. Although the desensitization rate was not affected by the Neto1-ECD, the recovery rates from the desensitized state are altered. Additionally, using chimeric receptors generated by swapping amino-terminal domains (ATD) between GluA2-AMPA receptor and GluK2-kainate receptor, we also highlight the role of ATD domains in interaction with Neto1. In overview. our work provides the first biophysical and structural insights into the mechanism of GluK2 receptor regulation by Neto1.

Our work on understanding the kainate receptor modulation by its auxiliary proteins has a significant impact on unravelling the basic biology of these receptors and mechanisms of their action. Also, since these receptors are implicated in multiple neuronal disorders, it's also likely to drive drug discovery programs targeting these receptors.

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Generation of Regulatory CD4 T Cells to Suppress the Allergic IgE Response to Food Antigen

Objectives of the study

- To induce Foxp3+ regulatory CD8 T cells from naïve CD4 T cells.
- To phenotypic and functional characterization of Foxp3+regulatory CD8 T cells.

Summary

Background

CD8+ T cells have also been shown to perform regulatory functions in infections, cancer, autoimmunity, and alloimmunity. In mice, the frequency of CD8+Foxp3+ Tregs is very low, ranging from 0.07 to 0.4% of CD8+ T cells in the spleen and peripheral lymph nodes and about two to three times higher frequency in the gut-associated lymphoid tissues. In humans, CD8+Foxp3+ T cells are about 0.1 to 1% of total CD8+ T cells, and their frequency distribution in human changes in different diseases and health statuses. Although, suppressive function of CD8+Foxp3+ Tregs is very well documented in different inflammatory and tolerogenic settings, given its low-frequency distribution, the clinical use of these suppressive cells as adoptive cellular therapy is limited. In the present work, we aim to develop an ex vivo method to generate CD8+Foxp3+ regulatory T cells from the most abundant naïve CD8 T cells and test its preclinical efficiency in controlling the allergic response to food antigen.

Main findings & Significance

We develop a new method to induce a very efficient way to differentiate the regulatory CD8+Foxp3+ regulatory T cells from the most abundant naïve CD8 T cells. In an ex vivo method, we treated the purified naïve CD8+ T cells in the presence of purified recombinant IL-2, anti-CD3e antibody, purified recombinant transformation necrosis factor-beta (TGF-ß), along with DNA methyltransferase I inhibitor 5-Aza-2'-deoxycytidine (5-Aza). This method differentiated 40 % of naïve CD8 T cells to expressed Foxp3 molecules in 4 days.

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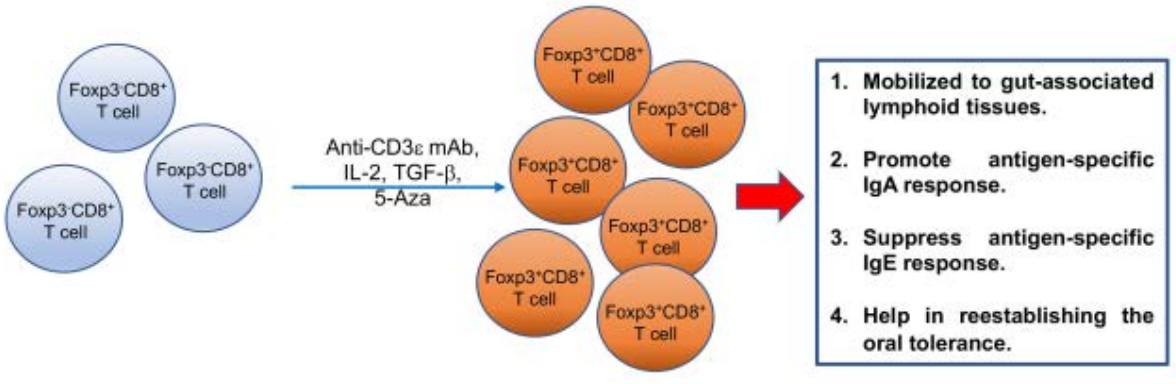

Figure 1.

Fig. legend: Purified Naïve CD8+CD25-Foxp3gfp- T cells from Foxp3-gfp transgenic mice were cultured in the presence of purified anti-CD3ε antibody, purified recombinant IL-2, purified recombinant TGF-ß and 5-Aza for four days to differentiate into CD8+Foxp3+ Tregs. These cells were used for controlling the ovalbumin-specific gut allergic response in mice.

These cells had stable Foxp3 expression and expressed molecules like CD39, CD73, FasL, GITR, and TGF-ß required for efficient immune response suppression. Further, our in vitro differentiated CD8+Foxp3+ regulatory T cells express chemokine receptors such as CCR9, and CCR6 molecules require efficient mobilizing these cells into the gut for its suppressive function. In a preclinical mouse model, injection of these in vitro differentiated CD8+Foxp3+ regulatory T cells prevented the Ovalbumin-specific IgE allergic response to ovalbumin and promoted beneficiary IgA immune response in the gut (Figure 1).

We developed a method to efficiently generate CD8+Foxp3+ Tregs from naïve CD8+ T cells. We also developed a technique to generate antigen-specific CD8+Foxp3+ Tregs and characterized its phenotype, functions, and stability. Further, we showed that the adoptive transfer of ex vivo differentiated CD8+Foxp3+ Tregs restored oral tolerance to ovalbumin and reduced the IgE levels in the serum.

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Fabrication and Characterization of Bioactive and Biocompatible Scaffolds for Various Tissue-Engineering Applications Using Stem Cells

Objectives of the study

- Fabrication and characterization of Bioactive and Biocompatible scaffolds and assessing their efficacy in bone tissue engineering using MSCs as the cellular source.

Summary

Stem cells residing in developing embryo as well as in discrete pockets within adult tissues/organs have drawn immense attention from fraternities of basic Biologists and Clinicians alike. Apart from using the stem cells to chalk out the events associated with normal development, they also carry a wide gamut of implications in the avenues pertaining to gene therapy, cell replacement therapy, disease modeling, drug screening and drug development, and also their potential is realized in the fascinating avenue of tissue engineering. Undoubtedly, tissue engineering offers an interdisciplinary platform that has gained immense interest among the investigators worldwide. The recent surge in exploring various biomaterials as bioinks for 3D bioprinting in view of fabricating tissue engineered implants does put emphasis on the scaffold environment mimicking the cellular niche as well as in selecting the ideal cellular source for the same. The scaffold materials can be selected based on the target tissue (hard / soft) type and fabricated utilizing various techniques such as electrospinning, freeze-drying, spectral lithography, 3D printing etc. Similarly, the cells can be considered from desired primary culture, pluripotent stem cells, tissue specific stem cells / progenitors as well as differentiated cells.

Bone tissue engineering holds potential significance for the development of

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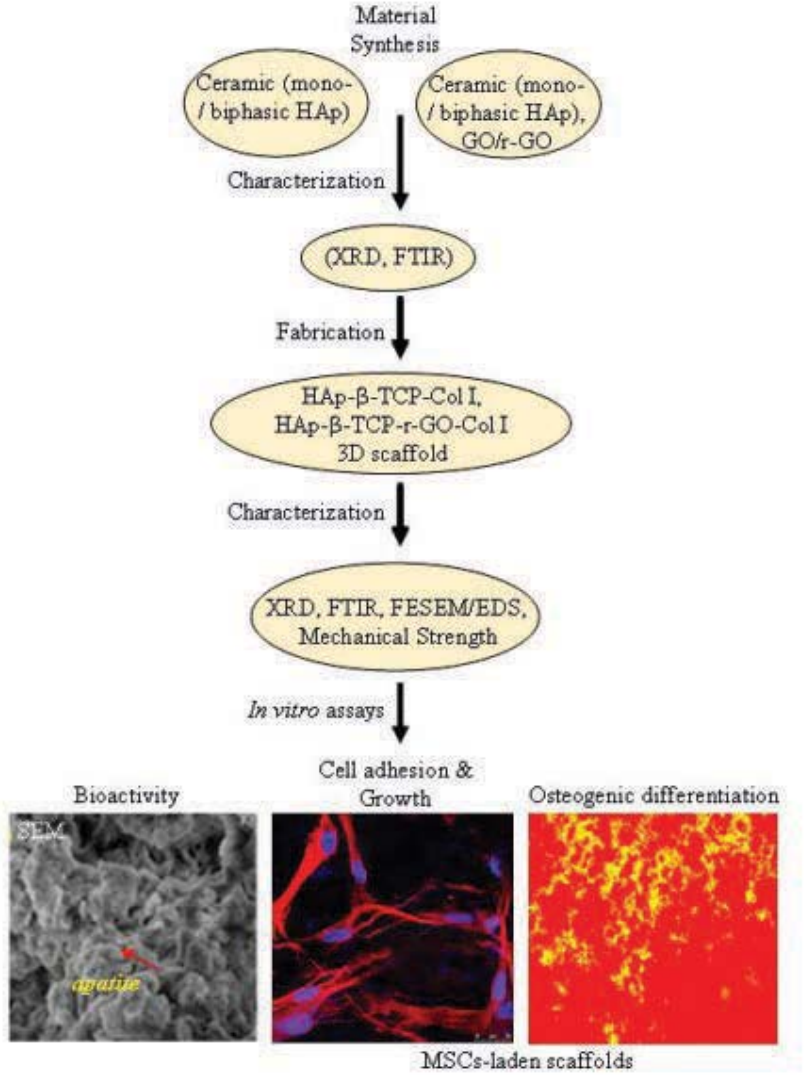
Fabrication of Bioactive and Biocompatible 3D ceramic-polymer composite scaffolds and assessing their efficacy in bone graft application



synthetic scaffolds for repairing/replacing fractured or damaged bones in the body. Biomaterials with better osteogenic capacity, rapid osteo-integration and desired mechanical strength are undoubtedly preferred for successful bone implant development. Calcium phosphate (CaP) nanomaterials, being a major inorganic component of bone, possess excellent biological properties. Hence, the tissue-engineered 3D scaffold made up of CaP nanomaterials shows the potential implication in the biomedical field for bone regeneration/substitution. Accordingly, we have successfully developed CaP based various nano-composites using Collagen, a major constituent of bone matrix along with grapheme to enhance the mechanical strength of the subsequently fabricated scaffold. We have further characterized those for their functional group, microstructural and elemental analyses, mechanical strength, degradation kinetics etc. The fabricated 3D scaffolds were not only found to be bioactive, those were also biocompatible and promoted osteogenic differentiation from Mesenchymal stem cells (MSCs), the cells that are bestowed with multipotent characteristics and give rise to bone, fat and cartilage tissues in our body. Further, we have demonstrated successful integration of MSCs into the scaffold, their adhesion and subsequent differentiation into osteogenic lineage. Together our data suggested that the fabricated 3D porous scaffolds could be ideally suited for bone tissue engineering applications (Fig. 1) and also it paved way for further exploration of combinatorial approaches for composite biomaterials synthesis and investigating their therapeutic potential using animal models.

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Understanding the Role of Protein Synthesis Regulation in the Context of Pathogenic Huntingtin Protein

Objectives of the study

- Understanding what all cellular factors are sequestered by Huntingtin aggregates.
- Identifying suppressors of toxic Huntingtin aggregation.

Summary

Huntington's disease is caused due to expansion of poly Q repeats on Huntingtin gene. This expansion causes the protein to aggregate and such aggregates can disturb several cellular processes including axonal transport, transcription, etc. Previously we observed pathogenic Huntingtin protein causes a reduction in protein synthesis in cells. Our studies suggested this is probably through the sequestration of a protein synthesis regulator Orb2. Co expression of Orb2 partially rescues the lethality assoiated with Huntingtin aggregates by restoring the deficit in protein synthesis in cells. We are interested in finding what other proteins are sequestered by Huntingtin aggregates. Towards this we are performing a screen with a library of RNA binding proteins and have got some initial hits, which we are characterizing in detail.

We are also addressing if the toxicity associated with Huntingtin aggregates can be rescued through coexpression of other proteins. As the Huntingtin aggregates are formed due to protein misfolding, we are investigating the compaonents of protein folding machinery. We have made a library of such proteins and initiated a screen to find out the regulators of Huntingtin-associated toxicity.

Apart from this, we also participated in COVID-related assignments, where I participated in running the COVID testing facility at NCCS. I also developed magnetic beads for isolating RNA for COVID tests and purified enzymes to run RT-PCR and RT-LAMP tests. However, none of these could be validated through ICMR, as they refused to run validations for academic institutes.

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Host Cell Factors in HIV Pathogenesis and Identification of New Anti-Viral Lead Molecules

Objectives of the study

- Role of viral regulatory proteins Tat and Nef in HIV pathogenesis.
- Differential gene expression studies to identify molecular mechanism of HIV-1 induced T-cell apoptosis.
- Identification of novel molecules with anti-HIV activity and their potential for use as microbicides.

Summary

Human immunodeficiency virus is the causative agent of acquired immunodeficiency syndrome (AIDS). The hallmark of the disease is gradual depletion in the number of CD4+ T cells leading to the onset of opportunistic infections. The therapeutic regimen being used at present can reduce the viral load significantly but is not the ultimate answer to AIDS patients as a treatment for cure from HIV is yet to be identified. Our group has been working on different aspects of HIV pathogenesis, related to host-virus interactions, immune response and drug discovery. The primary objective is to gain more understanding of the virus and its interaction with the host cell, which may lead to new antiviral strategies.

In the area of Host-Virus interactions, continuing with our studies on Nef interacting Heat shock protein 40, our laboratory has been now involved in comprehensive study on the role of cellular heat shock proteins in HIV pathogenesis and their possible use as targets for anti-viral therapy. We have recently reported a comprehensive study showing the expression profile of various HSP40 and 70 family members during HIV infection. Our expression profiling results targeting the isoforms indicate that a significant number of genes belonging to Hsp40 and Hsp70 family are differentially expressed during HIV-1 infection as compared to heat stress. We have also shown that silencing of several Hsp40 isoforms either reduced or enhanced viral gene expression and replication significantly. These results were further validated by over

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expression study as well and one of them, DNAJB8 is being functionally characterized at present. Similarly, we have also identified HSP70 isoforms important for regulating HIV life cycle. Heat shock protein 90 (Hsp90) is also an important cellular factor necessary for the completion of HIV-1 life cycle. Inhibition of Hsp90 leads to decreased HIV replication as well as inhibition of reactivation of the virus from latency. At present, we are trying to evaluate the role of specific Hsp90 isoforms in HIV-1 replication in order to find their functional relevance in HIV-1 pathogenesis. Furthermore, we are also trying to elucidate the molecular mechanism through which the selected HSP isoforms act on HIV-1 life-cycle.

Studies done till date to elucidate the pathways involved in HIV-1 induced T cell depletion has revealed that apoptosis underlie the etiology; however, a clear molecular understanding of HIV-1 induced cell death has still remained elusive. In this context, we are currently trying to functionally characterize the role of Death associated protein Kinase (DAPK-1) which is significantly down regulated during HIV infection and ZIP Kinase (ZIPK/DAPK-3) that has been shown to interact with viral Nef protein. Our initial results indicate that these proteins are involved in regulating autophagy and viral gene expression in infected cells. Although there is literature suggesting that host miRNAs play a fairly important role in HIV-1 infection, however, our comprehensive *in silico* analysis has led to identification of several differentially expressed miRNAs in HIV-1 infection. We have taken forward one such up regulated miRNA for further characterization. Furthermore, pathogenic exposures including virus infection leads to production of large quantity of viral proteins causing ER stress, which further results in Unfolded Protein Response (UPR). The host UPR modulation by HIV-1 has not been studied well and the detailed mechanism remains to be characterized. Our initial results indicate that HIV-1 induces the IRE1 dependent pathway, marked by increased phosphorylation of IRE1α followed by induced splicing of XBP1, an important participant of UPR activation. The initial results provide interesting leads to investigate further and derive the mechanism responsible for this activity, which is being pursued at present.

The current therapeutic strategy involving the use of anti-retrovirals in combination has proven to be useful in controlling the virus but is not sufficient to eradicate the virus from the patients. The recent burst of explorations on host factors as potential targets in virus research supports its emergence as a promising area of research. In this direction, our group has shown that Hsp90 could be used as a potential therapeutic target. For this, in collaboration with BIT, Mesra, we have designed and synthesized several Hsp90 inhibitors based on a novel scaffold. One of these molecules was shown to have several fold better anti-HIV activity than AUY922, the second generation HSP90 inhibitor. Our results suggest that this novel scaffold can attenuate HIV-1 replication significantly within the host and thus opens a new horizon to develop novel anti-HIV therapeutic candidates. Finally, by screening a library of well characterized bioactive molecules, we have been able to identify few drug molecules in clinical use to have strong potential to be used as effective antivirals. Thus, our current interest in repurposing of drugs for inhibiting HIV-1 is being pursued further.

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Identification of Potential Targets and Biomarkers for Multiple Myeloma using Quantitative Proteomics and Molecular Approaches

Objectives of the study

- Identification of potential bio-signature for multiple myeloma diagnosis and prognosis using multipronged quantitative proteomic approaches.
- Establishing MZB1 as a potential target for multiple myeloma pathogenesis using proteomic and molecular approaches.

Summary

Multiple myeloma (MM) is a plasma cell cancer that accounts for nearly 15% of all haematological malignancies. In MM, malignant plasma cells expand and accumulate in the bone marrow leading to bone resorption and over production of antibodies. It is one of the most dominant hematological malignancies in the Indian subcontinent, where 4 out of every 100,000 people are affected with MM every year. Despite several years of research in the area of hematological oncology, MM still remains as an incurable plasma cell malignancy with poor prognosis. Most importantly, there is no reliable protein marker available for MM diagnosis. Considering the restricted and economically limited facilities such as genetic testing and imaging for the diagnosis of MM, identifying novel targets and reliable markers can be highly useful for diagnosis as well as prognosis and it will also be useful for better understanding of the MM disease pathophysiology.

As the site of origin for MM occurrence is bone marrow, investigation of the proteome alterations in the bone marrow interstitial fluid (BMIF) is a relatively better source for understanding the underlying biology of MM. We analyzed

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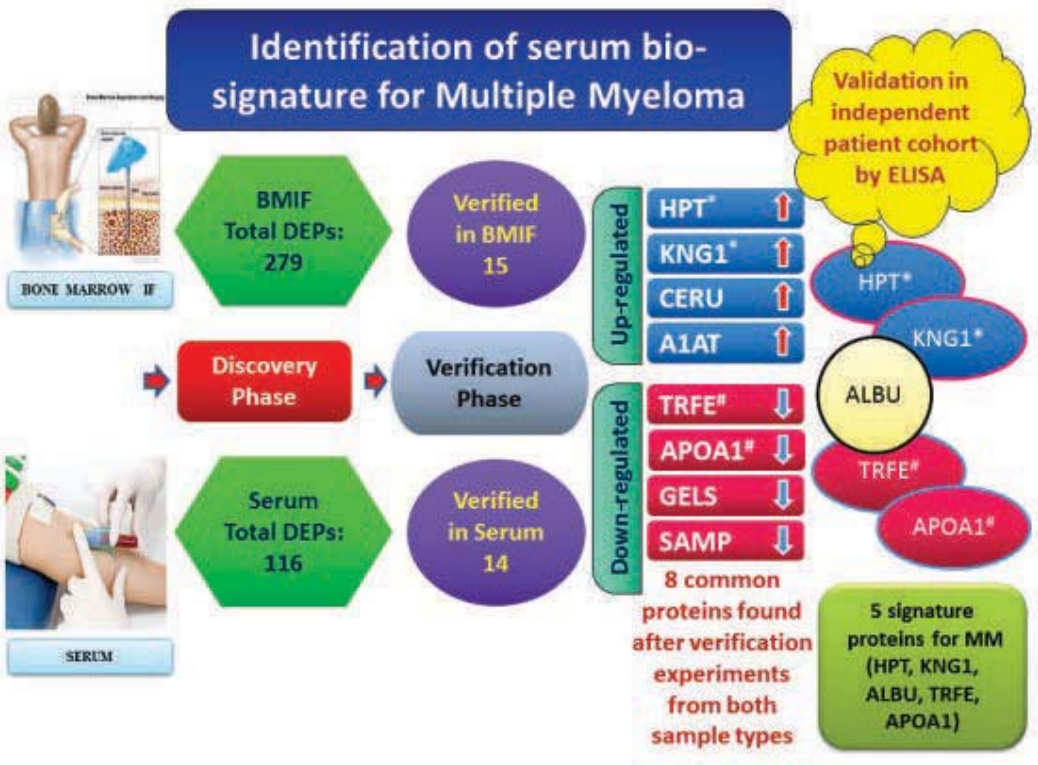

Fig. legend: An experimental design and overall results obtained for quantitative proteomic analysis of BMIF and serum samples of MM and controls. In the discovery phase, 279 and 116 non-redundant differentially expressed proteins were identified for BMIF and serum respectively using multipronged quantitative proteomic approaches. Western blotting and selected reactions monitoring (SRM) based verification in a new cohort of samples discriminates MM from healthy controls. Further, a common BMIF and serum protein signature consisting of 5 significant proteins was validated using ELISA in a fresh cohort of samples.

proteome alterations in the MM patients' BMIF compared to non-hematological malignancy controls using three proteomic approaches namely 2D-DIGE, iTRAQ and SWATH. We identified a total of 279 statistically significant differentially expressed non-redundant proteins using multipronged proteomic approaches. Western blotting and selected reactions monitoring (SRM) based verification in a new cohort of samples verified a panel of 15 proteins viz. HPT, KNG1, VTN, SAMP, FGA, APOH, ZA2G, A1AT, CERU, PLMN, APOA4, A1AG1, APOA1, TRFE and GELS which specifically discriminate MM BMIF from non-hematological malignancies BMIF samples. In addition, we identified the differentially expressed proteins in MM serum samples from the same patients as potential candidate bio-signature by all three quantitative approaches viz. 2D-DIGE, iTRAQ and SWATH. Using multipronged proteomic approaches, 116 non-redundant serum proteins were found to be differentially regulated in MM. Immunoblotting and SRM based validation in a different cohort of samples verified a panel of 14 proteins viz. HPT, KNG1, ZA2G, A1AT, CERU, PLMN, APOA1, TRFE, C3, VTDB, SAMP, GELS, SAA1 and AACT which specifically discriminate MM from healthy controls. Further, we identified a panel of 8 common proteins from the MM serum and MM BMIF with same pattern of expression. Among the panel, thorough data evaluation led to the identification of a panel of five proteins viz., haptoglobin, kininogen 1, transferrin, and apolipoprotein A1 along with albumin that was validated using ELISA in a larger cohort of serum samples. This panel of 5 proteins could be potential bio-signature that could discriminate MM from controls (Fig. 1). We believe that this panel of proteins could help in future MM disease management and thereby improving the survival expectancy of MM patients.

Further, we hypothesized that proteomic alteration in MM MNCs i.e., the actual site of MM disease origin may play a crucial role in disease occurrence and progression. To achieve this, we undertook the label-free quantitative (LFQ) proteomic approach and profiled the global proteomic changes in MM MNCs. We identified a panel of proteins that gets altered in

patient-derived MM MNCs as compared to the MNCs of non-hematological malignancies. Proteomic analysis identified 192 differentially abundant proteins where 79 proteins showed increased abundances while 113 proteins were downregulated. Among these differentially regulated proteins, MZB1 was upregulated more than 10-fold in patient-derived MM MNCs in comparison with controls. The MZB1 protein levels were verified in serum and BMIF from patients with MM. The results from western blot analysis were found to be consistent with the quantitative proteomic data generated from patient MNC samples. Moreover, functional studies using the MM cell line model, RPMI 8226, was undertaken to reveal the role of this protein in MM pathogenesis. Functional assays such as flow cytometry-based cell cycle analysis, cell proliferation assay, and soft agar colony formation assays exposed the involvement of MZB1 in the MM progression. Depletion of MZB1 resulted in the inhibition of anchorage independent growth potential, proliferation, and induction of apoptosis in MM cells suggesting that MZB1 may be a putative oncogene in MM pathogenesis and might be a potential theranostic target.

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In silico Annotation of Complement Regulatory RCA Proteins and Their Experimental Validation

Objectives of the study

To understand role of T cells and non-T cells in leishmaniasis and other infections that match or contrast leishmaniasis

Background

Leishmaniasis, a complex of diseases caused by the protozoan parasite Leishmania, neither has preventative measures nor unrestricted options for chemotherapy. Therefore, finding an immunotherapy now occupies a major share of efforts to control the disease.

Main findings & Significance

To compile all these efforts, we brought out two volumes of a special issue of the journal Cytokine [CytoLeish- comprised of 25 articles], wherein we formulated a succinct primer on cytokines, summarized the role of cytokines in the immunity and immunopathogenesis in leishmaniasis, and collated the findings from our European project on the metabolomics of leishmaniasis. We also exposed the duality of IL-27 in leishmaniasis and in airway allergies, and differential roles of interferons in viral infections- SARS-CoV-2 and Herpes Simplex Virus-1.

As we previously reported, regulation of leishmaniasis by CD40 and Toll-Like Receptor [TLR], we investigated how Dectin-1 (the lectin receptor on dendritic cells) and TLR2 co-localize to modulate the anti-leishmanial immune response. While TLRs have been shown to play both anti-leishmanial and pro-leishmanial roles, majority of the studies used single TLR gene or double gene knock-out

mice. Despite reflecting the effect of deficiency of one or two TLRs on anti-leishmanial immune responses, these studies failed to imply any interactions between TLRs, which is quite logical to happen in a cell expressing ten or more TLRs and encountering pathogens expressing ligands for multiple TLRs. Our studies resulted in the first-ever suggestion of "Inter-TLR dependencies" or "TLRs inter-dependencies". While working on the role of CD40 in leishmaniasis, our findings suggested that the residues on CD40L may dictate each of the CD40 functions. Distribution of functions to chosen amino acids thus suggest two significant phenomena: one, the specificity of a receptor's signaling as a function of collective stoichiometry of the signaling intermediates involved (as opposed to completely ascribing to one or two intermediates only), and two, the encryption of messages in the ligand and their decryption by the receptor reflecting a subtle-yet-significant exchange of energies through a process we termed "Quantum Cryptography". Establishing "Quantum cryptography" as an operational concept required theoretical physics group with appropriate computing facility and some sophisticated instruments including a microscope. We hope that someday some researchers will bring this concept to being for use in humans.

As an anti-leishmanial vaccine is not available till date, we reassessed the problems and formulated a new vaccine candidate. As a follow-up, a new natural adjuvant has been tested. A new hypothetical protein from Leishmania has been cloned, expressed and characterized as a decoy for protein kinase C. In silico structural studies and supportive evidence from different experiments indicate that it competes with PKC for diacylglycerol. As the classical PKCs require diacylglycerol as a co-factor for activation and as these PKC isoforms - among the eight PKCs expressed in macrophages - mediate anti-leishmanial functions (Sudan et al. 2012. J. Immunol.188: 2328-2337), this newly identified protein explains how Leishmania evades PKC-mediated immune response. The importance of this observation has been further strengthened, as Toll-like receptors- TLR1-TLR2 and TLR2-TLR6- are also observed to selectively signal through PKC isoforms, corroborating our previous observations that TLR1-TLR2 exerts primarily pro-leishmanial functions whereas TLR2-TLR6 exerts anti-leishmanial functions (Pandey et al. 2014. J. Immunol. 193: 3632-3643). Similar mechanisms may operate in keratinocytes and in immune-dependent functions of Lupeol and amphotericin B. These studies on TLR signaling through PKCs and inter-TLR dependencies thus significantly restructure our understanding of the TLR-mediated immune response in leishmaniasis.

The work on malaria has been published. In one, we proposed expanding the previously published observations (Das et al. 2018. New Eng J Med. 379:1262-1264; Das et al. 2019. Clin Inf Dis. 69:1144-1152), and in the other, what follows from it- the kit-negative parasites. This was extremely important, as Kit-negative parasites were more frequently detected in India. Therefore, it was important to develop this kit for quickly determining artemisinin-resistant parasites and find out how this influences the endemicity in India. We understand that someone will do it to help the people who have been suffering from the disease. We also described a novel anti-malarial nano-formulation inducing redox damage and mimicking cytokine response.

Finally, we consolidated the current understanding of Ras isoforms. We first showed that Ras isoforms were functionally different and that they exhibited signaling specificity [Chakraborty et al. 2015. J. Immunol. 194:3852-3860; Nair et al. 2020. Cell Commun. Signal. 18(1): 3; Jha et al. 2020. Cytokine. 126:154914]. Clearly, Ras isoforms do selectively regulate not only the transformation and carcinogenesis but also immune responses to antigens and pathogens in an isoform-specific manner- an understanding that is the key to the drugability of Ras.

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Role of Complement in *Aspergillus fumigatus* infection

Objectives of the study

- Role of complement and complement receptors in *Aspergillus* infection.
- Mechanism of complement-mediated protection from *Aspergillus* infection.

Summary

Background

Invasive aspergillosis (IA) is a cause of high mortality in immunocompromised individuals. It is, therefore, necessary to understand the immune pathways that control this infection. Although the primary infection site is the lungs, aspergillosis disseminates to other organs through unknown mechanisms. Herein, we have examined the in vivo role of various complement pathways and the complement receptors C3aR and C5aR1 during experimental systemic infection by *Aspergillus fumigatus*.

Main findings & Significance

Aspergillus fumigatus is an opportunistic fungal pathogen that causes invasive infection in immunocompromised individuals, including those with haematological disorders, acquired-immunodeficiency syndrome (AIDS), autoimmune diseases, and also those undergoing prolonged corticosteroid

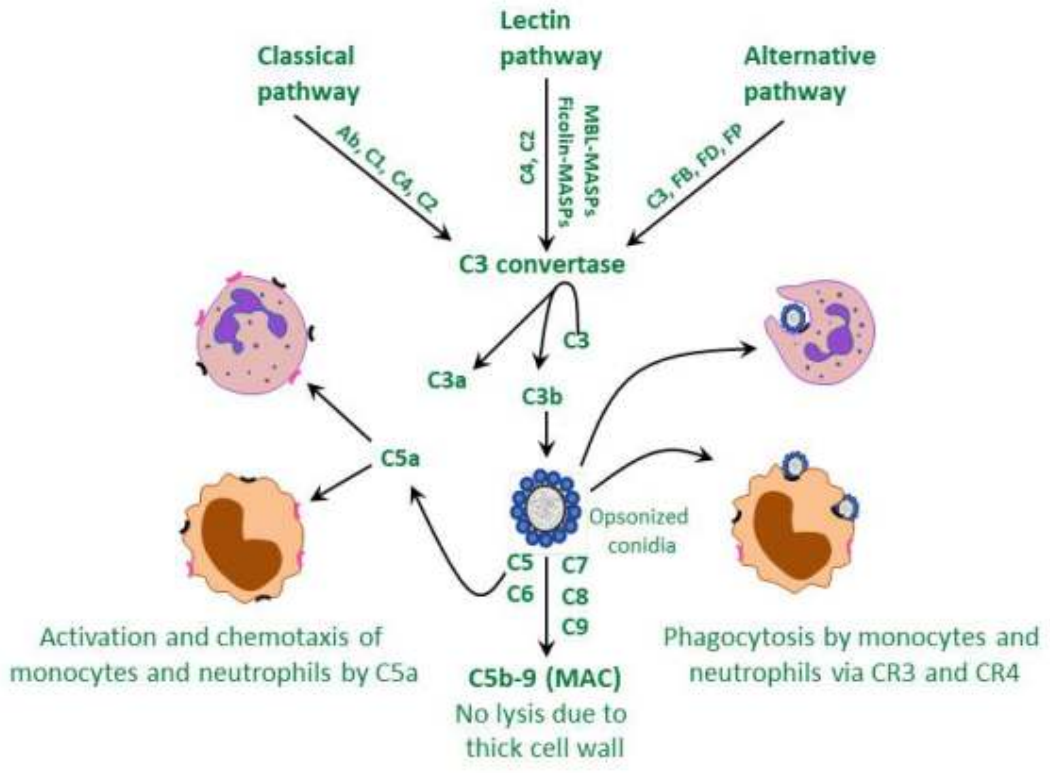

Fig. legend: Model for complement-mediated control of systemic *A. fumigatus* infection.

treatment such as patients with organ transplantation. In immunocompetent individuals, however, the inhaled conidia are cleared by the innate immune system. A significant body of knowledge is available on the clearance of the conidia by the immune cells. Nevertheless, the role of soluble mediators, and in particular the complement system, is poorly understood.

In the present study, we asked whether the complement system plays any protective role during systemic Aspergillus infection? If yes, which complement components participate in this process? And also, what contribution, if any, do the anaphylatoxins C3a and C5a make in host defense against systemic Aspergillus infection? To study disseminated aspergillosis, we employed the intravenous infection model. Intravenous infection in C3- and C5-deficient mice exhibited significantly higher mortality than the wild-type mice, suggesting an essential role of the complement system in the experimental systemic aspergillosis. The next obvious question then was how does complement contributes to the host resistance – owing to MAC-mediated lysis or C5a-mediated immune potentiation. The thick cell wall of conidia/hyphae is expected to block the MAC-mediated lysis of Aspergillus, and therefore, it is unlikely that C5 contributes via MAC formation and lysis of this pathogen. We thus asked, does the C5a-C5aR1 axis play a part in immune protection? Additionally, we also evaluated the participation of the C3a-C3aR axis, which has been reported to inhibit neutrophil mobilization. The data suggested that C5aR1, but not C3aR signalling, is required to mount a protective immune response against systemic aspergillosis. We thus conclude that C5-mediated protection against experimental systemic aspergillosis is owing to C5a-C5aR signalling.

Studies were also performed to determine how complement in general, and C5a in particular, contributes to protection against Aspergillus infection. Our data revealed that complement-mediated protection is not due to increased cytokines such as IL-6 and TNF-α, which are associated with a better prognosis of systemic aspergillosis, but is rather due to complement-mediated uptake and clearance of conidia by monocytes and neutrophils. Additionally, complement-mediated increases in natural antibodies were also partly responsible for the protection.

In summary, our data uncovered the importance of complement during experimental systemic aspergillosis. Based

on our data, we propose the following mechanism for complement-mediated protection against Aspergillus infection: i) C3b opsonization that occurs as a result of complement activation enhances the rate of phagocytosis via complement receptors CR3 and/or CR4, ii) C5a generated owing to complement activation trigger activation of phagocytic cells via C5aR1, and this results in migration and tissue penetration of phagocytes for fungal clearance. The effect of C5a, however, is not owing to increased synthesis of the cytokines IL-6 and TNFα.

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F-box Protein FBXO31 Functions as a Tumor Suppressor by Regulating Cell Cycle

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Objectives of the study

- To understand the cross talk of F-box FBXW1 and FBXW11 during DNA damage response.

Summary

The human genome encodes genes for 69 F-box family proteins. Each member of this family has conserved F-box motif typically present at the N-terminal domain of the protein. This class of proteins facilitates the ubiquitination of their substrates through forming SCF (SKP1, Cullin1, and F-box protein) complex and thereby plays vital roles numerous cellular processes. Therefore, deregulation of F-box proteins is closely associated with pathogenesis.

F-box proteins facilitate different types of ubiquitination and therefore nature of ubiquitination decides the fate of the ubiquitinated proteins. Ubiquitination of proteins may increase or decrease their stability. Previous studies suggested that F-box proteins play crucial role in various cellular processes and diseases including cancer. F-box protein FBXW1 (β-TrCP1) and FBXW11 (β-TrCP2) are widely studied. They form homodimer as well as heretodimer; however, homodimer is more functional in promoting the degradation of its substrate. Several studies have shown that cellular functions of β-TrCP1 and β-TrCP2 are indistinguishable and therefore maximum studies cited them as β-TrCP. Hence, it was difficult to understand whether the study is related to β-TrCP1 or β-TrCP2. β-TrCP is known to regulate many cellular processes like NF-κB signaling, β-catenin signaling, TGF-β signaling, apoptosis, autophagy and cell cycle. It was reported that β-TrCP can function as either tumor suppressor or oncogene or

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both in a context dependent manner. Generally, alteration of cellular function of tumor suppressor and/or oncogene results in impairment of DNA damage response/repair that gives rise to chromosomal instability and cancer predisposition. Recent studies showed that β-TrCP directs the degradation of MDM2 in response to DNA damage to initiate DNA damage response pathway through activation of p53, however, it is not clear whether β-TrCP1 or β-TrCP2 is involved in DNA damage-induced activation of p53. Though numerous studies have been done to understand the role of β-TrCP in DNA damage response; however, distinct role of individual β-TrCP1 and β-TrCP2 in DNA damage response and repair is poorly understood. Therefore, it is important to understand their distinct function during DNA damage response to design better therapeutic strategy.

Last year, we found that β-TrCP1 and β-TrCP2 cross talk each other during genotoxic stress. We observed that expression levels of β-TrCP1 are significantly increased while levels of β-TrCP2 are markedly decreased upon induction of genotoxic stress. Further, our results revealed that DNA damage-induced activation of ATM kinase plays an important role in maintaining the reciprocal expression levels of β-TrCP1 and β-TrCP2 via the phosphorylation of β-TrCP1 at Ser158. Phosphorylated β-TrCP1 potently promotes the proteasomal degradation of β-TrCP2 and MDM2, resulting in the activation of p53. Additionally, β-TrCP1 impedes MDM2 accumulation via abrogation of its lysine 63-linked polyubiquitination by β-TrCP2. Thus, β-TrCP1 helps to arrest cells at the G2/M phase of the cell cycle and promotes DNA repair upon DNA damage through attenuation of β-TrCP2. Interestingly, we found that β-TrCP2 is predominantly accumulated in cancer ells and directs the degradation of β-TrCP1 to facilitate cancer progression and thus functions as oncogene. In contrast, β-TrCP1 directs the degradation of β-TrCP2 to prevent cancer progression. Thus, β-TrCP1 may play critical role in executing the DNA damage repair in the normal cells to protect them from chemotherapeutic drug treatment-mediated cytotoxicity. Collectively, our findings elucidate an intriguing post-translational regulatory mechanism of these two paralogs under genotoxic stress and revealed β-TrCP1 as a key player in maintaining the genome integrity through the attenuation of β-TrCP2 levels in response to genotoxic stress.

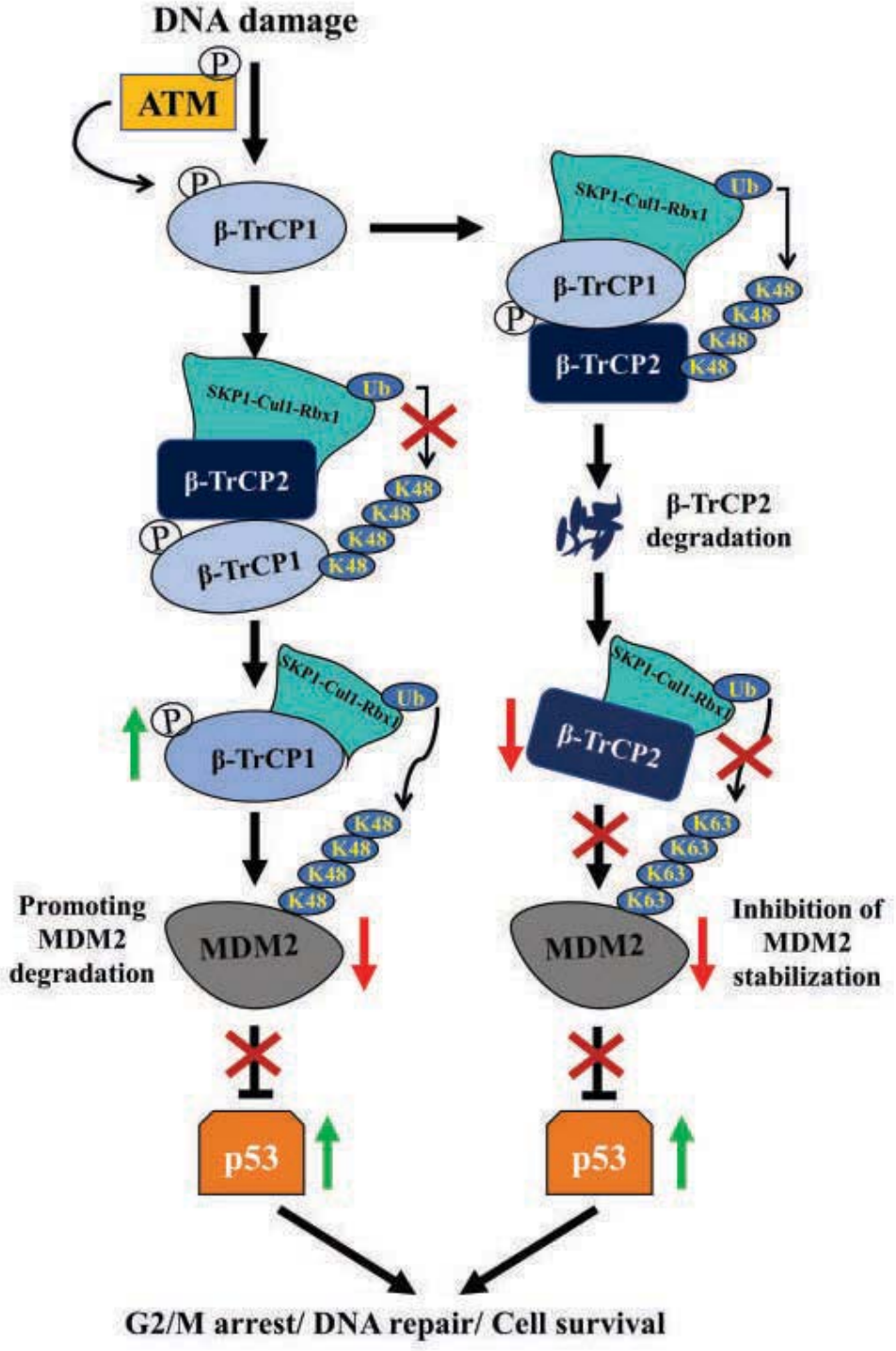

Fig. legend: Model depicting the proteasomal regulation β-TrCP2 by β-TrCP1 of following DNA damage

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Role of RNA-Protein Interactions in *Plasmodium falciparum* Infection

Objectives of the study

- Characterize the RNA binding acitivity of PIP4K protein and characterize its role in gene regulation.
- Identify other potential targets of PI4K2A to delineate the functional role of host proteins (PIP4K2A) in P. falciparum.

Summary

Background

It is believed that the main role of PIP4K2A is in regulating the levels of PI5P in mammalian cell. PIP4K2A is predominantly a cytoplasmic protein, however its substrate is membrane bound. Phospho inositides and their kinases also play an important role in the growth of *P. falciparum*. Parasite export several proteins to the erythrocytes that require the interaction of these proteins to lipid associated Phosphatidyl Inositol 3 Phosphate in the parasite endoplasmic reticulum. Proteins regulating these have been identified as specific target for drugs against malaria. We have shown that one member of this pathway, PIP4K2A is imported into the parasite from the host where it associates with specific parasite RNAs. The exact mechanism of how PIP4K2A is imported into the parasite is still unclear.

Main findings & Significance

We previously had shown that the RNA binding activity of PIP4K2A is conserved across species, we now show that not only the RNA binding activity is conserved

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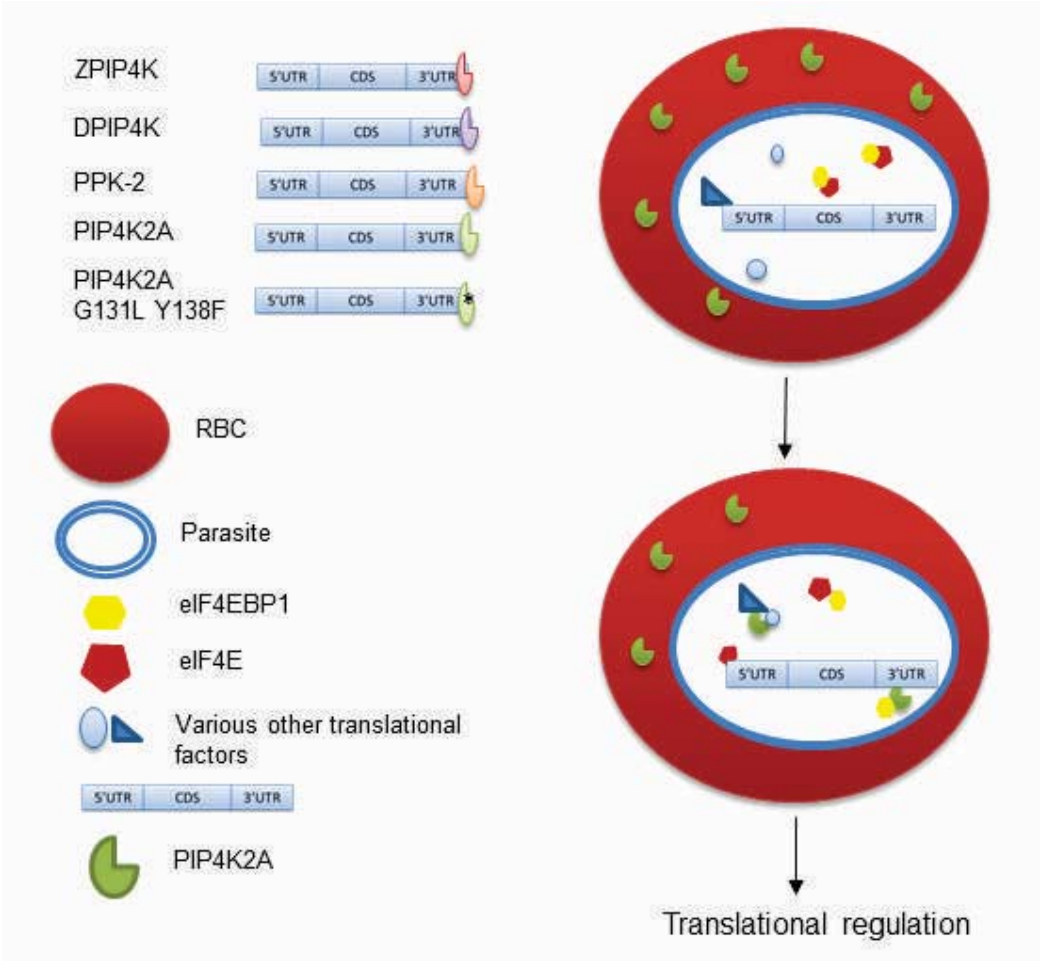

Fig. legend: RNA binding activity of PIP4K and its role in translation regulation. PIP4K from different species have RNA binding activity and bind to 3'UTR sequence. The RNA binding activity is independent of its kinase activity in PIP4K2A. PIP4K2A can specifically interact and sequester eIF4EBP1 which is a translational repressor. This in turn makes eIF4E available for mRNA cap binding and translation initiation and can potentially regulate the cap dependent translation of the target transcripts.

but also the import of the host PIP4K2A in conserved in other apicomplexen parasites like *P. berghei* and *T. gondii*. Although we show that PIP4K2A interact with few specific RNAs it is possible that it may bind to other targets in both host and parasite. We have characterized the specific sequences in the RNA that may be essential for its interaction with PIP4K2A. We show that the UUGU-motif present in the RNA is important for this interaction. We further used this information to identify specific region in the drosophila GluR2A RNA that may interact with PIP4K2A. Our results suggest that the RNA binding activity of PIP4K2A may be an important function of PIP4K2A in regulating gene expression apart from its role in phospho inositides metabolism. We now plan to further characterize the interaction PIP4K to GluR2A to understand the role of PIP4K2A in regulating gene expression. We plan to characterize the transcripts from drosophila and human cells that specifically associate with PIP4K2A by performing RNA immunoprecipitation followed by sequencing. We also plan to identify the minimal domain in the protein that may interact with the RNA and structurally characterize the RNA-protein interaction

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Human Microbiome Initiative of Select Endogamous populations in India

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Objectives of the study

- To characterize and generate baseline gut microbiome data for selected endogamous communities with varied dietary and lifestyle patterns.
- To harmonize/standardize protocol for sample collection, transportation, sample processing and sample preservation.
- To decipher the influence of diet and lifestyle on the gut microbial community composition and structure.
- To understand the influence of age across and within a specific endogamous community (tribal and non-tribal) on the gut microbiome.
- To understand the temporal variation in gut microbiome.
- To study the influence of vegetarian and non-vegetarian diet on gut microbiome.
- To understand the association between Ayurvedic phenotype and microbiome.

Summary

Background

The Indian population is a unique conglomeration of genetically and ethnically diverse groups having varied dietary habits and residing in vast biogeographic locations. Indian population thus brings in many opportunities as well as challenges and is a treasure for studying the gut microbiota as reviewed earlier. There are growing evidences to support occurrence of distinct microbiota

based on biogeographic location of the populations. Considering the geographic, ethnic and dietary diversity of Indian population, it is a perfect model to study association of 'Genetics, biogeography and diet with Microbiome'. However, as a first phase of the larger initiative (Indian Human Microbiome Initiative), we plan to focus on dietary and lifestyle patterns as confounding factors and hypothesize that the variations in the dietary habits across the communities under study and their lifestyle may influence the human microbiome profiles of the individuals. The individuals selected for this study will have overlap with "Genome India" study, which will make it possible to do genotype-microbiome associations. Another objective of the study is to test the hypothesis that there may exist three different microbial enterotypes between the three distinct Ayurvedic Prakriti types. Characterization of microbiome from autochthonous tribal populations, which are not influenced by modernization and changing lifestyle, may lead to identification of many unique and novel microbes. sampling also provided for a great exercise to optimize logistics, protocols and gain field experience about sample collection in remote areas. Community DNA extraction from fecal (representative of the gut) and oral-wash samples was done using QIAamp stool DNA mini kit and QIAamp DNA mini kit (Qiagen, USA) respectively. DNA extraction was performed according to the manufacturer's instruction with bead beating for 6 mintues. Metagenomic sequencing of V4 region of 16S rRNA gene is now planned.

Main findings & Significance

DNA extraction from 419 samples has been completed. Bacterial (16S), Archaeal (16S) and Micro-Eukaryotic (18S) sequencing of 230, 43 and 44 samples have been completed, respectively. Subsequently, preliminary analysis was carried out using R and the observations are as follows.

Bacterial Diversity of Bhil and Kallar Communities:

Bacteroidota and Firmicutes are the two most abundant phyla followed by Proteobacteria and Actinobacteria (Figure 1). Firmicutes, Actinobacteria, Proteobacteria and Bacteroidota showed significant differences between the two communities Bhil and Kallar (Figure 1). At the genera level Prevotella, Succinivibrio, Faecalibacterium, Agathobacter, Blautia, Alloprevotella, Dialister were found to be most abundant (Figure 2). Prevotella, Blautia, Roseburia, Bifidobacterium, Holdemanella, Lachnospiraceae and Dorea showed significant differences between the Bhil and Kallar communities (Figure 3)

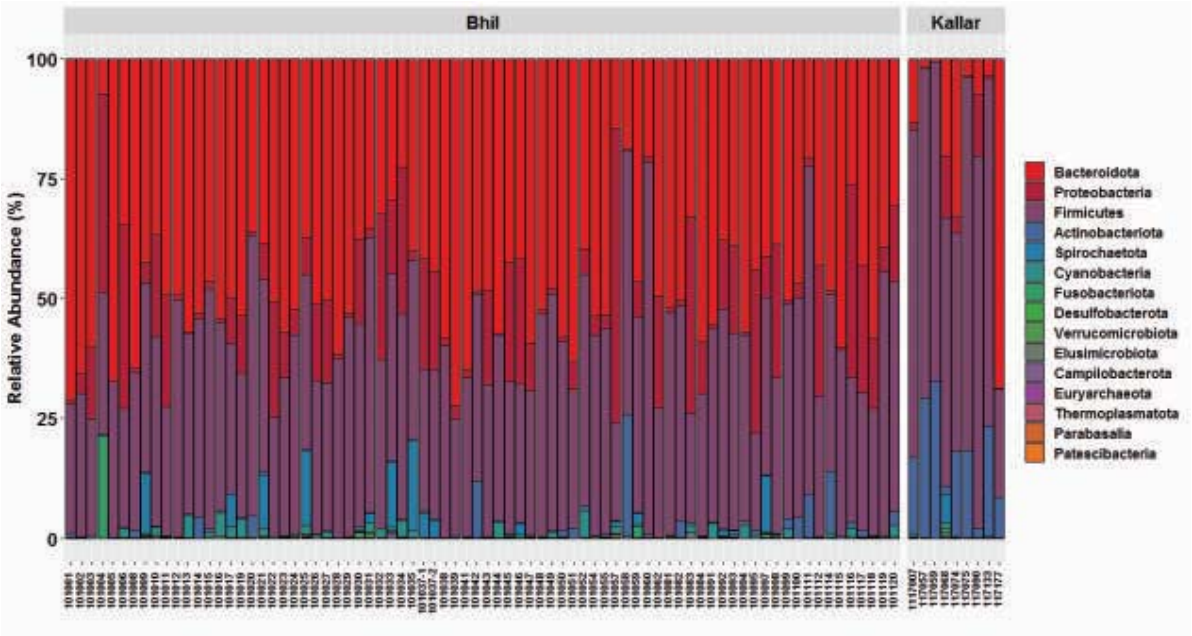

Fig. 1: Bacterial Diversity of Bhil and Kallar Communities at phyla level

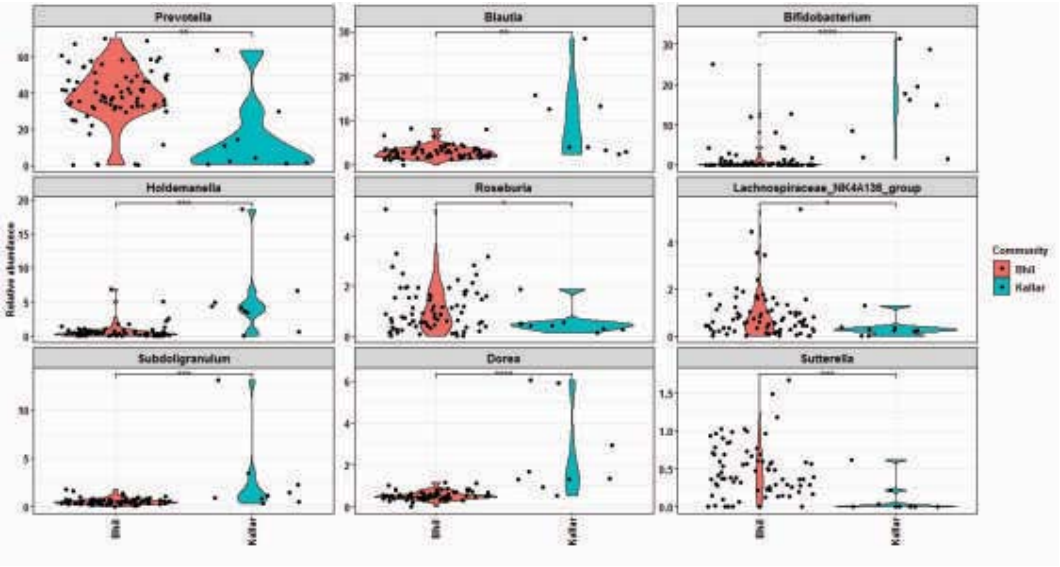

Fig. 2: Bacterial genera with significant differences in abundance pattern between Bhil and Kallar communities

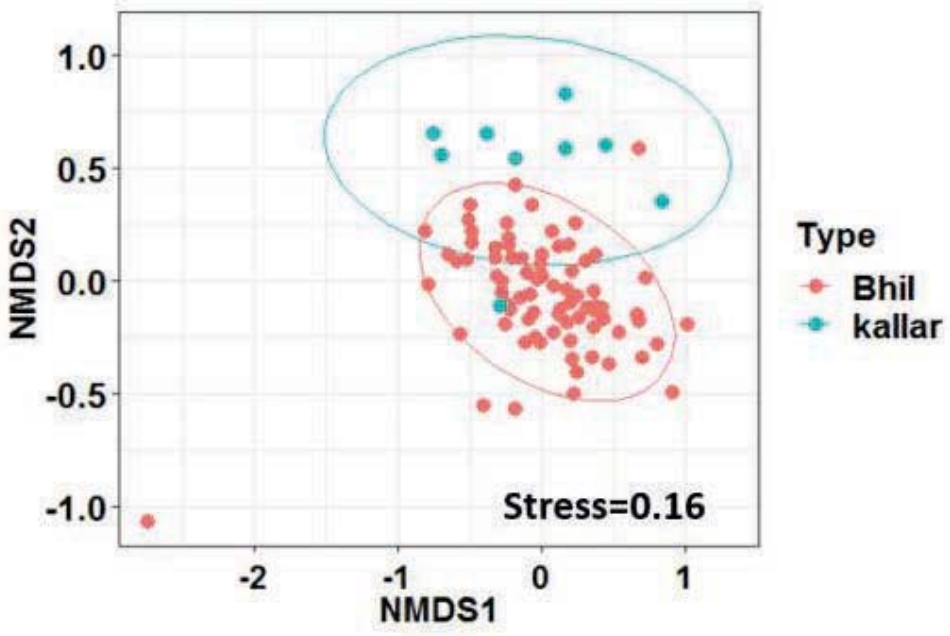

Fig. 3: NMDS plot of Bhil and Kallar communities

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Molecular Simulation to Biochemical Network Perturbation in Infectious Disease: Stability and Stochasticity in Synthetic Circuit

Summary

Our aim in this project is to illustrate the application of mathematical modeling of IL6 signaling network towards better understanding the immune response to L. major. To this end, we developed a spatiotemporal model tracking cytokine networks in L. major infection by solving the ordinary differential equations using MATLAB. This model serves as a template for the design of IL6 synthetic circuit. The model combined with experimental data captured the host-immune dynamics of parasitic infection and helped identify key components that is crucial for explaining individual variability of different cytokines for a dynamical cellular response (Figure 1). One of the prime important aspects of synthetic biology approach is that one can rationally design tailor-made molecular devices to target a specific function in the cell that results in less off-target effects. The impact of this approach has been visible in the present work, where we are selectively targeting the anti-inflammatory effect of IL6 during L. major infection by selecting the specific molecule of downstream signaling (SOCS1) instead of inhibiting the entire IL6 signaling. During the process of model refinement in this project, we have identified the ratio of SOCS1:SOCS3 as 3:2 for establishment of infection which is further exploited as a target for designing therapeutics. The elevated levels of SOCS1 protein (60,000 molecules/ cell) have been mathematically quantified and found to inhibit the signaling of pro-inflammatory cytokine such as IL12, IFNγ and TNFα. Further this inhibition resulted in increased production of anti-inflammatory cytokines (around 2-7 fold change have been found as compared with control samples). Model analysis at various levels such as flux, sensitivity and principle component analysis represented the key reactions governing the dynamics of diseased state and SOCS1 playing a crucial role in the same. To add to this, structural analysis of these proteins helped identify specific regions responsible for its

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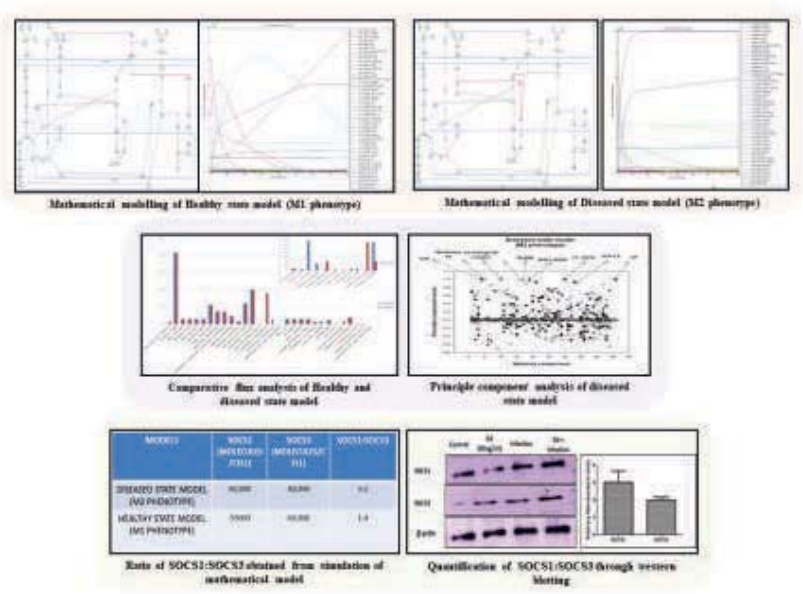


Fig. 1: Mathematical Modeling and its Validation

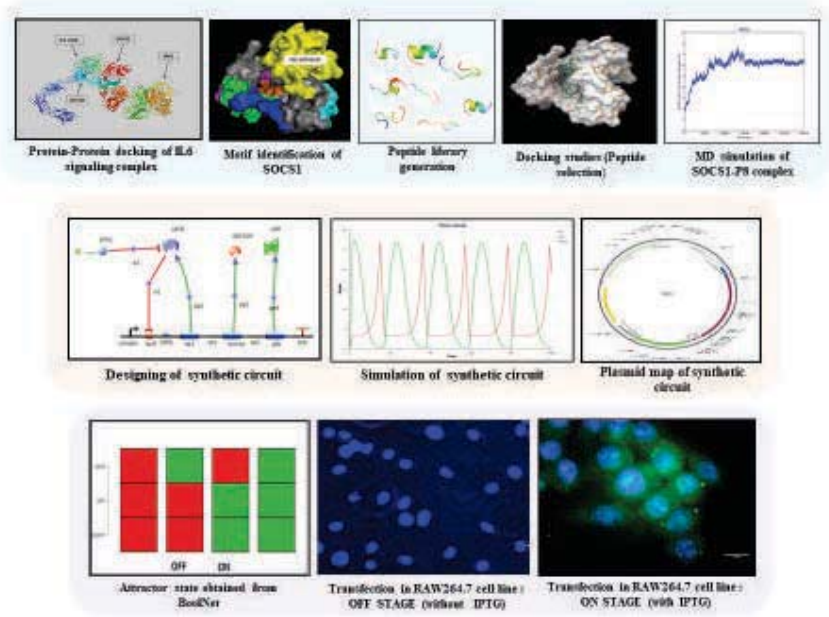


Fig. 2: Computational Pipeline for Synthetic Circuit Design and Transfection efficiency of the designed Synthetic Circuit

inhibitory action. The region is then targeted by designing set of peptides (NSQKADDLVDNNVI) against it (Figure 2). The in silico design and analysis of the SOCS1- peptide complex ensures us to test the efficiency in in vitro condition. In order to make the delivery of the peptide more specific and less expensive, we opt for synthetic biology approach, wherein, an inducible gene regulatory circuit delivers the designed peptide at specific location (in present work it is in cytoplasm where there is production of SOCS1 protein). Here, the circuit design is precise as well as simple to avoid unnecessary complications during its transfection or else like a Rube Goldberg machine the designed circuit may look exciting in silico but would rarely yield informative results in wet lab conditions. The confirmatory analysis of the designed therapeutic shows a remarkable up regulation in pro-inflammatory cytokines such as TNFα, iNOS, IFNγ, IL12 and consequently down regulation of anti-inflammatory cytokines IL10 and TGFβ is noted. We observed that the infected cells transfected with the synthetic circuit showed higher expression of pro-inflammatory cytokines such as iNOS and IFNγ with 2-7 fold change as compared to the infection group. Moreover, transfected & infected cells shows a significant reduction in the expression level of anti-

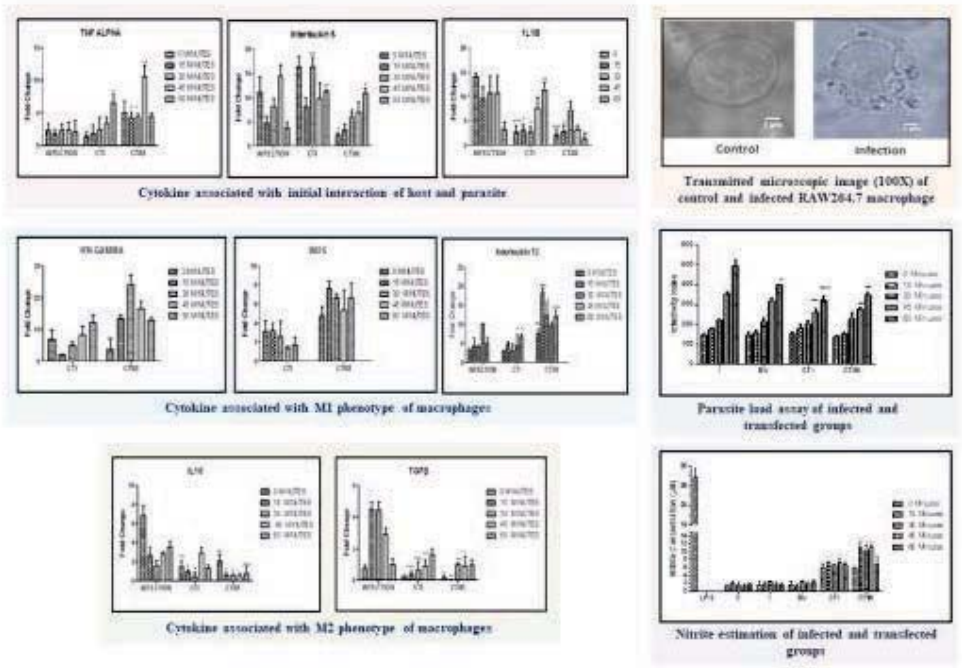
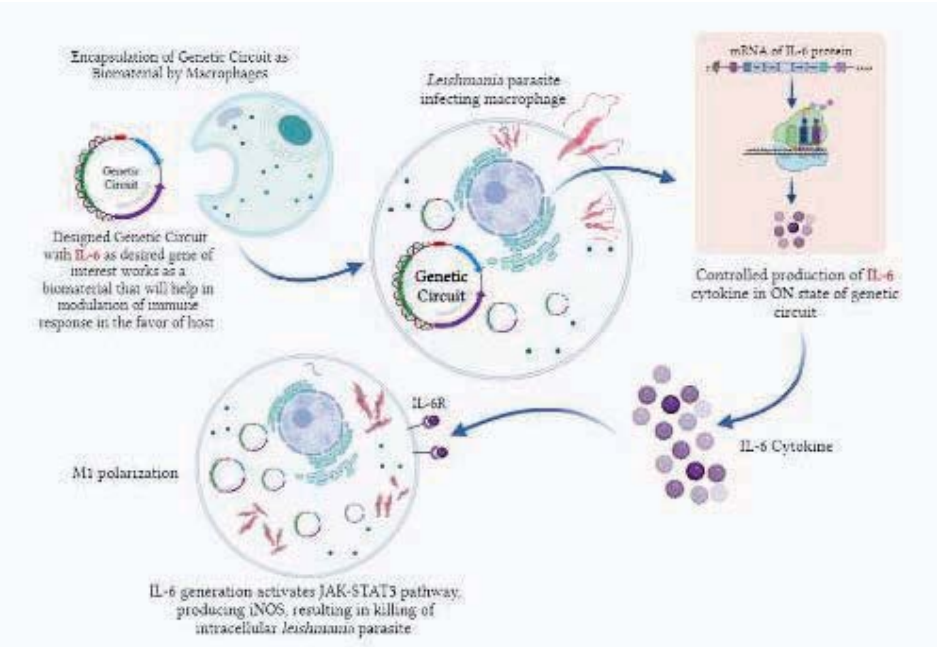


Fig. 3: In Vitro validation of the designed Synthetic Circuit

inflammatory cytokines such as IL10 and TGFβ (3-5 fold reduction) as compared to the infected group. Cytokine profiling confirms that the macrophage polarization is shifting towards M1 phenotype characterized by observing decreased parasite load in transfected and infected group (30 min post one hour of infection). The in vitro validation of designed synthetic circuit confirms its anti-leishmanial activity and has proven the potential of systems derived synthetic gene regulatory circuit in therapeutics (Figure 3).

Graphical Abstract



Dr. Nishant Singhal

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Generation of Transgene Free Down Syndrome Human iPSCs and Their Isogenic Normal Human iPSCs

Objectives of the study

- Generation of transgene free Down syndrome human iPSCs
- Generation of isogenic normal human iPSCs
- Pluripotency characterization of Down syndrome and its isogenic normal human iPSCs

Summary

With 1 in ~700 live births, Down syndrome (DS), first described by John Langdon Down in 1866, is major genetic cause of intellectual disability (ID). First described by Jerome Lejeune and Marthe Gautier in 1959, DS is caused by trisomy of human chromosome 21(HSA21; Homo Sapiens Autosome 21) (trisomy 21) in place of typical two copies in human cells. However, in spite of tremendous progress made in DS research in last 60 years, currently no effective treatment for ID is available.

ID in DS is due to dysfunction at various stages of neurodevelopment. Among them, reduced neurogenesis, dendritic hypotrophy and connectivity, imbalance of excitatory Glutamatergic and inhibitory GABAergic system seems to play a major role. From the limited data available from fetal stages of DS, reduced neurogenesis is one of the major pathological features observed. DS brain is reduced in weight, volume and demonstrates brachycephaly due to reduced forebrain. Corrected by body size, adult DS brain size is reduced by ~20%. DS brain demonstrates a globular configuration with simplified gyral patterning. At the microscopic level, DS cortex shows fewer neurons, decreased neuronal densities, and abnormal neuronal distribution, especially in cortical

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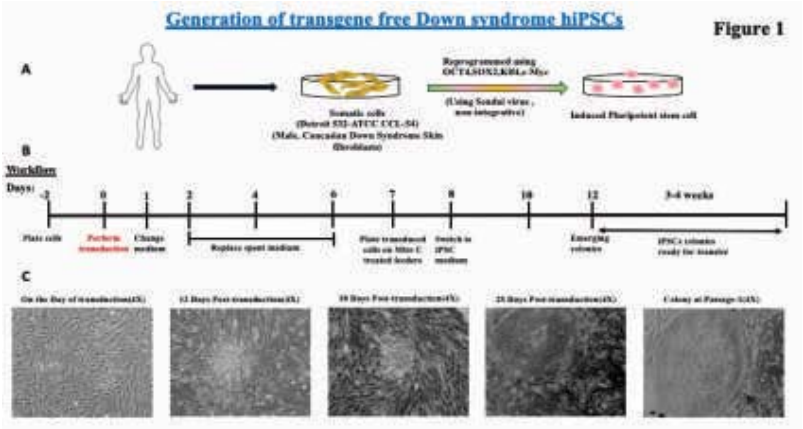
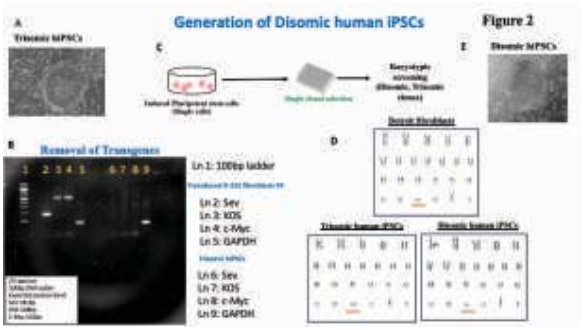


Fig. 1: Genration of Down syndrome human iPSCs. (A) Schematics of reprogramming, (B) Work flow and time line of reprogramming, (C) images from various stages of reprogramming.

Figure 2: Generation of disomic human iPSCs. (A) Representative image of Down syndrome human iPSCs, (B) PCR analysis for expression of sendai virus transgene (Sev) and exogenous reprogramming factors Klf4, Oct4 and Sox2 (KOS) as well as c-Myc. Analysis found absence of viral transgene and exogenous reprogramming factors after completion of repgramming. (C) Schematics of generation of disomic clone from Down syndrome hiPSCs. (D) Karyogram of parental Down syndrome skin fibroblast, Down syndrome human iPSCs and disomic human iPSCs. (E) representative image of isogenic disomic human iPSCs.



layer II and IV. These changes appear as early as second trimester of gestation. In fetal brain, 20- 50% fewer neurons are found in the entorhinal cortex, dentate gyrus of the hippocampus, hippocampal pyramidal layers, lateral parahippocampal gyrus and presubiculum. It is consistent with marked reduction in proliferation of cells in the DG (~50%), and the germinal matrix of the lateral ventricle (~25%) in fetal DS brain. Also consistent with this suggestion is the decrease in fetal DS cerebellar volume, which was attended by a decrease in cell density of all cerebellar layers and decreased cell proliferation in both external granular layer and ventricular zones (Guidi 2011). On the contrary, DS brain exhibits increased astrocytes in the entorhinal cortex, hippocampus, parahippocampal gyrus and presubiculum from the fetal brain stages 17 to 21 weeks onwards (Guidi 2008 and Zdaniuk, 2011). Additionally, second phase of cortical development i.e. emergence of lamination, is both delayed and disorganized in DS (Golden 1994). These observations have suggested an altered neurogenesis in DS.

Over last 30 years several mouse models of DS have been created to understand cellular and molecular mechanisms of intellectual disability and associated defective neurogenesis in DS. Of the 164 non-keratin coding genes present on long arm of HSA21, 158 human orthologues are distributed on MMU16, MMU10 and MMU17, causing difficulties in creating mouse models with complete trisomy 21. It led to generation of more than 35 mouse models of DS, either accidentally or intentionally, with varying degrees of trisomy in different genetic backgrounds. For instance, Ts65Dn, one of the most studied mouse models of DS, has an extra translocation chromosome that resulted from accidental fusion of a part of MMU16 syntenic region and the centromeric part of MMU17. Syntenic portion of MMU16 contains ~90 mouse genes out of 158 human orthologoues but also contains ~35 triplicated protein coding genes derived from MMU17 that are not triplicated in DS. Ts1Cje, another mouse model of DS generated accidentally and

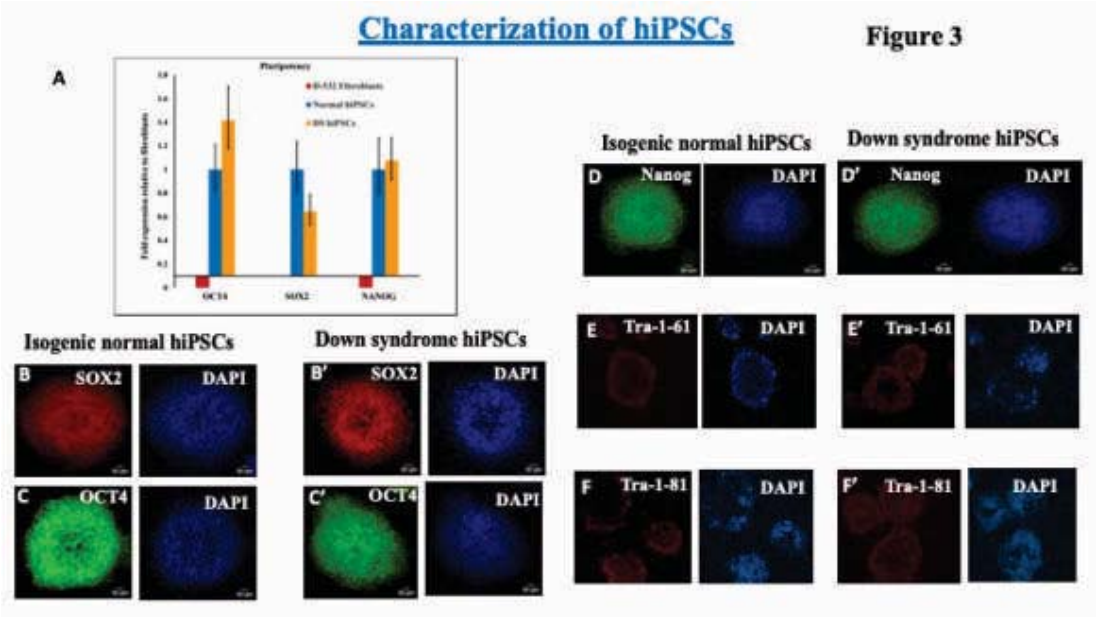


Figure 3: Characterization of Down syndrome and isogenic normal hiPSCs. (A) Quatitative PCR analysis for the expression of pluripotency genes Oct4, Sox2 and Nanog in Down syndrome and isogenic normal human iPSCs. Immunofluorescense analysis for the expression of SOX2 (B and B'), OCT4 (C and C'), Nanog (D and D'), Tra 1-61 (E and E') and Tra 1-81 (F and F'). Corresppoding DAPI images are shown alongside each image.

also used frequently, has a duplication of shorter segment of MMU16 translocated to MMU12 and carries 71 out of 158 protein coding human orthologoues but deletion of several genes. Apart from these accidentally generated mice, several mouse models have been generated by Cre/LoxP mediated chromosome engineering, CRISPR/Cas9 technology or mouse artificial chromosome technology but do not represent complete trisomy of HSA21 including recently developed humanized mouse models of DS, TcMAC21. These mouse models recapitulate several DS related phenotypes and postulated several mechanisms related to ID in DS but have not shown consistent phenotypes including prenatal brain development. Of note, recent analysis of cytogenetically distinct mouse models of DS Ts1Cje, Ts65Dn and Dp(16) 1/Yey over the lifespan found that Ts65Dn mice were most consistently affected with respect to somatic growth, neurogenesis and brain morphogenesis (Aziz 2018). Underlying reasons for these inconsistencies could be incomplete trisomy of HSA21 protein coding genes, differences in regulatory sequences and non-coding genes, human specific genes removal, presence of mouse-specific transcripts, and differing genetic backgrounds of mouse models. Species specific difference could also be a major cause of failed clinical trials in DS. Till now more than half dozen pharmaceuticals have reported promising effects in Ts65Dn mouse but failed to improve ID in individuals with DS e.g. GABA- 5 antagonist RG1662 showed improvements in Ts65Dn mice but failed in human trials. Nonetheless, mouse models of DS have been very useful in understanding abnormal brain development in DS.

However, in addition to genetic differences related to trisomy 21, there are several significant differences between human and mouse brain development, which limits their use for DS neurogenesis modeling. For instance, humans have enlarged brain with more than 1000-fold increase in total neuron numbers and exhibit several human specific characteristics of neocortical development, including cortical expansion and protracted time of development. Recently, human specific loci capable of regulating radial glial cells expansion and neurogenesis have also been described (Fiddes 2018, Suzuki 2018, Boyd 2015). Consequently, not all aspects of DS neurogenesis can be recapitulated in animal models. Thus, it can be envisioned that mechanistic knowledge generated using human DS neural cells may produce more successful outcome in clinical trials. However, only source of human DS neural cells are postmortem brain tissue, which does not allow studies to

understand mechanistic basis of reduced neurogenesis or drug screening.

This limitation was overcome by invention of induced pluripotent stem cells (iPSC) (Takahashi, 2007, Takahashi, 2006). IPSCs provided an opportunity to study the progression of human disorders by first generating disorder/disease specific human iPSCs by reprogramming somatic cells derived from diseased individual and later differentiating them towards desired lineage to study disease progression, identify mechanisms and develop drug screening platforms. Earlier attempts to explore neurogenesis in human iPSCs from people with DS yielded inconsistent findings. Using embryoid bodies (EB)-based methods, reduced neurogenesis was detected in one study (Hibaoui, 2014) while in another, neural differentiation was reportedly normal (Briggs et al., 2013). In other studies, using monolayer-based methods, there was no difference in neurogenesis (Shi, 2012; Weick, 2013). Among the possible explanations for the differences in findings are the use of significantly different protocols for provoking and examining neurogenesis and neural differentiation (Briggs, 2013; Hibaoui, 2014; Lu, 2013; Sobol, 2019; Weick, 2013). Among these studies, Hibaoui et. al., found that DS cell show impaired cell proliferation during neural differentiation, which could be rescued by knockdown of DYRK1A, a HSA21 gene. However, data from fetal brain section has shown that in DS brain there is not only impaired cell proliferation, but also delayed cortical lamination and increased astroglial production. It has been described that in cortex, layer 2 and 4 neurons are specifically reduced in DS. These observations alone can not be explained by impaired cell proliferation of DS cells.

In our ongoing work we have developed DS neurogenesis model in a dish using human iPSCs. However, since human iPSCs are known to have variations in phenotypes as well as human iPSCs currently in use in the study were generated by retroviral vectors that leaves transgenes inserted into the genome. Thus, to overcome these limitations and develop more robust DS neurogenesis model, we sought to generate transgene free isogenic pair of DS and normal human iPSCs.

To generate DS hiPSCs, we collaborated with Dr. Paresh Singhal, AFMC to obtain somatic cells from individuals with DS. However, due to COVID pandemic and delay in IEC approvals, we decided to reprogram DS skin fibroblasts of caucassian origin Detroit 532-ATCC CCL-54 obtained from ATCC.

For reprogramming, cells were expanded and reprogrammed as depicted in Figure 1A using sendai virus mediated delivery of reprogramming factors Oct4, Sox2, Klf4 and c-Myc Work flow and duration for this work has been shown in figure 1B. Briefly, 2 days before transduction, human fibroblasts are plated to achieve a density of 50% - 70%. On the day of transduction, sendai virus carrying reprogramming factors are added to fibroblast for overnight and washed next day. For another 5 days cells are maintained in fibroblast medium. On day 7, transduced cells are transferred on to mitotically inactivated mouse embryonic fibroblast feeder cells. Next day medium is switched to human iPSCs medium. Cells are maintained in the hiPSCs medium till hiPSC colonies emerges. Afterwards, individual clones are picked and expanded separeately. Various stages of reprogramming have been shown in figure 1C.

DS human iPSCs (figure 2A) were expanded for several passaged in feeder dependent conditions and tested for the absence of sendai virus transgenes. As shown in Figure 2B, DS hiPSCs were found to be free from viral transgenes as well as exogenous reprogramming factors. For generation of isogenic normal human iPSCs, DS human iPSCs are culture as single cells in feeder free conditions for several passages since these conditions are known to exert stress on the cells leading to expulsion of extra chromose 21 and thus generating disomic cells (Figure 2C). To identify disomic cells, individual clones were picked, expanded and frozen in replicates. Afterwards, individual clones were thawed and expanded for karyotypic screening. About 50 individual hiPSC clones were screened by G- banding karyotyping (Figure 2D). After screening, we successfully obtained a disomic human iPSC clone (Figure 2E). Correspoding hiPSC clone was thawed from frozen plate, further verified by karyotyping and expanded for further characterization.

DS and isogenic normal hiPSCs were further expanded for pluripotency characterization. As shown in figure 3A, real time PCR analysis found expression of Oct4, Sox2 and Nanog transcripts in DS and isogenic normal hiPSCs. Further, immunofluorescence analysis was carried out to analyze the expression of pluripotency markers in these hiPSC clones. As shown in figure 3 panels, Down syndrome and isogenic normal hiPSCs were found to express pluripotency markers Sox2 (Figure 3B and B'), Oct4 (Figure 3C and C'), Nanog (Figure 3D and D'), Tra -1-61 (Figure 3E and E') and Tra 1-81 (Figure 3F and F').

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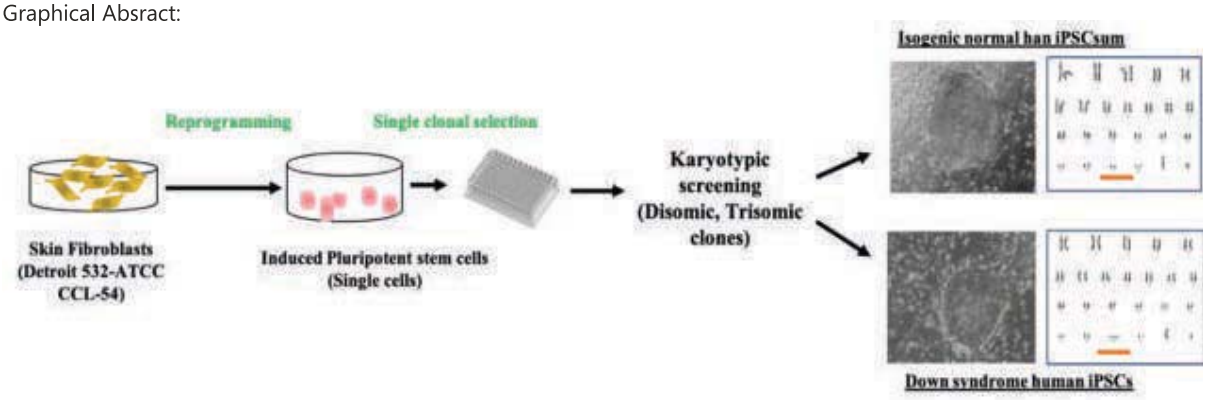

These results indicated that DS and its isogenic normal human iPSCs are pluripotent.

Significance

In this work we have successfully generated transgene free Down syndrome human iPSCs and its isogenic normal human iPSCs. These cell lines will be helpful to develop robust model of DS neurogenesis.

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Role of NADPH Oxidase 4, (Nox4) in Breast Cancer Progression

Objectives of the study

- To study the role of NOX4 in breast cancer cell migration and its underlying mechanism in normal breast epithelial cells and cancer cells.
- The subcellular localization of NOX4 and its interacting partners.
- Identification and characterization of NOX4 splice variants (protein isoform) in breast cancer cell lines and their role in invasive behaviour of breast cancer cell lines.

Summary

Background

Reactive oxygen species (ROS) and the underlying oxidative stress is thought to contribute to breast cancer aggressiveness and thus progression. NOX4 is overexpressed in breast cancer, however, limited data is available regarding its biological function and molecular mechanism in breast cancer. Nox4 is a hydrogen peroxide-producing NADPH oxidase highly expressed in breast cancer cells and tissues which has been linked to tumor progression, including cellular senescence, resistance to apoptosis, and tumorigenic transformation. The functional significance of this enzyme however, is unclear.

Main findings & Significance

In this study we showed that, NOX4 mRNA is increased in MDA-MB-231 while NOX4 protein expression was more in MCF-7 cells. Also, MDA- MB-231 cells

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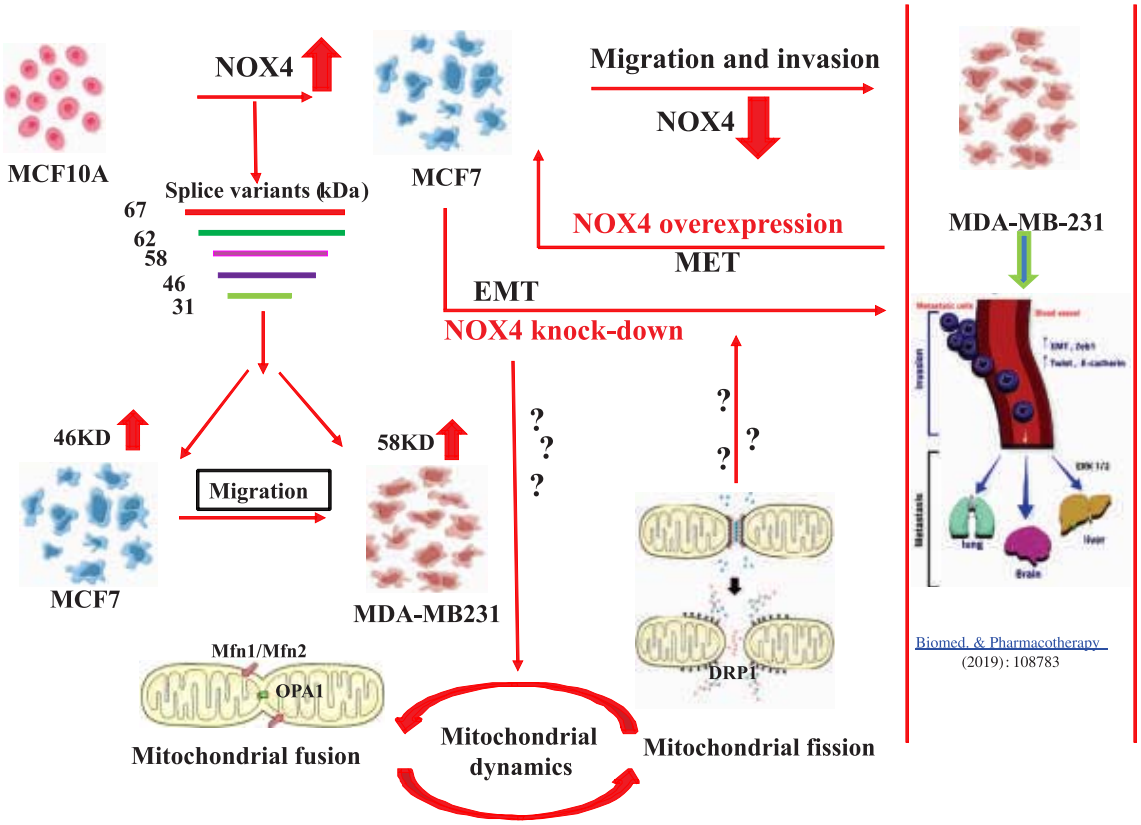

Schematic representation of the molecular mechanisms of NOX4 in breast cell migration.

showed increased H_2O_2. The interacting partner P22phox mRNA was more in MCF7 cells while Poldip2 mRNA was increased in MDA-MB231 cells. NOX4, inhibitor Plumbagin significantly inhibited cell migration.

The subcellular localization of NOX4 was different in these cell lines, while NOX4 was found to be localized majorly into the nucleus and cytoplasm in MCF10A and MDA-MB231, it was overexpressed and distributed throughout MCF7 cells.

We observed a predominant overexpression of 46 kDa isoform in MCF7 cells and 58KD isoform in MDA-MB231 cells, while knockdown of NOX4 in MCF-7 cells showed upregulation of other isoforms (58 kDa and 67 kDa). This is the first study where a differential upregulation of NOX4 splice variants is observed in breast cancer aggressiveness. Also, the epithelial marker (E-cadherin) was down regulated and the mesenchymal markers (N-cadherin, Vimentin, Snail and Twist) upregulated in these cells, suggesting that, 46 kDa isoform might be playing a role in maintaining epithelial characteristic in the less invasive MCF7 cells. Cell migration was further validated using scratch wound, trans well migration assays and Zymography in these cells.

Since mitochondrial dynamics regulates the cell migration in breast cancer cells, and mitochondrial fusion is showed more in MCF7 cells and mitochondrial fission is more in MDA-MB-231 cells, we also checked the markers of fission and fusion in the knockdown cells and found a significant downregulation of the mitochondrial fusion markers (Mfn1, Mfn2 and OPA1) and a significant upregulation of the mitochondrial fission marker (Drp1). More importantly, inhibition of Drp1 with Mdivi1 up regulated the expression of 46kDa isoform, suggesting that 46 kDa NOX4 isoform majorly localized to mitochondria and might play a significant role in regulating mitochondrial fusion in MCF7 cells and ultimately regulate the breast cancer cell migration.

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Understanding the Role of Clathrin-Mediated Endocytosis in Development and Disease

Objectives of the study

- To determine the role of clathrin-mediated endocytosis in embryonic stem cells, in lineage-specific differentiation and during development.

Summary

Background

Vesicular transport or trafficking is required for the accurate transport of molecules within a cell. A number of studies have shown that alterations in the process of intracellular trafficking can affect development of an organism. Pluripotent embryonic stem cells possess the ability to differentiate into cell types belonging to all three germ layers. These cells provide a useful model system to study cell fate changes and choices in early mammalian development. Pluripotency in embryonic stem cells is regulated by numerous factors, including epigenetic modifications, small non-coding RNAs, and more recently, the process of intracellular trafficking. Our research aims to understand the role of intracellular trafficking in the context of embryonic stem cell differentiation.

Main findings & Significance

Our previous work has shown that embryonic stem cells lacking the clathrin heavy chain (CLTC) lose their stemness and resemble differentiated cells (Narayana et al, 2019; Stem Cell Reports). In a bid to further understand the effects of loss of CLTC, we focused on studying the physical properties of these cells. Our results demonstrated that loss of CLTC resulted in an increased stiffness of cells, which was due to reorganization of the actin cytoskeleton.

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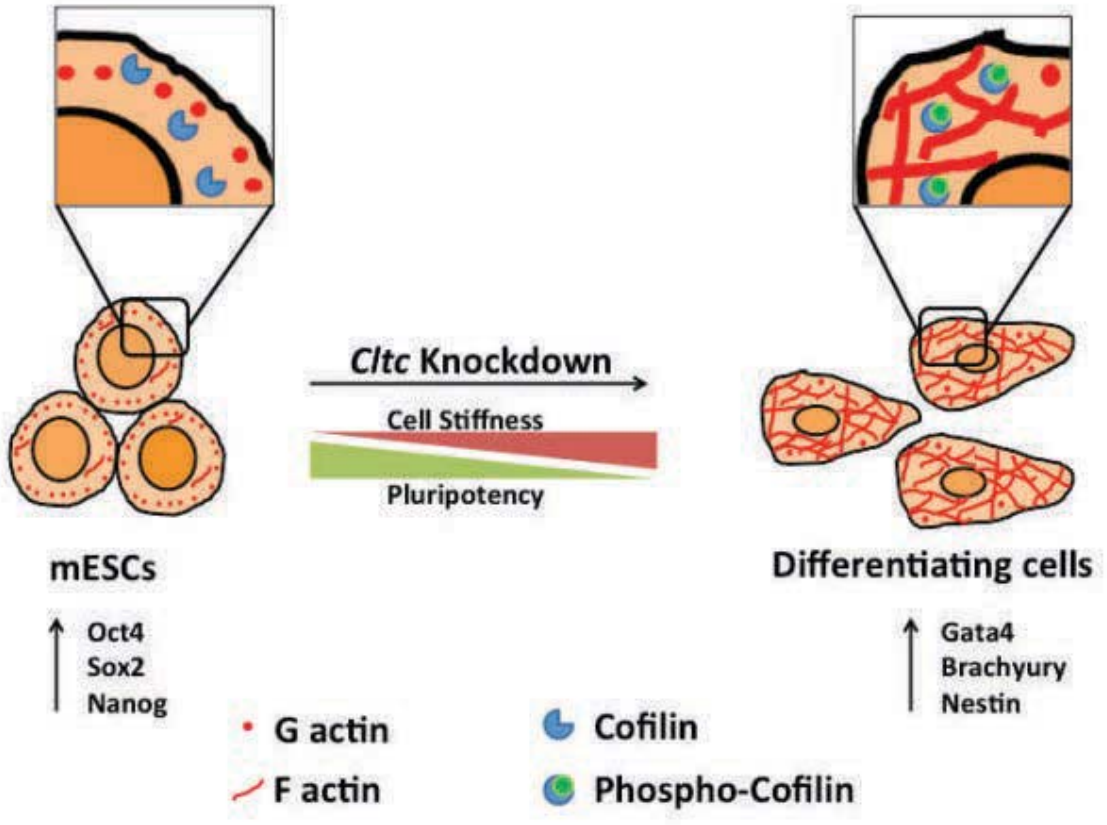

Fig. 1: Figure shows the rearrangement of the actin cytoskeleton in stem cells and differentiated cells, and its relation with the clathrin heavy chain (CLTC)

These cells also displayed reduced expression of pluripotency markers. While destabilization of the actin cytoskeleton resulted in a reduction of stiffness, this did not result in a restoration of expression of pluripotency markers, indicating that active intracellular transport through the clathrin pathway may be a critical requirement in attaining pluripotency. An initiation of CME may be essential for the transport of molecules that ultimately regulate the pluripotency network of a stem cell. Our results also suggest that a rescue of mechanical properties need not necessarily always reflect a change in the transcriptional network of a stem cell. Furthermore, this may also suggest that an inherent hierarchy may exist with respect to specific events that dictate when a cell achieves pluripotency (Figure 1).

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Gene Regulatory Functions of Mammalian Long Noncoding RNAs [lncRNAs] During Quiescence Proliferation Axis

Objectives of the study

Characterize complete lncRNA signature associated with cellular quiescence and proliferation.
Delineate regulatory mechanisms through which lncRNAs orchestrate these processes.

Summary

Background

The human body has about 1013 -1014 cells; a greater part of which are in a non- dividing state. A few of these non- dividing cells are irreversibly arrested (senescent & terminally differentiated cells), while the rest of them have a capacity to re-enter the cell cycle depending upon physiological cues. The latter group of reversibly arrested cells are termed as quiescent cells. Cellular quiescence is thus described as a reversible, non- dividing state prompted by varied anti- mitogenic cues, contact inhibition & various stresses. This property is exhibited by various cell types, including adult stem cells, fibroblasts, lymphocytes, progenitor cells, hepatocytes, some epithelial cells & cancer stem cells. On appropriate stimuli, cells may leave the quiescent state, re-enter the cell cycle and begin to proliferate. When stimulated, an intracellular signaling cascade drives global changes in gene expression accompanied by alterations in chromatin modifications that results in their rapid proliferation until required and then the cells exit the cell cycle and re-enter quiescence. De-regulation of the balance between quiescence & proliferation can lead to various hypo- and hyper-proliferative pathologic conditions such as fibrosis, autoimmune

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diseases, neurodegeneration, cancer and ageing. Recent studies have confirmed quiescence to be a highly active state characterized by distinctive transcription and epigenetic profile and metabolic status. Various factors such as Rb, p53, p21, p27, p57, HES1, FOXO3 & many others have been discovered to play important roles in regulating quiescence. Additionally, certain miRNAs such as miR-436, miR-126, miR-31 have been shown to regulate the expression of specific genes in cells undergoing quiescence. However, it is still not completely understood what helps the cells to enter and maintain the quiescence state. Considering the utmost importance of the balance between a proliferative and non-proliferative state for the maintenance of the cellular homeostasis, thus the organismal health, it thus becomes necessary to understand this phenomenon in a great detail.

Elucidating the different mechanism of action of lncRNAs will not only provide the basic biological understanding of cellular function but also a critical nexus for revealing the basis of lncRNAs in disease etiology and their use as targets in subsequent drug design. Most importantly, the fact that mammalian transcriptome comprises several thousands lncRNAs with diverse signatures, the question that whether all of them have biological purpose still stands unanswered. Thus, a comprehensive knowledge of their function would greatly facilitate our current understanding of various cell regulatory networks and disease mechanisms.

Main findings & Significance

Our studies identified several differentially expressed lncRNAs at the quiescence- proliferation axis, out of which LNC339, LNC607, LNC67L2, LNC1279, and MIR503HG were the top hits. MIR503HG is a 786 bp long, RNA polII transcribed, non-polyadenylated miRNA host gene transcribed from chromosome X (Xq26.3) that encodes miR-503 and is expressed in diverse cell types. MiR-503 encoded by this RNA is also up-regulated during quiescence and it also been shown to have anti- proliferative roles in various cancer cell types. However, direct involvement of miR503 in regulation of cellular quiescence has not been deciphered yet. This also elevated our curiosity to understand if MIR503HG has a specific molecular function independent of miR-503.

In order to understand the potential role of MIR503HG in regulating quiescence, we performed in-vitro experiments to examine the effect of their depletion in asynchronously growing HDFs that have a finite life span. The PI flow cytometry data revealed no significant effect on cell cycle progression upon MIR503HG depletion, suggesting that this lncRNAs might not play a crucial role in driving the normal cell cycle progression. Interestingly, when we performed Hoechst/Pyronin staining for the asynchronously growing MIR503HG depleted cells, we observed a marked reduction in G0 population, indicating that MIR503HG might be required for maintaining the cells into quiescence. In order to further confirm this, we examined the effects of MIR503HG depletion on the cells induced to undergo quiescence, followed by PI-Flow cytometric analysis and Hoechst/Pyronin staining. Interestingly, MIR503HG depleted cells showed a drastic decrease in the G0 population with a parallel increase in G1, S and G2/M population. These results indicate a potential role of MIR503HG in initiating and/or maintaining a quiescent state.

It is a well-established fact that miR503 targets CCND1 and CDC25a to induce cell cycle arrest in cells. To confirm this, we checked CCND1 and CDC25a both at RNA and protein levels in G0 cells and observed a significant reduction in their levels. Also, depletion of MIR503HG leads to a marked increase in CCND1 and CDC25a RNA and protein levels. This further suggests that MIR503HG encoded miR503 targets CCND1 and CDC25a to maintain cells during quiescence.

Mounting evidence highlight roles of numerous lncRNAs as competitive endogenous RNA (ceRNA) for specific miRNAs in wide variety of cellular contexts. To identify MIR503HG miRNA targets of relevance to quiescence, we performed a computational analysis (LncTar, miRanda & TargetScan) to screen for the miRNAs that share complementarity with MIR503HG lncRNA. Interestingly, we found complementary binding sites of miR508 in the 3'region of MIR503HG. The miRNA, miR508 has been reported to target PTEN, INPP5J and INPP4A. miR508 directly suppresses these phosphatases resulting in constitutive activation of PI3K/Akt signaling. We first checked the effect of MIR503HG depletion on the transcript levels of PTEN, INPPJ and INPP4A. We found that the transcript levels of PTEN, INPPJ and INPP4A are quite high in quiescence condition; however, their levels are drastically lowered upon MIR503HG depletion. To gain more insight, we also checked PTEN and Akt protein levels in cells upon MIR503HG depletion. Interestingly, PTEN levels were high in quiescent cells, however, MIR503HG depletion led to a significant reduction in PTEN levels with a concomitant increase in pAkt levels. This suggests

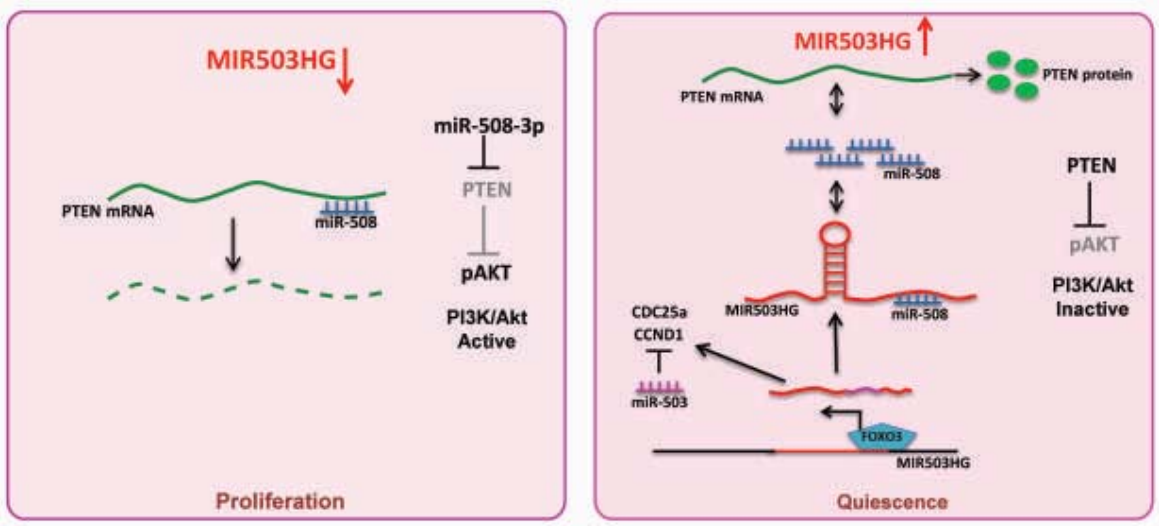

Fig. legend: In proliferating cells, MIR503HG levels are low therefore, miR508 can efficiently target PTEN mRNA to its degradation leading to active PI3K/AKT signalling in cells. However, during quiescence when MIR503HG levels are high, it competes with PTEn mRNA for binding with miR508, therefore, sequestering miR508 and reducing its availability for PTEN. High PTEN levels in cells then actively blocks the PI3K/AKT signalling in cells thus not allowing the cells to proliferate. Additionally, miR503 encoded by MIR503HG targets CCND1 and CDC25a and helps in maintenance of cells in quiescence.

that MIR503HG might negatively regulate miR508 function. In order to confirm direct interaction between MIR503HG and miR-508, we performed Ago2 pull down and luciferase assay. The Ago2 pull down showed higher enrichment of MIR503HG in quiescence as well as MIR503HG overexpression conditions, while the enrichment of PTEN and INPP5J remained very low in both these conditions. However, MIR503HG knockdown lead to the increased enrichment of both PTEN and INPP5J, suggesting that MIR503HG might function as a ceRNA for miR-508 to regulate PTEN and INPP5J in quiescence conditions. Overall, we conclude that MIR503HG acts as a ceRNA for miR-508 by regulating the PTEN levels in quiescent conditions.

MIR503HG genomic sequence analysis revealed that MIR503HG has binding sites for transcription factors- FOXO3 and FOXO4. FOXO3 has already been reported to serve as an essential transcription factor that promotes quiescence in adult stem cells by activating NOTCH signaling. We assumed that FOXO3 transcriptionally regulates MIR503HG levels in quiescence. In agreement with our assumption, we found that overexpression of both FOXO3 and FOXO4 leads to the upregulation of MIR503HG. Also, the FOXO3 immuno-precipitation (IP) showed significant enrichment of MIR503HG in quiescence conditions. These results strongly indicate that MIR503HG is transcriptionally regulated by FOXO3 in quiescence conditions. The overall results indicate that the FOXO3 regulated MIR503HG acts as a ceRNA for miR-508 by regulating the PTEN levels in quiescent condition.

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Studies on role of IL-3 in bone remodeling

Objectives of the study

- To investigate the in vivo role of IL-3 on bone resorption and formation using animal model of human osteoporosis.
- To conduct cohort study to analyze the serum samples of human osteoporotic patients for the level of IL-3.

Summary

Bone remodeling is the key phenomenon for maintenance of bone homeostasis and regulation of pathophysiology of osteoporosis and age-related bone loss. It is regulated by various osteotropic factors including cytokines secreted by activated T lymphocytes. Interleukin-3 (IL-3), a cytokine secreted by T helper cells is known to stimulate the proliferation, survival and differentiation of hematopoietic stem cells. We have previously shown that IL-3 inhibits receptor activator of NF-κB ligand (RANKL)- and TNF-α-induced osteoclast differentiation by down-regulating NF-κB and TNF-receptors 1 and 2 respectively. IL-3 also inhibits osteoclast differentiation in presence of several pro-inflammatory cytokines including IL-1, IL-6, TGF-β and PGE_2. These results suggest that IL-3 is potent inhibitor of pathological bone loss. Moreover, IL-3 inhibits RANKL-induced osteoclast differentiation in human peripheral blood monocytes. Interestingly, we have observed that IL-3 enhances the differentiation of osteoblasts, bone mineralization and new bone formation from human mesenchymal stem cells. However, the role of IL-3 on in vivo bone remodeling is not yet known. Since IL-3 showed potential to inhibit osteoclast differentiation in both mice and human cell cultures, and also enhanced bone regeneration, we hypothesized that the administration of IL-3 may influence

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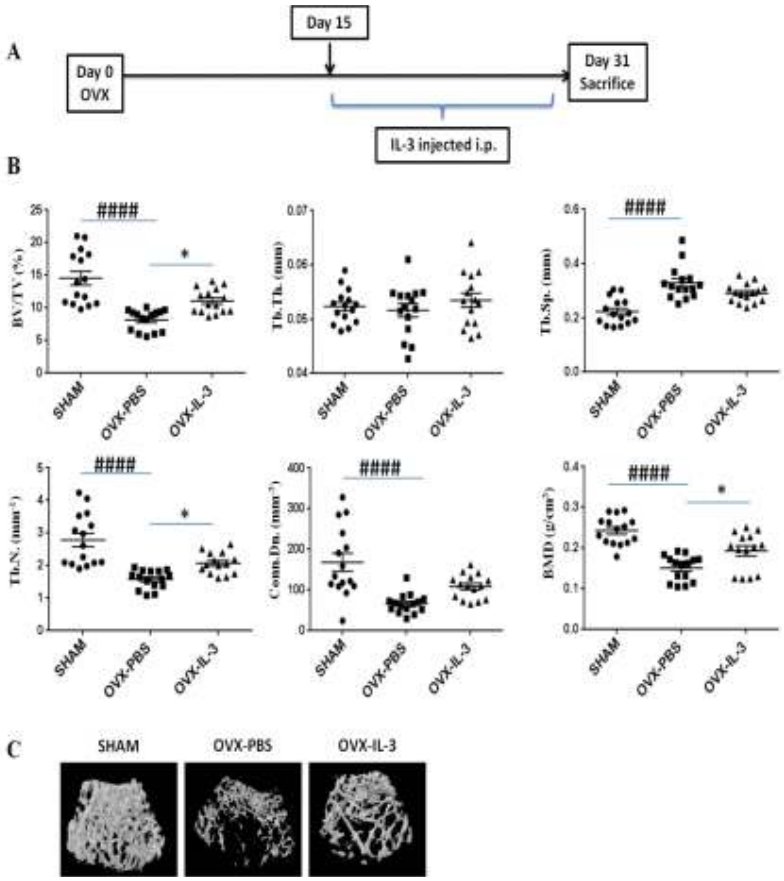


Figure 1. IL-3 prevents OVX-induced bone loss in distal femur metaphysis when injected daily from day 15-30post-OVX. (A) Mice were ovariectomized and IL-3 was injected daily for a period of 15 days from day 15 today 30 post-ovariectomy. (B) The femoral bones were excised and subjected for histomorphometric analysis using µ-CT. (C) Representative 3D µ-CT images of distal femur metaphysis trabecular bone. Data is presented as mean ± SEM, n = 15 mice/ group. ####$p \leq 0.0001$ vs SHAM; *$p \leq 0.05$ vs OVX.

the in vivo bone remodeling by inhibiting osteoclast differentiation and enhancing osteoblast differentiation, which in turn could help to prevent the bone loss. In further studies we investigated the role of IL-3 on bone remodeling using animal model of human osteoporosis.

To understand the in vivo role of IL-3 on pathological bone remodeling we used ovariectomy (OVX)-induced bone loss mouse model of post-menopausal human osteoporosis. For this, Balb/c mice of 6-8 weeks old were ovariectomised and IL-3 treatment was given from day 15 to day 30 post-OVX (Fig. 1A). Mice were sacrificed on day 31 and femur bones were subjected to microcomputed tomography (µ-CT) analysis for evaluation of bone microarchitecture and bone mineral density (BMD). CT Analyser software was used for 3D morphometric analysis of trabecular and cortical bone indices such as bone volume/tissue volume (BV/TV), trabecular thickness (Tb.Th), trabecular separation (Tb.Sp), trabecular number (Tb.N), connectivity density (Conn.dn), cortical thickness (Ct.Th) and cortical medullary volume. BMD of trabecular and cortical bones was also analyzed. We found that IL-3 significantly improved femur trabecular BV/TV and Tb.N (Fig. 1B). There was some improvement in Tb.Th. and Conn.Dn by IL-3. Increased Tb.Sp. in OVX mice was also normalised to some extent in IL-3 treated mice. Interestingly, BMD was significantly improved in IL-3 treated mice as compared to OVX (Fig. 1B). 3D images of distal femur metaphysis trabecular bone confirmed the prevention of OVX- induced bone loss by IL-3 (Fig. 1C). Thus, IL-3 not only protected the trabecular bone microarchitecture but also improved BMD.

We further evaluated whether IL-3 can prevent bone loss when injected before the initiation of disease process, which will mimic the pre-osteopenic condition. In this experiment, IL-3 treatment was given from day 8 to day 37 post-OVX. Mice were sacrificed on day 38 (Figure 2A) and femur and tibia bones were excised and subjected to µ-CT analysis. It was observed that IL-3 administration before the initiation of bone loss significantly prevented bone loss by improving femur trabecular bone parameters such as BV/TV, Tb.Sp., Tb.N. and Conn.Dn (Figure

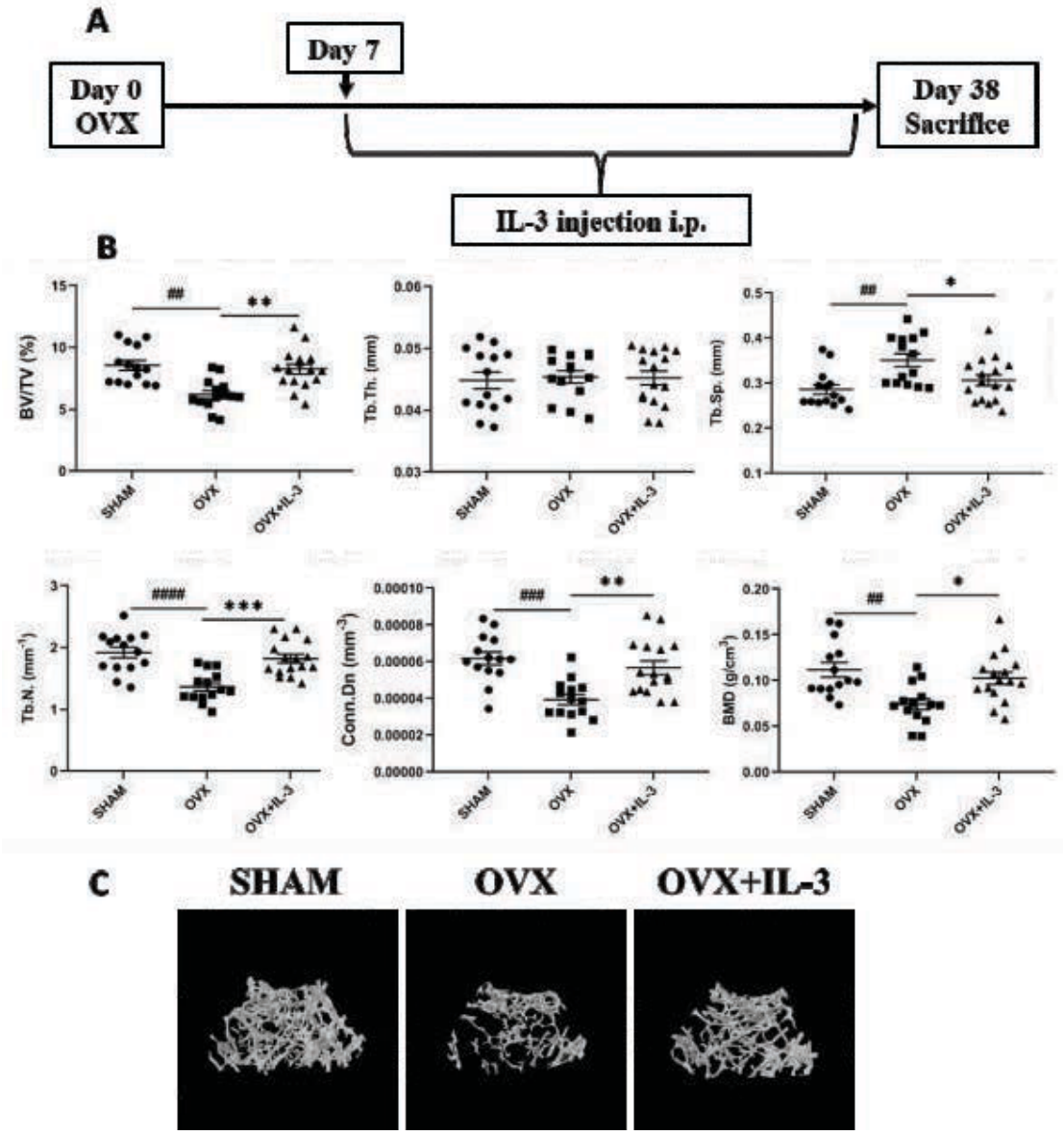


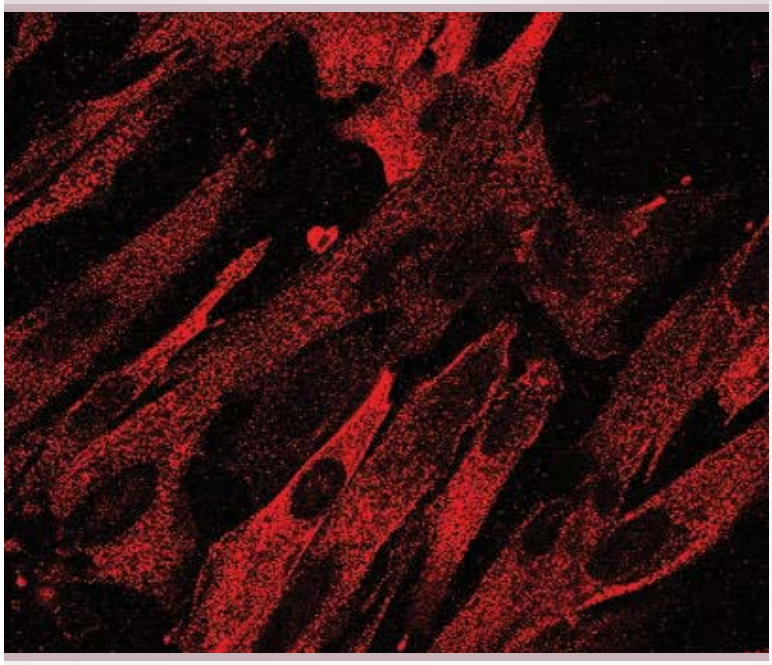
Fig. 2. IL-3 prevents OVX-induced bone loss in distal femur metaphysis when injected daily from day 8-37 post-OVX. (A) Mice were ovariectomised and IL-3 was injected daily for a period of 30 days from day 8 till day 37 post-OVX. (B) The femoral bones were excised and subjected μ-CT analysis. (C) Representative 3D models of femur trabecular bone. Significance was calculated by a one-way ANOVA followed by a post hoc Bonferroni multiple comparison test. Data is presented as mean ± SEM, n = 14-16 mice/ group. ##p ≤ 0.01 ###p ≤ 0.001 ####p ≤ 0.0001 vs SHAM and *p ≤ 0.05, **p < 0.01, ***p < 0.001 vs OVX.

2B). Interestingly, trabecular BMD was also significantly improved in IL-3 treated mice as compared to OVX mice. 3D model images of trabecular bone of distal femur metastasis further confirmed that IL-3 prevented bone loss induced upon OVX (Figure 2C). Thus, IL-3 prevented the trabecular bone loss in ovariectomised mice when injected from day 8 till day 37.

Cortical bone architecture of femur was also assessed by μ-CT. It was observed that OVX showed no effect on cortical bone indices like Ct.Th, cortical BV/TV, cortical volume inside periosteum and cortical BMD and on 3D structure of the cortical bone (data not shown). Also, IL-3 showed no effect on cortical parameters. These results suggest that bone loss has not been started in cortical bone during this short period of post-OVX. Also, mice were treated for only 30 days and improvement of cortical parameters within this short period may not be possible. In addition to femur trabecular bone, IL-3 also prevented the trabecular bone loss of tibia. In conclusion, our results indicate that IL-3 can prevent the post-OVX bone loss in mouse model of human osteoporosis.

Future Research Plans

We will evaluate the effect of IL-3 on pathological bone loss in OVX mice after induction of complete osteoporosis. IL-3 will be injected from day 30 post-OVX to evaluate the anabolic effect of IL-3 in mice by μ-CT. Also, the serum samples of human osteoporotic patients will be evaluated for determining the level of IL-3 along with other cytokines. Tibia and femur bones will be evaluated by histopathology for quantification of osteoclasts and osteoblasts.



Support Units & Other Facilities

Experimental Animal Facility

Dr. Ramanamurthy Boppana
(Scientist In-Charge)

The Experimental Animal facility (EAF) is a research support facility of the Institute providing a spectrum of services in the area of Laboratory animal Experimentation for Research and Development programs of the Institute. The facility is registered with the "Committee for the Purpose of Control and Supervision of Experiments on Animals" (CPCSEA) and operates in compliance within the guidelines laid down by the Committee. It is a facility for the breeding, maintenance and supply of small laboratory animals viz. inbred and mutant mice, rats, rabbits etc. for the ongoing research projects of the Institute. The following is the list of various laboratory animals maintained at the facility:

MICE:

BALB/cJ
C57BL/6J
DBA/2J
DBA/1/J
129/SvJ
FVB/NJ
SWISS#
BALB/c*
NZB
AKR#
Cf1
Cd1

Genetically engineered mutant mice (knock-out, transgenic and mutant mice

RATS: WISTAR

RABBITS: NEWZEALAND WHITE

* BALB/c with cataract mutation # Outbred

The Team

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Mr. Md. Shaikh
Mr. A. Inamdar
Mr. Prakash T. Shelke
Ms.Vaishali Bajare
Mr. Mahavir Rangole
Mr. Rahul B. Kavitake
Mr. Ganesh B. Yadav
Mr. Sanjay Gade
Mr. Harshal G. Gaonkar
Mr. Dilip B. Thorat

Standard Operating Procedures are in place for every activity that has a direct bearing on the management and husbandry of animals housed in the facility.

The breeding program for the propagation of the inbred mice is planned and executed to meet the needs of Scientists of the Institute for the conduct of animal experiments. Complete scientific support and advice is extended as per demand to the Scientists and their group members for the conduct of experiments under IAEC approved projects.

During the current year a total of 19 mice lines which include both inbred and mutants were added. The total number of mice lines, inbred, outbred, and mutant and hybrids, being maintained at the Experimental Animal Facility stands at 60. The foundation/nuclear colonies of mice are housed in Individually Ventilated Caging systems. Genetic monitoring using standard PCR protocols for mutant mice and select microsatellite markers for the major inbred strains is carried out regularly by PCR.

As a part of human resource development, the facility conducts training/course work for the research fellows of the Institute in the area of Laboratory Animal Experimentation and Ethics. During the year 2020-21, a total of 38 fellows underwent the course which comprised of both theory and practical sessions.

As per the rules and regulations framed by the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) Govt. of India, the EAF provides the requisite oversight on the conduct of experiments on laboratory animals in the Institute.

The breeding of laboratory animals has been planned to meet the needs of Scientists / Research Scholars for various animal experiments.

Publications:

1: Vipparthi K, Patel AK, Ghosh S, Das S, Das C, Das K, Sarkar A, Thatikonda V,Pal B, Remani ASKN, Arora N, Parihar M, Vijayakumar MV, Bhat MK, Boppana R, Bhattacharjee S, Biswas NK, Arun P, Sharan R, Singh S. Two novel cell culture models of buccal mucosal oral cancer from patients with no risk-habits of tobacco smoking or chewing. Oral Oncol. 2021 Feb;113:105131. doi:10.1016/j.oraloncology.2020.105131. Epub 2020 Dec 30. PMID: 33387705.

2: Mittal S, Inamdar S, Acharya J, Pekhale K, Kalamkar S, Boppana R, Ghaskadbi S. miR-3666 inhibits development of hepatic steatosis by negatively regulating PPARγ. Biochim Biophys Acta Mol Cell Biol Lipids. 2020 Oct;1865(10):158777. doi:10.1016/j.bbalip.2020.158777. Epub 2020 Aug 2. PMID: 32755726.

Proteomics Facility

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Technical Staff

Dr. M. V. Vijayakumar, Technical officer

Mr. Venkatesh Naik, Technician

The proteomics facility is a core service facility of the institute with an objective to provide mass spectrometric analysis of biological samples. The following is the list of various instruments available at the facility:

Orbitrap Fusion Tribrid LC-MS/MS system

Orbitrap Fusion Tribrid LC-MS/MS system (Thermo Scientific) combines the best of quadrupole, ion trap and Orbitrap mass analysis in revolutionary tribrid architecture to provide unprecedented depth of analysis and ease of use. The system enables analyzing the most challenging low-abundance, high-complexity samples to identify more compounds faster, quantify more accurately and elucidate structures more thoroughly. This system is capable of multiple dissociation techniques viz. CID, HCD and ETD with ion trap or Orbitrap detection at any level of MSn maximize flexibility for research applications. The system performs a wide variety of analyses, from in-depth discovery experiments to characterization of complex PTMs and comprehensive qualitative and quantitative workflows. The number of samples analyzed is approximately 270 samples including 7 external samples from April-2020 to March-2021.

4800 LC-MALDI-TOF/TOF

4800 MALDI TOF/TOF system (Sciex) is a tandem time-of-flight MS/MS system used for protein identification and intact mass analysis. The system identifies proteins by determining accurate masses of peptides formed by enzymatic digestion. Additionally, the system can more definitely identify and characterize proteins by isolating and fragmenting a molecular ion of interest and measuring the fragment ion masses. The number of samples analyzed is 25 samples including 4 external samples from April-2020 to March-2021.

4000 Q-Trap LC-MS/MS

AGILENT GC-MS

4000 Q-Trap LC-MS/MS system (Sciex) is a hybrid triple quadrupole/linear ion trap mass spectrometer coupled to Eksigent Express Micro LC-Ultra System. The system is used for targeted proteomic applications, metabolomic applications and lipidomic applications. The number of samples analyzed is 20 samples including 6 external samples from April-2020 to March-2021.

Gas Chromatography Mass Spectrometry (GC-MS) system (Agilent) with 7890B GC and 5977A MSD provides unmatched sensitivity for ultra-trace analysis, and increased performance. It is highly suitable for volatile and semi-volatile compounds. GC-MS set-up is used for identifying volatile metabolites involved in cancer.

Bioinformatics and High Performance Computing Facility

Dr. Shailza Singh
(Scientist and Facility In-charge)

Pratibha Patil
Technical Officer 'A'

The bioinformatics facility at NCCS provides access to high-performance computing resources and programming expertise. The compute infrastructure serves scientists at NCCS to master the informatics needs of their research in a proficient and cost-effective manner.

Hardware Infrastructure

SGI Altix XE 1300 Cluster

Head Node:

SGI Altix XE 270 Serve.

Dual Quad Core XEON 5620 @ 2.4GHz / 12MB cache,12GB Memory,5 x 2TB SATA Disk @ 7.2K RPM RAID 5

Compute Nodes:

SGI Altix 340 Servers

2 x HEXA Core XEON 5670 @ 2.93GHz / 12MB cache, 24GB Memory, 250GB SATA Disk @ 7.2K RPM, Dual Gigabit Ethernet Card

SGI Cluster Software Stack:

SLES Ver 11

SGI ProPack 7

SGI Foundation Software Ver 2.0

Interconnect:

24-Ports Gigabit Ethernet Switch

GPU Computing HP Proliant SI6500

2x Intel Xeon X5675 @3.06GHz/6 core/12MB L3 Cache

96 GB (8 GB x 12) PC3 – 10600 (DDR3 – 1333) Registered DIMM memory

2 x 1 TB hot Plug SATA Hard Disk @7200 rpm

Integrated Graphics ATI RN50/ES1000 with 64 MB memory

2x NIVIDIA Tesla 2090 6 GB GPU computing module

Specialized Workstations:

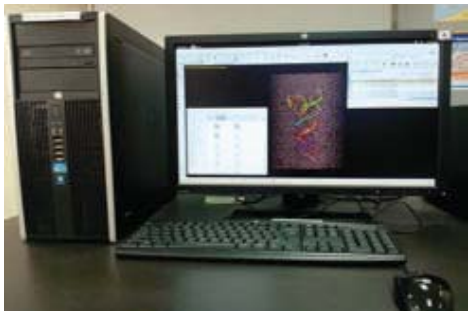
HP Elite 8200 CMT PC

Second generation Intel core i7-2600 processor 3.40 GHz, 8M cache, 4 cores/8 threads

Integrated 4 port SATA 6GBs controller

Integrated Intel HD graphics

HP Z800 High End Work Station (2 in number)

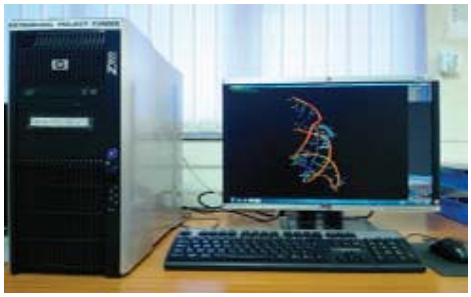


2x Intel Xeon E5649 6 core @2.53 GHz, 80 watt 12MB cache
5.86GTs QPI, DDR3 1333 MHz, HT Turbo
NVIDIA Quadro FX380 Graphics with 256MB memory
SATA 6 GBs controllers with RAID 0/105 & 10 support
19" LCD wide Display with Windows OS
HP Z820 High End Work Station
2x Intel Xeon E5-2690@2.9GHz, 8 core/20MB L3 cache
8 GTs QPI, DDR3 1600 HT Turbo 2 with vPro support
NVIDIA Quadro 4000 Graphics with 2GB DDR memory
SATA 6 GBs controllers with RAID 0/105 & 10 support
22" LCD wide Display with Windows OS

High End Desktop (4 in number)

HP workstations of Intel Core 2 Duo @3.00GHz with 8 GB of DDR2 memory, 320 GB of SATA storage and 19" LCD wide Display with Linux/Windows OS

HP Elite Desktop of Intel i7 processor, 3.4GHz with 16GB RAM, 2TB SATA storage and 21.1" LCD wide display with Windows 8.1 Professional OS.



Desktop Computers

Desktop computers with Intel core 2 duo processor @1.8Ghz to 2.8GHz with 2 GB to 4 GB of DRR2 memory, 160GB to 320GB of SATA storage with 17" wide LCD display and with Windows XP OS

iMAC: For running specialized software like Biojade

Printer: HP Laser jet M1136MFP, Canon Network Printer, HP laserjet pro 8000 color printer

APC UPS 10 KVA for supporting the HPCF

Software infrastructure

The Bioinformatics Facility at NCCS has procured several software for scientific research having commercial and/or academic license. These are:

Sequence analysis: BLAST, CLUSTAL-W, MEGA, Eisen

Molecular Modeling: Modeler

Molecular Docking: AUTODOCK, HADDOCK, ClusPro

Pharmacophore Modeling: Auto Pharmacophore generation, Receptor-ligand pharmacophore generation, 3D QSAR pharmacophore generation, Steric Refinements with excluded volumes.

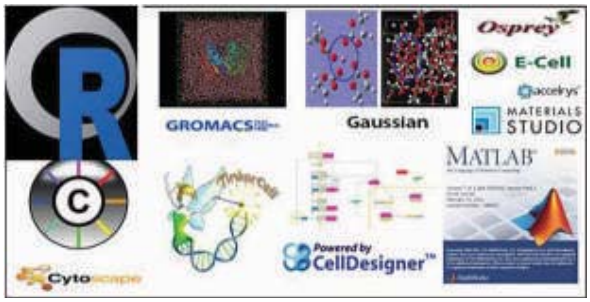
Network Modeling: CellDesigner

Toxicity Prediction: Molinspiration, DSSTox, PreADMET Toxicity Prediction

QSAR: Create Bayesian Model, Recursive Partioning Model, Multiple Linear Regression Model, partial least squares model, genetic function approximation model, 3D QSAR model. Intelligent QSAR using molecular fragments of interest and their features, evaluation of descriptors from template scaffold to form relationship with the activity.

Molecular Dynamics: CHARMM, GROMACS, NAMD, MOIL

Molecular Visualization: Rasmol, MolMol, WinCoot, Swiss PDB viewer, MolScript, VMD



ab initio modeling: GAUSSIAN

Systems Biology Tools: Virtual Cell, M-cell, Cell Designer, GEPASI, Cytoscape, Osprey, E-Cell, SimBiology

Artificial Intelligence: SVMlight and SNNS

Material Modeling and Simulation: Material Studio 5.5

Graphs and Graphics: Sigma Plot, GNU Plot, Corel Draw and Adobe PhotoShop

Statistical packages: MATLAB and R

Workshops conducted at Bioinformatics and High Performance Computing Facility:

In-house "Applications of Computational Biology" training to graduate students which helps them to develop a computational framework for gene survey of the biological sequences, which includes structure prediction, phylogenetic analyses, motif prediction, network modeling, molecular docking, protein-protein interaction, NGS Data Analysis etc. The workshop helps them to develop inferences of the biological mechanism and hypothesis for further experimental testing.

Training is being conducted regularly for the students enrolled in PhD coursework.

Dates: 3/12/20,10/12/20, 11/12/20, 17/12/20,24/12/20, 31/12/20, 2/01/21, 4/01/21, 7/01/21, 8/01/21, 09/01,21, 14/01/21, 21/01/21, 30/01/21, 04/02/21, 11/02/21, 18/02/21, 25/02/21

Online training programme for the students of PhD Coursework 2020. They involve students from ARI, NIV, NCCS and Department of Biotechnology, Microbiology and IBB from SavitriBai Phule Pune University, (SPPU). Online workshop was organised for students and faculties outside NCCS (More than 160 participants were trained).

1) Different types of structure representation and implications – PyMol, Chimera 2) Surface calculation and implications: Hydrophobic, charge representation 3) Secondary structure prediction 4) Structure based alignment 5) Binding pocket prediction – Castp; Glycosylation,

phosphorylation sites prediction 6) Modeller – homology modeling, threading 7) Energy Minimisation 8 Validation of models – Procheck, Whatif, Verify 3d 9) Auto dock VINA 10) NGS Data Analysis 11) Genome Browsers 12) AI & ML

Library

The Team

Mr. Krupasindhu Behera, *Technical Officer*

Mr. Rameshwar Nema, *Technical Officer*

The NCCS library is listed in the Union Catalogue of Biomedical Serials in India created by National Institute of Science Communication and Information Resources (NISCAIR), New Delhi.

The NCCS library has a collection of publications in frontier areas of biotechnology. The library's priority is to support the research activities of NCCS. Therefore, the collection is expanded in consultation with the NCCS faculty. The library's print collection is growing by approximately 429 volumes per year. The library holds approximately fifteen thousand one hundred seventy-eight bound journals, three thousand eight hundred nineteen books, and three hundred twenty-eight NCCS Ph.D. theses. Eight scientific journals and twenty-three other periodicals in print form were subscribed to. The staff and students are also provided access to online publications, including journals and the online book series, Methods in Enzymology, which are published by various publishers, including Springer, John Wiley, Nature Publishing group, Mary & Libert, Oxford, Elsevier Science Direct, through DeLCON, the online journal consortium of DBT. The DeLCON consortium currently subscribes 985 e-journals from twelve publishers. The library subscribes to seven additional online journals related to research areas of interest to the NCCS faculty. Furthermore, the library regularly purchases books and magazines in Hindi for general reading.

The library has the Linux-based SLIM21 library software for its housekeeping operations and Web-OPAC for online searching of the library documents. Additional facilities in the library include CD-ROMs for a number of books and a local area network providing access to the internet for PubMed search and other associated activities.

The library personnel are involved in providing library-related information for the NCCS website (English), including library holdings, services, useful links and other relevant information. During the period under review, they have created a digital archive of the Ph.D. theses submitted by the NCCS research scholars to the University, and the NCCS publications published during the said year, which are accessible through the NCCS intranet. The library has also set up an open access repository for the research publications of the NCCS faculty, which is available through the link: http://nccs.sciencecentral.in

In addition to the above, the library also provides in-house services for scanning documents using the iThenticate Anti-Plagiarism Software for scanning Ph.D. theses and publications prior to their submission to the Savitribai Phule Pune University. The library also subscribed to Grammarly to provides the staff and students of NCCS with full access to this writing assistant software.

Computer Section

Dr. Sharmila Bapat

(Scientist In-charge)

The Computer Section provides various computing and network infrastructure services and training to NCCS Staff, personnel on extra-mural grants and students. Routine support includes setup and configuration of servers, desktops, laptops, printers, scanners, software, network services and management of their maintenance.

The section is also responsible for secured network services including the design of campus wide LAN/WAN solutions, intranet solutions besides making available basic computing infrastructure required for the implementation of ongoing R&D projects. Two Internet links are installed at NCCS viz. 100Mbps (NKN) and 30Mbps (Tata Communications Ltd.). Internet facilities are extended to all institute users, visitors to Guest house and student's hostel. The present Network security system has been upgraded with latest Sophos UTM firewall CR-1500XP and Sophos Antivirus with Intercept-X for desktops and laptops to provide a cohesive secured environment.

Technical Support Services provided:

- Wired and Wireless Networking Solutions & Services to Desktops, Laptops and Mobile phones.
- Setting up temporary wifi network for Conferences, seminars and meetings.
- Providing Internet Connectivity to all Scientists, Staff and Students through NKN and Tata Links.
- Computer hardware Infrastructure Procurement, Installation, configuration and Maintenance
- Web Services include design and maintenance of NCCS and Website and its management.
- Providing User Support Services including new Desktop specifications, Software and Hardware installations, printers, scanners and other computer related devices.
- Providing E-mail Service to regular and project staff members including Scientists, Technical and Administrative Staff and Research scholars.
- Providing Technical support in Video Conferencing / SKYPE / DROPBOX / VPN access.

The Team

Mr. Rajesh Solanki *(Technical Officer and Facility In-charge)*

Mr. Shivaji Jadhav *(Technical Officer)*

Mrs. Rajashri Patwardhan *(Technical Officer)*

Mrs. Kirti Jadhav *(Technical Officer)*

- Management of Virtualised High-performance Servers for hosting services like WWW, DNS, E-mail, DHCP and Proxy.
- Network Management and maintenance of high-speed Routers, Switches and WL Access points.

New Initiatives:

1. Installation of Server -Storage for Manav Project:
   Two HP DL380G10 servers with HP 3PAR storage having 100TB capacity were installed in the Computer Server room and configured with Ubuntu 18.04 OS for MANAV project.
2. Establishment of new Data Centre
   The design layout to install a new state of the art Data Centre (DC) for NCCS was finalized. This proposed DC will provide centralized NCCS IT operations involving Computer servers and network infrastructure to store, analyse, manage and disseminate data. The DC will house the network's most critical systems that are vital to the continuity of daily operations. As a beginning, the DC will house 4 Nos. of Smart racks collocating all servers and network devices. The work contract for establishing the proposed DC has been given to CPWD, Pune.
3. Renewed Secured SSL certificate for NCCS website
   The GeoTrust SSL certificate already installed on NCCS website has been renewed for next 1 year whereby, all website visitors will have secure protected access. This not only affirms NCCS identity but also provides better search engine ranking and visibility.
4. Online Video Conferencing applications
   Due to COVID-19 pendemic, subscription of online videoconferencing applications like GoTo-Meeting and Google Meet was procured and has been utilised for organising online interviews, meetings, seminars etc.
5. LAN expansion in NCCS Staff Colony
   Due to lockdown situation, the schools and colleges were operating online so there was a need felt to provide at least a single wired Internet connection in each staff quarter. Computer Section did a survey and designed a network plan to extend the local network from new hostel to the staff quarters. A cat-6 cable connection has been provided in each quarter from the switch installed in parking basement of each block.
6. New NCCS website
   The new NCCS website development work has been awarded to a NIC empanelled company and the new website development is in final stages.
7. NCCS logo
   The work of design and development of NCCS logo was awarded to NID Ahmendabad after rigorous discussion and meetings. The logo design work is in progress.
8. Renewal of Tata Internet Connectivity
   The 30 Mbps (1:1) Internet bandwidth from TATA Communications that is being used for E-mail, DNS and browsing has been renewed for next one year i.e. 2020-21.
9. Online Meeting facility
   Computer Section has provided direct Internet connectivity in five places for conducting online Audio-video conference meetings / seminars. These places are New Board room, Lilavati, Library, Old Seminar Hall and FACS.
10. New Internet Leased Line (ILL) from BSNL
    A proposal of establishing new ILL connectivity of 100 MBPS (1:1) is in process to cater to the online meetings, seminars, interviews etc.
11. Buy-Back of old Desktop Computers
    The Old win. 7 / XP based Desktop Computers (46 Nos.) were replaced with new DELL ALL-In-One 23" Desktop PCs. These were distributed to all Scientists and HoDs.

General Assistance

Regular maintenance and up-dating of the NCCS website, intranet website and uploading tenders / corrigendum's on CPP Portal is done by the Computer Section. Several operating systems and common application software were installed / updated on user computers. These include MS Office 2010, Adobe Suite X, Sigma Plot Suite 12.0 and Reference Manager 12.0. Updation of Saral Paypack software that takes care of staff salary process which includes TDS, EPF and NPS deductions. Support is also provided in uploading notification material on the LED display screens placed across the campus.

Technical support provided

- Provide technical help in organising online interviews for Project posts, JRF posts, NCCS staff assessment, NCCS Foundation Day, etc.
- COVID-19 patients Data report uploading on ICMR, New Delhi portal in COVID-19 sample testing facility
- NGS4ALL workshop organised on 10 Dec. 2020.
- Annual IISF 2020 conference (23-25 Dec. 2020)
- National Science Day (28 Feb. 2021)

Bio-Imaging Facility

The Team

- **Dr. Arunkarthick S.** – *Scientist C & Facility In-Charge (arun@nccs.res.in)*
- Dr. Ashwini N. Atre - *Technical Officer B*
- Mrs. Trupti P. Kulkarni - *Technician C*
- Mr. Sourav Chowdhury – Technical Assistant (Operator for HCA System provided by Thermo Fisher Scientific, posted in NCCS)

At the bio-imaging facility, graduate and postdoctoral students are trained in microscope research techniques, including advanced light microscopy, confocal microscopy, digital image processing of microscope images, and related laboratory techniques. Computer image processing and analysis are taught individually. In addition, the facility offers workshops related to microscopy, including those designed to train students in modern and classical methods to prepare microscope slides. The team comprises full time staff members who, among other things, demonstrate the correct use of the instruments, train students in microscopic techniques required for cell biology research, and help with all aspects of light microscopy and computer image processing and analysis, as well as purchase the consumables and spare parts of various instruments in the facility.

Microscopes Available at NCCS Bio-Imaging Facility:

i) Leica SP5 II Confocal Microscope
ii) Olympus FLUOVIEW FV10i Confocal Microscope
iii) Olympus FLUOVIEW FV3000 Confocal Microscope
iv) Thermo Cellinsight CX7 LZR – Confocal based High Content Analysis (HCA) System
v) Zeiss LSM880 Confocal Microscope Airy Scan and ELYRA P.1
vi) Olympus SpinSR – Spinning Disk High Resolution Microscope
vii) Zeiss LSM510 META Confocal Microscope (under repair)

All the above confocal microscope systems are inverted microscopes and have a wide range of lasers. The systems can be used for doing FRET, FRAP, 3D imaging and reconstruction and live cell imaging, which are required for most cell biology research. The softwares for confocal imaging, 3D imaging and

reconstruction, time lapse, colocalization, FRET (SE & AB), FRAP are also available. These are used by in-house researchers as well as those from neighbouring organizations.

Usage of Microscopes during 2020-2021

The numbers of samples imaged during this year were approximately 5521 in-house samples, plus 56 samples received from other institutes. 20 live samples were imaged during the said year.

Activities of the Bio-Imaging Facility :

1. Training Programs (Intramural):

The Facility In-Charge organized the following training sessions for the staff and faculty of NCCS:

S. No.	Training Details	Date(s) of Training	No. of Participants
1	Olympus Spin SR microscope installation and training	02/11/2020 to 04/11/2020	2 Technicians
2	Cilika Tab Pro 2019 Microscope installation and training	29/07/2020	2 Faculty members & 3 Technicians

2. Technical Seminars :

TThe bio-imaging facility organized a technical seminar on "Introduction to Spinning disc Super resolution microscope" by Olympus India on 9th February 2021.

3. Image analysis trainings:

Training and assistance were provided to individual students for post-acquisition analysis of images and data using the ImageJ and other softwares.

4. Purchase of new Spinning Disk High Resolution Microscope:

An Olympus Spin SR - Spinning Disk High Resolution microscope was purchased and installed under the Pune BioCluster project.

Bio-imaging facility staff with the SpinSR microscope

5. Microscope for Outreach Purpose :

A small, portable tablet microscope (Cilika Tab Pro 2019) was purchased for the purpose of outreach activities. The microscope is installed in the bio-imaging facility and will be used for microscope demonstrations during intramural and extramural outreach activities.

6. Participation in Virtual Events :

Information about the bio-imaging facility & the services offered by this facility were publicized through posters displayed at the virtual NCCS booths at online events like the Indian International science festival (IISF 2020) and the Global Bio-India (GBI 2021). Staff members from this facility served as representatives at the IISF 2020, and were available to answer questions from visitors to the NCCS virtual booth.

7. COVID-19 Diagnostic Testing:

The staff members from the bio-imaging facility were involved in the activities of the COVID-19 diagnostic testing facility set up at NCCS during the said year.

FACS Facility

The Team

Dr. Arunkarthick S. – *Scientist C & Facility In-Charge (arun@nccs.res.in)*

Mr. Amit Salunkhe – *Technician C*

Mrs. Ashwini Kore – *Technician C*

Mr. Dnyaneshwar Waghmare – *Technician B*

Mr. Atul Khirwale – *Flow Cytometry Operator (provided by BD and posted in NCCS under BD-NCCS STEM CELL CoE*

Flow cytometry is a powerful tool for the multiparameter analysis of cells of all types. The flow cytometry core facility serves as a centralized resource for technical expertise and major equipment. The team from this facility supports and enhances experimental design and execution of research that requires flow cytometric cell analysis or cell sorting.

To achieve this objective, the facility offers the following services:

- Expert consultation is provided through the Facility In-Charge & technical specialists
- FACS instruments are selected for complementary functions.
- Equipment use is accessible through dedicated technicians.
- Assistance with data analysis can be customized to the needs of individual investigators and research projects.

The facility team is also involved in the purchase of spare parts like lasers for the instruments, consumables, etc., to ensure the smooth functioning of the FACS facility.

Instruments Available in the FACS Core Facility :

There are six flow cytometer machines purchased from Becton Dickinson (BD) available in the FACS core facility. These are operated on a rotation basis by three dedicated operators. Of the six flow cytometers, three are analyzers and three are sorters. The FACS facility has introduced internal user charges from 15th September 2020. The charges are rupees 150 per hour for use of the analyzer, and rupees 300 per hour for use of the sorter.

Benchtop Analyzers:

1) FACS Calibur: 2 Lasers, 4Colours. 2b-2r (Blue 488 nm, Red 633 nm)

2) FACS Canto II (Old): 3 Lasers, 8 Colours. 4b-2r-2v (Blue 488 nm, Red 633 nm, Violet 405 nm)

3) FACS Canto II (New): 3 Lasers, 8 Colours. 4b-2r-2v (Blue 488 nm, Red 633 nm, Violet 405 nm)

Cell Sorters:

1) 1) ARIA II SORP: 4 Lasers, 11 Colours. 5b-2r-2v-2uv. (Blue 488 nm, Red 640 nm, Violet 405 nm, UV 355 nm)

2) ARIA III SORP: 5 Lasers, 16 Colours. 3b-2r-4v-3uv-4yg. (Blue 488 nm, Red 640 nm, Violet 405 nm, UV 355 nm, Yellow Green 561 nm)

3) ARIA III STD: 5 Lasers, 11 Colours. 3b-2r-4yg-2 violet/yg.(Blue 488 nm, Red 633 nm, Violet 405 nm / UV 375 nm, Yellow Green 561 nm)

Bd™ Cytometer Setup and Tracking (CS&T) beads, Rainbow QC and BD FACS Accudrop beads used for quality control check.

The usage of the six instruments for the period under consideration is summarized below:

Immunophenotyping & Cell Cycle Analysis:

Equipment	Surface / Intrace-llular staining	DNA Cell cycle	CBA flex	CBA	After Office Hrs.	Total Samples Acquired
FACS Calibur	227	575	–	–	39	841
FACS Canto II (Old)	2840	–	–	47	3293	6180
FACS Canto II (New)	4100	65	–	20	–	4185

STERILE SORTING:

EQUIPMENT	SORTING	ACQUISITION **
FACS Aria II SORP	47	84
FACS Aria III SORP	131	656
FACS Aria III Standard	84	319

** Includes analysis of samples that require UV laser, as we do not have UV analyzers.

Samples from outside users:

In the light of the increase in workload from outsiders' samples, NCCS has been following the policy of charging external users since June 2012. The charges are less for academic and research institutes, and higher for private companies. Researchers from institutes like ARI in Pune utilized our facility during the year under review. The facility acquired around 41 samples for surface/intracellular staining and DNA cell cycle analysis.

Other Central Facility Instruments available in the FACS Core Facility:

1) Bio-Plex 200 System from Bio-Rad

The Bio-Plex® 200 system is a suspension array system which offers researchers working with protein and nucleic acids a reliable multiplex assay solution that permits analysis of up to 100 biomolecules in a single sample.

2) Droplet Digital PCR Systems from Bio-Rad

Digital PCR is a breakthrough technology that provides ultrasensitive and absolute nucleic acid quantification. It is particularly useful for low-abundance targets, targets in complex backgrounds, allelic variants (SNPs), and for monitoring subtle changes in target levels that cannot be detected with real-time PCR.

Activities of FACS core facility :

1. The following training sessions were organized in batches during this year

Training Details	Date(s) of Training	No. of Participants
FCS Express7 Software online Demo (Part -I)	15-10-2020	45
Full Spectrum Flow Cytometry Webinar	20-10-2020	20
FCS Express7 Software online Demo (Part -II)	26-10-2020	26
FCS Express7 Software online Demo (Part -III)	17-11-2020	21

2. Participation in Virtual Events :

Information about the FACS facility & the services offered by this facility were publicized through posters displayed at the virtual NCCS booths at online events like the Indian International science festival (IISF 2020) and the Global Bio-India (GBI 2021). Staff members from this facility served as representatives at the IISF 2020, and were available to answer questions from visitors to the NCCS virtual booth.

3. COVID-19 Diagnostic Testing :

The staff members from the FACS facility were involved in the activities of the COVID-19 diagnostic testing facility set up at NCCS during the said year.

Other Facilities

1) Protein crystallization and X-ray diffraction facility

The Team

Dr. Radha Chauhan

Dr. Janesh Kumar

Description

A new state of the art X-ray diffraction facility for single crystals was setup in July 2018. This facility is equipped with Rigaku FRX generator with HyPix 600 detector and Oxford cryojet cooling system. This facility is also capable of screening crystals directly from crystallization plates. Additionally, a sophisticated protein crystallization facility is being setup with capabilities of protein crystallization at different temperature, robotic crystallization of proteins including membrane proteins, stereomicroscope for visualization and various tools for freezing protein crystals in liquid nitrogen for either in house X-ray diffraction data collection or at synchrotron.

2) DNA sequencing facility

The Team

Dr. Yogesh Shouche (Scientist and Facility In-charge)

Dr. Kamlesh Jangid *(Scientist In-Charge, NCMR)*

Dr. Sarang Satoor *(Technical Officer)*

Mr. Vikas Patil *(Technician)*

Ms. Shaima Rifaie *(Technician)*

The central sequencing facility of NCCS is located at the National Centre for Microbial Resource (NCMR) and houses two Sanger-based instruments from Applied Biosystems (3730 and 3730xl), along with all sequence and data analysis software. The facility offers services related to sequencing of plasmids, PCR products and cloned inserts; primer walking; and genotyping and fragment analysis, to researchers from NCCS and other organizations. This facility caters to the needs of research institutions and industrial clients across the country, for the identification of bacterial and fungal isolates. In addition, the facility serves as the back-bone of culture authentication and identification for NCMR's preservation activities.

Over the year 2020-21, a total of 21649 sequencing reactions were run on the machine. The facility provided support to the internal institutional research

activity by delivering 20221 sequencing reactions. 357 services against payment were provided to 88 different academic and research institutions from 18 states across the country. Bacterial identification using 16S rRNA gene sequencing and fungal identification using the ITS region sequence were mainly performed. For the identification of bioprospection cultures stored in the biobank at NCMR, 10455 cultures were processed. Also, 1260 cultures were validated for various deposits in the culture collection during this year.

a) Name of the machine: ABI 3730XL DNA Analyzer.
b) Number of 96-well plates run on the machine during the said period: 230.
c) Number of sample reactions run on the machine during the said period: 21649.
d) No. of in-house users: 26
e) No. of extramural users benefited: 88 different institutions/universities from 18 states (Assam, Bihar, Haryana, Himachal, Gujarat, Rajasthan, Jammu & Kashmir, Karnataka, Kerala, Maharashtra, M.P., Punjab, Sikkim, Tamil Nadu, Tripura, U.P., Uttarakhand and West Bengal).

3) Surface Plasmon Resonance Facility (SPR) Facility

The Team

Dr. Arunkarthick S. - *Scientist and Facility In-Charge (arun@nccs.res.in)*

Ms. Mary Beulaa Jayapragasam - *Operator provided by Cytiva, (formerly GE Healthcare Life Sciences) and posted at NCCS from June 2019 (Ph: +91-20-25708290, Email: beulaanccs@gmail.com)*

Name of the Instrument: Biacore T200 (Installed on 04 June, 2019)

A versatile system for high quality characterization of molecular interactions ranging from ions to viruses in real time using label-free detection based on the phenomenon of surface plasmon resonance (SPR). Capable of reliable ligand-binding assays, even for the most complex biologics.

The SPR facility offers these services:

- Expert consultation and service by technical specialists.
- Assistance with Biacore T200 software for reliable kinetic analysis.
- Conducts regular training programs to develop skilled manpower.

Biacore T200 usage during the period under review:

Pi's Name	No Of Samples	Chips Used	Total Number Of Hours Used
Dr. Shekhar Mande	13	NTA-1	249h 58min
Dr. Radha Chauhan	3	NTA-1	17h 3min
Dr. Vasudevan Seshadri	1	CAP-1	3h 51min
Dr. Shailza Singh	3	NTA-1 & CM5-1	127h 7min
Dr. Janesh Kumar	6	L1 -1	89h 25min
Total	**26**		**487h 24min**

Training imparted during the period under review (Intramural)

Training Details	Date(s) of Training	No. of Participants
SPR training and examination (with the chip CM5-FC 1,2)	17 to 19 February 2021 (3 Days)	* Faculty: 1 * Ph.D. Scholars: 6 * Postdoctoral Fellows: 3

Trainees who received the SPR training

Other activities:

Participation in Virtual Events

Information about the SPR facility & the services offered by this facility were publicized through posters displayed at the virtual NCCS booths at online events like the Indian International science festival (IISF 2020) and the Global Bio-India (GBI 2021).

NCCS Centre of Excellence: National Centre for Microbial Resources (NCMR)

Dr. Yogesh Shouche

yogesh@nccs.res.in

The Team

Milind Patole, *Scientific Consultant*
Kamlesh Jangid, *Scientist D*
Om Prakash, *Scientist D*
Amaraja Joshi, *Scientist C*
Amit Yadav, *Scientist C*
Neetha Joseph, *Scientist C*
Praveen Rahi, *Scientist C*
Rohit Sharma, *Scientist C*
Aehtesham Hussain, *Scientist B*
Dhiraj Paul, *Scientist B*
Kranti Karande, *Scientist B*
Mahesh Chavadar, *Scientist B*
Tushar Lodha, *Scientist B*
Lucky Thakkar, *Technical Officer A*
Sonal Chavan, *Technical Officer A*
Mahesh Sonawane, *Technician C*
Nikeeta Chavan, *Technician C*
Sonia Thite, *Technician C*
Swapnil Kajale, *Technician C*
Yogesh Nimonkar, *Technician C*
Aabeejjeet Pansare, *Technician B*
Ajay Paul, *Technician B*
Archana Suradkar, *Technician B*
Kunal Jani, *Technician B*
Madhuri Vankudre, *Technician B*
Mitesh Khairnar, *Technician B*
Prachi Karodi, *Technician B*
Shalilesh Mantri, *Technician B*
Shraddha Vajjhala, *Technician B*
Tushar Ghole, *Technician B*
Umera Patawekar, *Technician B*
Vikas Patil, *Technician B*
Vikram Mohite, *Technician B*
Vipool Thorat, *Technician B*
Mahesh Gudade, *Technical Assistant*
Yogesh Kalbhor, *Officer A*
Aniruddha Sarode, *Office Assistant*
Madhavi Bhosale, *Office Assistant*
Mangal Waydande, *Office Assistant*
Pratibha Wagh, *Office Assistant*
Sachin Pawar, *Office Assistant*
Suhas Bharekar, *Office Assistant*
Vishal Paygude, *Office Assistant*
Kiran Gaikwad, *Lab Helper*
Laxman Kadam, *Lab Helper*
Mangesh Gawande, *Lab Helper*
Santosh Bhise, *Lab Helper*
Devika Jadhav, *JRF*
Krishna Kumar Yadav, *JRF*

Objectives

- The Complete characterization of the existing collection of 1.8 lakh isolates so as to increase their utility for investigators.
- To develop an infrastructure to facilitate services of the highest standard, such as the supply of authentic microbial cultures, identification of microorganisms, a deposit of microorganisms, their long-term protection and other related areas.
- To serve as a repository of meta-omics libraries and to develop and maintain a database of information about the not yet cultured organisms generated from high throughput meta-omics studies.
- To serve as International Depositary Authority for deposit of Microorganisms under the Budapest Treaty for protection of intellectual property rights.
- To serve as Designated National Repository under the Biological Diversity Act 2002 of India.
- Stimulation of deposit of strains subject to publication and research in India to protect national investments.
- To become a global leader in the collection of microbial resource, its maintenance and ex situ conservation including patent cultures and thus safeguarding the enormous microbial diversity ofour nation.
- Networking to increase the range of resources and expertise available to Indian researchers.
- To develop quality manpower with creative abilities in microbiology/ microbial biotechnology/ technology management by providing both long and short-term training courses and workshops involving experts from across the globe.
- To undertake research in the relevant areas of microbial ecology and systematics so as to strengthen the services.

Summary

This rich collection of microbes at NCMR is represented by ~250 microbial taxa harboring an array of activities of human, industrial, environmental and ecological importance. Of these, Acinetobacter, Aeromonas, Arthrobacter, Bacillus, Burkholderia, Enterobacter, Klebsiella, Ochrobactrum, Pseudomonas and Stenotrophomonas represent the 10 most abundant taxa with numerous applications known so far (Fig.1). NCMR holds more than 5,900 authentic and

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Vaibhavi Dhure, *JRF*
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Prof. Rup Lal TERI, *New Delhi*
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well characterized microbial strains (wild types, mutants, type strains, genetically modified and engineered and patented) that can be supplied to researchers in academia and industry without any restrictions. NCMR is actively supplying these cultures all over India and abroad. Additionally, NCMR holds IDA and Safe deposit cultures. Also, through in-house screening, more than 1900 fungal cultures have been screened for production enzymes, such as laccase, cellulase, amylase and pectinase. Out of these, 150 were found positive for laccase, 163 were positive for pectinase, 168 were positive for amylase and 68 were positive for cellulase enzymes.

Over the last year, NCMR has enriched its collection by ~1300 cultures received as general deposits. This year; NCMR has launched a new service of Detection and Diagnostic of Phytoplasma. The detection of Phytoplasma-related diseases is difficult due to the lack of disease symptoms in the early stages of plant life cycle resulting in significant yield loss later. This service will be helpful for researchers mainly in agriculture field. To save the valuable enriched microbial community from loss and to make them available for future generatuion, NCMR has initiated the facility for deposition of intact microbiome, aerobic and anaerobic enrichment culture in its biobank.

Over the last year, 35 peer-reviewed publications have been published from NCMR. Of these, six were novel taxa descriptions. One of the novel taxa published is the first description of phytoplasma species from India. Sugarcane phytoplasma is now termed as '*Candidatus* Phytoplasma Sacchari'. A novel bacteria *Pseudomonas lalkuanensis* sp. Nov., MCC 3792^{T} was isolated from a bacterial consortia of contaminated soil enriched for the remediation of e-waste. Four other novel bacteria were named as *Rhizobium indicum* sp. Nov., MCC 3961^{T} isolated from root nodules of pea, *Klebsiella indica* sp. Nov., MCC 2901^{T} isolated from the surface of a tomato *Nostoc neudorfence* sp. Nov., ARC8 (Fig. 2) isolated from river water and *Savagea serpentis* sp. Nov., SN6^{T}.

Figures

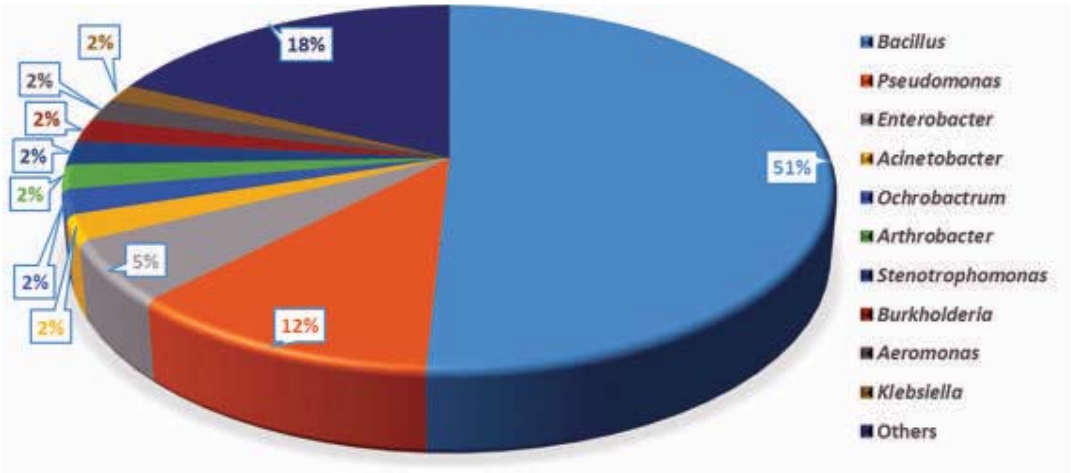


Fig. 1: Ten most abundant microbial taxa preserved and available at NCMR for further exploitation.

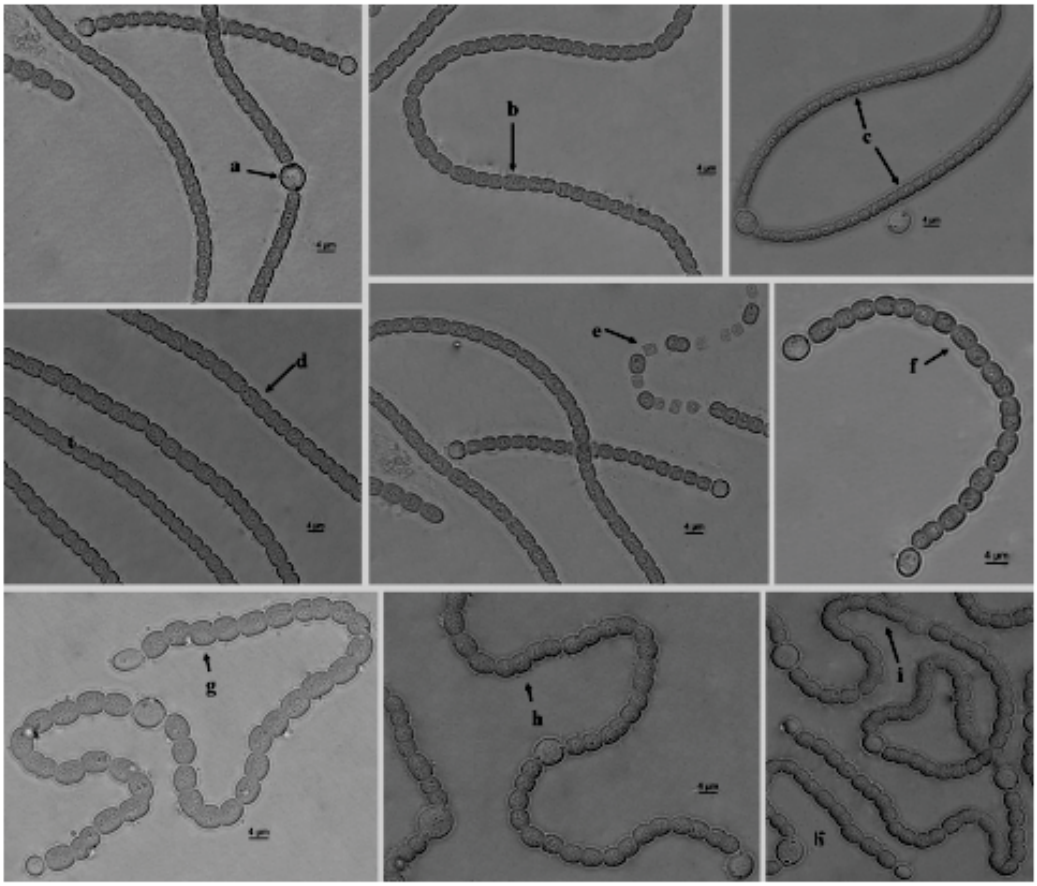
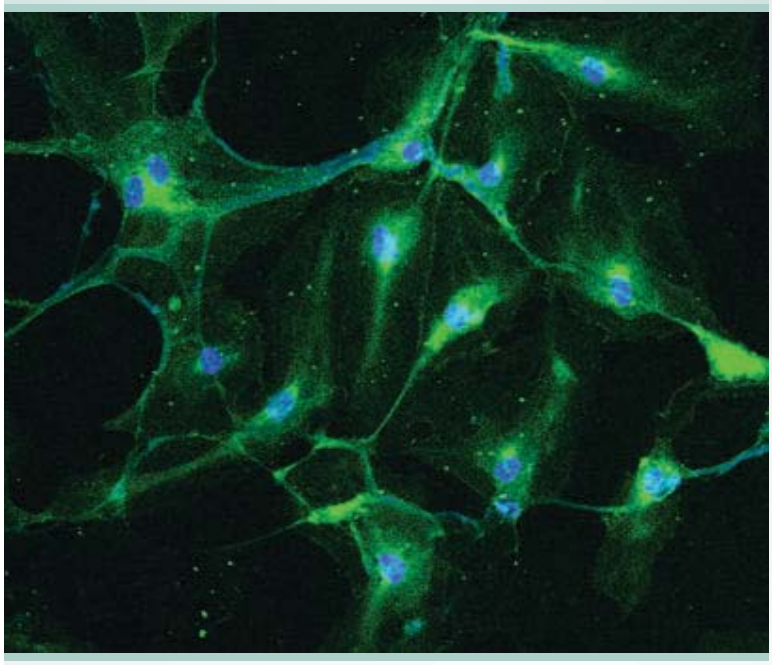


Fig. 2: Morphological characters of the laboratory-grown culture of *Nostoc neudorfense* ARC8.



COVID-19 Related Initiatives

Contributions of NCCS Towards the National Efforts Against COVID-19

In 2020, when the entire world faced an unprecedented crisis thrown up by COVID-19, NCCS rose to the challenge and shared its infrastructure and expertise to facilitate the national efforts to tackle the pandemic. The multiple activities undertaken are summarized below.

1] Contributing to COVID surveillance by serving as a diagnostic centre :

NCCS began testing samples for SARS-CoV-2, with approval from the DBT, ICMR and the State Government, on 25 April, 2020, when very few testing laboratories were available in Maharashtra, the worst-hit state at the time. This was preceded by extensive preparation, including setting up of a diagnostic facility on a war footing, with appropriate infrastructure, PPE, consumables and other materials, formulation and validation of an SoP, and registration with the appropriate authorities, as required. The NCCS diagnostics team was also given training by ICMR-NIV: Fifteen members (8 technical staff and 7 scientists) received COVID-related biosafety training, & ten members (8 technical staff and 2 scientists) received training for COVID testing. As an ICMR-approved COVID-diagnostic centre, NCCS tested over 26600 samples from Pune and the surrounding areas in Maharashtra, using RT-PCR during the period under report.

10000 samples were tested within the first 10 weeks with efficient teamwork

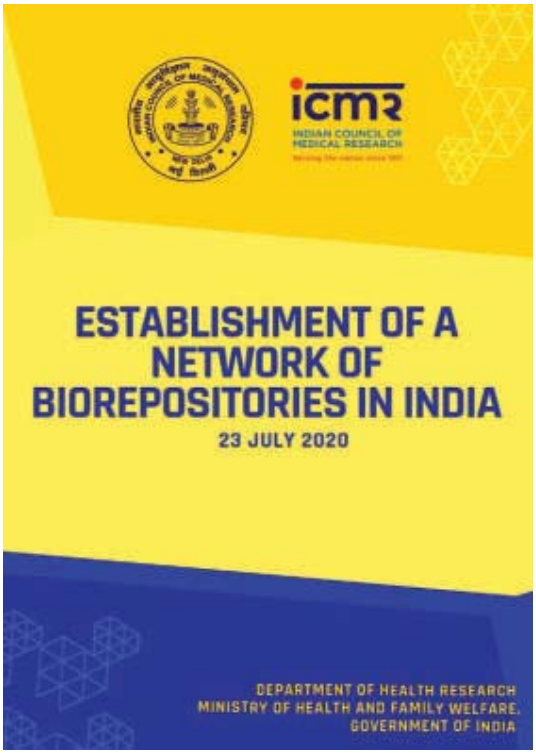
2] Services provided by the NCCS national cell repository to facilitate COVID-19 research in India:

a) Cell cultures were provided to facilitate COVID-related research:

The national cell repository at DBT-NCCS has been playing a pivotal role in facilitating COVID research in India, by supplying cell cultures required for this purpose. 28 cell cultures were supplied to 15 organizations in India, which includes national research organizations, a medical college, a university and the industry

b) Biorepository for COVID bioresources:

- The national cell repository of DBT-NCCS set up a biobank of peripheral blood mononuclear Cells (PBMCs) and plasma from SARS-CoV-2 infected and convalescent patients to serve as a repository of these valuable bioresources to be used for research.
- NCCS was recognized as an ICMR-approved bio-repository, and was included among the 17 institutes listed in the document titled, 'Establishment of a network of biorepositories in India', published by the ICMR.
- 127 samples obtained in association with the B.J. Medical College and the Armed Forces Medical College (AFMC), Pune, have been preserved at NCCS so far.
- 4 projects from within and outside NCCS were reviewed and approved by the Access Control Committee (ACC), for sharing the biorepository resources. 124 samples were shared with internal and external researchers.



3] SARS-CoV-2 viral genome sequencing from clinical samples

a) NCCS participated in DBT's pan-India initiative to sequence 1000 viral genomes, aimed at understanding the genetic variations of the SARS-CoV-2 virus across the country. NCCS submitted 180 sequences from COVID-positive patients from Maharashtra to this initiative as well as the GISAID database. Analysis of the genome sequences revealed a newly emerging pattern of unique linked mutations in the genome sequences from western India, suggesting that region-specific evolution of the virus genome might have occurred during the lockdown period.

The insights gained into the genomic sequences of the viral strains from western India, & collated findings of the pan-India 1000 genome sequencing initiative, which have yielded valuable information about the virus strains prevalent in different parts of the country, were made available as pre-prints of research articles on bioRxiv:

https://www.biorxiv.org/content/10.1101/2020.07.30.228460v2

https://www.biorxiv.org/content/10.1101/2020.08.03.233718v1

b) NCCS is one of the laboratories participating in the nationwide consortium to sequence the coronavirus genome, the Indian SARS-CoV-2 Genomics Consortium (INSACOG). Sequence data for 562 samples from Maharashtra, Goa, Gujarat, Kerala and Karnataka were submitted to the consortium, including those from international travelers, UK returnees, surveillance (5 % of the positive) samples, and samples from the Akola, Yawatmal and Pune regions that had shown a spike in COVID cases. This initiative is ongoing.

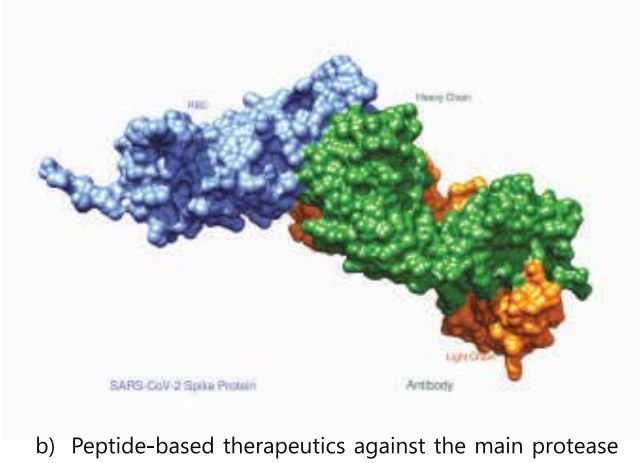
4] Research Initiatives

Several research activities were initiated, aimed at facilitating the development of COVID-19 vaccines & diagnostics in the long run.

a) Generation of virus-neutralizing human monoclonal antibodies against the SARS-CoV-2 virus as a potential therapeutic strategy to contain the COVID-19 pandemic.:

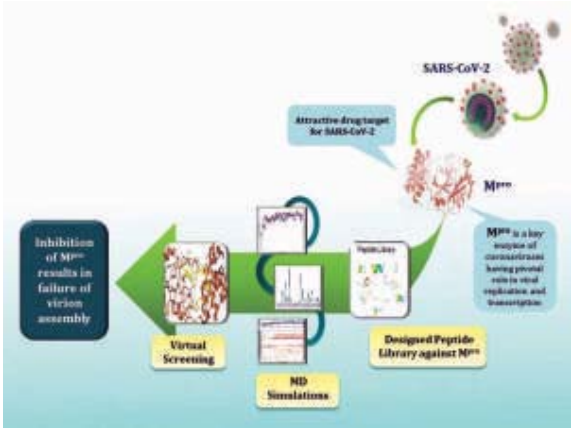
- This CSIR-NMITLI funded project of NCCS was initiated in partnership with IIT Indore, PredOmix Technologies Pvt. Ltd., Bharat Biotech International Ltd. (BBIL) & the Armed Forces Medical College (AFMC), Pune.
- Serum samples from patients were screened for the presence of receptor-binding domain (RBD)-specific antibodies. B cells from patients who were positive for RBD-specific antibodies were grown in the laboratory.

- Novel clones secreting human monoclonal antibodies (mAbs) against SARS-CoV2 were generated. Some of these novel clones were transferred to BBIL for testing and further development.
- A provisional patent application for the sequences of the novel mAb-secreting clones that showed specific binding to the SARS-CoV2 receptor-binding domain (RBD) was filed in India.
- Supernatents from the human mAb clones generated against SARS-Cov2 were transferred to Bharat Biotech International Limited (BBIL) to test for virus neutralization.
- This project is ongoing and for further studies.



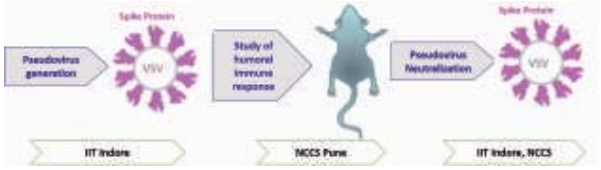
b) **Peptide-based therapeutics against the main protease of SARS-CoV-2** (Mpro) using machine learning (proof of concept for therapeutic peptides)

- A proof-of-concept synthetic peptide-based therapeutic approach, and a peptide-based approach for antibody generation were explored.
- Machine learning algorithms were used to select diverse viral sequences of COVID-19 reported from different countries.
- Using these sequences, peptides with therapeutic potential to target the Mpro protein of the COVID-causing virus were identified, to be subsequently tested by an industry partner. Simulation studies suggested that the peptides are stable.
- A paper based on outcomes of this research were published in BBA Molecular Basis of Disease.



c) **Production of pseudotyped SARS-CoV-2 using a vesicular stomatitis virus (VSV) platform for candidate vaccine development and biomedical research use -** Proof of concept for vaccine candidate. (BIRAC-funded project by IIT-Indore, in collaboration with DBT-NCCS)

- SARS-CoV-2 pseudovirus was generated at IIT-Indore using two strategies, and tested for neutralization with patient sera. Pseudovirus production was established.
- Immune response studies in animal models were done at NCCS, to test in vivo efficacy of antibody response and pseudovirus neutralization. Mice were immunized with the pseudovirus and their antibody response was tested. This was followed by a booster dose, which was found to induce a potent IgG response. IgM and IgA antibodies were also induced.



d) **Development of nanobodies as prophylactic and therapeutic candidates against SARS-CoV-2 virus** - (DST SERB-funded project):

Screening of high-affinity nanobodies (Nbs) against SARS-CoV-2 proteins from the synthetic yeast surface display library and their characterization was initiated. These nanobodies could potentially be used as neutralizing agents for SARS-COV-2 virus. This project is ongoing.

e) **Nasal microbiome of SARS-CoV-2 infected and uninfected individuals.**

Studies were initiated to understand the differences between the nasal microbiome of SARS-CoV-2 infected and uninfected individuals. This project is ongoing.

f) **Generation of SARS-CoV-2-specific IgA to protect lungs / mucosal surfaces :**

Preliminary explorations towards identifying a potential vaccine candidate were initiated. Antigenic peptides were designed & used to immunize mice. A preliminary assessment of their immune response by ELISA showed a strong IgG signal against Antigen-2, which needs to be verified.

g) **Kit development to facilitate diagnostics :**

A magnetic beads-based viral RNA isolation kit was developed, and in-house testing & validation were done.

5] Major outcomes of COVID-related initiatives :

INDUSTRY COLLABORATIONS

Monoclonal antibodies (mAb)-secreting clones that showed specific binding to the SARS-CoV2 receptor-binding domain (RBD) (NC-1H, NC-1L, NC-2H and NC-2L) were transferred to Bharat Biotech, as a part of the collaborative project funded by CSIR-NMITLI, for further testing and development.

PATENT FILED

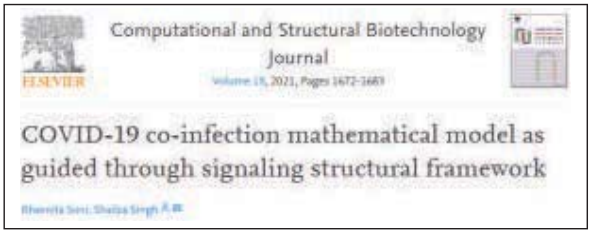
Title: SARS-COV-2 Neutralization Antibody and its Application Thereof

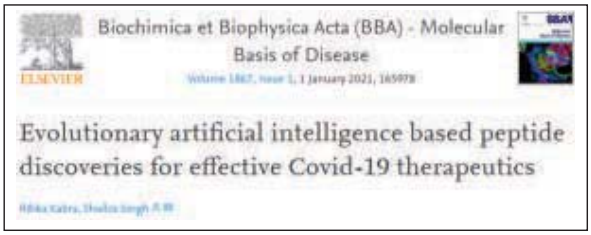
Applicants: NCCS, IIT-Indore, PredOmix Technologies Pvt. Ltd.

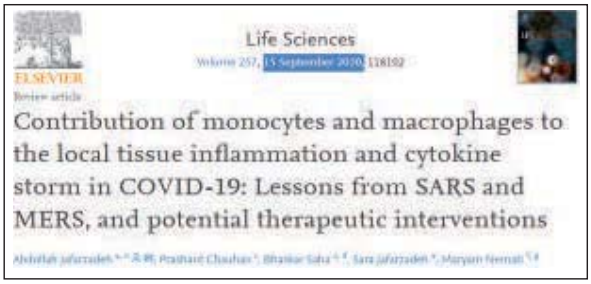
Patent Application No.: 202021044304
Date of filing: 12.10.2020 Filed in: India

PUBLICATIONS

(with NCCS scientists as lead authors or coauthors)







6] Vaccine testing facility

NCCS was entrusted with the responsibility of establishing a COVID-19 Vaccine Testing Laboratory by the Government of India, to function as a Central Drug Laboratory (CDL) for testing COVID-19 vaccines. With support from the PM CARES Trust Fund, & under the guidance of the Secretary, Department of Biotechnology, the Central Drugs Standard Control Organisation (CDSCO), and CDL-Kasauli, this activity was initiated during the FY 2020-21.

7] Outreach

NCCS engaged in various oureach activities through the year under review to help spread awareness, dispel myths and answer questions about diverse aspects of COVID-19. These are listed under the "Outreach" section of the annual report.

8] Participation in the "Jan Andolan for COVID-19 Appropriate Behaviour" campaign

The NCCS family took a pledge to take all necessary precautions & #Unite2FightCorona

Banners in Marathi, Hindi & English were displayed at the entrance and across the campus to remind people about the precautions to be taken.

9] News articles on the COVID initiatives at NCCS

a) Indian Express, 12 June, 2020:

https://indianexpress.com/article/cities/pune/biobank-of-blood-cells-plasma-from-covid-patients-to-be-set-up-at-nccs-6454448/

b) Punekar News, 12 June, 2020:

https://www.punekarnews.in/pune-national-centre-for-cell-science-nccs-facilitates-the-ongoing-efforts-against-covid-19/

c) Maharashtra Times & Loksatta, 02 August 2020.

d) The Indian Express, Hindustan Times & Punekar News, 04 August 2020.

e) The Times of India, 26 August 2020.

f) BBC News Marathi:
https://www.youtube.com/watch?v=iJW6pCP2LHI&feature=youtu.be

10] Precautionary measures at NCCS against COVID-19

Several measures were undertaken at NCCS to prevent COVID-19 on the campus -

- Whenever appropriate, work from home was practiced as per the norms laid down by the Government authorities.
- Employees were encouraged to stay at home if feeling unwell, and inform the administration immediately in the event of testing positive for COVID-19. Contact tracing was followed on campus.
- Posters and banners strategically placed at the entrance and at various locations across the campus remind people to follow appropriate preventive measures at all times.
- Mandatory use of masks & physical distancing were followed on campus.
- Frequent hand-washing were encouraged, especially following contact with frequently touched surfaces such as door handles, elevator buttons, etc.
- Foot-operated taps were installed in washrooms.
- The COVID-19 diagnostic laboratories were set up and operated according to ICMR guidelines.

Disinfecting vehicles prior to entering the NCCS campus

The practice of checking the temperature of employees, students and visitors at the entrance was diligently followed

Foot-operated & automated sanitizer dispensers were installed at various key locations

Frequent cleaning and sanitization of surfaces was done

Entry and access to the COVID testing areas were restricted to trained personnel.

Appropriate precautionary measures were followed by the teams handling COVID samples.

Dustbins were provided at multiple locations to dispose masks, gloves, etc.

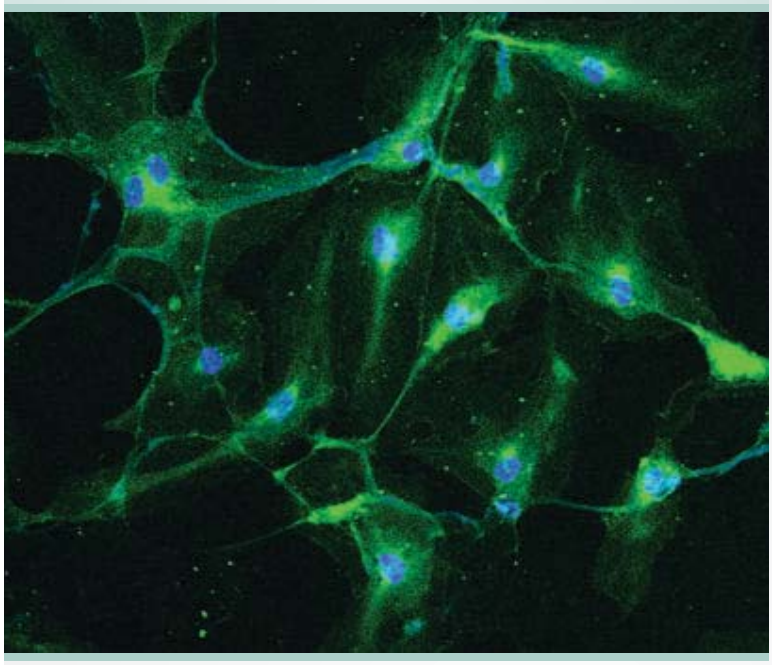
Waste generated was appropriately disposed using protocols for biohazardous waste.


CORONAVIRUS
Virus in Maharashtra shows distin
mutations, not found in virus
from other parts: Study by NCCS


पुण्यात आढळणारा विषाणू वैशिष्ट्यपूर्ण


'एनसीसीएस'चे यश

NCCS COVID-19 Related Initiatives featured in the news



Other Information

Publications & Patents

Publications

Research Articles

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1. Dhanasekaran D, Paul D, Amaresan N, Sankaranarayanan A, Shouche YS. Microbiome-Host Interactions. 2021. CRC Press.
2. Kabra R, Singh S. Chapter One - Transporter proteins and its implication in human diseases. Protein Kinases in Drug Discovery. Advances in Protein Chemistry and Structural Biology. Volume 124, 2021, Pages 1-21.
3. Misra P, Singh S. (2020). Vaccine Design, Nanoparticle Vaccines and Biomaterial Applications. In: Systems and Synthetic Immunology. Springer, 25 April 2020, pp 1-52.
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Patents

Patent Applications Filed / Granted

Sr.No.	Title	Inventors	Applicant	PCT/ Country	Patent No. (Filed)	Date of Filing / Grant
1	A Novel Anti- Cancer Combination	Athavale, Dipti Anil & Bhat, Manoj Kumar	NCCS	India	20202105307	07.04.2020 (Filed)
2	DAF-MCP chimeric protein, process to manufacture the same and use of the chimeric protein for treating pathological conditions involving the complement system	Arvind Sahu; Hina Ojha; Payel Ghosh; Sagar Barage & Hemendra Singh Panwar	NCCS	PCT (India)	PCT/IN2020/050337	09.04.2020 (Filed)
3	Chimeric transcripts and peptides as method of diagnosis and prognosis of high-grade serous ovarian cancer	Sharmila Bapat	NCCS	India	202021023346	03.06.2020 (Filed)
4	A novel chimeric protein kinase C as an immunomodulator.	Shailza Singh; Dipali Kosey & Milsee Mol	NCCS	Brazil	BR 11 2020016654-5	14.08.2020 (Filed)
5	SARS-COV-2 Neutralization Antibody and its Application Thereof	Akansha Chaturvedi; Radha Chauhan; Arvind Sahu; Kanury Rao & Debashish Nayak	NCCS	India	202021044304	12.10.2020 (Filed)
6	Antiviral drug compounds and composition thereof	Debashis Mitra & Jay Trivedi	NCCS	USA	17/055,321	13.11.2020 (Filed)
7	Antiviral drug compounds and composition thereof	Debashis Mitra & Jay Trivedi	NCCS	India	202017052930	04.12.2020 (Filed)
8	Antiviral drug compounds and composition thereof	Debashis Mitra & Jay Trivedi	NCCS	Europe	19803404.3	15.12.2020 (Filed)
9	A novel anti-cancer combination and a method of therapy using the combination	Padma Shastry	NCCS	India	202117007583	23.02.2021 (Filed)

Patent Applications Filed / Granted

Sr.No.	Title	Inventors	Applicant	PCT/ Country	Patent No. (Filed)	Date of Filing / Grant
10	A novel anti-cancer combination and a method of therapy using the combination	Padma Shastry	NCCS	USA	17/273,642	04.03.2021 (Filed)
11	A novel anti-cancer combination and a method of therapy using the combination	Padma Shastry	NCCS	Europe	19857142.4	26.03.2021 (Filed)
12	Identification, quantification, monitoring and analysis of intra-tumor heterogeneity	Sharmila Bapat & Rutika Naik	NCCS I	ndia	358225	10.02.2021 (Granted)
13	Novel Quinolizine Based Anti-Leishmanial Compounds	Shailza Singh & Nutan Chauhan	NCCS	India	201921054193	28.12.2020 (Complete application filed)
14	A nanohybrid, its method of preparation and use	NCCS: Gopal C. Kundu; Sumit Das; Amit Yadav & Mahadeo Gorain IITB: Rohit Srivastava; Rajendra Prasad; Janahvi Devrukhar; Barkha Singh & Deepak Singh Chauhan	NCCS & IIT Bombay	India	201921020693	23.05.2020 (Complete application filed)
15	Novel peptides combination for its use in leishmaniasis	Shailza Singh	NCCS	India	201921043619	26.10.2020 (Complete application filed)

Technologies

- A license agreement for a cell line (stable clone CHO-HIRc-mycGLUT4eGFP) generated at NCCS was signed by NCCS with Applied Biological Materials, Inc., Canada, on 22nd March 2021. This was facilitated by Techex.in, the Technology Transfer Hub at Venture Center supported by the National Biopharma Mission (Govt of India), implemented by the Biotechnology Industry Research Assistance Council (BIRAC) of the Department of Biotechnology (DBT).

- Monoclonal antibodies (mAb)-secreting clones that showed specific binding to the SARS-CoV2 receptor-binding domain (RBD) (NC-1H, NC-1L, NC-2H and NC-2L) were transferred to Bharat Biotech, as a part of the collaborative project funded by CSIR-NMITLI, for further testing and development.

Extramural Funding

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty & Other Early-Career Scientists

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
1	Dr. Sharmila Bapat	Development of a predictive algorithm for precision medicine in ovarian Cancer	07.07.2017	06.07.2020 Extended up to 31.03.2022	Nil	DBT	India
2	Dr. Bhaskar Saha	JC BOSE Fellowship	06.11.2018	05.11.2023	Nil	SERB	India
3	Dr. Deepa Subramanyam	Dissecting the individual roles of Clta and Cltb in early mammalian development through selective CRISPR - Cas9-based knockout and knockin models	27.03.2018	26.03.2021 Extended up to 26.03.2022	Nil	DBT	India
4	Dr. Gaurav Das	Neurobiology of food choice driven by nutrient specific memories and diet.	13.02.2018	12.02.2023	Nil	SERB	India
5	Dr. Jyoti Singh	Understanding the role of RNAi - mediated antiviral host defense against DNA Viruses.	01.01.2018	31.12.2023	Dr. V. Sivaprasad CSRTI, Mysore	DBT/ Wellcome Trust India Alliance	India
6	Dr. Lalita Limaye (Honorary Scientist)	Molecular analyses of extra-cellular vesicles isolated from bone marrow-derived mesenchymal stromal cells treated with specific signaling modifiers and assessment of their effects on the fate of hematopoietic stem cells	26.03.2018	25.03.2021 Extended upto 25.03.2022	Dr. Anuradha Vaidya & Dr. Swagata Roy Biotechnology, Symbiosis School of Biomedical Sciences, Pune (MH)	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
7	Dr. Janesh Kumar	Centre of Excellence in Biomolecular Structure and Function on Host-Pathogens Interactions.	28.12.2016	27.12.2021	Dr. Sharmistha Banerjee, Dr. Krishnaveni Mishra Department of Biochemistry, University of Hyderabad, Hyderabad, Telangana	DBT	India
8	Dr. Manoj Kumar Bhat	Establishment of A Pune Biotech Cluster, "Model Organism to Human Disease.	29.06.2018	28.06.2021	Dr. Jayant B Udgaonkar, IISER, Pune, MH	DBT	India
9	Dr. Radha Chauhan	Assessment of antimicrobial and plant growth promoting potential of Indigenous Endophytic Bacterial Strains of Manipur.	11.09.2018	10.09.2021 Extended up to 10.03.2022	Dr. Shekhar Mande, Dr. Debananda S Ningthoujam, Department of Biochemistry, Manipur University Imphal, Manipur	DBT	India
10	Dr. Janesh Kumar	Structural perspective of molecular interactions in pathogenicity: Role of regulatory proteins of HIV-1 and heat shock proteins of M. Tuberculosis	28.12.2016	27.12.2021	Dr. Shekhar Mande, Dr. Sharmistha Banerjee, Associate Professor. Department of Biochemistry, School of Life Sciences, University of Hyderabad, Hyderabad.	DBT	India
11	Dr. G. C. Mishra (NASI Platinum Jubilee Chair Distinguished Professor)	Regulation & differentiation of T helper 17 & T regulatory cells in collagen induced arthritis by modulating antigen presenting dendritic cells.	21.08.2018	20.08.2023	Nil	NASI	India
12	Dr. Debashis Mitra	Centre of Excellence in Biomolecular -Cellular Stress Proteins in HIV Infection: Biochemical and functional characterization.	28.12.2016	27.12.2021	Nil	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
13	Dr. Radha Chauhan	Centre of Excellence in Biomolecular -Structural & functional role of Nuclear Envelope in HIV infection.	28.12.2016	27.12.2021	Dr. Krishnaveni Mishra & Dr. Sharmistha Banerjee Dept. Of Biochemistry, University of Hyderabad, Hyderabad, Telangana.	DBT	India
14	Dr. Radha Chauhan	Establishing the Structural and functional role of Nup155 and Nup35 in Nup93 sub complex of the nuclear pore Complex.	11.10.2018	10.10.2021	Nil	DBT	India
15	Dr. Manas Santra	Quest for Cancer Drugs: Screening and Bioassay guided phytochemical Investigation of selected Endemic medicinal plants of Eastern Himalaya.	18.09.2018	17.09.2021	Dr. Dwipen Kakati Dept. of Chemistry Rajiv Gandhi University, Itanagar, Arunanchal Pradesh Dr. Ashish K Bhattacharya Div. of Organic Chemistry NCL, Pune, MH Prof. Mohan Chandra Kalita, Biotechnology, Guwahati University, Guwahati, Assam; Dr. Temin Payum Dept of Botany Jawaharlal Nehru College, Pasighat, Itanagar Dr. Jogendra Chandra Kalita Dept of Zoology, Guwahati University, Assam Dr. Kandarpa K Saikia Dept of Bioengineering & Technology Guwahati University, Guwahati, Assam	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
16	Dr. Vasudevan Seshadri	Development of a stable and inducible CRISPR-Cas9 system for high throughput site specific genome editing in Plasmodium falciparum	03.10.2018	02.10.2021	Dr. Krishnapal Karmodiya, Dept. of Biology, IISER, Pune Prof. Mrinal Kanti Bhattacharyya Dept. of Biochemistry University of Hyderabad	DBT	India
17	Dr. Yogesh Shouche	Establishment of Center of Excellence for "National Center for Microbial Resource (NCMR)"	30.03.2017	29.03.2020 Extended upto 30.09.2022	Nil	DBT	India
18	Dr. Mohan Wani	Regulation of development of pathogenic T - helper 17 cells in collagen induced arthritis	25.10.2018	28.09.2021	Nil	DST	India
19	Dr. Mohan Wani	To evaluate the translational potential of IL - 3 for the treatment of osteoporosis and osteoarthritis	25.10.2018	28.09.2021	Nil	DBT	India
20	Dr. Zahid Kamal	Decoding organism related evolution of surviving, a hub protein.	01.07.2015	30.06.2020 extended upto 31.12.2021	Dr. Chandra Shekhar Prabhakar Institute for Stem Cell Biology & Regenerative Medicine, Hyderabad	DBT/ Wellcome Trust India Alliance	India
21	Dr. Debashis Mitra	Host Cell Factors in HIV Pathogenesis	18.05.2018	30.06.2020 extended upto 28.05.2023	Dr. Ashoke Sharon Department of Chemistry Birla Institute of Technology, Mesra, Ranchi, JH	SERB - JC Bose Fellowship	India
22	Dr. Debashis Mitra	Synthesis and development of novel HSP90 inhibitors as potential anti - HIV candidate molecules and elucidation of their mechanism of inhibition	03.10.2018	02.10.2021	Dr. Ashoke Sharon, Department of Chemistry, Birla Institute of Technology, Mesra, Ranchi, Jharkhand	DST	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
23	Dr. M. V . Krishnasastry	MANAV Human Atlas Initiative	27.02.2019	26.02.2022	Dr. N. Balasubramanian IISER, Pune & Dr. Anamika Krishnapal Persistent Systems Limited, Pune Dr. Kundan Sengupta, IISER, Pune Mr. Vivek Kulkarni Persistent Systems Limited, Pune	DBT	India
24	Dr. Amitabha Majumdar	Generation of knockout and Gal4 collection using CRISPR and recombineering for studying the in vivo function and DnaJ domain containing protein in Drosophila melanogaster	05.03.2019	04.03.2022	Nil	DBT	India
25	Dr. Jomon Joseph	Characterization of acute necrotizing encephalopathy-1 (AEN-1) associated mutations in Nup358.	07.03.2019	06.03.2022	Nil	DBT	India
26	Dr. Arvind Sahu	Role of complement an aphylatoxin's C3a, C4a and C5a generated intracellularly in the infection locale in providing protection against viral infection.	12.03.2019	11.03.2022	Nil	DBT	India
27	Dr. Deepa Subramanyam	Role of actin remodelling and membrane fluctuations in regulation of embryonic stem cell pluripotency	05.07.2019	04.07.2022	Dr. Bidisha Sinha Dept. of Biological Sciences, IISER, Kolkata	DBT	India
28	Dr. Yogesh Shouche	Impact of mass bathing on the natural microbiota of the river Ganges; a concern to human health	26.09.2019	25.09.2022	Prof. Shanthy Sundaram Centre of Biotechnology University of Allahabad Allahabad, UP	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
29	Dr. Girdhari Lal	Effect of neuro-immune communication in the gut inflammation and auto-immunity	25.06.2019	24.06.2024	Nil	DST	India
30	Dr. Srikanth Rapole	A CRISPR-based gene therapy approach for targeting the breast cancer stem cells in vivo	18.10.2019	17.10.2022	Dr. Gopal Kundu (PI)	SERB	India
31	Dr. Yogesh Shouche	Human Microbiome Initiative of select Endogamous Population of India	09.03.2020	08.03.2022	Dr. Girish Shreekrishna Tillu, Associate Professor, AYUSH - Center of Excellence, SPPU, Pune. Prof. Shaunak Kulkarni Professor, Department of Anthropology, SPPU, Pune. Prof. Balakrishnan S Ramakrishna Professor, SRM Institutes for Medical Science, Chennai, Tamilnadu. Dr. Sarangthem Indira Devi, Scientist C, Microbial Resources Division, Institute of Bioresources & Sustainable Development, Imphal, Manipur. Dr. Subramanya Kumar Assistant Professor, I nstitute of Trans-Disciplinary Health Science & Technology, Bangalore, Karnataka. Dr. Sanjay Kamlakar Juvekar Senior Research Scientist, KEMHRC, Pune, Maharashtra. Prof. Govind K Makharia Professor, All India Institute of Medical Sciences, New Delhi.	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
32	Dr. Priyanka Dutta	Functional Characterization of the Novel Actin-Interacting Protein Kaptin and its Regulation of Cytoskeleton Dynamics in Neurons.	07.02.2020	06.02.2023	Dr. Sankar Maiti Department of Biological Sciences, IISER, Kolkata, West Bengal. Dr. Aurnab Ghose Biology, IISER, Pune.	SERB	India
33	Dr. Punam Nagvenkar	Establishment of GMP-Compliant National Repository for banking, safe deposit and supply of characterized mammalian cells for us in biopharma	01.10.2019	31.09.2023	Nil	BIRAC	India
34	Dr. Akanksha Chaturvedi	Elucidating the role for Toll-like receptor 9 mediated extra cellular vesicle release from B cells	26.03.2020	25.11.2022	Nil	SERB	India
35	Dr. Sharmila Bapat	Proteogenomics based identification and Characterization of a novel ITGB8 isoform in ovarian cancer and elucidation of its functional relevance.	27.03.2020	26.03.2023	Nil	SERB	India
36	Dr. Arvind Sahu	Generation of neutralizing human monoclonal antibodies against the SARS - CoV2 virus as therapeutic strategy to contain the COVID - 19 Pandemic	29.05.2020	28.05.2021 extended up to 30.11.2021	Dr. D.N. Nayak IIT, Indore. Dr. Krishna Ella Bharat Biotech International Ltd., Hyderabad. Dr. Kanury V.S. Rao PredOmix Technologies Pvt.Ltd., Gurugram, Haryana.	CSIR	India
37	Dr. Gaurav Das	The neurophysiological pathways of emesis in Drosophila melanogaster	12.06.2020	11.06.2023	Nil	SERB	India
38	Dr. Arvind Sahu	J C Bose Fellowship	25.11.2020	24.11.2024	Nil	SERB	India
39	Dr. Jomon Joseph	Characterization of inter-cellular transport of Ran GTPase	27.08.2020	26.08.2023	Nil	DBT	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
40	Dr. Vidisha Tripathi	Deciphering the role of long noncoding RNAs (lncRNAs) in mediating replication stress response during cell division	21.02.2020	20.02.2023	Nil	SERB	India
41	Dr. Akanksha Chaturvedi	Production of pseudotyped SARS-CoV-2 in BSL-2 setting using vesicular stomatitis virus VSV platform for candidate vaccine development and biomedical research use	06.06.2020	05.06.2021	Dr. Debasis Nayak, Associate Professor IIT Indore Simrol Campus, Khandwa Road, Simrol, Indore, Madhya Pradesh	BIRAC	India
42	Dr. Deepika Puri	Epigenetic mechanisms of regulation of autophagy in development, differentiation and disease.	27.11.2019	26.11.2024	Nil	DST	India
43	Dr. Janesh Kumar	Development of Nanobodies as prophylactic and therapeutic candidates against SARS-CoV-2 virus.	26.10.2020	25.10.2021	Nil	SERB	India
44	Dr. Vidisha Tripathi	Comprehensive characterization of novel lncRNA-protein network orchestrating the mammalian cell cycle program	03.12.2020	02.12.2023	Nil	DBT	India
45	Dr. Janesh Kumar	Structural investigations of GluK2 and GluK3 kainate receptors in lipidic environment	14.01.2021	13.01.2024	Nil	SERB	India
46	Dr. Manas Santra	To understand the immunosuppressive activity of secretory PD-L1 and its regulation by F-Box proteins to develop potent immunotherapeutic leads for cancer	14.01.2021	13.01.2024	Nil	SERB	India
47	Dr. Deepa Subramanyam	Understanding the role of clathrin mediated endocytosis in neural development and function	15.02.2021	14.02.2024	Nil	ICMR	India

EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
48	Dr. Yogesh Shouche	Genomic based approaches for characterization of the microbial antibiotic resistance and resistome in dairy production system	25.03.2021	24.03.2024	Dr. Rashmi H M, Scientist (Senior Scale), Diary Microbiology Division, ICAR-NDRI, Karnal	ICMR	India
49	Dr. Yogesh Shouche	Genomic surveillance for SARS-CoV-2 in India: Indian SARS-CoV-2 Genomics Consortium (INSACOG)	26.03.2021	25.07.2021 Extended up to 25.10.2021	Dr. Arindam Maitra, Associate Professor, National Institute of Biomedical Genomics (NIBMG), West Bengal; Dr. Ajay Parida, Director, Institute of Life Science (ILS), Bhubaneshwar; Dr. Dasaradhi Palakodeti, Assistant Research Investigator, Institute of Stem Cell Biology and Regenerative Medicine (InStem), Bengaluru; Dr. K Thangaraj, Director, Centre for DNA Fingerprinting and Diagnostics Hyderabad; Dr. Sridhar Sivasubbu, Principal Scientist, CSIR Institute of Genomics and Integrative Biology (IGIB), Delhi; Dr. Karthik Tallapaka, Scientist, CSIR Centre for Cellular and Molecular Biology (CCMB), Hyderabad; Dr. Anita Sudhir Desai, Professor, National Institute of Mental Health and Neuro Sciences Hospital (NIMHANS), Bengaluru	DBT	India
50	Dr. Punam Nagvenkar & Dr. Yogesh Shouche	Vaccine Testing Facility	13.01.2021	12.01.2022	National Institute of Animal Biotechnology (NIAB), Hyderabad	DBT	India

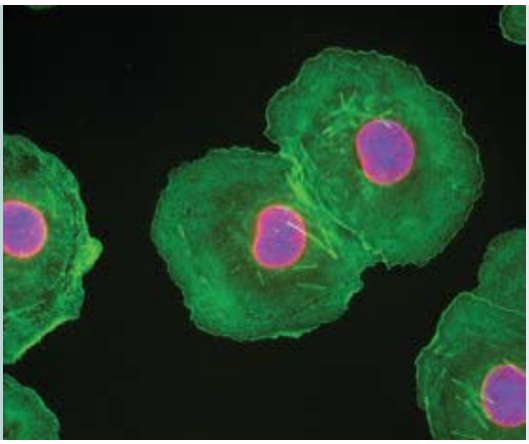
EXTRAMURAL FUNDING

Extramurally-Funded Projects / Fellowships of NCCS Faculty

No.	PI	Title	Start Date	End Date	Collaborator(s)	Funding agency	Country
51	Dr. Yogesh Shouche	Study on distribution, function, and genomic reconstruction of deep-subsurface abundant and rare microbial communities in different depth of the rock (Basalt - granite Zone) at Koyan -Waran region	05.02.2020	04.02.2022	Dr. Dhiraj Paul NCCS-NCMR, Pune	Ministry of Earth Science	India

Parties with whom MOA / MoU were signed for research collaborations

- The Armend Forced Medical College (AFMC), Pune.
- B.J. Medical College, Pune
- IIT, Indore
- Becton Dickinson India Pvt. Ltd, New Delhi
- Gennova Biopharmaceuticals Limited, Pune.
- Entrepreneurship Development Center, Pune
- Dr. D.Y. Patil Vidyapeeth, Pune.
- CSIR
- Bharat Biotech International Ltd.,Hyderabad
  PredOmix Technologies Pvt. Ltd., Haryana.
- DBT



Awards / Honours

Awards / Honours - NCCS Faculty

Sharmila Bapat

- Miltenyi Biotec MACS® Project Grant 2020. She is one of 3 awardees from the Asia Pacific region.

Akanksha Chaturvedi

- Miltenyi Biotec MACS® Project Grant Award 2021.

Radha Chauhan

- Dr. Radha Chauhan and her group's research article published in Protein Science was among the top 10% of the most downloaded papers, which underscores the immediate impact generated by this research. In recognition of this, each author of the paper was awarded with a certificate of achievement by the journal publishers.

Janesh Kumar

- Dr. Janesh Kumar & his team's research recently published paper in Nature Structural and Molecular Biology (https://www.nature.com/articles/s41594-019-0359-y) was selected as one of the most exciting subjects investigated at the European Synchrotron Radiation Facility (ESRF) in 2020, and was featured in 'ESRF Highlights 2020'.
- Dr. Janesh Kumar and his group's research (Burada et al, 2020) was among the top 5% of all research outputs scored by Altmetric
- On the Editorial Boards of the following journals:
  - Communications Biology (Nature) - Editorial Board
  - BMC Molecular and Cell Biology- Associate Editor
  - Plos One- Editorial Board
  - Scientific reports -Editorial Board
  - FEBS OpenBio- Advisory Editorial Board
  - Neuropharmacology- Guest Editor
- Member of the Technical Monitoring and Advisory Committee for periodic monitoring of the progress of the "GenomeIndia" and "Human Microbiome" initiatives

Nibedita Lenka

- Chairperson, Institutional Ethical Committee and Member, IC-SCR, OCT Therapies & Research Pvt. Ltd. Mumbai.
- Speaker of Eminence & Convenor - Workshop on "Stem Cell Engineering"; 'Virtual Expert Lectures and Workshop Series on 21st Century: The Era of Biotechnology', Dept. of Biotechnology, AKS University, Satna, MP, India; 13-14 October 2020.

Amitabha Majumdar

- Dr. Amitabha Majumdar & Dr. Vasudevan Seshadri were awarded the India EMBO Lecture Course Awards 2021 by the DBT/Wellcome Trust India Alliance (India Alliance) and the European Molecular Biology Organisation (EMBO), to organize a lecture course on: "RNA binding proteins: From RNA binding to condensation and aggregation" (08 – 11 February, 2021).

Srikanth Rapole

- General Secretary, Proteomics society of India (PSI)
- Editorial board member, Journal of Proteins and Proteomics

Arvind Sahu

- J.C. Bose National Fellowship awarded by SERB.
- Invited to serve as Associate Editor, Frontiers in Immunology, for Molecular Innate Immunity (a speciality section of Frontiers in Immunology).

Manas Kumar Santra

- Elected as Fellow of the National Academy of Sciences (FNASc), Allahabad, 2021.

Yogesh Shouche

- Elected to the Executive Board of the International Committee on Systematics of Prokaryotes. He is the only Indian scientist elected to this Board that took charge on 1st September, 2020.
- Elected as Fellow of the Indian National Science Academy (INSA).
- Nominated as an opted member of the World Federation for Culture Collections (WFCC) Executive Board.

Shailza Singh

- Academic Editor, Plos One

Mohan Wani

- FAMS, Fellow, National Academy of Medical Sciences (NAMS), India, 2020.

Awards / Honours - Postdoctoral and other Scientists, Students & Technical Staff

- Sharmila Bapat's group
  - **Arpita Wagale: :** Praj Best M.Tech. Thesis Gold Medal (Chemistry & Biotechnology)

- Janesh Kumar's group
  - **Ananth P. Burada:** DBT-Wellcome Trust India Alliance Early Career Fellowship
  - **Rajesh Vinnakota :** Department of Biotechnology Research Associate Fellowship.

- Manas Kumar Santra's group
  - **Sehbanul Islam :** Invited to deliver a talk at the '6th Annual International Remote Conference – Science and Society' organized by the Beyond Sciences Initiative; He delivered a talk on "F-box only protein FBXO31 functions as a tumor suppressor by inactivating oncogenes associated with ovarian cancer malignancy"; 21 February 2021.
  - **Yashika Agrawal :** Selected as an AWSAR 2020 "Best Stories" awardee in the Ph.D. category under the DST-Augmenting Writing Skills for Articulating Research (AWSAR) programme of the DST; Her write-up was selected as one of the top 100 stories (from among 2063); February 2021.

- Yogesh Shouche's group
  - **Dr. Om Prakash Sharma :** (Project Scientist, NCCS-NCMR): Elected as Chairman of the Subcommittee on Methanoarchaea, of the International Committee on Systematics of Prokaryotes (ICSP).
  - **Dr. Avinash Sharma :** (WT/DBT-IA Early Career Fellow): Appointed as Editor of the journal, Frontiers in Sustainability (for the topic: Sustainable Production of Ethnic Alcoholic Beverages).
  - **Sahabram Dewala :** (research scholar at NCCS-NCMR): Was awarded the Young Investigator Award and secured the first position for his work on gluten-degrading microbes from the human gut, at the Annual Conference of Indian Society of Gastroenterology.

- Deepa Subramanyam's group
  - **Surya Bansi Singh :** Bursary to attend the 'Vesicle Trafficking & Pathways to Neurodegeneration 2021' Wellcome courses and conferences.

- NCCS Alumni
  - **Dr. Bhavana Muralidharan:** Scientist E at inStem, was awarded the Har Gobind Khorana - Innovative Young Biotechnologist Award 2020, by the Department of Biotechnology, Government of India.

Research Fellows awarded with Ph. D. Degrees

(01.04.2020 – 31.03.2021)

No.	Research Scholar	Title of the Thesis	Date of award of Ph.D.	Research Guide
1	Mr. Chanukuppa Venkatesh	Identification of new targets and biomarkers for multiple myeloma using proteomic and metabolomic approaches	18.06.2020	Dr. Srikanth Rapole
2	Ms. Mohsina Khan	Functional elucidation of FBXO16 an E3 ubiquitin ligase in glioblastoma	05.08.2020	Dr. Anjali Shiras
3	Mr. Ramesh Butti	Studies on role of tumor-derived osteopontin in trans-differentiation of resident fibroblasts into myofibroblasts to promote breast cancer progression	10.08.2020	Dr. Gopal Kundu
4	Ms. Madhvi Mandhania	Diversity dynamics of the fermentation of idli batter	17.08.2020	Dr. Milind Patole
5	Mr. Varun Haran	Investigation of signalling cues guiding mesoderm induction and cardiomyogenesis from ES cells in vitro	21.10.2020	Dr. Nibedta Lenka
6	Ms. Apoorva Parulekar	Epigenetic regulation of hTERT by SMAR1 dictates proliferation and metastasis of colorectal cancer cells	26.11.2020	Dr. Samit Chattopadhyay
7	Ms. Rutuja Kuhikar	Characterization and mechanistic studies on red blood cells and neutrophils generated in-vitro from haematopoietic stem cells	01.12.2020	Dr. Lalita Limaye
8	Mr. Aditya Sarode	CD40 signaling cascades induced by differential CD40L interaction	17.12.2020	Dr. Bhaskar Saha
9	Mr. Ananth Burada	Structural and functional studies on orphan ionotropic glutamate receptors	28.12.2020	Dr. Janesh Kumar
10	Mr. Yashwant D. Bansode	Characterization of anti-herpes simplex virus immune response	05.01.2021	Dr. Bhaskar Saha
11	Ms. Prachi Deshmukh	Characterization of protein-protein interactions involved in miRNA pathway	02.02.2021	Dr. Jomon Joseph
12	Mr. Sehbanul Islam	Understanding the post-translational regulation of β-TrCP	17.02.2021	Dr. Manas Kumar Santra
13	Ms. Ritika Kabra	Drug efflux mechanism and transport proteins in Leishmania: Translating allosteric machinery	02.03.2021	Dr. Shailza Singh
14	Mr. Sunil Kumar	Characterization of priming -induced memory T-cell generation in Leishmania infection	02.03.2021	Dr. Bhaskar Saha
15	Mr. Shubhranshu Zutshi	Generation of novel anti-Leishmania vaccine	10.03.2021	Dr. Bhaskar Saha
16	Mr. Ashok Patidar	Toll-like receptors in anti-tumor immune response	12.03.2021	Dr. Bhaskar Saha
17	Ms. Bhavnita Soni	Systems biology of interleukin 6 signaling in leishmaniasis	24.03.2021	Dr. Shailza Singh

POSTDOCTORAL FELLOWS & OTHER EARLY-CAREER SCIENTISTS SUPPORTED

Name	Designation	Date of joining NCCS	Date of leaving NCCS	PI whose research group they are affiliated with
Dr. Md. Zahid Kamal	Wellcome Trust DBT Early Career Fellow	01-07-2015	Currently at NCCS	Dr. Janesh Kumar
Dr. Ravindra Taware	CSIR-RA	01-06-2017	31-05-2020	Dr. Srikanth Rapole
Dr. Snehal Kulkarni	ECS BioCARe Fellow	17-07-2017	16-01-2021	Dr. Yogesh Shouche
Dr. Manjushree Bahir	DST WOS A Fellow	27-10-2017	Currently at NCCS	Dr. Nibedita Lenka
Dr. Jyoti Singh	Wellcome Trust DBT Early Career Fellow	01-01-2018	Currently at NCCS	Dr. Janesh Kumar
Dr. Pragya Misra	CSIR-SRA	07-03-2018	21-05-2020	Dr. Shailza Singh
Dr. Priyanka Dutta	DST Inspire Faculty Fellow	01-05-2018	Currently at NCCS	Dr. Radha Chauhan
Dr. Deepika Puri	DST Inspire Faculty Fellow	30-07-2018	Currently at NCCS	Dr. Deepa Subramanyam
Dr. G. C. Mishra	NASI Platinum Jubilee Chair Distinguished Professor	04-09-2018	Currently at NCCS	Dr. Manoj Kumar Bhat
Dr. Ameya Bendre	DBT-RA	01-01-2019	Currently at NCCS	Dr. Janesh Kumar
Dr. Amruta Naik	DST WOS A Fellow	01-03-2019	14-08-2020	Dr. Mohan Wani
Dr. Bhargab Kalita	DBT-RA	01-07-2019	Currently at NCCS	Dr. Srikanth Rapole
Mr. Khushman Taunk	CSIR-RA	22-08-2019	Currently at NCCS	Dr. Srikanth Rapole
Dr. Avinash Sharma	Wellcome Trust DBT Early Career Fellow	30-08-2019	16-05-2021	Dr. Vasudevan Seshadri
Dr. Parshuram Sonawane	DBT-RA	03-01-2020	Currently at NCCS	Dr. Radha Chauhan
Dr. Upasana Narula	ICMR-RA	15-02-2021	Currently at NCCS	Dr. Nibedita Lenka
Dr. Archana Rajendran	SERB-N-PDF	15-03-2021	Currently at NCCS	Dr. Nibedita Lenka

Teaching, Training and Outreach

Teaching and Training

Talks/lectures delivered & hands-on activities/training conducted by NCCS scientists

Scientist	Topic / Symposium	Class / Department	Institution	Date
Gaurav Das	Invited webinar: 'The food fly: Nutrition-specific memories & diet-mediated neuronal plasticity in Drosophila'	Bachelors and Masters students	G.N. Ramachandran Science Club, Mar Athanasios College for Advanced Studies Tiruvalla, Kerala	19.10.2020
Nibedita Lenka (Course Resource Person)	'S.T.E.M.: Stem Cells Perspective': At the AICTE QIP Short term Training Programme on "Recent Advances in Stem Cells and Tissue Engineering"	College and University Teachers (Life Sciences)	Organized by IITM, Chennai.	24.08.2020 - 28.08.2020
Nibedita Lenka (Invited Convener and Speaker of Eminence)	'S.T.E.M. Concerning Stem Cells'" At the Workshop on "Stem Cell Engineering" during Virtual Expert Lectures and Workshop Series on 21st Century: The Era of Biotechnology, Dept. of Biotechnology	B.Sc., M.Sc. and Ph.D. students (Biotechnology)	AKS University, Satna, MP, India	13.10.2020 - 14.10.2020
Manas Kumar Santra	Seminar	B. Sc., M. Sc. and Ph. D. students	M. S. Ramaiah University of Applied Sciences	12.09.2020
Manas Kumar Santra	Refresher course	M. Sc. and Ph. D. students	Utkal University	19.02.2021
Manas Kumar Santra	PSI webinar	M. Sc. & Ph. D. students faculty	Proteomics Society	26.02.2021
Vasudevan Seshadri	RNA protein interactions and the current COVID research	XI and XII standard students	MAHSS, Goa	19.07.2020
Deepa Subramanyam	Biotechnology tools	Class XII	DPS school, Pune	08.10.2020
Dr. Amaraja Joshi	Webinar: "Strory of my Ph. D."	9th and 10th students	New English School, Satara	22.10.2020
Dr. Amaraja Joshi	Webinar: "Role of National Centre for Microbial Resource, Pune in Preservation & Identification of Microbial Cultures	Life sciences students	Annakkili Amma Research Institute (AARI)	14.06.2020
Dr. Amaraja Joshi	Webinar: "Research Opportunities in Life Sciences"	Life sciences students	School of Life Sciences, SRTM University, Nanded	08.03.2021
Dr Amit Yadav	Webinar Session on 'Trends in Plant Sciences' - PHYTOPLASMA that transform the plants into Zombies!	UG, PG students, Scientists, Faculty	BIOMICS, Bangalore	19.12.2020
Dr. Rohit Sharma	Fungi: Biotechnological Innovation	Bachelors students	Department of Zoology, Prof. Ramkrishna More Arts, Commerce & Science College, Akurdi, Pune	25.02.2021

Scientist	Topic / Symposium	Class / Department	Institution	Date
Dr. Rohit Sharma	Button mushroom cultivation	Masters students	Department of Botany & Microbiology, St. Aloysius College (Autonomous), Jabalpur (M.P.)	16.02.2021
Dr. Rohit Sharma	Cultivation management: Pest management	Masters students	Department of Botany & Microbiology, St. Aloysius College (Autonomous), J abalpur (M.P.)	17.02.2021

Classes taught by NCCS scientists for the Ph.D. course work (2020)

(for Ph.D. students registered with the S.P. Pune University, Department of Biotechnology)

Scientist	Topic / Module
Dr. Rahul Bankar	Laboratory Animal experimentation and ethics
Dr. Sharmila Bapat	Coordinator for the Cancer Biology Coursework Advances in Cancer Biology - Introduction to Cancer Biology; Hallmarks of Cancer; Assays of metastases
Dr. Akanksha Chaturvedi	Advance and Applied Immunology Course
Dr. Radha Chauhan	Structural Biology, course coordinator - Advances in structural biology Quantative methods - Instructor
Dr. Gaurav Das	Research Communication
Dr. Jomon Joseph	Research communication Molecular Biology Techniques
Dr. Janesh Kumar	Advances in Structural biology - Quantitative methods Membrane Proteins
Dr. Girdhari Lal	Tumor Immunology Transplantation Immunology
Dr. Nibedita Lenka	Research ethics - Facts and Facets of Stem Cell Research and Ethical Guidelines
Dr. Amitabha Majumdar	Advances in cell biology Stem cells, development and neurobiology
Dr. Ajay Pillai	Research ethics
Dr. B. Ramanamurthy	Laboratory Animal experimentation and ethics
Dr. Srikanth Rapole	Proteomics basics and applications Mass spectrometry Instrumentation (MALDI-MS, ESI-MS, GC-MS) MS based proteomics and PTMs characterization Quantitative Proteomics (DIGE, iTRAQ, SILAC, Label Free etc.) Cancer Biomarkers
Dr. Manas Kumar Santra	Molecular biology and genetic engineering - Molecular Biology/Transcrition Cancer Biology/Cell cycle
Dr. Vasudevan Seshadri	Research communication Q-PCR, Tools and Techniques Protein Translation and its regulation, Molecular Biology Microarray and Linkage analysis, Molecular Biology
Dr. Shailza Singh	Computer applications - Mathematics for Biosciences-Computer Application (Theory+ Practicals)
Dr. Sandhya Sitasawad	Research ethics
Dr. Deepa Subramanyam	Stem Cells and Development
Dr. Vidisha Tripathi	Molecular Biology Quantitative methods Cancer Biology

Other In-house Training

a) In-house online training: How to use the FCS Express software for flow cytometry data analysis

- Conducted by Dr. Hemant Agrawal, Technical Application Specialist, De Novo Software, for researchers at NCCS (students, postdoctoral scientists and faculty); 15 & 26 October, 10 November 2020.

b) An in-house short practical training course on Biacore T200

Conducted for researchers of NCCS; 17 - 19 February 2021.

Other Talks Delivered by NCCS Faculty

Radha Chauhan

- 'Role of academic organization in current challenges': Delivered at a virtual meeting organized by the Maharastra Chambers of Commerce, Industries & Agriculture (MCCIA) under the Pune Knowledge Cluster, 29 September 2020.
- 'Structure, functions and stability of proteins': Invited talk at S.P. Pune University Biotechnology Department, 16 March 2021.
- 'Cryo-EM structure of human Nup155 and its basis for genetic mutation R391H linked with atrial fibrilliation': Key Stone virtual symposia, USA, 2-4 March 2021.
- 'Structural biology of human NPC: Challenges and the road ahead': Speak your Science (SyS webinar series at NCCS; 19 March 2021.

M. V. Krishnasastry

- 'Game Theory: Applications in biology & in a pandemic': Talk delivered at the data science webinar series organized by the 'Manav-Human Atlas Initiative'; 11 & 18 June 2020.

Janesh Kumar

- 'Structural Insights into Enigmatic Ionotropic Glutamate Delta Receptors': Invited talk (virtual mode); 1st Annual Symposium on Single particle CryoEM and Cellular Tomography (CEM3DIPSI) organized by Indian Institute of Science Education and Research, Thiruvananthapuram, India Dec 19, 2020.
- 'Single-Particle CryoEM: Revolution in structural Biology': Invited talk (virtual mode); Institute of Bioinformatics & Biotechnology (IBB), Savitribai Phule Pune University, Pune, India, August 20, 2020.
- 'Structural biology in the era of cryo-electron microscopy': Invited talk (virtual mode); UGC-Human resource development centre, Devi Ahilya University, Indore, India, December 27, 2020.
- 'Solving the Enigma of Orphan Glutamate Delta Receptors': Invited talk (virtual mode); UGC-Human resource development centre, Devi Ahilya University, Indore, India, December 27, 2020.
- 'Cryo-EM- recent advances and its role in biology and biomedicine': Invited talk (virual mode); UGC-Human resource development centre, Ruia College, Mumbai University, Mumbai, India, January 15, 2021.

Girdhari Lal

- 'CCR9+ dendritic cells promote the differentiation of Foxp3+ regulatory CD4 T cells' (Lal G, Patahak M, Namrita Halder, and Padghan P): Oral Presentation at Immunology 2020, Hawaii Convention Center, Honolulu, USA; 8-12 May 2020.
- 'Chemokine receptor CCR6 intrinsic signaling alters metabolic reprogramming of Th17 cell during gut inflammation and autoimmunity' (Heikrujam T., Kulkarni T, Shirolkar A, Rapole S, Sharma P, Lal G.): Oral Presentation at the 12th International Congress on Autoimmunity, Athens, Greece; 20-24 May 2020.
- 'CCR9 intrinsic signaling in dendritic cells promote the differentiation of Foxp3+ Regulatory CD4 T cells in the gut' (Pathak M, Halder N, Padghan P, Lal G.): Oral Presentation at the 12th International Congress on Autoimmunity, Athens, Greece; 20-24 May 2020.
- 'Chemokine Receptor CCR6 signaling in Gut inflammation and autoimmunity': Invited talk, Virtual Annual Meeting of the Society for Leukocyte Biology, in a meeting titled 'Host-Microbial Interactions in Health and Disease: The Good, the Bad and the Ugly'; Portland, Oregon; 28 July 2020.
- 'Mechanism of Immunopathogenesis in cancer': Invited Talk at the virtual FIMSA course 2020, PGI, Chandigarh, 8-10 October 2020.
- 'Intrinsic signalling of chemokine receptors in inflammation and autoimmunity': Talk delivered at SIRCON 2020, organized by the Society of Inflammation Research; 17 October, 2020.

- 'Activated NK T cells promote the inflammatory tumor microenvironment and control the growth of the solid tumor' (Paul S, Mishra A, Chhatar S, Lal G): 35th Anniversary Annual Meeting of the Society for Immunotherapy of Cancer (SITC 2020), USA; 11-14 November 2020.
- 'Cellular and molecular crosstalk in inflammation and autoimmunity': Invited Talk, Online Faculty Development Programme on Current Trends in Life Sciences at Vellore Institute of Technology (VIT), Vellore; 17 December 2020.
- 'Cell receptors, cellular communication and linked-disease': Invited talk delivered at the virtual Bi-monthly Lecture Series on Immunology and Inflammation, organized by the Society of Inflammation Research (2-7 March 2021), Bangalore; 07 March 2021.
- 'Role of natural killer (NK) cells and NKT cells in controlling the anti-tumor immunity': Invited talk delivered at the international webinar on New Horizons and Breakthrough in Cancer Research in the Present Era, organized by the B. N. Patel Institute of Paramedical and Science, Anand, Gujrat; 27 March 2021.

Nibedita Lenka

- 'S.T.E.M. concerning stem cells': Talk delivered at a workshop on 'Recent Advances in Stem Cell Engineering' organized by the AKS University, Satna (M.P.) as part of an e-Refresher Course; 13 October 2020.
- Delivered a talk at the 34th annual meeting of the Society for Neurochemistry India (SNCI); 11 December 2020.
- 'Wnt-DUB link dictating early neurogenesis': Invited talk; Society of Neurochemistry, India (SNCI) – 34th Annual Conference on Brain Diseases, Injuries and Infections: Emerging challenges and treatment strategies, Univ. of Hyderabad, India; 11-13 December 2020.

Ajay Pillai

- 'Challenges in IP licensing and technology transfers in academic institutions' - talk delivered at the India Research Management Initiative Annual Conference organized by India Alliance DBT Wellcome; February 2021.
- 'Bio innovation, Patenting and Entrepreneurship Opportunities in Biotechnology for Sustainable Environment' - talk delivered at an AICTE-sponsored two weeks Virtual Faculty Development Programme organized by the Karnataka State Council for Science and Technology (KSCST), IISC campus, Bangalore, and Oxford College of Engineering, Bangalore; 15 - 26 February 2021 (Phase 1 organized by the Department of Biotechnology).

B. Ramanamurthy

- 'Health and Hygiene of Experimental Animals' - Keynote talk delivered at the online work shop on 'Prominence of Animals in Research' organized by IIT Ropar; 10 July 2020.

Srikanth Rapole

- 'Mass spectrometry-based proteomics': Invited talk at PSI education day organized by National Chemical Laboratory, Pune; 21 November 2020.
- 'Identification of candidate Cancer biomarkers/targets using mass spectrometry-based proteomics': Invited talk at Basic & Advanced Proteomics approaches organized by IIT-Bombay, Mumbai; February 15-19, 2021.
- 'Identification of candidate Cancer biomarkers/targets using mass spectrometry-based proteomics': Invited talk at National seminar on Recent Trends in Biology organized by Department of Zoology, Savitribai Phule Pune University, Pune; 12-13 March 2021.
- 'Identification of candidate Cancer biomarkers/targets using mass spectrometry-based proteomics': Invited talk at online conference on Proteomics in Agriculture & Healthcare organised by the school of life sciences, University of Hyderabad, Hyderabad; 13-14 March 2021.
- 'Identification of potential biomarkers/targets for Breast Cancer using proteomic and metabolomic approaches': Invited talk at Analytical community of Science (ACOS) 2021 Symposium organized by Biocon Bristol Myers Squibb Research & Development Center (BBRC), Bangalore; 18-19 March 2021.

Arvind Sahu

- 'COVID-19: Current Understanding': Key Note Speaker, Science & Technology for Mankind webinar series organized by Indrashil University; 22 July 2020.
- 'COVID-19: Current Understanding': Talk delivered as Guest Speaker, Webinar on Dimensions of Biological Research during Post-COVID time organized by School of Life Sciences, Central University of Gujarat; 24 September 2020.
- I'Complement – A true multitasking system': Invited talk, FIMSA Immunology Course-2020, A Virtual School - From Basic to

Advanced Immunology, organized by the Indian Immunology Society; 08 October 2020.

- 'Complement system in Physiology and Pathology': Invited talk, Virtual Bi-monthly Lecture Series on Immunology and Inflammation, organized by the Society of Inflammation Research (2–7 March 2021); 06 March 2021.

Shailza Singh

- 'Allosteric Conformational Changes induced by Co-evolutionary Residues in Leishmania: Combating Drug Resistance': Invited online talk at NIT Warangal for FDP; 16 July 2020.
- 'Machine Learning for Engineering Biology in the Era of Network Science': Invited online talk at IMSc, Chennai; on 22 September 2020.
- 'Machine Learning based Peptide Therapeutics for Covid-19': Invited online talk in International Symposium "Global Collaboration on Data beyond Disciplines", Research Organization of Information and Systems (ROIS), Japan; 24 September 2020.
- 'MD simulations': Invited online talk in International Workshop "Machine Learning, Structural Biology, MD Simulation, and Genome Annotations", followed by demonstration session for participants across diverse nations; 18 October 2020.
- 'Signaling Framework for Synthetic Circuit Immunomodulation-Case Studies': Invited online talk on Synthetic Biology at Pandit RaviShankar Shukla University, Raipur; 16 December 2020.
- 'Protein-Peptide Interaction using Autodock vina': Invited online International Workshop Session; 26 December 2020.

Deepa Subramanyam

- 'Traffic control in embryonic stem cells': Invited talk, Amity Institute of Biotechnology; 11 February 2021.
- 'Intracellular trafficking in embryonic stem cells – to go or not to go': Invited talk, Presidency University, Kolkata; 19 December 2020.
- 'Controlling stem cell fate through intracellular trafficking': Invited talk, Biomics talk series; 07 November 2020.
- 'Trafficking in stem cells': Invited talk delivered at a workshop on 'Recent Advances in Stem Cell Engineering' organized by the Dept of Biotechnology, AKS University, Satna (M.P.), as part of an e-Refresher Course; 13 October 2020.

Mohan Wani

- 'Stem cell therapy in rheumatoid arthritis': Invited talk, SIRCON 2020, organized by the Society of Inflammation Research; 18 October 2020.
- 'Cytokines in the Physiology and Pathology of Autoimmune Diseases': Delivered at the virtual Bi-monthly Lecture Series on Immunology and Inflammation, organized by the Society of Inflammation Research (2–7 March 2021); 07 March 2021.

Other Talks Delivered by Other Scientists & Postdoctoral Fellows

Dr. Om Prakash Sharma

- Landfill a good source for Solid Waste Management; Webinar; Amity Institute of Biotechnology, Amity University, Gwalior, MP, India, 21 May 2020.
- OMICS as a Tool for Microbial Biodiversity Study; in Webinar "COVID-19 Pandemic: Opportunities and Challenges" ; Department of Microbiology & Institute of Engineering and Technology Dr. Rammanohar Lohia Avadh University, Ayodhya, UP, India, 19-20 May 2020.
- Role of Wastewater Treatment Plants in Public and Environmental Health; Webinar; Department of Biochemistry University of Lucknow, Lucknow, India, 30 May 2020.
- Trends, Biases and limitations of Cultivation based Diversity analysis; Invited talk; AMI-2021 Jointly organized by AMI and INSCR, India, 01-05 February 2021.
- Methanaoarchaea in Public and Environmental Health; Invited talk; AIIMS-ASM 2-days International webinar organized by Anaerobic Forum, India, 04-05 March 2021.
- Anaerobes and Anaerobic Processes; Invited talk; online meeting of Microbiological Society of India, February 2021.

Dr. Mahesh Chavadar

- Magnetotactic Bacteria and Their Applications in Nano-Biotechnology; Invited talk; 2nd International Conference 'Emerging Trends in Life Sciences (ICTLS-2021); Nizamabad (TS), India, January 2021.

Other Outreach

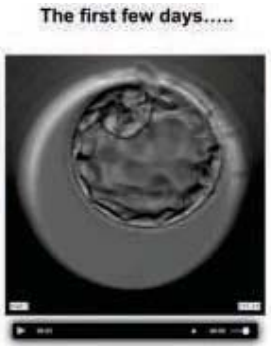
India International Science Festival (IISF 2020)

- NCCS organized the "Vigyan Yatra" on 04 December 2020 as a prelude to IISF 2020.
- NCCS organized a Curtain Raiser on 10 December 2020, to spread awareness about IISF 2020.
- NCCS displayed exhibits at the virtual Science & Technology Mega Expo of IISF 2020: 20–25 December 2020.
- Dr. Yogesh Shouche gave a talk at the "Vigyan Yatra" organized by NIBMG: 07 December 2020.
- Dr. Janesh Kumar participated in the Young Scientist Conference as a jury member and judge for evaluating & selecting abstracts for oral presentations. He also participated as a judge for the oral presentations during 21-25 December 2020.

National Science Day

Public Talk (webinar):
'The Fascinating World of Stem Cells'
by Dr. Deepa Subramanyam
Scientist, NCCS, Pune, India

28 February, 2021



Outreach activities under the umbrella of 'India@75' and 'DBT Science Setu'

India@75 + Science Setu webinar -

'Genomic Drivers of Oral Cancer and Proximal Metastasis'
by Prof. Partha Majumder
Distinguished Professor, NIBMG, Kalyani, India
22 February 2021

Students and faculty of thirteen DBT Star Colleges & the general public were invited to participate

Science Setu -

Workshop on 'How to Read Scientific Papers'
- conducted for the students & faculty of the DBT Star College, Tuljaram Chaturchand College of Arts Science & Commerce, Baramati
(under the aegis of the DBT-funded project, 'Manav: Human Atlas Initiative')
26 February 2021

International Women's Day & India@75 events 08 March 2021

- 'Building the Brain: Role of Transcription Factors and Chromatin Regulators'
  Webinar by Dr. Bhavana Muralidharan
  (NCCS alumna, 'Har Gobind Khorana-Innovative Young Biotechnologist 2020' awardee & Assistant Investigator at inStem);.

- Panel discussion on: 'Gender Equality in STEM and Research'
  The above events were open to all and the students and faculty of DBT Star Colleges were also specially invited, under the 'DBT Science Setu' programme.

Training provided to extramural participants

- Dr. Shailza Singh conducted online training in the thematic area of "Molecular Dynamics Simulations", Docking, Molecular Modeling, Network Biology" for >160 extramural participants.

Other Outreach Activities

a) The possible scientific reasons behind the sudden change in colour of the water of Lonar lake to pink were discussed through various media:

- A webinar on "Why Lonar lake turned pink: Microbiological Aspects of Lonar Meteoritic Impact Crater", was presented by Dr. Yogesh Shouche, for the Jyotirvidya Parisansthan - https://www.youtube.com/watch?v=mVx2pobQNDM

- Dr. Yogesh Shouche was interviewed in Marathi by 'Sanshodhan India'-
  https://www.youtube.com/watch?v=tb-WYINhf84&feature=youtu.be

- An article was published in Marathi by Dr. Yogesh in the e-magazine, 'Sakal Saptahik':
  http://product.sakaalmedia.com/portal/epaperclient/EpaperClient.aspx?curr_page=04&date=27062020&ed=00057&fbclid=IwAR2wjO2XvB343_szWyLiDijs792IuO8g7BnNVo4C_365H8dMpoxvJrQKOi4

b) "The World's Largest collection of Microorganisms":
This talk aimed mainly at 8th graders in rural India, was delivered online in Hindi by Dr. Kamlesh Jangid, project scientist at NCCS-NCMR, for the Indo Science Education Trust.
https://www.youtube.com/watch?v=kmdqLQjFq-Q

c) Dr. Yogesh Shouche participated as a panelist:
On a live web cast about the annular solar eclipse 2020, organized by IUCAA SciPop.

d) "The exciting life of a stem cell":
Dr. Deepa Subramanyam delivered this popular science public talk at the virtual "Sci Talk Lecture series" on Life Sciences organized by the Muktangan Exploratory; 13 September, 2020. >750 members of the general public, including students, attended the talk.

e) Popular science articles in Marathi published in the Diwali-special issue of 'Bhavtal', which was guest edited by Dr. Yogesh Shouche. The topics were as follows:

- Biological warfare - Dr. Yogesh Shouche
- Facing arduous situations - Dr. Avinash Sharma (participant of the recent Indian scientific expedition to Antarctica)
- Foldscope - Dr. Praveen Rahi

f) "Cellular Insights: A Relentless Quest", a film on NCCS, was one of the official entries selected to be screened at the 10th National Science Film Festival of India.
This festival was organized online by the Vigyan Prasar, Department of Science & Technology, Government of India, in collaboration with the Tripura State Council for Science & Technology, Government of Tripura. 'Cellular Insights', directed by Nandan Kudhyadi, was screened on 25 November 2020.

g) 'Bird flu in India': Virtual public talk in Marathi
Dr. Arvind Sahu delivered this talk, and participated in a QnA session organized by 'Bhavtal'; 24 January 2021.

h) Dr. Nibedita Lenka participated in the IBM and Quest Alliance sponsored STEM for Girls
Role Model Interaction for High School students (Odisha Chapter), organized by Restless Development India, 30 January 2021.

i) Popular science talk on the World AIDS Day (01 December 2020)
Dr. Debashis Mitra delivered a talk on 'The fight against HIV/AIDS: New strategies targeting the virus' at the Dr. D.Y. Patil Institute of Bioinformatics and Biotechnology, Pune.

j) Popular science talk on 'Genomics in Health and Disease'
Delivered by Dr. Debashis Mitra at the Commencement Ceremony of Biotechnology students at the Dr. D.Y. Patil Biotechnology & Bioinformatics Institute, Tathawade, Pune; 07 September 2020. About 100 students and their parents attended the talk.

k) 'Current research in diabetes & COVID, and carreer opportunities in biotechnology'
Webinar delivered by Dr. Vasudevan Seshadri for the Mushtifund Aryaan Higher Secondary School (MAHSS), Goa; 19 July 2020. This was attended by about 80 students of class XI and XII.

l) 'Microbes & Humans - Friends or Foes?'
Public talk delivered by Dr. Yogesh Shouche at a webinar in Marathi organized by 'Bhavatal'; 05 June 2020.

m) 'Microbes in Public health'
Popular science virtual talk organized by NCCS-NCMR for 100 students from clasees X, XI and XII of the United Science Foundation; 27 December 2020.

n) Virtual Open Day
Organized by NCCS-NCMR for >50 participants from NEERI, Nagpur; Theme: Anaerobes and anaerobic processes; 16 February 2021.

o) Landfills Leachate: A Black Devil for Environmental and Public Health
Blog article by Om Prakash & Kranti Karande of NCCS-NCMR; 03 June 2020.
https://thescientificfactor.com/landfills-leachate-a-black-devil-for-environmental-and-public-health/

p) 'Microbe World' blogsite (https://ncmrnccs.wordpress.com/).
Around 45 articles were published on this blogsite, including interviews of researchers, stories based on publications from NCCS-NCMR, services at NCCS-NCMR etc.

'Manav' Data Science Webinar Series

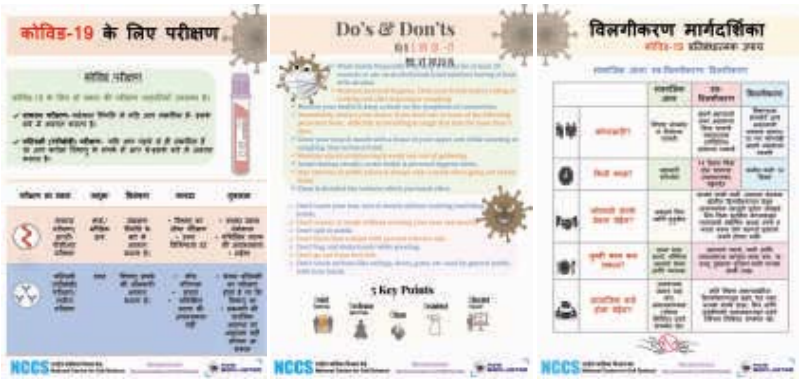
Organized by the 'Manav-Human Atlas Initiative', a collaborative project between NCCS, IISER-Pune and Persistent Systems (PS), funded by the DBT and co-funded by PS.

This series of free webinars was initiated by the 'Manav' team at IISER to increase public awareness about the various aspects of data science and its applications in studying pandemics and in other fields. The 'Manav' team at NCCS collaborated with the IISER team, and twenty-three webinars were organized during the period under review. The talks were delivered by data science experts from various fields and from renowned institutions within India, the USA, the UK, and Singapore. The webinars were attended by several hundred science enthusiasts, including faculty and students of DBT Star Colleges, under the 'DBT Science Setu' programme of NCCS.

COVID-19-Related Outreach

a) Posters with information about COVID-19

Posters with reliable and authentic bite-size information and infographics were prepared in Marathi, Hindi & English by the Pune BioCluster team to create awareness about various aspects of the pandemic (basic information about the disease, precautions, symptoms, dos & don'ts, myths & facts, etc.). These were distributed & shared on the websites of NCCS (https://www.nccs.res.in/index.php/Events/Covid) and the Pune Biocluster (http://pune-biocluster.co.in/Profile/Home.aspx).



b) Dr. Yogesh Shouche responded to questions about COVID-19 and SARS-CoV-2 in a Q&A session conducted in Marathi by the All India Radio (AIR), Pune, which was broadcast on 10th April, 2020.

c) Dr. Ajay Pillai was a panelist on the "COVIDGyan Sundowner Session on Research Funding" organized by the BLiSC Communications Office; 20 August, 2020.

d) Dr. Manoj Kumar Bhat, Director, NCCS, shared the COVID-related initiatives of NCCS at the DBT webinar, "Response of the DBT's Autonomous Institutes to COVID-19 (Part I)"; 21 August, 2020.

e) The significance of sequencing the viral genome from Indian patients, the outcomes of the studies done through DBT's pan-India 1000 genome sequencing initiative & the findings of the work carried out at NCCS were shared with the public in Marathi & English by Dr. Yogesh Shouche through the following means:

- Q&A sessions in Marathi on COVID-19 and viral genome sequencing – organized by the All India Radio Pune; BBC Marathi, Mumbai; & Vidnyan Bharati, Pune.
- An article on 'The Corona virus, mutations, and you' pubished in the Marathi newspaper, Maharashtra Times; 06 September, 2020.
- A talk in Marathi, titled, 'करोना विषाणूचे महाराष्ट्रातील बदलते स्वरूप' (The changing nature of the corona virus in Maharashtra), delivered by Dr. Yogesh Shouche at the virtual Vidnyan Samvad virtual series organized by Vidnyan Bharati, Pune; 13 September.
- Participation in discussions on the Corona virus, and its genome sequencing, on NDTV.
- Participation in discussions on the significance of mutations in the COVID-causing virus, vis-à-vis the effectiveness of vaccines, organized by 'Marathi Vidnyan'.
- Article published in the Marathi newspaper, Maharashtra Times, titled, 'The Corona virus, mutations, and you'.

e) Dr. Yogesh Shouche delivered a popular science talk on 'History of pandemics and what we learnt from them' at the virtual "Sci Talk Lecture series" on Life Sciences organized by the Muktangan Exploratory; 30 September 2020. It was attended by over 1000 students.

f) Dr. Yogesh Shouche was interviewed by a representative from the online magazine in Marathi, "ऐसीअक्षरे" (Aisiakshare). This conversation, published online under the heading, "व्हायरस, करोनाव्हायरस, आणि इतर काही" on 10 September, 2020, helped disseminate information about viruses, the coronavirus, biobanking and the NCCS CoE, NCMR.
The link: https://aisiakshare.com/index.php?q=node/7811

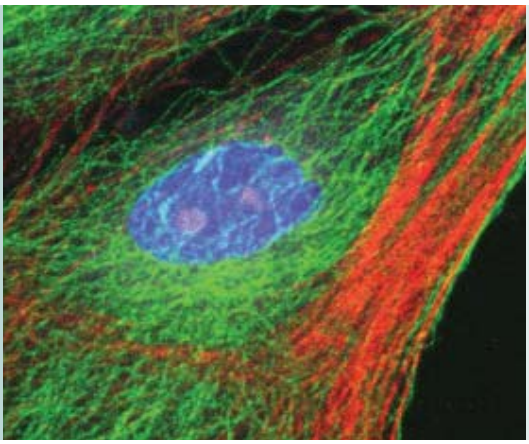
g) Dr. Arvind Sahu spoke about the second wave of the COVID pandemic and the emerging threat of antimicrobial resistance, at a webinar in Marathi organized by 'Bhavatal'; 27 November 2020.

h) Dr. Arvind Sahu contributed a popular science article, 'दुसरी लाट टाळण्यासाठी' (to prevent the second wave of COVID-19). This was published in the Diwali-special November 2020 issue of the Marathi magazine, 'Bhavtal', guest edited by Dr. Yogesh Shouche.

i) A public talk in Marathi about the changing nature of the corona virus and its current status was delivered by Dr. Yogesh Shouche at the Vigyan Yatra organized by NCCS as a prelude to IISF 2020; December 2020.

j) To help address questions and spread awareness about COVID vaccines, Dr. Yogesh Shouche participated in a discussion and Q&A session in Marathi, organized by 'Bhavatal', in association with the Association of the Microbiologists of India (AMI); 17 January 2021.

k) 'COVID-19: Current Understanding': Talk delivered by Dr Arvind Sahu at:
- The 'Science & Technology for Mankind' webinar series organized by the Indrashil University, Ahmedabad, 22 July 2020.
- The webinar on 'Dimensions of Biological Research during Post-COVID time' organized by the School of Life Sciences, Central University of Gujarat; 24 September 2020.



Conferences / Workshops / Other Events

Conferences / Workshops / Other Events Participated in

Participation by the NCCS Faculty

Nibedita Lenka

- 5th Annual Cell and Gene Therapy Symposium, Sept. 3-4, 2020, CMC, Vellore.
- 14th annual BioPharma Summit, Virtual edition, USA-India Chamber of Commerce., Sept. 4, 2020.
- The NewYork Stem Cell foundation (NYSCF) GALA and Science Fair, Oct. 27, 2020.
- International Society for Stem Cell Research (ISSCR) networking Meeting on Covid 19, every Thursday May, 2020 – Feb 2021.
- International Society for Stem Cell Research (ISSCR) convened resource events on "Stem Cell based Embryo Models and "Digital-computational stem cell biology", Apr-May, 2020.

Amitabha Majumdar

- EMBO laboratory leadership virtual course; 04 March 2021.

Yogesh Shouche

- Participated in a panel discussion on 'Promoting Research and Innovation in a Multidisciplinary Environment' organized by the Department of Biotechnology, 03 March 2021.

Deepa Subramanyam

- Participated as an invited panelist in an international panel discussion on 'Women in Science' organized online by #THEmeshwork. The other panelists were Sarah Snelling (University of Oxford) and Prachee Avasthi (Geisel School of Medicine at Dartmouth); 25 March 2021.
- Participated as a panelist invited to represent a woman scientist from Asia, at a panel discussion on 'Women's Careers in Cell Biology: Perspectives from Around the Globe', hosted by the American Society for Cell Biology (ASCB)/EMBO; 03 December 2020. Other panelists: Frances Brodsky, Susan Gasser & Harmit Malik.

Participation by Early-career & Project Scientists, Students, & Technical Staff

Sharmila Bapat's group

- Aravindam Narayanan : '12th International Summer School on Computational Mass Spectrometry- Based Proteomics, MaxQuant Summer School, 2021 (Max Plank Institute of Biochemistry, Germany)

Manoj Kumar Bhat's group

- Ankita Deb: 'Molecular Insights of Resistin Associated Proliferation by inducing Hypercholesterolemia in Breast Cancer', Deb A, Bhat MK. 2020: Annual Meeting of American Association of Cancer Research, 22-24 June, 2020; San Diego, USA. Abstract published: Cancer Res August 13 2020 80 (16 Supplement) 1466-1466; DOI:10.1158/1538-7445.AM2020-1466.

Radha Chauhan's group

- Shrankhla Bawaria : Virtual S2C2 Cryo-EM CCP-EM Modelling workshop; 10-13 November 2020.

Srikanth Rapole's group

- Bhargab Kalita: Presented an oral presentation entitled "Immunoprecipitation mass spectrometry" at PSI education day organized by National Chemical

Laboratory, Pune; 21 November 2020.

Shailza Singh's group

- Anurag Kumar : Participated in ISNTD d3 online conference. His abstract titled "Biophysical characterization and integrated MD simulation studies of Trypanothione Reductase in Leishmania major" was selected. 24-25 February 2021.

Deepa Subramanyam's group

- Understanding the effect of Huntingtin aggregates on clathrin-mediated endocytosis; Surya Bansi Singh, Amitabha Majumdar and Deepa Subramanyam; American Society for Cell Biology; 02 -16 December 2020.

Vidisha Tripathi's group

- Sonali Jathar : 'Regulation of cellular quiescence by MIR503HG'; Virtual conference: RNA at the Bench and Bedside II (Nature Conferences); 11-13 November 2020.
- Juhi Srivastava: 'Regulation of cellular proliferation by long noncoding RNAs'; Virtual conference: RNA at the Bench and Bedside II (Nature Conferences); 11-13 November 2020.
- Vikas Dongardive: 'Investigating the role of novel lncRNA lnc667 during cell cycle progression'; Virtual conference: RNA at the Bench and Bedside II (Nature Conferences); 11-13 November 2020.

Mohan Wani's group

- Satish Pote : Training program on 'Biosafety Practices in Laboratory for working with SARS-CoV-2' (COVID-19) at ICMR-NIV, Pune; 08 April 2020.
- Satish Pote : Training program on 'Laboratory Diagnosis of SARS-CoV-2' by Real-time RTPCR at ICMR-NIV, Pune; 17-18 April 2020.

Participation in the Vaishvik Bhartiya Vaigyanik (VAIBHAV) Summit organized by the Government of India

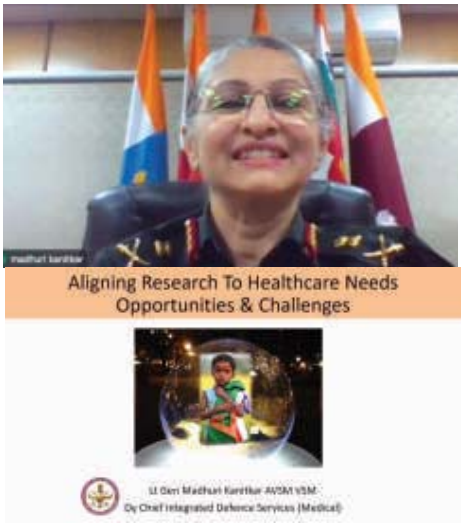
- Dr. Manoj Kumar Bhat was a panelist at the session on 'Precision medicine: Molecular insights'; 19 October 2020.
- Dr. Sharmila Bapat was a panelist at the session on 'Cancer Genomics India'; 20 October 2020.
  She delivered an invited talk on 'Cancer Research in India: Challenges / Potential solutions' during the V14H1S4 vertical.
- Dr. Yogesh Shouche delivered a talk on "Implications of Biological Diversity Act on Exchange of Microbial Resources", at the session on 'Microbial Resources for Sustainable Agriculture'; 10 October 2020.

Global Bio-India (01–03 March 2021)

NCCS participated in the Global Bio-India 2021 expo organized by the Department of Biotechnology. The expertise, services and patents of NCCS were displayed at a virtual booth.

Conferences & Other Events Organized

NCCS Foundation Day



Foundation Day Oration:

delivered by
Lt Gen (Dr) Madhuri Kanitkar
Deputy Chief, Integrated Defence Staff (Medical)

(26th August, 2020)

Other Talks Delivered by Invitees

Dr. Tatyarao Lahane
(Director, DMER, Government of Maharashtra)
addressed NCCS to express his appreciation when NCCS completed testing 10000 samples for COVID-19
10 July 2020

- 'Acoustic community structure in south Asian birds' - Dr. Anand Krishnan (DST-INSPIRE Faculty fellow, IISER, Pune); 04 December 2020.
- 'Pune Knowledge Cluster: A Project for Our City' - by Dr. Ajit Kembhavi, Professor Emeritus, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune; 08 January 2021.
- Talks delivered by Ms. Vrinda Walimbe, NCCS Counsellor, for the staff and students of NCCS:
  - 'Being Positive': Guidance for stress management especially through the pandemic; 07 October 2020 (ahead of the World Mental Health Day on 10 Oct, 2020).
  - 'Emotional Literacy': Bilingual talk in Hindi and English; 18 February 2021.

Technical Webinars

- 'Full Spectrum Flow Cytometry' - by Dr. Hemant Agrawal of Labindia Analyticals, India; 20 October 2020.
- 'Introduction to spinning disc super resolution' - by Olympus National Manager (Application); 09 February 2021.
- 'Introduction to Biacore and its applications' - 17 February 2021.

Speak your Science (SyS)

An in-house Young Researchers' Webinar Series, in celebration of the 75th year of India's independence. Thirty-five webinars were delivered by young researchers, including PhD students and faculty members of NCCS.

Other Happenings

The Constitution Day and Dr. Ambedkar Jayanti

This was commemorated from 26.11.2019 to 14.04.2020. The Preamble was circulated to all NCCS staff via email, for reading to be carried out at home on 14/04/2020, on the occasion of Dr. Ambedkar Jayanti.

Ambedkar Jayanti - taking a pledge to strengthen bonds of social unity, while maintaining social distancing.

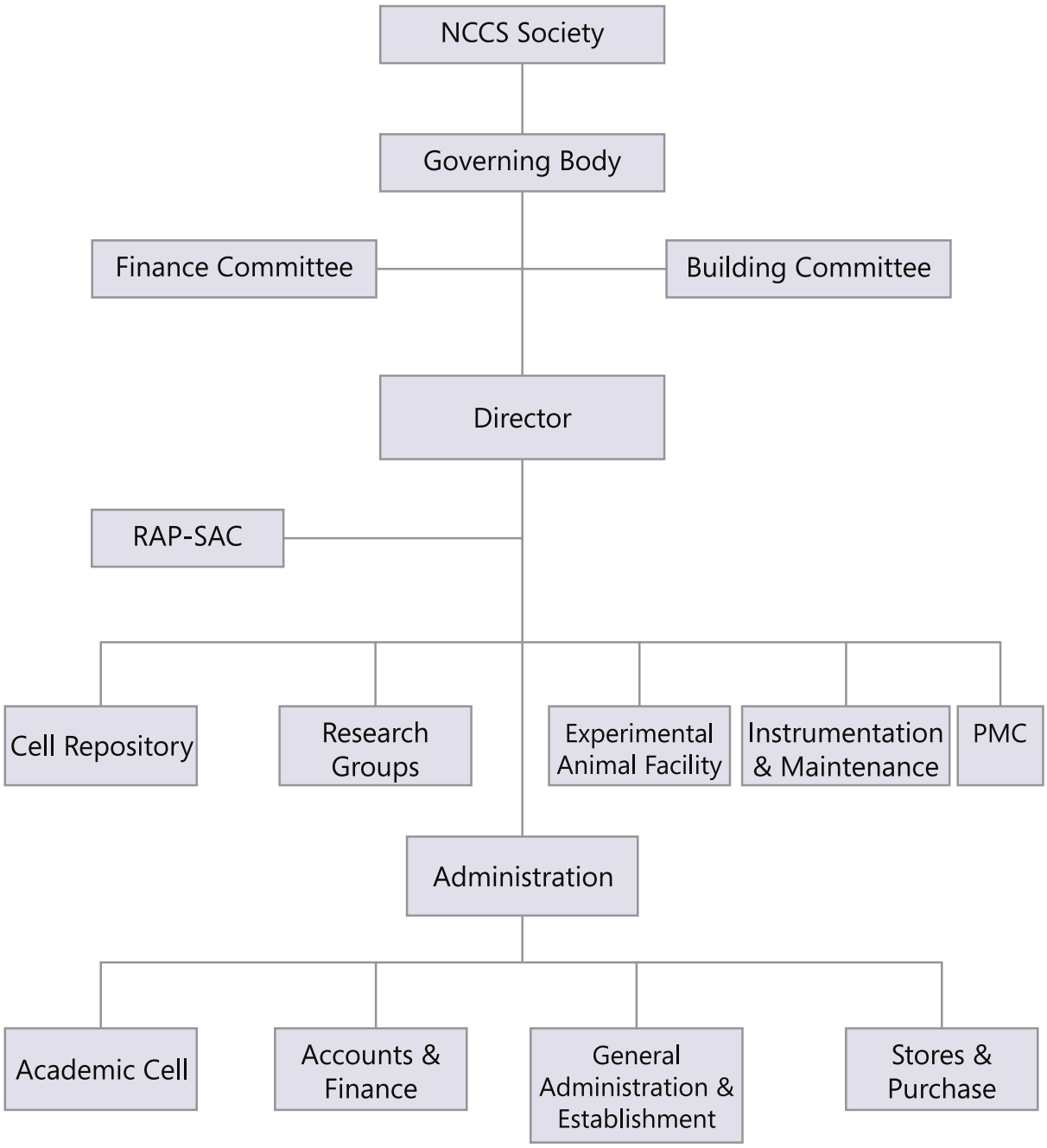
'Run for Fit India' (02 October 2020)

'Samvidhan Diwas'

Led by the Director,
Dr. Manoj Kumar Bhat,
NCCS joined the nation in
reading The Preamble

(26 November 2020)

NCCS Organization



NCCS Committees

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   New Delhi-110067, India

2. **Dr. Rajan Sankaranarayan** — Member
   Group leader
   Structural Biology Laboratory,
   Center for Cellular and Molecular
   Biology (CCMB), Uppal Road,
   Hyderabad 500 007, India

3. **Prof. Tapas Kundu** — Member
   Director,
   CSIR-Central Drug Research
   Institute, Sector 10,
   Jankipuram extension, Sitapur Road,
   Lucknow-226031, India

4. **Prof. Jayant B. Udgaonkar** — Member
   Director
   Indian Institute of Science Education
   & Research (IISER) Pune,
   Dr. Homi Bhabha Road,
   Pune – 411008, India

5. **Prof. Sujata Mohanty** — Member
   All India Institute of Medical Sciences(AIIMS),
   Stem Cell Facility,
   Sri Aurobindo Marg, Ansari Nagar,
   Ansari Nagar East,
   New Delhi 110029, India

6. **Prof. Udaykumar Ranga** — Member
   HIV-AIDS Laboratory,
   Molecular Biology & Genetics Unit,
   Jawaharlal Nehru Centre for Advanced
   Scientific Research,
   Rachenahalli Lake Rd, Jakkur,
   Bengaluru- 560064, India

7. **Prof. Kumarvel Somasundaram** — Member
   Associate Professor
   Microbiology & Cell Biology,
   Indian Institute of Science ,
   Banguluru - 560 012, India

8. **Dr. Alok Srivastava** — Member
   MD, FRACP, FRCPA, FRCP
   Professor of Medicine
   Head, Department of Hematology &
   Centre for Stem Cell Research,
   Christian Medical College
   Vellore - 632004, India

9. **Dr. Ram A. Vishwakarma** — Member
   Director
   Indian Institute of Integrative Medicine,
   Post Bag No. 3,
   Canal Road, Jammu-180001, India

10. **Dr. Sanjay Singh** — Member
    Chief Executive Officer
    Gennova Biopharmaceuticals Ltd.
    Hinjwadi, Pune - 57, India

11. **Prof. Sankar Ghosh** — Member
    Columbia University Irving
    Medical Center, Vagelos College of
    Physicians & Surgeons,
    630 West 168th Street,
    New York, NY 10032, USA

12. **Prof. Frances Brodsky** — Member
    Professor of Cell Biology
    Director, Division of Biosciences,
    Medical Sciences Building (Room 129),
    University College London
    London, WC1E 6BT, UK

13. **Prof. Roop Malik** — Member
    Department of Biological Sciences,
    Tata Institute of Fundamental Research

(TIFR), Homi Bhabha Road,
Navy Nagar, Colaba
Mumbai 400 005, India

14. **Dr. Suchita Ninawe** Member
Scientist 'G'
Senior Scientific Advisor
Department of Biotechnology
11 Lodi Road, CGO Complex
7-8th floor, II Block
New Delhi 110 003, India

Administration

The NCCS Administration consists of the following sections: General Administration & Establishment, Civil Maintenance, Accounts & Finance, and Stores & Purchase. The centre also has an Instrumentation & Maintenance unit. All these sections provide support services to the main scientific activities of the centre.

The NCCS staff strength (as on 31st March, 2021):

Scientists	:	29
Administrative Staff	:	39
Technical Staff	:	71

Total	:	139

Reservation Policy

NCCS follows the Government of India orders on reservation matters. For direct recruitments, respective rosters are followed, with reservation as follows: 15% for SC, 7.5% for ST and 27% for OBC, on an All India Basis other than Open Competition. Liaison officers have been nominated to ensure compliance with the reservation orders issued in favour of SC/ST/OBC. NCCS also follows the Government of India reservation policy for physically handicapped candidates

Right to Information Act 2005

As per the requirement of the RTI Act 2005, NCCS has nominated Shri. V. S. Shinde, Officer 'C' (Administration) as the CPIO and Dr. Jomon Joseph, Scientist 'F', has been nominated as the First Appellate Authority.

Security

NCCS has engaged a private Security Agency for providing security services on a contractual basis. All important places in the complex have been manned by security personnel throughout 24 hours in a day. As on date, there is no security-related problem at the Centre.

Committees

The Centre has formed the following committees as required under various statutes and guidelines for smooth functioning of the institute:

1. Grievance Committee
2. Internal complaints committee (for the prevention of sexual harassment at the workplace)
3. Institutional Animal Ethics Committee (IAEC)
4. Institutional Biosafety Committee (IBSC)
5. Institutional Ethical Committee (IEC) and Institutional Committee for Stem Cell Research (IC-SCR)

Disciplinary Matters

The Centre follows CCS (CCA) rules 1965 and NCCS bye-laws for monitoring disciplinary matters at the Centre.

Vigilance-related Matters

The National Centre for Cell Science (NCCS), Pune has been regularly sending the monthly, quarterly and yearly reports of all the vigilance-related matters including probity report, information about foreign tours of the staff, and responses to departmental inquiries and complaints (if any), to the CVO of the Department of Biotechnology, New Delhi. The 2020 Vigilance Awareness Week was observed from 27th October to 2nd November, 2020 with the theme "**सतर्क भारत, समृद्ध भारत**" ("Vigilant India, Prosperous India").

Implementation of the Official Language

The Director, NCCS, strongly supports the use of the Official Language in official work, and other related activities carried out at the Centre. NCCS has constituted the Official Language Implementation Committee to implement the orders of the Government of India to use the Official Language in day-to-day official work.

The Hindi Fortnight was held during the time period from 07 to 21 September, 2020. Due to the COVID-19 pandemic, the competitions, the Hindi workshop and the event held on Hindi Divas were all organized online. Despite being organized online, there was overwhelming response from the staff and students for the 'Hindi essay writing', and 'Hindi handwriting & dictation' competitions. Dr. Girdhari Lal, Mrs. Prachi Dani and Mr. Rameshwar Nema were deputed as internal examiners for these competitions. To encourage students and staff with diverse linguistic abilities to participate in these competitions, the

tradition of giving separate prizes to "Hindi bhashi" & "A-Hindi bhashi" particpants was followed this year as well. The Hindi Day function was held on an online platform on 18th September, 2020. Prof. Sadanand Bhosale, Professor & HOD, Department of Hindi, S. P. Pune University, Pune, graced the function as the Chief Guest. He expressed his views on the importance of using Hindi in official work. Dr. Manoj Kumar Bhat, Director, NCCS, gave an overview of the day-to-day activities conducted or organized in Hindi at the Institute, and released the eighth issue of the annual Hindi magazine, 'Meemansa'. The Hindi Day event was compered by Mr. Rameshwar Nema, Technical Officer (Library), NCCS.

Prof. Sadanand Bhosale, Chief Guest at the Hindi Divas, delivered a talk online

Release of the 8th issue of 'Meemansa'

A joint Hindi workshop was organised in association with CSIR-National Chemical Laboratory, Pune, during the Hindi fortnight. Dr. M. L. Gupta, Founder Director 'Vaishwik Hindi Sammelan', Home Ministry, Govt. of India, was invited as a speaker for the workshop. He shared his views on how & when Hindi became the Official Language & on the importance of Hindi in day-to-day official work.

Quarterly workshops in Hindi conducted by external experts were organized online. To promote the use of the official language, and to provide a platform to the staff members to express their ideas in Hindi, workshops in Hindi conducted by the NCCS staff were also initiated.

To spread awareness about COVID-19 among the staff and students of NCCS, and the general public, posters and banners in Hindi were displayed on the NCCS website and across the campus, as mentioned in the section on COVID-19.

NATIONAL CENTRE FOR CELL SCIENCE

An Autonomous Institute of
Department of Biotechnology, Govt of India
NCCS Complex, Savitribai Phule Pune University Campus,
Ganeshkhind, Shivaji Nagar, Pune 411007.

AUDITED STATEMENTS OF ACCOUNT

FOR

F.Y. 2020-2021

AUDITORS

M/S BHIDE & SHAH
CHARTERED ACCOUNTANTS,
5th Floor, 1025 Sadashiv Peth, Opp. Shivaji Mandir,
Pune-411030.
Tel : 020-24472314 / 24474737
bhideandshah@hotmail.com

BHIDE & SHAH
Chartered Accountants

5th Floor, 1025, Sadashiv Peth,
Opp. Shivaji Mandir, Pune – 411030
Phone Nos. : 24472314 / 24474737 / 24486357
E-mail : bhideandshah@hotmail.com

INDEPENDENT AUDITOR'S REPORT

To
THE DIRECTOR
NCCS Complex, P.B. No.40,
Ganesh Khind P.O.,
Pune-411007

Opinion

We have audited the financial statements of National Centre For Cell Science (the entity), which comprise the Balance Sheet as at 31st March 2021, and the Income And Expenditure Account for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.
In our opinion, the accompanying financial statements of the entity are prepared, in all material respects, in accordance with The Maharashtra Public Trust Act 1950, read with ,the common format of accounts for all Autonomous Institute as per letter No. BT/MED/NCCS/ADMN/2002 dtd.June 10,2002 of Department of Biotechnology, New Delhi and comptroller & Auditor General of India letter No. OA-VII(MISC/CORRES/2002-03/1165)dtd.16 October 2002.

Basis for Opinion
We conducted our audit in accordance with Standards on Auditing (SAs). Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the ethical requirements that are relevant to our audit of the financial statements, and we have fulfilled our other responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation of the financial statements in accordance with The Maharashtra Public Trust Act 1950 , read with ,the common format of accounts for all Autonomous Institute as per letter No. BT/MED/NCCS/ADMN/2002 dtd. June 10,2002 of Department of Biotechnology, New Delhi and comptroller & Auditor General of India letter No. OA-VII(MISC/CORRES/2002-03/1165)dtd.16 October 2002 and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.
In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so. Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements
Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

BHIDE & SHAH ★ PUNE-30. ★ CHARTERED ACCOUNTANTS

(SAMIR V.BHIDE)
PARTNER
M.NO.46274
UDIN: 21046274AAAACQ2918

Date: 27.08.2021
Place: Pune

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

BALANCE SHEET AS AT 31.03.2021

Amount (Rs.)

CORPUS/CAPITAL FUND AND LIABILITIES	Schedule	2020-2021	2019-2020
CORPUS/CAPITAL FUND	1	98,54,58,821.88	1,02,72,46,633.41
GENERAL RESERVE	2	-	-
EARMARKED/ENDOWMENT FUNDS	3	43,86,74,950.88	31,71,94,600.77
CURRENT-LIABILITIES & PROVISIONS	4	11,65,54,291.44	13,35,22,723.78
Total		**1,54,06,88,064.20**	**1,47,79,63,957.96**
ASSETS			
FIXED ASSETS	5	83,14,76,037.00	84,69,66,868.56
CURRENT ASSETS, LOANS, ADVANCES	6	70,92,12,027.20	63,09,97,089.40
MISCELLANEOUS EXPENDITURES (to the extent not written off or adjusted)			
Total		**1,54,06,88,064.20**	**1,47,79,63,957.96**
SIGNIFICANT ACCOUNTING POLICIES	14		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	15		

The schedules referred to above form an integral part of the Balance Sheet.
The above Balance Sheet to the best of our knowledge & belief contains a True Account of the Funds & Liabilities of the Property and Assets of the National Centre for Cell Science.

Date: 27.08.2021
Place: Pune

As per our report of even date.

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

(SAMIR V.BHIDE)
PARTNER
M.NO.46274

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

OFFICER 'C' ACCOUNTS
NCCS
वैभव अ. अरगडे
Vaibhav A. Argade
अधिकारी 'ग' (लेखा)
Officer 'C' (Accounts)
रा.को.वि.कें./NCCS Pune-411007

DIRECTOR
NCCS
मनोज कुमार भट, पीएच डी
निदेशक, एनसीसीएस, पुणे
Manoj Kumar Bhat, PhD
Director, NCCS, Pune

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31.03.2021

Amount (Rs.)

INCOME	Schedule	2020-2021	2019-2020
INCOME FROM SALES/SERVICE	7	1,04,00,337.00	85,37,200.00
GRANTS/SUBSIDIES	8	40,10,00,000.00	45,00,00,000.00
FEES/SUBSCRIPTIONS	9	-	18,220.00
INTEREST EARNED	10	70,317.00	2,33,353.00
OTHER INCOME	11	27,67,000.71	23,15,729.00
TOAL (A)		**41,42,37,654.71**	**46,11,04,502.00**
EXPENDITURE			
ESTABLISHMENT EXPENSES	12	23,43,37,150.00	23,66,65,698.00
OTHER ADMINISTRATIVE EXPENSES	13	17,35,15,850.24	21,97,65,803.71
DEPRECIATION	5	11,81,72,466.00	11,79,92,551.01
TOTAL (B)		**52,60,25,466.24**	**57,44,24,052.72**
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO			
CORPUS/CAPITAL FUND		**(11,17,87,811.53)**	**(11,33,19,550.72)**
SIGNIFICANT ACCOUNTING POLICIES	15		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	16		

The schedules referred to above form an integral part of the Income & Expenditure Account.

We hereby certify the above statement to be true and correct to the best of our knowledge and belief.

Date: 27.08.2021

Place: Pune

As per our report of even date.

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

BHIDE & SHAH * PUNE-30. * CHARTERED ACCOUNTANTS

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

OFFICER 'C' ACCOUNTS
NCCS
वैभव अ. अरगडे
Vaibhav A. Argade
अधिकारी 'ग' (लेखा)
Officer 'C' (Accounts)
रा.को.वि.के./NCCS Pune-411007

DIRECTOR
NCCS
मनोज कुमार भट, पीएच डी
निदेशक, एनसीसीएस, पुणे
Manoj Kumar Bhat, PhD
Director, NCCS, Pune

(SAMIR V.BHIDE)
PARTNER
M.NO.46274

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

RECEIPTS & PAYMENTS ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2021

Receipts	Amount	Amount	Payments	Amount	Amount
Opening Balance		**60,97,31,758.80**	**ESTABLISHMENT EXPENSES**		**2,47,30,919.00**
Bank Accounts			Admin Charges	4,72,891.00	
NCCS Bank Accounts			Salaries	2,42,58,028.00	
Axis BANK	2,26,883.00				
Bank of India - 4911	24,10,28,375.26		**OTHER ADMINISTRATIVE EXPENSES**		**2,54,33,433.27**
State Bank of India	97,56,702.73		Bank Charges	74,520.83	
Project Bank Account			Electricity and Power	7,92,750.00	
Bank Of India 4912	34,84,83,323.31		Eligibility Fees	7,600.00	
Bank of India (for SERB)- 8403	1,21,27,732.50		Rent, Rates and Taxes	1,35,91,238.00	
Cash-in-hand	1,28,742.00		Consumables	35,65,843.85	
			Contingencies	52,65,042.79	
GRANTS/SUBSIDIES		**40,10,00,000.00**	TA-DA	1,36,438.00	
Grant in Aid General	18,00,00,000.00				
Grant in Aid Salary	22,10,00,000.00		**Payment against Provisions**		**5,47,82,548.00**
			Provision for Leave Encashment & Gratuity	1,29,98,604.00	
			Provision for Works on Contract	4,37,85,944.00	
CORPUS/CAPITAL FUND		**7,00,00,000.00**	**Purchase of Fixed Assets**		**9,53,87,056.39**
Corpus/Capital Fund	7,00,00,000.00		Library	8,93,935.78	
			Building	2,124.00	
Fixed Assets		**14,160.00**	Capital W.I.P-Building	1,00,31,876.00	
Covid 19 Vaccine Testing Facility	14,160.00		Equipments	8,44,59,120.61	
Earmarked Fund		**42,13,44,089.68**	**Earmarked Fund**		**12,53,78,880.79**
Sales Accounts		**49,55,000.00**	**Payment against Current Liabilities**		**51,06,87,482.05**
Income from Sales / Service	49,05,000.00		Dr. Mitra - Leave Salary Payable	3,18,490.00	
			Hostel Charges Recovery-Payable	1,47,544.00	
Indirect Incomes		**81,69,902.00**	Medical Insurance -Payable	2,67,172.00	
Cont-Misc. Income	1,107.00		Payable	11,35,228.00	
Guest House	45,336.00		Duties & Taxes	3,50,24,608.00	
Interest Earned	77,29,890.00		Sundry Creditors	30,78,51,192.05	
Interest Earned on Covid Testing Receipts A/c 8574	65,957.00		Earnest Money Deposit	6,75,750.00	
Interest on Income Tax Refund	1,70,341.00		Salary Payable	16,39,41,381.00	
Sale of Scrap	18,228.00		Security Deposit	13,26,126.00	
Transit House Charges	35,735.00				
Usage of Premises for ATM	1,03,308.00				
Acadamic Other Income		**13,97,006.40**	**Payment against Current Assets**		**31,91,631.00**
Application Fees	2,03,418.40		Loans & Advances (Asset)	31,91,631.00	
Hostel Charges	2,39,038.00				
Ph.D Fees	9,54,550.00		**Indirect Expenses**		**6,30,317.46**
			Covid Testing Expenditure	6,30,317.46	
Current Liabilities		**3,01,088.00**			
Salary-Employees Welfare	2,22,775.00				
Performance Guarantee Deposit (PBG)	13,813.00				
Student - Caution Money	64,499.00		**Closing Balance**		**68,79,79,220.96**
			Bank Accounts		
Collection from Debtors		**1,11,90,522.04**	Bank of India - CSR 8574	36,76,848.54	
Sundry Debtors	1,11,85,122.04		NCCS Employee Welfare Current A/c 0538	2,22,775.00	
Receivable	5,400.00		NCCS Bank Accounts		
			Bank of India - 4911	20,13,31,265.34	
			State Bank of India	29,15,780.17	
OTHER ADMINISTRATIVE EXPENSES		**1,27,974.00**	Project Bank Account		
Work On Contract	1,27,974.00		Bank Of India 4912	35,39,26,999.47	
			Bank of India (for SERB 8403)	2,10,07,185.44	
			Bank of India (Vaccine Facility)8783	10,46,48,387.00	
			Cash-in-hand	50,000.00	
Total		**1,52,82,01,498.92**	**Total**		**1,52,82,01,498.92**

SIGNIFICANT ACCOUNTING POLICIES	SCH "14"
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	SCH "15"

The schedules referred to above form an integral part of the Receipts & Payments Account.
This is the Receipts & Payments Account referred to in our report of even date.

EXAMINED AND FOUND CORRECT AS PER BOOKS OF ACCOUNT PRODUCED AND INFORMATION GIVEN, SUBJECT TO OUR SEPARATE REPORT OF EVEN DATE

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

(SAMIR V.BHIDE)
PARTNER
M.NO.46274

OFFICER 'C' ACCOUNTS
NCCS
वैभव अ. अरगडे
Vaibhav A. Argade
अधिकारी 'ग' (लेखा)
Officer 'C' (Accounts)
रा.को.वि.के./NCCS Pune-411007

DIRECTOR
NCCS
मनोज कुमार भट, पीएच डी
निदेशक, एनसीसीएस, पुणे
Manoj Kumar Bhat, PhD
Director, NCCS, Pune

BHIDE & SHAH ★ PUNE-30. ★ CHARTERED ACCOUNTANTS

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE 1 - CORPUS/CAPITAL FUND

(Amount-Rs.)

Particulars	2020-21	2019-20
SCHEDULE 1- CORPUS/CAPITAL FUND:		
Balance at the beginning of the year	1,02,72,46,633.41	96,05,66,184.13
Add /(Deduct) : Balance of net income /(expenditure)	-	-
Deduct : Capital grants written off	-	-
	1,02,72,46,633.41	96,05,66,184.13
Add : Contribution towards Capital Fund	7,00,00,000.00	18,00,00,000.00
Add : General Reserve	-	-
	1,09,72,46,633.41	1,14,05,66,184.13
Add/(Deduct) : Bal. Of net income/(expenditure) transferred from the Income and Expenditure A/c.	(11,17,87,811.53)	(11,33,19,550.72)
BALANCE AS AT THE YEAR - END	**98,54,58,821.88**	**1,02,72,46,633.41**

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE 2 -GENERAL RESERVE

Amount (Rs.)

Particulars	2020-21	2019-20
General Reserve	-	-
Grand Total	-	-

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE-3 EARMARKED/ENDOWMENT FUND

(Amount-Rs.)

No.	Name of the Project & P.I.	Opening	Additions	Interest &	Total	Utilization/Expenditure			Closing
		Balance	Grant. Recd.	Other Receipts		Capital	Revenue	Total	Balance
1	AB/JK/DBT-RA-DR. AJINKYA BENDRE	39,094.00	7,97,720.00	545.00	8,37,359.00	-	8,13,199.00	8,13,199.00	24,160.00
2	AB/MW/BIOCARE/07/9813-AMRUTA BARHANPURKAR	(2,88,776.00)	-	-	(2,88,776.00)	-	-	-	(2,88,776.00)
3	AC/BIRAC/COVID-0032-DR. AKANKSHA CHATURVEDI	-	4,00,000.00	2,634.00	4,02,634.00		33,783.00	33,783.00	3,68,851.00
4	AC/SERB/CRG/004981-DR. AKANKSHA CHATURVEDI	24,90,133.00	-	78,997.00	25,69,130.00	-	7,21,524.00	7,21,524.00	18,47,606.00
5	AM/BT/PR-25893-DR. MAJUMDAR	16,60,902.34	-	35,851.00	16,96,753.34	2,38,994.00	11,25,451.26	13,64,445.26	3,32,308.08
6	AM/DBT-WELLCOME-DR. MAJUMDAR	(9,19,479.14)	-	359.00	(9,19,120.14)	-	53,638.00	53,638.00	(9,72,758.14)
7	AM/ECR/SERB/000429-DR, MAJUMDAR	12,08,478.00	-	37,287.00	12,45,765.00	-	8,30,095.82	8,30,095.82	4,15,669.18
8	AN/MW/SR/WOS-A/LS-25-DR. AMRUTA NAIK	(1,70,784.00)	10,48,000.00	-	8,77,216.00	-	8,77,216.00	8,77,216.00	-
9	AS/BT/PR-10852-DR. SHIRAS	1,27,738.00	-	2,857.00	1,30,595.00	-	1,63,831.00	1,63,831.00	(33,236.00)
10	AS/BT/PR-15178-DR. SHIRAS	15,86,045.00	-	35,807.00	16,21,852.00	-	11,92,344.43	11,92,344.43	4,29,507.57
11	AS/BT/PR-28506-DR. A K SAHU	9,41,378.00	17,03,801.00	38,692.00	26,83,871.00	2,37,549.00	14,82,706.80	17,20,255.80	9,63,615.20
12	AS/BT/PR8739-DR. SHIRAS	60,574.00	-	1,719.00	62,293.00	-	-	-	62,293.00
13	AS/BT/PR-9725-DR. A K SAHU	(1,93,404.00)	-	-	(1,93,404.00)	-	933.00	933.00	(1,94,337.00)
14	AS/CSIR-NMITLI-DR. A K SAHU	-	57,10,000.00	65,432.00	57,75,432.00	-	4759984.64	47,59,984.64	10,15,447.36
15	AS/DST-551/IPSC (CORE)-DR. SHIRAS	30,22,420.00	-	85,744.00	31,08,164.00	30,00,000.00	-	30,00,000.00	1,08,164.00
16	AS/DST/VI-D&P/551-DR. SHIRAS	(11,81,674.74)	-	8,916.00	(11,72,758.74)	(71,03,422.74)	52,72,612.72	(18,30,810.02)	6,58,051.28
17	AS/ICMR/90-DR. SHIRAS	-	-	-	-	-	32,924.00	32,924.00	(32,924.00)
18	AS/PR-14258-DR. SHIRAS	(73,843.00)	-	-	(73,843.00)	-	-	-	(73,843.00)
19	AS/SERB/JCB/000020-DR. A K SAHU	-	12,00,000.00	9,587.00	12,09,587.00		1,74,000.00	1,74,000.00	10,35,587.00
20	AS/UNILEVER-DR. SHIRAS	6,71,914.00	-	-	6,71,914.00	-	-	-	6,71,914.00
21	AS/WELLCOME-DR. AVINASH SHARMA	7,55,555.00	25,53,617.00	25,917.00	33,35,089.00	-	11,40,480.00	11,40,480.00	21,94,609.00
22	ASHWINI DHAMANGE/GM/NASI/620/3	3,80,407.00	4,09,962.00	5,534.00	7,95,903.00	-	5,14,800.00	5,14,800.00	2,81,103.00
23	AY/KR-03/NMPB-IV-DR. AMIT YADAV	-	10,18,000.00	11,706.00	10,29,706.00		5,04,190.78	5,04,190.78	5,25,515.22
24	AY/YS/EEQ/2016/000752-DR. AMIT YADAV	1,59,198.00	-	2,833.00	1,62,031.00	-	1,62,031.00	1,62,031.00	-
25	AY/SEB/000889/CONFERENCE-DR, AMIT YADAV	4,757.00	-	-	4,757.00	-	4,757.00	4,757.00	-
26	BAHIR/WOS-LS-602-DR. BAHIR	83,969.00	-	-	83,969.00	-	5,90,060.00	5,90,060.00	(5,06,091.00)
27	BHATNAGAR AWARD-DR, KUNDU	45,000.00	-	-	45,000.00	-	45,000.00	45,000.00	-
28	BIVALKAR/WOS-A/LS/2016-DR. BIVALKAR	(1,60,453.00)	-	-	(1,60,453.00)	-	-	-	(1,60,453.00)
29	BK/SR/DBT-RA/DR. BHARGAB KALITA	1,357.00	7,71,680.00	1,426.00	7,74,463.00	-	7,71,007.68	7,71,007.68	3,455.32
30	BS/INFECT-ERA/33-DR. BHASKAR SAHA	(78,041.00)	15,98,983.00	10,020.00	15,30,962.00	-	12,81,832.49	12,81,832.49	2,49,129.51
31	BS/BT/PR10785 - DR. SAHA	(4,60,986.00)	-	-	(4,60,986.00)				(4,60,986.00)
32	BS/BT/PR-718-DR. SAHA-27.09.11TO26.09.16	(6,56,982.00)	-	-	(6,56,982.00)				(6,56,982.00)

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BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

SCHEDULE-3 EARMARKED/ENDOWMENT FUND

{ Amount-Rs.}

No.	Name of the Project & P.I.	Opening	Additions	Interest &	Total	Utilization/Expenditure			Closing
		Balance	Grant. Recd.	Other Receipts		Capital	Revenue	Total	Balance
33	BS/BT/PR-7505-DR. BHASKAR SAHA	(1,17,090.00)	-	-	(1,17,090.00)	-	-	-	(1,17,090.00)
34	BS/DST/INDO-UK/P-123-DR. SAHA	(31,970.00)	22,27,533.00	25,415.00	22,20,978.00	-	20,39,203.01	20,39,203.01	1,81,774.99
35	BS/PR-14435-DR. SAHA	(4,21,933.00)	-	-	(4,21,933.00)	-	-	-	(4,21,933.00)
36	BS/SERB/JCB-DR. SAHA	9,56,672.00	9,50,000.00	31,845.00	19,38,517.00	-	16,50,252.66	16,50,252.66	2,88,264.34
37	CICS-ISRF FELLOWSHIP-MR. SUJIT SHAH	8,727.00	-	248.00	8,975.00	-	-	-	8,975.00
38	CSIR FELLOWSHIP	(1,98,84,913.05)	93,332.00	-	(1,97,91,581.05)	-	39,487.00	39,487.00	(1,98,31,068.05)
39	CSIR-RA FELLOWSHIP	(13,25,946.00)	-	-	(13,25,946.00)	-	-	-	(13,25,946.00)
40	DBT-BINC FELLOWSHIP	2,62,437.00	5,89,540.00	3,245.00	8,55,222.00	-	7,57,111.00	7,57,111.00	98,111.00
41	DBT FELLOWSHIP	(52,395.00)	88,66,630.00	10,217.00	88,24,452.00	-	92,77,998.47	92,77,998.47	(4,53,546.47)
42	DBT-JRF PROGRAMME	3,77,623.00	-	8,155.00	3,85,778.00	-	2,49,560.00	2,49,560.00	1,36,218.00
43	DBT - PDF PROGRAMME	22,94,239.00	-	65,086.00	23,59,325.00	-	-	-	23,59,325.00
44	DBT TWAS FELLOWSHIP	4,99,414.00	1,75,650.00	9,324.00	6,84,388.00	-	6,46,675.00	6,46,675.00	37,713.00
45	DM/BIRAC-DR. MITRA	(2,22,629.00)	-	-	(2,22,629.00)	-	-	-	(2,22,629.00)
46	DM/BT/HRD/35/01/03-DR.MITRA	(46,996.00)	-	-	(46,996.00)	-	-	-	(46,996.00)
47	DM/BT/PR-14226-DR. MITRA	(4,76,857.00)	-	-	(4,76,857.00)	-	-	-	(4,76,857.00)
48	DM/BT/PR-15450-DR. MITRA	(2,05,693.00)	16,69,432.00	16,287.00	14,80,026.00	-	13,44,531.22	13,44,531.22	1,35,494.78
49	DM/JCB/18-19-DR. MITRA	3,058.00	19,00,000.00	18,902.00	19,21,960.00	-	12,07,946.73	12,07,946.73	7,14,013.27
50	DM/SERB/003331-DR. MITRA	(2,580.00)	8,00,000.00	9,249.00	8,06,669.00	-	5,89,495.00	5,89,495.00	2,17,174.00
51	DM/THSTI-DR. MITRA	(18,445.00)	-	-	(18,445.00)	-	-	-	(18,445.00)
52	DP/PACER-POP/BS-01-DR. DHIRAJ PAUL	6,55,892.00	3,22,500.00	16,524.00	9,94,916.00	-	8,76,010.17	8,76,010.17	1,18,905.83
53	DS/BATTELE INDIA-DR. DEEPA	(22,472.00)	-	-	(22,472.00)	-	-	-	(22,472.00)
54	DS/BT/PR-25883 - DR. DEEPA	33,190.34	18,86,742.00	20,777.00	19,40,709.34	-	10,92,485.96	10,92,485.96	8,48,223.38
55	DS/BT/PR-30450-DR. DEEPA	5,32,549.22	16,06,383.00	14,980.00	21,53,912.22	-	6,45,861.00	6,45,861.00	15,08,051.22
56	DS/ICMR-2020-3076/SCR-DR. DEEPA	-	15,05,118.00	-	15,05,118.00	-	-	-	15,05,118.00
57	DST INSPIRE FELLOWSHIP	(14,50,078.00)	19,62,004.00	1,520.00	5,13,446.00	-	5,72,545.00	5,72,545.00	(59,099.00)
58	DS/WELLCOMETRUST-DR. DEEPA	5,66,272.58	-	5,982.00	5,72,254.58	11,04,665.65	6,86,877.93	17,91,543.58	(12,19,289.00)
59	GD/CRG/2019-005587 - DR. GAURAV DAS	-	15,12,120.00	35,810.00	15,47,930.00	-	8,87,531.79	8,87,531.79	6,60,398.21
60	GD/SB/52/RJN-048/2017-DR. GAURAV DAS	71,056.00	6,90,000.00	3,811.00	7,64,867.00	30,432.00	4,24,220.00	4,54,652.00	3,10,215.00
61	GK/5TH INTERNATIONAL CONF. TRANSLATION RES.-DR. KUNDU	2,83,533.44	-	-	2,83,533.44	-	-	-	2,83,533.44
62	GK/BT/MED/30/VNCI-Hr/BRCA-DR. KUNDU	(2,63,982.00)	-	-	(2,63,982.00)	-	80,823.00	80,823.00	(3,44,805.00)
63	GK/BT/PR-14430-DR. KUNDU	1,06,505.00	-	3,020.00	1,09,525.00	-	-	-	1,09,525.00
64	GK/BT/PR-2573-DR.KUNDU	(3,52,346.00)	-	-	(3,52,346.00)	-	-	-	(3,52,346.00)
65	GK/BT/PR-28794-DR. KUNDU	4,64,050.76	-	6,438.00	4,70,488.76	-	4,70,488.76	4,70,488.76	-
66	GK/BT/PR-3021-DR.KUNDU	(3,68,191.00)	-	-	(3,68,191.00)				(3,68,191.00)
67	GK/BT/PR-4569 - DR. KUNDU	(1,08,652.00)	-	-	(1,08,652.00)				(1,08,652.00)

SCHEDULE-3 EARMARKED/ENDOWMENT FUND

(Amount-Rs.)

No.	Name of the Project & P.I.	Opening Balance	Additions Grant. Recd.	Interest & Other Receipts	Total	Utilization/Expenditure Capital	Revenue	Total	Closing Balance
68	GK/BT/PR-7665-DR. KUNDU	(5,12,786.00)	-	-	(5,12,786.00)	-	-	-	(5,12,786.00)
69	GK/CSIR-DR. KUNDU	(47,957.00)	-	-	(47,957.00)	-	-	-	(47,957.00)
70	GK/DST/IMRCD/INNO-INDIGO-DR. KUNDU	1,97,653.00	-	5,608.00	2,03,261.00	-	-	-	2,03,261.00
71	GK/MANAV/BT/PR-27731-DR. KUNDU	2,38,34,382.00	1,01,16,597.00	5,31,036.00	3,44,82,015.00	63,15,344.00	1,23,26,892.00	1,86,42,236.00	1,58,39,779.00
72	GK/PR-12730-DR. KUNDU	(5,34,424.00)	-	-	(5,34,424.00)	-	-	-	(5,34,424.00)
73	GK/BT/PR-17945	56,639.00	-	960.00	57,599.00	-	48,399.00	48,399.00	9,200.00
74	GK/SERB/002298-DR. KUNDU	13,87,422.00	-	35,733.00	14,23,155.00	-	6,84,667.72	6,84,667.72	7,38,487.28
75	GK/SR/SO/HS-70-DR. KUNDU	(3,32,350.00)	-	-	(3,32,350.00)	-	-	-	(3,32,350.00)
76	GL/BT/03/IYBA-DR. LAL	(5,62,237.00)	-	-	(5,62,237.00)	-	-	-	(5,62,237.00)
77	GL/BT/PR-14156-DR. LAL	10,30,114.00	-	20,957.00	10,51,071.00	-	8,16,460.20	8,16,460.20	2,34,610.80
78	GL/BT/PR-15533-DR. LAL	(6,75,674.46)	-	2,084.00	(6,73,590.46)	-	(9,81,877.46)	(9,81,877.46)	3,08,287.00
79	GL/DST/SJF/LSA-01-DR. LAL	36,23,559.86	10,00,000.00	74,665.00	46,98,224.86	-	47,70,420.39	47,70,420.39	(72,195.53)
80	GL/EMR/2016/007108-DR. LAL	8,34,627.00	-	31,950.00	8,66,577.00	-	5,28,967.59	5,28,967.59	3,37,609.41
81	GL/KEMHRC-DR. LAL	10,60,691.00	-	-	10,60,691.00	-	2,63,344.80	2,63,344.80	7,97,346.20
82	GL/KEMHRC-II-DR. LAL	60,71,731.00	14,45,771.00	-	75,17,502.00	-	10,22,364.68	10,22,364.68	64,95,137.32
83	GM/NASI PLATINUM JUBILEE CHAIR-DR. MISHRA	10,85,303.00	26,68,208.00	36,430.00	37,89,941.00	-	27,11,098.00	27,11,098.00	10,78,843.00
84	ICMR FELLOWSHIP	(27,85,954.02)	17,90,654.00	-	(9,95,300.02)	-	13,30,722.00	13,30,722.00	(23,26,022.02)
85	INSPIRE FACULTY AWARD-DEEPIKA PURI	11,52,169.00	22,48,000.00	25,089.00	34,25,258.00	-	21,89,142.00	21,89,142.00	12,36,116.00
86	INSPIRE FACULTY AWARD-DR. DEBASRI MUKHARJEE	(42,253.00)	-	-	(42,253.00)	-	-	-	(42,253.00)
87	INSPIRE FACULTY AWARD-DR. JYOTI SINGH	(3,497.00)	-	-	(3,497.00)	-	-	-	(3,497.00)
88	INSPIRE FACULTY AWARD-PRIYANKA DUTTA	5,40,091.00	22,48,000.00	9,017.00	27,97,108.00	51,818.16	24,19,235.75	24,71,053.91	3,26,054.09
89	INTRAMURAL PROJECT-IM-001	(6,99,824.74)	15,30,000.00	7,911.00	8,38,086.26	-	6,90,960.00	6,90,960.00	1,47,126.26
90	INTRAMURAL PROJECT-IM-002	19,23,373.20	-	47,938.00	19,71,311.20	-	12,54,838.95	12,54,838.95	7,16,472.25
91	IUSSTF-SONALI JATHAR	-	18,588.00	-	18,588.00	-	18,588.00	18,588.00	-
92	IUSSTF FELLOWSHIP	12,785.00	-	362.00	13,147.00	-	-	-	13,147.00
93	JJ/BT/PR-14537-DR.JOSEPH	(4,88,490.00)	-	-	(4,88,490.00)	-	-	-	(4,88,490.00)
94	JJ/BT/PR-27451-DR. JOSEPH	3,49,150.00	-	8,026.00	3,57,176.00	-	3,70,184.00	3,70,184.00	(13,008.00)
95	JJ/BT/PR32331-DR. JOSEPH	-	28,22,560.00	24,300.00	28,46,860.00	-	19,43,278.57	19,43,278.57	9,03,581.43
96	JJ/PR-727-DR. JOSEPH	(2,59,430.00)	-	-	(2,59,430.00)	-	-	-	(2,59,430.00)
97	JJ/SERB/001092	(85,886.00)	-	-	(85,886.00)	-	-	-	(85,886.00)
98	JK/DBT/WELLCOME-DR.JANESHKUMAR	4,67,480.00	-	-	4,67,480.00	-	4,67,480.00	4,67,480.00	-
99	JK/SERB/003971-DR. JANESH KUMAR	-	17,48,200.00	-	17,48,200.00	-	-	-	17,48,200.00
100	JK/SERB/CVD/000298-DR. JANESH KUMAR	-	16,00,000.00	12,783.00	16,12,783.00	-	6,61,040.49	6,61,040.49	9,51,742.51
101	JS/WELLCOME - DR. JYOTI SINGH	23,81,880.00	65,837.00	57,141.00	25,04,858.00	-	19,93,386.58	19,93,386.58	5,11,471.42
102	LL/BT/PR-11928-DR. LIMAYE	5,49,478.00	-	14,782.00	5,64,260.00	-	1,74,337.30	1,74,337.30	3,89,922.70

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

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SCHEDULE-3 EARMARKED/ENDOWMENT FUND

(Amount-Rs.)

No.	Name of the Project & P.I.	Opening Balance	Additions Grant. Recd.	Interest & Other Receipts	Total	Utilization/Expenditure			Closing Balance
						Capital	Revenue	Total	
103	LL/BT/PR-12696-DR. LIMAYE	42,897.10	-	-	42,897.10	-	-	-	42,897.10
104	LL/BT/PR-23620-DR. LIMAYE	2,10,728.00	1,59,272.00	5,281.00	3,75,281.00	-	1,66,059.00	1,66,059.00	2,09,222.00
105	LL/DAE/37B/BRNS-DR. LIMAYE	(1,08,965.00)	-	-	(1,08,965.00)	-	-	-	(1,08,965.00)
106	LL/JAI RESEARCH FOUNDATION-DR. LIMAYE	(25,46,806.00)	-	-	(25,46,806.00)	-	-	-	(25,46,806.00)
107	MB/BIRAC/BT/CRS0400/PACE-DR. BHAT	2,16,087.00	-	2,859.00	2,18,946.00	-	2,04,890.33	2,04,890.33	14,055.67
108	MB/BT/PR-23968 - DR. BHAT	8,13,79,440.00	12,00,84,431.00	34,12,908.00	20,48,76,779.00	5,89,940.00	1,65,64,150.51	1,71,54,090.51	18,77,22,688.49
109	MB/IED/04/2020-DR. BHAT	-	10,00,000.00	7,136.00	10,07,136.00	-	10,07,136.00	10,07,136.00	-
110	MB/ITC/CONSULTANCY - DR. BHAT	8,23,389.00	-	-	8,23,389.00	-	-	-	8,23,389.00
111	MS/BT/PR-15889-DR. MANAS SANTRA	(1,60,649.00)	-	-	(1,60,649.00)	-	-	-	(1,60,649.00)
112	MS/BT/PR-25181-DR. MANAS SANTRA	1,48,275.00	7,69,814.00	2,551.00	9,20,640.00	-	1,61,394.00	1,61,394.00	7,59,246.00
113	MS/CSIR/37/(1655)/15/EMR-II-DR. MANAS SANTRA	38,658.00	-	1,097.00	39,755.00	-	-	-	39,755.00
114	MS/EMR/002277-DR. MANAS SANTRA	5,19,774.00	-	2,702.00	5,22,476.00	-	4,69,453.00	4,69,453.00	53,023.00
115	MS/HRD/NBA/39-DR. MANAS SANTRA	27,869.00	4,92,000.00	3,453.00	5,23,322.00	-	5,17,316.29	5,17,316.29	6,005.71
116	MS/PR-152/TWINNING-DR. MANAS SANTRA	56.00	-	4.00	60.00	-	-	-	60.00
117	MS/SERB/CRG/005433-DR. MANAS SANTRA	-	24,89,600.00	-	24,89,600.00	-	-	-	24,89,600.00
118	MS/UNILEVER-DR. SANTRA	20,00,399.50	-	-	20,00,399.50	-	-	-	20,00,399.50
119	MW/BHU-DR. WANI	20,327.00	-	632.00	20,959.00	-	-	-	20,959.00
120	MW/HRD/35/01/04/2018-DR. WANI	5,33,651.00	-	15,855.00	5,49,506.00	-	5,00,968.00	5,00,968.00	48,538.00
121	MW/SERB/004441-DR. WANI	81,986.00	19,00,000.00	16,286.00	19,98,272.00	-	12,14,718.10	12,14,718.10	7,83,553.90
122	MW/SPPU/AYUSH-DR. WANI	4,62,680.00	-	12,790.00	4,75,470.00	-	4,14,598.26	4,14,598.26	60,871.74
123	NAM S&T FELLOWSHIP	7,649.00	-	217.00	7,866.00	-	-	-	7,866.00
124	NA5/141/7/2014-15-DR. RANI LEKHA	(2,34,000.00)	-	-	(2,34,000.00)	-	-	-	(2,34,000.00)
125	NE/SB/FT/CS-067/2014-DR. N D ERANDE	(75,165.00)	-	-	(75,165.00)	-	-	-	(75,165.00)
126	NL/BT/MUTAGENESIS(INDO-AUS)-DR.LENKA	(13,208.00)	-	-	(13,208.00)	-	-	-	(13,208.00)
127	NL/BT/PR-16655-DR. LENKA	2,74,395.00	-	7,514.00	2,81,909.00	-	45,558.00	45,558.00	2,36,351.00
128	NL/BT/PR-8219/31.03.14-30.03.16-Dr. Lenka	(1,10,957.00)	-	-	(1,10,957.00)	-	-	-	(1,10,957.00)
129	NL/ICMR/47/80-DR. LENKA	1,88,324.00	-	-	1,88,324.00	-	1,88,324.00	1,88,324.00	-
130	OP/EMR/2016/006589-DR. OM PRAKASH	(78,170.00)	7,00,000.00	2,530.00	6,24,360.00	-	6,27,721.00	6,27,721.00	(3,361.00)
131	OP/YSS/BT/PR-13969-DR. OM PRAKASH	(2,44,477.00)	8,34,854.00	1,030.00	5,91,407.00	-	1,08,810.00	1,08,810.00	4,82,597.00
132	PD/SERB/CRG/001727-DR. PRIYANKA DUTTA	3,40,000.00	-	6,941.00	3,46,941.00	-	3,38,096.00	3,38,096.00	8,845.00
133	PN/BT/NBM0166/04/19/BIRAC-DR. NAGVENKAR	12,25,44,527.00	-	34,77,770.00	12,60,22,297.00	-	2,08,258.00	2,08,258.00	12,58,14,039.00
134	PN/CVTF-DR. NAGVENKAR	-	11,19,60,000.00	-	11,19,60,000.00	76,80,856.00	-	76,80,856.00	10,42,79,144.00
135	PR/BT/IN/INDO-US/FOLDSCOPE/39-DR. PRAVEEN RAHI	22,568.00	-	-	22,568.00	-	22,568.00	22,568.00	-
136	PR/NMHS-DR. PRAVEEN RAHI	8,03,553.00	-	20,513.00	8,24,066.00	-	2,56,381.00	2,56,381.00	5,67,685.00
137	Project Overheads	2,03,60,874.16	34,37,309.08	-	2,37,98,183.24	-	23,93,816.89	23,93,816.89	2,14,04,366.35

BRUDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

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SCHEDULE-3 EARMARKED/ENDOWMENT FUND

(Amount-Rs.)

No.	Name of the Project & P.I.	Opening Balance	Additions Grant. Recd.	Interest & Other Receipts	Total	Utilization/Expenditure			Closing Balance
						Capital	Revenue	Total	
138	PS/DBT RA-DR. PARSHURAM SONAWANE	1,25,300.00	7,56,800.00	999.00	8,83,099.00	-	8,56,509.61	8,56,509.61	26,589.39
139	PS/ICMR/53/6/BM-DR. PADMA SHASTRY	(6,60,992.00)	-	-	(6,60,992.00)	-	-	-	(6,60,992.00)
140	PUNE BIOCLUSTER-DR. SHEKHAR MANDE	5,62,45,656.78	-	14,64,440.00	5,77,10,096.78	2,88,25,215.12	33,06,592.70	3,21,31,807.82	2,55,78,288.96
141	PV/JJ/DBT-RA-PALLAVI VARSHNEY	(2,731.00)	-	-	(2,731.00)	-	-	-	(2,731.00)
142	RC/BT/PR-15450-DR. RADHA CHAUHAN	(2,79,953.00)	14,53,126.00	11,780.00	11,84,953.00	-	11,85,904.85	11,85,904.85	(951.85)
143	RC/BT/PR-26398-DR. RADHA CHAUHAN	7,10,991.00	-	19,059.00	7,30,050.00	-	1,82,483.00	1,82,483.00	5,47,567.00
144	RC/BT/PR7118/15-18-DR. RADHA CHAUHAN	(96,573.00)	-	-	(96,573.00)	-	-	-	(96,573.00)
145	RC/SB/SO/BB-0030/13-16-DR.RADHA CHAUHAN	(2,46,623.00)	-	-	(2,46,623.00)	-	-	-	(2,46,623.00)
146	RC/SERB/000272-DR. RADHA CHAUHAN	7,92,025.00	-	10,898.00	8,02,923.00	-	8,11,743.00	8,11,743.00	(8,820.00)
147	RL/SR/WOS-A/LS-456-DR. RANI LEKHA	2,93,629.00	-	-	2,93,629.00	-	2,93,629.00	2,93,629.00	-
148	RS/BT/PR-25368-DR. ROHIT SHARMA	93,603.00	-	2,724.00	96,327.00	-	41,353.00	41,353.00	54,974.00
149	RS/BT/PR-25490-DR. ROHIT SHARMA	(1,85,241.00)	6,33,011.00	-	4,47,770.00	-	76,544.00	76,544.00	3,71,226.00
150	RS/BT/PR-29526-DR. ROHIT SHARMA	(58,629.00)	7,46,323.00	787.00	6,88,481.00	-	6,03,376.00	6,03,376.00	85,105.00
151	SANDHYA/DAE/35/14/31-BRNS-DR. SANDHYA	3,82,594.00	2,51,641.00	12,189.00	6,46,424.00	-	5,91,345.35	5,91,345.35	55,078.65
152	SANDHYA/SR/SO/BB-0119-DR.SANDHYA	(33,598.00)	-	-	(33,598.00)	-	-	-	(33,598.00)
153	SB/BT/11465-DR. BAPAT	(3,72,384.00)	-	-	(3,72,384.00)	-	-	-	(3,72,384.00)
154	SB/HRD-35/01/04-DR. BAPAT	78,680.00	8,53,820.00	5,675.00	9,38,175.00	-	7,87,235.79	7,87,235.79	1,50,939.21
155	SB/BT/INDO-FINNISH-DR. BAPAT	(1,74,378.00)	-	-	(1,74,378.00)	-	(1,74,378.00)	(1,74,378.00)	-
156	SB/CRG/2019/001157 - DR. BAPAT	21,16,120.00	-	79,451.00	21,95,571.00	-	12,89,401.80	12,89,401.80	9,06,169.20
157	SB/GODAVARI BIOREFINERIES-DR. BAPAT	18,600.00	-	-	18,600.00	-	-	-	18,600.00
158	SB/INDO AUSTRALIA SYMPOSIUM-DR. BAPAT	(16,664.00)	-	-	(16,664.00)	-	-	-	(16,664.00)
159	SC/AMRITA THERAPEUTICS-DR. SAMIT	(1,08,000.00)	-	-	(1,08,000.00)	-	-	-	(1,08,000.00)
160	SC/BT-11381-DR.SAMIT	(5,30,464.00)	-	-	(5,30,464.00)	-	-	-	(5,30,464.00)
161	SC/CSIR/37(1572)-DR.SAMIT	(2,27,473.00)	-	-	(2,27,473.00)	-	-	-	(2,27,473.00)
162	SC/SB/S2/JCB-II/2013-18-DR.SAMIT	1,30,546.00	-	3,798.00	1,34,344.00	-	-	-	1,34,344.00
163	SERB PDF FELLOWSHIP	11,28,402.72	11,85,573.00	26,201.00	23,40,176.72	-	2,81,514.72	2,81,514.72	20,58,662.00
164	SK/YS/BT/PR-19641-DR. SNEHAL KULKARNI	7,36,996.00	-	16,035.00	7,53,031.00	-	5,66,850.00	5,66,850.00	1,86,181.00
165	SM/BT/47/TE/TBP-DR. MANDE	(90,175.00)	-	-	(90,175.00)	-	-	-	(90,175.00)
166	SM/BT/IN/NEW INDIGO/05/SB/TB-OMICS-DR.MANDE	(32,671.30)	-	-	(32,671.30)	-	-	-	(32,671.30)
167	SM/BT/NEW INDIGO/18-DR. MANDE	(6,59,959.00)	-	-	(6,59,959.00)	-	-	-	(6,59,959.00)
168	SM/BT/PR-15450 (CORE GRANT)-DR. MANDE	4,08,248.00	2,64,063.00	15,470.00	6,87,781.00	-	4,43,937.00	4,43,937.00	2,43,844.00
169	SM/BT/PR-15450 (PROJECT 1)-DR. MANDE	(2,62,245.00)	17,79,002.00	22,833.00	15,39,590.00	-	9,69,085.09	9,69,085.09	5,70,504.91
170	SM/BT/PR-25395-DR. MANDE	2,92,252.00	4,55,755.00	6,015.00	7,54,022.00	-	4,00,063.00	4,00,063.00	3,53,959.00
171	SM/BT/PR-3260/BRB/2012-17	1,75,338.00	7,10,724.00	9,162.00	8,95,224.00	-	6,192.00	6,192.00	8,89,032.00
172	SM/BT/PR-7265-DIRECTOR,NCCS	2,57,314.00	-	7,300.00	2,64,614.00	-	-	-	2,64,614.00

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

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SCHEDULE-3 EARMARKED/ENDOWMENT FUND

[Amount-Rs.]

No.	Name of the Project & P.I.	Opening	Additions	Interest &	Total	Utilization/Expenditure			Closing
		Balance	Grant. Recd.	Other Receipts		Capital	Revenue	Total	Balance
173	SM/DST/INDO-RUSSIA/23.04.14-22.04.16-Dr. Mande	(1,07,683.00)	-	-	(1,07,683.00)	-	-	-	(1,07,683.00)
174	SM/DST/INT/RFBR/P-89-DR. MANDE	(2,38,142.00)	-	-	(2,38,142.00)	-	-	-	(2,38,142.00)
175	SM/DST/SPAIN/P-26/23.7.12-22.7.15-DR. MANDE	(4,30,348.00)	-	-	(4,30,348.00)	-	-	-	(4,30,348.00)
176	SR/BT/PR-10536-DR. SRIKANTH	(28,775.00)	-	-	(28,775.00)	-	-	-	(28,775.00)
177	SR/BT/PR-10855-DR. SRIKANTH	6,89,652.00	22,47,000.00	11,393.00	29,48,045.00	-	8,46,607.00	8,46,607.00	21,01,438.00
178	SR/BT/PR-4152/BRB/2013-DR.SRAPOLE	(44,269.00)	-	-	(44,269.00)	-	-	-	(44,269.00)
179	SR/DST/IMRCD/INNO-INDIGO-DR. SRIKANTH	(2,25,736.00)	-	-	(2,25,736.00)	-	-	-	(2,25,736.00)
180	SS/BT/PR-10286-DR. S SINGH	(47,218.00)	-	-	(47,218.00)	-	-	-	(47,218.00)
181	SS/BT/PR-16065-DR. S SINGH	(3,30,947.00)	-	-	(3,30,947.00)	-	19,920.00	19,920.00	(3,50,867.00)
182	SS/NATL. CONF. ON EMERGING TRENDS-REGN. FEES	1,27,203.00	-	-	1,27,203.00	-	-	-	1,27,203.00
183	SS/NATIONAL CONF. ON EMERGING TRENDS IN DMS-DBT	(25.00)	-	-	(25.00)	-	-	-	(25.00)
184	SS/NATIONAL CONF. ON EMERGING TRENDS IN D.M.S.-NASI	(694.00)	-	-	(694.00)	-	-	-	(694.00)
185	SS/BT/LS-400-DR. SINGH	(1,303.00)	-	-	(1,303.00)	-	-	-	(1,303.00)
186	STRUCTURAL BASED DRUG DESIGNING (SBDD)	(1,57,063.00)	-	-	(1,57,063.00)	-	-	-	(1,57,063.00)
187	TL/SERB/SRG/2019/001818-DR. TUSHAR LODHA	4,72,705.00	5,50,000.00	12,836.00	10,35,541.00	-	7,69,682.64	7,69,682.64	2,65,858.36
188	TRAVEL GRANT - CD318	45,887.00	-	-	45,887.00	-	-	-	45,887.00
189	UGC FELLOWSHIP	(93,19,749.50)	-	-	(93,19,749.50)	-	(11,41,593.00)	(11,41,593.00)	(81,78,156.50)
190	VK/BT/PR-14036-DR. KALE	(2,01,332.00)	-	-	(2,01,332.00)	-	-	-	(2,01,332.00)
191	VK/BT/PR-4227-DR.KALE	(37,115.00)	-	-	(37,115.00)	-	-	-	(37,115.00)
192	VK/DAE/PR-37B/BRNS-DR.KALE	(2,47,647.00)	-	-	(2,47,647.00)	-	-	-	(2,47,647.00)
193	VS/BT/PR-14109-DR.SESHADRI	(1,36,955.00)	-	-	(1,36,955.00)	-	-	-	(1,36,955.00)
194	VS/BT/PR-25858-DR. TRIPATHY	(49,946.00)	10,83,662.00	15,417.00	10,49,133.00	-	6,05,390.12	6,05,390.12	4,43,742.88
195	VS/SERB/2014/001093-DR. SESHADRI	19,925.00	-	566.00	20,491.00	-	-	-	20,491.00
196	VT/BT/PR-31772-DR. TRIPATHY	-	13,05,640.00	4,265.00	13,09,905.00	-	8,50,487.93	8,50,487.93	4,59,417.07
197	VT/RLF-DR. VIDISHA TRIPATHI	(59,543.00)	-	-	(59,543.00)	-	-	-	(59,543.00)
198	VT/SERB/004159-DR. TRIPATHI	15,71,244.00	2,00,000.00	55,378.00	18,26,622.00	-	14,94,632.93	14,94,632.93	3,31,989.07
199	VT/SERB/000242-DR. TRIPATHI	(22,336.00)	-	-	(22,336.00)	-	-	-	(22,336.00)
200	YS/BHORUKA CHARITABLE TRUST-DR. SHOUCHE	51,619.00	-	-	51,619.00	-	-	-	51,619.00
201	YS/BIRAC-DR. SHOUCHE	5,57,030.00	11,60,000.00	16,490.00	17,33,520.00	-	17,74,115.00	17,74,115.00	(40,595.00)
202	YS/INSACOG - DR. SHOUCHE	-	61,44,640.00	-	61,44,640.00	-	-	-	61,44,640.00
203	YS/BT/PR-1489-DR. SHOUCHE	(3,98,473.00)	-	-	(3,98,473.00)	-	-	-	(3,98,473.00)
204	YS/BT/PR-14956-DR. SHOUCHE	(1,40,225.00)		-	(1,40,225.00)	-	-	-	(1,40,225.00)
205	YS/BT/PR-20390-DR. SHOUCHE	(2,86,512.00)		-	(2,86,512.00)	-	61,967.00	61,967.00	(3,48,479.00)
206	YS/BT/PR-31340-DR. SHOUCHE	20,85,612.00	-	50,300.00	21,35,912.00	4,72,314.00	10,88,432.48	15,60,746.48	5,75,165.52
207	YS/BT/PR-3461-DR.SHOUCHE	(1,68,241.00)		-	(1,68,241.00)	-	-	-	(1,68,241.00)

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BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30

SCHEDULE-3 EARMARKED/ENDOWMENT FUND

(Amount-Rs.)

No.	Name of the Project & P.I.	Opening Balance	Additions Grant. Recd.	Interest & Other Receipts	Total	Utilization/Expenditure			Closing Balance
						Capital	Revenue	Total	
208	YS/DNB-DR. SHOUCHE	(1,27,174.00)	-	-	(1,27,174.00)	-	-	-	(1,27,174.00)
209	YS/ES/PO/SEISMO/1(361)/2019	15,71,280.00	-	38,638.00	16,09,918.00	-	8,73,669.00	8,73,669.00	7,36,249.00
210	YS/MCC-DR. SHOUCHE	(5,02,86,201.44)	-	-	(5,02,86,201.44)	-	-	-	(5,02,86,201.44)
211	YS/MS/RGSTC/FILE 2007-DR.SHOUCHE	(2,30,135.00)	2,30,135.00	-	-	-	-	-	-
212	YS/NCMR-DR. SHOUCHE	4,86,74,792.65	3,44,90,013.00	44,81,946.00	8,76,46,751.65	1,29,56,220.22	8,50,34,216.03	9,79,90,436.25	(1,03,43,684.60)
213	YS/TATA STEEL/PHASE-I-DR. SHOUCHE	(1,19,450.00)	-	-	(1,19,450.00)	-	-	-	(1,19,450.00)
214	YS/TATA STEEL/PHASE-II-DR. SHOUCHE	11,54,704.00	8,54,582.00	-	20,09,286.00	-	12,60,034.38	12,60,034.38	7,49,251.62
215	YS/UNILEVER-DR. SHOUCHE	64,782.00	-	-	64,782.00	-	-	-	64,782.00
216	ZK/WELLCOME-DR. ZAHID KAMAL	31,42,421.00	6,76,211.00	77,783.00	38,96,415.00	-	22,28,916.80	22,28,916.80	16,67,498.20
217	DBT/CTEP/01/2014-15 WORKSHOP	1,68,591.00	-	-	1,68,591.00	-	1,68,591.00	1,68,591.00	-
218	DBT/CTEP/02/20190950654-POULOMI BANERJEE	-	85,818.00	-	85,818.00	-	85,818.00	85,818.00	-
219	DBT/CTEP/02/20191150875-SHEHNAZ BANO	-	1,52,907.00	-	1,52,907.00	-	1,52,907.00	1,52,907.00	-
220	ITS/2018/2706-DR. AVINASH SHARMA	1,83,624.00	-	-	1,83,624.00	-	-	-	1,83,624.00
221	ITS/2018/003276-DR. PRAVEEN RAHI	71,002.00	-	-	71,002.00	-	-	-	71,002.00
222	MASSTRICH UNIV. PROJECT	(3,50,730.00)	-	-	(3,50,730.00)	-	-	-	(3,50,730.00)
223	SHYAMANAND CSIR TA/DA	44,394.00	-	-	44,394.00	-	44,394.00	44,394.00	-
224	SPONSORSHIP FEE-SIGNALS FROM GUT SYMPOSIUM -ARUN K	1,40,000.00	-	-	1,40,000.00	-	-	-	1,40,000.00
225	SVETNER INNOVATIONS P LTD. - DR. SHOUCHE	23,600.00	-	-	23,600.00	-	-	-	23,600.00
226	TA/DA-CTEP CLAIM-MR. ROHAN KULKARNI,EX SRF. CSIR	(45,887.00)	-	-	(45,887.00)	-	-	-	(45,887.00)
227	TA/DA-DBT FUND SANGEETA NIRANJANE	-	1,16,083.00	-	1,16,083.00	-	1,16,083.00	1,16,083.00	-
228	TA/DA-DST/JANGID/SCOTLAND	90,400.00	-	-	90,400.00	-	90,400.00	90,400.00	-
229	TRAVEL GRANT / CSIR - B V RAMRAJU AMBATI	-	1,64,250.00	-	1,64,250.00	-	1,64,250.00	1,64,250.00	-
	Total	**31,48,58,177.26**	**37,56,49,221.08**	**1,51,95,367.00**	**70,57,02,765.34**	**4,67,33,229.41**	**22,39,76,652.48**	**27,07,09,881.89**	**43,49,92,883.45**

No.	Name of the Project & P.I.	Opening Balance	Addition Unidentified during the year	Interest	Total	Deletion identified and trf to project		Total	Closing Balance
1	SUSPENSE A/C	23,36,423.51	12,51,741.11	1,38,877.00	37,27,041.62	-	44,974.19	44,974.19	36,82,067.43
	Grand Total	**31,71,94,600.77**	**37,69,00,962.19**	**1,53,34,244.00**	**70,94,29,806.96**	**4,67,33,229.41**	**22,40,21,626.67**	**27,07,54,856.08**	**43,86,74,950.88**

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BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE 4 - CURRENT-LIABILITIES

Amount (Rs.)

Particulars	2020-21	2019-20
Canteen Deposit	10,000.00	10,000.00
Earnest Money Deposit	13,21,998.00	22,14,248.00
Gardening Contract Deposit	30,000.00	30,000.00
Laundry Deposit	500.00	500.00
Security Deposit	31,92,756.00	32,17,692.00
Security Deposit/ Caution Money	34,91,000.00	34,79,524.00
Tele. Deposit	3,164.00	3,164.00
* M/s Shalaka Infra-Tech(I) Pvt. Ltd.	15,55,516.00	15,55,516.00
GST Payable	6,37,128.00	1,90,256.00
Tax Deducted at Source payable	7,57,686.00	5,66,407.00
Sundry Creditor	3,82,626.00	5,53,810.00
#Interest Earned Payble to DBT	83,95,549.20	71,57,597.58
IISER, Pune	-	2,55,00,000.00
Advance from Customers	34,16,988.24	20,82,053.20
EPF Payable	9,40,888.00	9,96,008.00
NPS Payable	4,51,504.00	4,37,490.00
NPS Payable-Mr. Mahadeo	-	12,000.00
Salary GSLI Payable (Mr. Mahadeo)	1,440.00	660.00
Salary Profession Tax Payable	52,100.00	52,000.00
Performance Gurantee Deposit (PBG)	10,33,430.00	9,93,288.00
Centre Reserve Funds	10,000.00	10,000.00
Conti.-Welfare Fund (Project)	7,95,575.00	7,95,575.00
Salary welfare payable	(1,225.00)	43,200.00
Payable to Staff Welfare trf.A/c 5% User Charges	2,36,650.00	-
Salary- Employee Welfare Deduction	2,22,775.00	-
Provision for Gratuity & Leave Encashment	7,99,49,528.00	7,26,67,587.00
Provision for Electricity & Power	33,67,540.00	32,45,290.00
Provision for Works on Contract	35,71,618.00	38,39,187.00
Provision for Charity Commissioner	25,15,157.00	23,66,064.00
Provision of Auditors Fee	2,12,400.00	33,630.00
Dr. Mitra-Leave Salary Payable	-	3,18,490.00
Salary payable	-	16,259.00
Payable from Extra Mural projects	-	11,35,228.00
Grand Total	**11,65,54,291.44**	**13,35,22,723.78**

Note

*Amount hold against M/s Shalaka Infra-Tech(I) Pvt. Ltd. due to non-completion of work within contract period.

As per guideline of Department of Biotechnology, Government of India, Interest earned for F.Y. 2020-21 of Rs. 83,95,549.00 refunded to Department of Biotechnology through Bharatkosh vide Challan No. 25924217052100001056 dated 17.05.2021

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE 5 - FIXED ASSETS

(Amount-Rs.)

DESCRIPTION	Rate	GROSS BLOCK				DEPRECIATION / AMORTIZATION				NET BLOCK	
		As at begining of the year	Additions during the year	Deduction during the year	Cost valuation at the year-end	As at the beginning of the year	Additions during the year	Deduction during the year	Total up to the Year-end	As at the Current year-end	As at the Previous year-end
A. FIXED ASSETS:											
1. Lease Hold Land Baner											
a> Lease Hold Land - Baner		1,54,41,563.00	-	-	1,54,41,563.00	15,44,156.31	5,14,719.00	-	20,58,875.00	1,33,82,688.00	1,38,97,406.69
b> Lease Hold Land - Baner - Compound Wall		17,48,412.00	-	-	17,48,412.00	-	62,443.00	-	62,443.00	16,85,969.00	17,48,412.00
2. BUILDINGS:	**4.87%**										
a> Jopasana		60,26,554.30	-	-	60,26,554.30	36,35,402.42	1,16,449.00	-	37,51,851.00	22,74,703.00	23,91,151.88
b> Jidnyasa		69,14,265.25	-	-	69,14,265.25	41,29,871.62	1,35,600.00	-	42,65,472.00	26,48,793.00	27,84,393.63
c> University Campus		49,45,53,768.46	1,92,21,904.00	-	51,37,75,672.46	16,13,24,485.62	1,67,34,003.00	-	17,80,58,489.00	33,57,17,183.00	33,32,29,282.84
3.Furniture & Fixtures	**25.89%**	7,35,92,651.73	6,68,566.00	-	7,42,61,217.73	5,64,52,486.66	45,26,533.00	-	6,09,79,020.00	1,32,82,198.00	1,71,40,165.07
4.Library Books	**18.10%**	10,09,46,655.47	16,93,411.78	-	10,26,40,067.25	8,08,47,918.70	38,34,305.00	-	8,46,82,224.00	1,79,57,843.00	2,00,98,736.77
5.Equipment											
a> Institute *	**18.10%**	1,58,52,58,445.65	9,65,65,878.61	2,55,00,000.00	1,65,63,24,324.26	1,13,06,94,618.84	9,68,49,531.00	(46,15,500.00)	1,22,29,28,650.00	43,33,95,674.00	45,45,63,826.81
b> Fetal Liver project #		2,00,000.00	-	-	2,00,000.00	1,89,484.34	10,515.00	-	1,99,999.00	1.00	10,515.66
6.Vehicles #		13,11,895.00	-	-	13,11,895.00	13,08,025.79	3,868.00	-	13,11,894.00	1.00	3,869.21
Total A		**2,28,59,94,210.86**	**11,81,49,760.39**	**2,55,00,000.00**	**2,37,86,43,971.25**	**1,44,01,26,450.30**	**12,27,87,966.00**	**(46,15,500.00)**	**1,55,82,98,917.00**	**82,03,45,053.00**	**84,58,67,760.56**
Capital WIP											
A) Advance CPWD		10,99,108.00	63,75,926.00	-	74,75,034.00	-	-	-	-	74,75,034.00	10,99,108.00
B) Advance (Air Conditioner)		-	36,55,950.00	-	36,55,950.00	-	-	-	-	36,55,950.00	-
Total B		10,99,108.00	1,00,31,876.00	-	1,11,30,984.00	-	-	-	-	1,11,30,984.00	10,99,108.00
Total (A+B)		**2,28,70,93,318.86**	**12,81,81,636.39**	**2,55,00,000.00**	**2,38,97,74,955.25**	**1,44,01,26,450.30**	**12,27,87,966.00**	**(46,15,500.00)**	**1,55,82,98,917.00**	**83,14,76,037.00**	**84,69,66,868.56**

Note: The aforesaid expenditure is incurred out of Govt. Grants, disposal of which is subject to conditions attached to these Grants.

* Amount received towards Equipment of 'Brucker Micro-CT High Resolution In-vivo Micro-CT system from 'IISER, Pune' under Project entitled "National Facility for Laboratory Model Organisms" (a collaborative initiative between DBT-IISER-NCCS-UAB)' Project, hence Asset of Rs.2,55,00,000.00 is reduced.

As the useful lifes of Vehicle and Fetal Liver are expired, both are recorded at nominal value of Rs.1.00.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF BALANCE SHEET AS ON 31.03.2021

SCHEDULE 6 - CURRENT ASSET LOAN AND ADVANCES

Amount (Rs.)

Particulars		2020-21	2019-20
CURRENT ASSET			
Cash-in-hand		50,000.00	1,28,742.00
SAVING ACCOUNTS			
Axis Bank		-	2,26,883.00
Bank of India - 4911		20,15,31,265.34	24,10,28,375.26
Bank of India - 4912		35,39,26,999.47	34,64,83,323.31
State Bank Of India		29,15,760.17	97,56,702.73
Bank of India-SERB 8403		2,10,07,185.44	1,21,27,732.50
Bank of India - 8574		36,76,848.54	-
Bank of India - 8783		10,46,48,387.00	-
Bank of India - NCCS Employee Welfare A/c 0538		2,22,775.00	-
TOTAL (A)		**68,79,79,220.96**	**60,97,51,758.80**
LOAN AND ADVANCES			
Advance-LTC		8,49,000.00	82,541.00
Advance - TA/DA		-	2,29,000.00
Advance - Contingency		1,94,676.00	91,200.00
Advance - Equipment		2,65,200.00	-
Staff Computer Advance		84,058.00	15,565.00
Staff Vehicle Advance		-	2,973.00
Deposit for Compressor for AC Plant		38,29,000.00	38,29,000.00
Deposit to DAE-University Campus		59,77,000.00	59,77,000.00
Equipment-Security Deposit		38,663.60	38,663.60
Gas Deposit		49,650.00	49,650.00
MSED Deposit		73,12,600.00	73,12,600.00
MSED Deposit (Kothrud)		2,82,200.00	2,82,200.00
Telephone Deposit		1,21,701.00	1,21,701.00
Prepaid Expenditure Postage		3,894.00	3,835.00
TDS Receivable FY 2016-17		-	8,65,968.00
TDS Receivable FY 2017-18		6,20,934.00	6,20,934.00
TDS Receivable FY 2018-19		8,08,568.00	8,08,568.00
TDS Receivable FY 2019-20		5,33,212.00	5,33,212.00
TDS & TCS Receivable FY 2020-21		1,41,569.64	-
Fellowship Receivable		1,20,880.00	3,80,720.00
TOTAL (B)		**2,12,32,806.24**	**2,12,45,330.60**
GRAND TOTAL		**70,92,12,027.20**	**63,09,97,089.40**

राष्ट्रीय कोशिका विज्ञान केंद्र पुणा

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 7 - INCOME FROM SALES/SERVICE

Amount (Rs.)

Particulars	2020-21	2019-20
Cell Line Handling	44,61,773.00	73,94,580.00
Plasmon Resonance Interactive Analysis Facility	1,36,877.00	-
LC-MS/MS Proteome Analysis (Digested Samples)	60,000.00	-
FACS Analysis Charges	14,000.00	7,40,820.00
Bio Imaging Facility	12,000.00	6,000.00
Cell Line Authentication	3,000.00	1,26,000.00
Covid Testing Receipts	49,00,000.00	-
Donation-in-kind for Covid Testing	8,12,687.00	-
Cell Culture Workshop	-	67,800.00
GC MS Analysis	-	1,62,000.00
Proteomene Analysis of chronomus samples	-	40,000.00
Grand Total	**1,04,00,337.00**	**85,37,200.00**

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 8 - GRANTS/SUBSIDIES

Amount (Rs.)

Particulars	2020-21	2019-20
GRANTS/SUBSIDIES	40,10,00,000.00	45,00,00,000.00
Grand Total	**40,10,00,000.00**	**45,00,00,000.00**

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 9 - FEES/SUBSCRIPTIONS

Amount (Rs.)

Particulars	2020-21	2019-20
Tender Fees	-	18,220.00
Grand Total	-	**18,220.00**

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 10 - INTEREST EARNED

Amount (Rs.)

Particulars	2020-21	2019-20
Interest On Staff Computer Adv.	44,670.00	28,088.00
Interest On Staff HBA	23,472.00	2,01,123.00
Interest On Staff Vehicle	2,175.00	4,142.00
Grand Total	**70,317.00**	**2,33,353.00**

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 11 - OTHER INCOME

Amount (Rs.)

Particulars	2020-21	2019-20
Ph.D Fees	13,53,900.00	11,95,800.00
Application Fee	2,03,418.40	46,084.00
Hostel Charges	2,50,765.00	2,85,905.00
Conti (Mis Income)	1,112.31	20,410.00
Sundry balances writeback	2,52,705.00	-
License Fee	2,36,195.00	2,11,400.00
Usage of Premises for ATM	1,03,308.00	14,386.00
Transit House Charges	65,735.00	60,000.00
Guest House	45,336.00	3,32,961.00
Interest on Income Tax Refund for A.Y.2017-18	1,70,341.00	-
Interest earned on Covid Testing Recepits A/C No.8574	65,957.00	-
Sale of Scrap	18,228.00	27,783.00
Auditorium Charges	-	16,000.00
Income from Road Show	-	1,05,000.00
Grand Total	**27,67,000.71**	**23,15,729.00**

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BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 12 - ESTABLISHMENT EXPENSES

Amount (Rs.)

Particulars	2020-21	2019-20
Salaries	21,74,45,702.00	21,88,99,539.00
Contribution to Provident Fund	1,15,78,530.00	1,18,93,886.00
Contribution to NPS	53,12,918.00	58,72,273.00
Grand Total	**23,43,37,150.00**	**23,66,65,698.00**

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNTS FOR THE YEAR ENDED 31.03.2021

SCHEDULE 13 - OTHER ADMINISTRATIVE EXPENSES

Amount (Rs.)

Particulars	2020-21	2019-20
Consumables	4,56,68,710.06	6,12,16,594.68
Contingencies (as per attached details)	2,26,51,705.05	2,93,92,203.60
Work On Contract	3,99,88,012.00	4,58,01,917.00
Electricity and Power	3,69,97,489.00	4,02,01,589.20
Rent Rates and Taxes	2,54,50,457.00	3,54,85,512.00
PMC Water Charges	22,32,518.00	27,65,795.00
User Charges @5% trf to Staff Welfare A/c	2,36,650.00	-
TA-DA	2,08,100.00	48,69,867.00
Bank Charges	74,609.13	24,725.23
Eligibility Fees	7,600.00	7,600.00
Grand Total	**17,35,15,850.24**	**21,97,65,803.71**

NATIONAL CENTRE FOR CELL SCIENCE, PUNE - 411 007.

SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31.03.2021

CONTINGENCIES BIFURCATION

Amount (Rs.)

Particulars	2020-21
Conti-Local Conveyance	15,14,149.00
Conti-Advertisement and Publicity	7,22,742.00
Conti-Vehicle Petrol Exps	84,488.00
Conti-Academic Recognition Fee	10,00,000.00
Conti-Auditors Remunerations	2,12,400.00
Conti-Fees Registration& Membership Charges	7,063.00
Conti-Honorarium	7,97,208.64
Conti-Hospitality Expenses	2,05,675.00
Conti-Vehicle Insurance	33,292.00
Conti-Laundry Exps	92,140.00
Conti-Meeting Exp.	3,925.00
Conti-Membership Fees and Subscriptions	1,80,207.00
Conti-Misc. Purchase	26,28,335.00
Conti-MIS EXP	2,21,299.26
Conti-Postage and Telephone	19,50,276.00
Conti-Printing and Stationery	16,11,048.75
Conti-Professional & Legal Charges	16,61,072.40
Conti-Repairs and Maintenance	30,03,195.00
Conti-Repairs and Maintenance- Contract	47,30,638.00
Conti-Seminar / Symposia	4,08,214.00
Covid-19 (Contingencies)	4,09,667.00
Intramural Manpower Expenses	11,67,000.00
Covid Testing Expenditure	7,670.00
Grand Total	**2,26,51,705.05**

राष्ट्रीय कोशिका विज्ञान केंद्र पुणे

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

SCH. "14" : SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS FOR THE YEAR 2020-2021

The Accounts are generally prepared as per the common format of accounts for all Autonomus Institute as per letter No. BT/MED/NCCS/ADMN/2002 dtd.June 10,2002 of Department of Biotechnology, New Delhi and comptroller & Auditor General of India letter No. OA-VII(MISC/CORRES/2002-03/1165)dtd.16 October 2002.

A. SIGNIFICANT ACCOUNTING POLICIES

1) ACCOUNTING CONVENTION :

The financial statements are prepared on the basis of historical cost convention, unless otherwise states and on the accrual method of accounting.

2) INVENTORY VALUATION :

Inventory is valued at cost or realizable value whichever is less. At the year end value of inventary is NIL.

3) REVENUE RECOGNITION

All Revenue items are accounted for on accrual basis except Guest House/ Hostel fees & bank account interest, accounted for on Receipt basis.

4) FIXED ASSETS :

Fixed assets are stated at cost of acquisition inclusive of inward freight, duties and taxes and incidental and direct expenses related to acquisition.

5) DEPRECIATION /AMORTIZATION:

i)'The effective rate of Depreciation on the basis of Useful Life of Assets prescribed against each category of asset as mentioned in Part-C, Schedule-II of Companies Act 2013. The rate of depreciation under WDV method is arrived at on the basis of formula given in the "Guidance Note on Accounting for Depreciation in Companies in the context of Schedule II to Companies Act 2013" by ICAI.

The above Rates are considered for calculation with effective from F.Y.2015-16.

Sr.No.	Group of Asset	Part 'C' 'Schedule II- Ref.No.	Rate of Depreciation
1	Building	I (a)	4.87%
2	Furniture	V (a)	25.89%
3	Library Books	IV (a) (i)	18.10%
4	Equipment	IV (a) (i)	18.10%
5	Vehicle	VI (b)	39.30%

Note: In the earlier year there was a typographical error as, rates of Companies Act 1956 instead of Companies Act 2013. Although the rates applicable are as montioned above.

ii) Assets costing Rs. 5000/- or less each are fully provided.

iii) Lease hold Premises are amortized over the period of lease. The annual amortization expense for a leasehold land is the cost of the leasehold land divided by the lease term, assuming straight-line amortization.

6) GOVERNMENT GRANTS/SUBSIDIES :

i) Where the Government Grants are in the nature of capital contribution, i.e., they are given with reference to the total or part investment or by way of contribution towards its total or part capital outlay, are recognized as "Contribution towards Capital Fund" under head "Corpus/Capital Fund".

ii) Grant received towards recurring expenditure are treated as income under income & expenditure account.

iii) Grants received from sponsoring agencies for sepcific Projects are recognized as "Earmarked Funds"

iv) Government grants/ subsidy's are accounted on realization basis.

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

BHIDE & SHAH CHARTERED ACCOUNTANTS PUNE-30.

7) FOREIGN CURRENCY TRANSACTION:

Transactions denominated in foreign currency are accounted at the exchange rate prevailing at the date of the transaction.

8) RETIREMENT BENEFITS :

i) Provision for Liability towards gratuity payable on death/retirement of employees is made on the basis of estimated liability (as per Central Government Rules) to the extent of employees retiring in next five years.

ii) Provision for accumulated leave encashment benefit to the employees is accrued and computed on the assumption that employees are entitled to receive the benefit as at the end of current financial year.

9) CURRENT ASSETS, LOANS & ADVANCES.

It is explained to us that, the value of all current assets, advances and deposits, outstanding income and other realisable assets, if any, are not less than their realisable value in the ordinary course.

10) EARMARKED/ENDOWMENT FUNDS :

i) As explained to us, Grants/Funds received from Sponsoring agencies for specific Projects are recognised as " Earmarked Funds". These Grants/Funds are credited to respective Project Funds as per the norms associated with these Projects.

ii) The amounts represent at the year end of Rs. 54,82,68,707.35/- are Unspent / and Rs. (11,32,75,823.90/-) (Overspent) grants and receivables in respect to Projects are subject to confirmation from the granting authorities, reconciliation and consequential adjustments, if any.

iii) The Suspense account having balance amount of Rs. 36,82,067.43/- represents the funds are received directly from these Sponsoring Agencies without any prior maping towards the projects, the same will be accounted for to the concern project after getting the payment advice from the sponsoring agency.

iv) Since F.Y. 2002-2003 the agreegate accumulated cost upto F.Y. 2020-2021 of Rs. 57,08,49,262.27/- for aquiring fixed assets in respect of resptective Project.

Date: 27.08.2021
Place: Pune

BHIDE & SHAH ★ CHARTERED ACCOUNTANTS ★ PUNE-30.

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

(SAMIR V.BHIDE)
PARTNER
M.NO.46274

OFFICER 'C' ACCOUNTS
NCCS

वैभव अ. अरगडे
Vaibhav A. Argade
अधिकारी 'ग' (लेखा)
Officer 'C' (Accounts)
रा.को.वि.के./NCCS Pune-411007

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

DIRECTOR
NCCS

मनोज कुमार भट, पीएच डी
निदेशक, एनसीसीएस, पुणे
Manoj Kumar Bhat, PhD
Director, NCCS, Pune

SCH. "15" : CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS FOR THE YEAR 2020-2021

1) Taxation:- Inview of there being no taxable income under Income Tax Act 1961, No provision for Income Tax has been considered necessary.

Assessment Year	Status of assessment (Pending / completed/ appeal filed)	Demand outstanding (in Rs. if any)	Remark
2016-17	Assessment Complete u/s 143(3). We have filed an appeal with CIT (A) Form 35 dt. 14.01.2019	10,43,59,421	ITAT Order awaited & follow up with IT authorities is in progress.
2018-19	Refund kept on hold by department considering the praposed adjustments as mentioned in the Intimation u/s 245	Nil	Follow up with IT authorities is in progress.
2019-20	TDS credit was not allowed in the 143(1) intimation received and refund not allowed.	Nil	Follow up with IT authorities is in progress.

2) It is explained by the management it has maintained fixed assets register and has also conducted physical verification of fixed assets during the financial year 2020-21. We verified the fixed assets register as well as fixed assets on random basis.

3) As informed to us, the land on which the NCCS complex is situated is owned by the State Government of Maharashtra. Agreement for the ground rent/ lease rent payable, if any, for the use of land is not entered into and no provision in respect of the same has been made.

4) Interest Earned on Grants Received from DBT :

a) The amount represent Interest Earned on Grant received, refunded to DBT, New Delhi as per their instructions.

b) Interest earned on Grants received towards Earmarked funds has also been credited to their respective project fund account.

5) Amounts of earlier year are regrouped to make them comparable with the current year wherever necessary.

Date: 27.08.2021
Place: Pune

BHIDE & SHAH ★ PUNE-30. ★ CHARTERED ACCOUNTANTS

FOR BHIDE & SHAH
CHARTERED ACCOUNTANTS
FIRM REG. NO. 119383W

OFFICER 'C' ACCOUNTS
NCCS

वैभव अ. अरगडे
Vaibhav A. Argade
अधिकारी 'ग' (लेखा)
Officer 'C' (Accounts)
रा.को.वि.के./NCCS Pune-411007

राष्ट्रीय कोशिका विज्ञान केंद्र पुना

DIRECTOR
NCCS
मनोज कुमार भट, पीएच डी
निदेशक, एनसीसीएस, पुणे
Manoj Kumar Bhat, PhD
Director, NCCS, Pune

(SAMIR V.BHIDE)
PARTNER
M.NO.46274

National Centre for Cell Science
An autonomous institution aided by the Department of Biotechnology, Govt. of India

Photographs courtesy : Mahavir Rangole, Gaurav Das, Sunil Kachare, personnel from the central facilities and NCCS–NCMR, Smita Khadkikar, Jyoti Rao, and other staff and students of NCCS.

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