INSTITUTE OF ADVANCED VIROLOGY
THIRUVANANTHAPURAM

ANNUAL REPORT
2023-24

PUBLICATION COMMITTEE

Dr. Mohanan Valiya Veettil
Dr. Jithesh Kottur
Mr. Renjith R S Nair
Mrs. Fathima Zahra C
Mr. Gopikrishnan K

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Director's Desk

The year was eventful and satisfying. From the baby-steps in the past year, we witnessed IAV gaining momentum with a steady foot-hold in 2023-24. Our research outputs and academic activities have increased in line with the infrastructure that we could establish with a magnanimous support from the Government of Kerala.

We could fully functionalize eight BSL-2 laboratories and a centralized training laboratory. An 80-seater seminar room and a start-up small animal facility could be established; and could finalize the construction plans for a BSL-3 and transgenic animal facility. Also, in 2023-24, we could significantly augment our core instrumentation facility with the addition of high-end equipment to support the advanced research activities. Establishment of an 130kWP roof-top solar power system this year support the global green energy initiatives and brings a significant reduction in our electricity expenditure. Procurement of an outbreak investigation and sample collection vehicle through CSR support is expected to boost IAV's support on Kerala Government's public health activities.

The start-up ecosystem in Kerala is vibrant and nationally acclaimed, and to enhance its focus on infectious diseases and attract young talents, we plan to establish and nurture start-ups in our new 25,000 sq.ft. area laboratory area that is getting ready. It will be a major initiative of IAV in the coming year, managed through IAV's Innovation and Translation Facilitation Centre (ITFC), which will also support our initiatives on participatory R&D with private players in the virology field.

A steady funding support from the Government of Kerala in the last two years was a boon to firmly establish the research-base of the institute. The plan fund-supported flagship programs started generating outputs in terms of publications. The recent manuscript from the Department of General Virology exemplifies IAV's commitment to generate mitigation measures to tackle Nipah in Kerala. Major activities are currently going on in generating therapeutic and diagnostic monoclonal antibodies against a wide range of viral infections of significant public health importance, including Nipah. Also, the Viral Bioassay facility approved during the year with the funding support from Department of Biotechnology, Government of India, will be a national facility for augmenting diagnostic viral antigen production, seroprevalence and vaccine evaluation studies. In the last year, IAV empowered the state of Kerala also with early disease detection and pandemic preparedness with a robust functioning of the advanced molecular diagnostic facility. The syndromic testing algorithm followed by us to test around 83 viral pathogens and a quick turn-around time of 24hrs for reporting are gaining appreciation in the clinical settings to streamline treatment protocols.

The academic and training programs initiated by IAV to generate critical human resources in the arena of Virology is well received. An independent and dedicated laboratory at IAV for imparting systematic training is unique and the initiation of a certificate program soon is expected to have wider acceptance. IAV also provides its PhD students options to register either in Cochin University of Science & Technology, a reputed university within the state or in the Regional Centre for Biotechnology, New Delhi, an institution of national importance and deemed-to-be university under the auspices of UNESCO, to ensure their future career opportunities.

Considering its young existence, IAV could make an impressive progress that is comparable to many established institutions. The state-of the art laboratory infrastructure and cutting-edge research activities in the past two years have made IAV internationally competitive; and gives us the energy and enthusiasm to go forward. Resonating the thoughts of the visionaries of the Institute, we envisage IAV as a reputed Global centre in Virology. In unison, we move ahead towards this vision...

Introduction

Institute of Advanced Virology (IAV), was established in the year 2019 as an autonomous institution under the Science and Technology department, Government of Kerala focusing on the high end research and diagnosis of virus and infectious diseases. IAV is located in the Bio 360 Life Sciences park, Thonnakkal, Thiruvananthapuram. The institute was successful in accomplishing global standards in research, diagnosis and management of emerging/re-emerging viruses, particularly in the perspective of the state of Kerala. IAV acts as a center of excellence in virology and serves as a key player in productive scientific exchange. To address the pressing needs in virology research and to foster young talents, IAV is well-equipped with state-of-the-art laboratories. IAV contributes to the society through discoveries and knowledge generation in various domains of virology. IAV's flagship programs are devised towards generating products that are potentially translatable for the overall benefit of mankind.

Vision

To harness the best and eliminate the worst of viruses for a better human life.

Mission

To develop state-of-the-art infrastructure, skilled scientific & technical personnel, and services & products in virology to serve local, national and global needs.

Events of the Year

New Initiatives

Establishment of BSL-3 Laboratory and Transgenic Animal Experimental Facility

Academic Activities: Courses/ Affiliations

Doctoral Programs

Institute of Advanced Virology is recognized as the affiliated centre of CUSAT and RCB, Faridabad. The institute has commenced the PhD programme in Virology during the AY 2023-24. Four students (3 registered with CUSAT and 1 with RCB) have joined for the PhD programme during the academic year 2023-24.

Certificate Course

Institute has commenced certificate programme in cell culture & molecular virology techniques for those who completed PG courses in Life Science subjects with a focus to develop a pool of highly skilled manpower to meet the requirements of pharma companies, diagnostic laboratories, R&D organisations and to equip the post-graduate students for higher studies in life sciences. Currently, the opportunity for such a training programme is very limited and Institute aims to plug this gap by providing intensive lab oriented hands-on training programme in dedicated research laboratories. A dedicated training lab was established for this purpose. Seven personnel have undergone the certificate courses.

Dissertation/Internship

Institute offers facility for dissertation/Internship for the Graduate/Postgraduate students in life science subjects for duration ranging from one month to six months. Forty-one students from different educational institutions across the country has undergone internship for various durations.

External Funded Projects received during 2023-24

Sl No.	Name of the project	Name of PI	Funding agency	Total Amount sanctioned (In rupees)
1	Synthesis of polyhydroxylated pyrrolidine iminocyclitol-based novel antivirals against Dengue Virus	Dr. E. Sreekumar	ICMR	33,74,823/-
2	Viral Bio-Assay Facility(Vbaf) for Recombinant Monoclonal Antibody Generation and Pseudovirion – based services for vaccine response and therapeutics evaluation	Dr. E. Sreekumar	DBT -SAHAJ	6,93,670,00/-
3	Identification and characterization of a functional cellular receptor for Kyasanur forest disease virus entry	Dr. Mohanan Valiya Veettil	SERB	73,42,720/-
4	Role of TRIM family proteins in megakaryocyte development/ maturation and platelet production in dengue virus-induced thrombocytopenia	Dr. Anismrita Lahon	SERB- SRG	32,00,000/-
5	Engineering Anti-Zika virus neutralizing human monoclonal antibodies to reduce Fcy receptor -mediated antibody dependent enhancement (ADE) effect – [51003]	Dr. Priya P	DBT-BioCare	58,00,000/-
6	Evaluation and in vivo validation of Tryptanthrin analogues as potent lead molecules for malignant melanoma chemotherapy	Dr. Ruby John Anto	CSIR	33,72,000/-
7	Evaluation of uttroside B, a furanosyl saponin from Solanum nigrum Linn as a candidate drug molecule against Aflatoxin-induced liver carcinogenesis and Non-alcoholic steatohepatitis (NASH)	Dr. Ruby John Anto	DST SERB	44,92,240/-

Research Breakthroughs

The scientific team led by Dr. Mohanan Valiya Veettil, Senior Principal Scientist developed non-infectious Nipah Virus-Like Particles (NiV-VLPs) that mimic the native NiV in its morphology. This work entitled -Highly sensitive and quantitative HiBiT-tagged Nipah virus-like particles: A platform for rapid antibody neutralization studies- by Dr. Arathi et al., is published in Cell Press Journal-Heliyon. The work represents a significant advancement in the field of Nipah viral research in developing monoclonal antibodies and creating vaccines for NiV.

Public health initiatives

Outbreak investigations and containment responses

- Nipahvirus outbreak (Sept. 2023)
- Influenza like illness at Trivandrum (June 2023)
- Zika virus outbreak investigation at Trivandrum (June 2023)
- Production and supply of Virus Transport Medium (VTM)

Events, Workshops Conferences

Exposure visit for the start-up founders and aspiring entrepreneurs about the incubation opportunities, scientific expertise and instrumentation facility available at Institute of Advanced Virology was conducted on 30.01.2024.

Outreach program

- Participated in the Huddle Global 2023 organized by Kerala Start-up Mission (KSUM) from 16th - 18th November 2023.
- Showcased the activities of the institute at Global Science Festival Kerala (GSFK) organised by the S&T Department, Govt. of Kerala.

Infrastructure development

The Phase 1B building with an area of 80,000Sq. Ft was made functional during the FY 2023-24. Eight BSL 2 labs, 80 seat capacity seminar room and small animal house facility were established and made operational. The "Department of Virus Epidemiology, Vector Dynamics & Public Health" and "Training Laboratory" are functioning at Phase IB.

Commissioned Facilities

1.Solar Power Plant

As part of the green initiatives by the Institute of Advanced Virology, a 130 KWp solar power plant (grid connected) was installed and commissioned.

The solar power plant generates about 60% of the power requirement of the Institute during production hours. The consultancy for the project was provided by M/s HLL HITES. The facility is expected to achieve breakeven in a period of eight years.

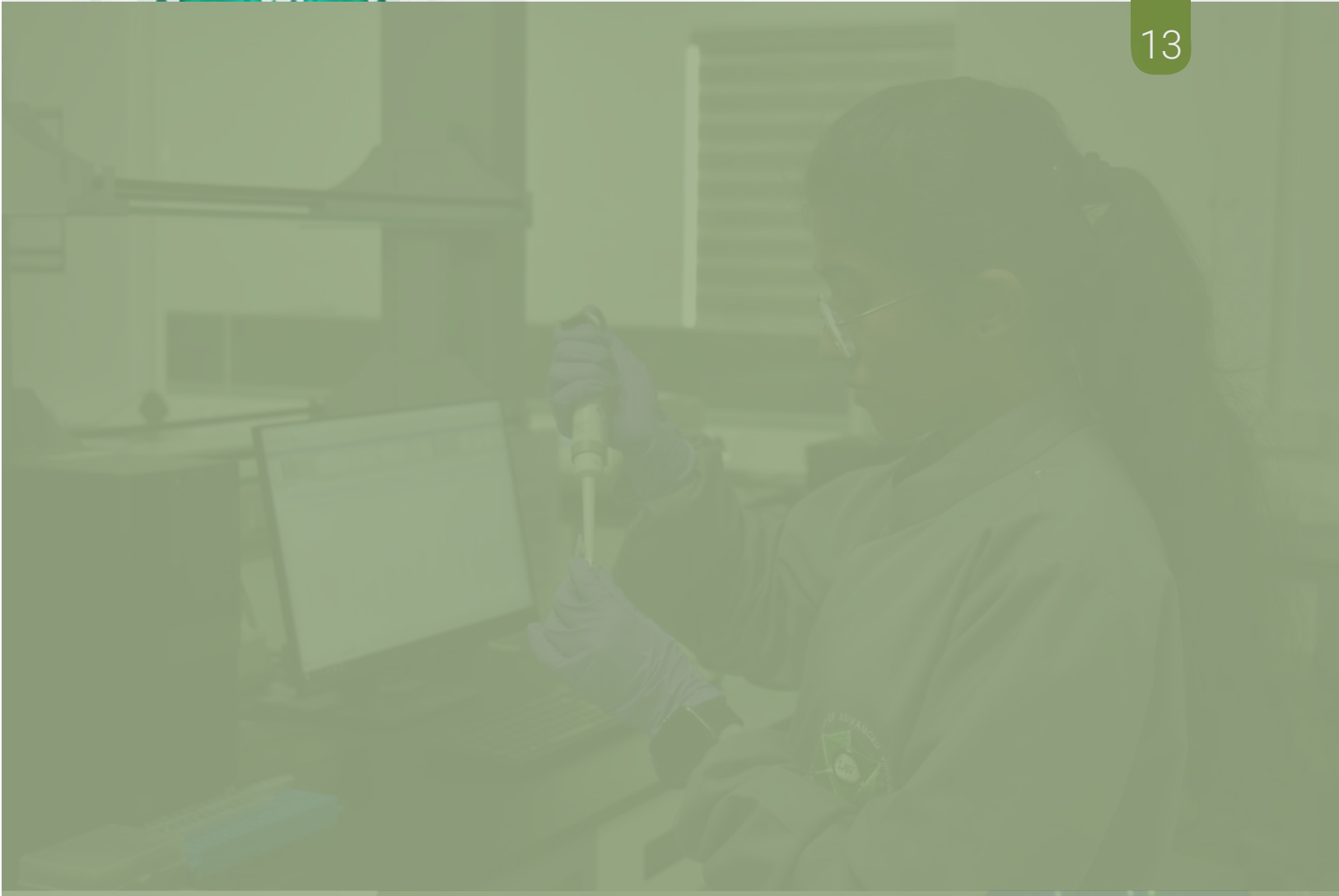
2.Animal house facility

A small animal house has been established in the institute during the reporting period to keep, breed and carryout animal related experiments in mice. The facility has designated space for quarantine, breeding, experiment and carryout the procedures. The animals will be accommodated in Individual ventilated cages (IVC). The facility was approved by CCSCA and have all the necessary equipment required to carry out research on small animals.

Distinguished Visitors

Prof. Morten P Meldal

Prof. Morten P Meldal, renowned Nobel Laureate in Chemistry visited Institute of Advanced Virology on 7th February 2024 and interacted with the scientists, students and project staff.



TEAM IAV

Scientific Staff

Dr. E Sreekumar

Director, IAV

Dr. Sreekumar holds a Master's degree in Immunology from the Indian Veterinary Research Institute and a PhD in Biotechnology from the University of Kerala. He is a recipient of the Fulbright-Nehru Professional and Academic Excellence (FNAPE) Fellowship in 2015 and was a visiting faculty (2015-2016) in the Johns Hopkins Bloomberg School of Public Health, Baltimore, USA. His laboratory in Rajiv Gandhi Centre for Biotechnology, where he served as a scientist for 18 years before moving to IAV, focused on studies on emerging viruses, with a focus on dengue and chikungunya; and has established molecular assays and animal models to test antiviral compounds and vaccines. He has mentored 11 PhD students and has 56 manuscripts published in international journals of repute. He serves in various national and state scientific expert committees; and was an active member in the state expert group on COVID-19. His current research at IAV focuses on identifying broad-spectrum antivirals using host-targeted approaches; and development of rapid neutralization assays for screening monoclonal antibodies and serosurveillance of emerging viruses.

Dr. Mohanan earned his PhD in Biotechnology from Cochin University of Science and Technology, Kerala, in 2005. He completed his post-Doctoral studies in virology at University of Kansas Medical Centre and at Chicago Medical School, Rosalind Franklin University of Medicine and Science, USA. Following his post-doctoral studies, he served as an Assistant Professor (Research) and Associate Member of the School of Graduate and Postdoctoral studies in the Department of Microbiology and Immunology at Chicago Medical School, Rosalind Franklin University of Medicine and Science, USA. He returned to India in 2016 and joined Cochin University of Science and Technology, Department of Biotechnology as DBT-Re-Entry Faculty. Dr. Mohanan Valiya Veettil joined as Senior Principal Scientist in Department of General Virology at Institute of Advanced Virology in 2020. Dr. Mohanan's work focuses on the interaction of viruses with their host cellular receptors, virus like particle production, monoclonal antibody production, and antibody mediated neutralization of viruses as well as virus entry, and gene expression.

Dr. Mohanan Valiya Veettil

Senior Principal Scientist

Dr. Anismrita Lahon

Scientist C

Dr. Anismrita received her PhD from the National Institute of Virology, Pune in 2014. Her doctoral research focused on rotavirus infection in humans and animals. Later, she joined Prof. Rebecca Rico-Hesse as a post-doc (2014-2017) at Baylor College of Medicine, USA and studied humanized mouse models of flavivirus and mosquito saliva induced immune response. In 2017, she joined NII, New Delhi as DST-INSPIRE Faculty and uncovered many viral and host factors associated with dengue virus pathogenesis. Dr. Anismrita joined as Scientist C in the Department of Viral Vaccines at Institute of Advanced Virology in 2021. Her research at IAV is centered on developing nucleic acid-based vaccines for zika and chikungunya viruses.

Scientific Staff

Dr. Aswathyraj S

Scientist C

Dr. Aswathyraj completed MSc in Clinical Virology and PhD in Virology from Manipal Institute of Virology, Manipal Academy of Higher Education, Karnataka. She served as a senior research officer at the Manipal Institute of Virology and also worked as a Research Associate at Inter-University Centre for Biomedical Research and Super Specialty Hospital (IUCBR & SSH). She joined the Institute of Advanced Virology as scientist C in 2021 in the Department of Viral Diagnostics. Her research interests are public health aspects of Virology, emerging and remerging viral diseases, diagnostic virology, epidemiology of viral diseases, public health response during infectious disease outbreaks and translational Virology including development of virus diagnostic assays.

Dr. P A Desingu

Scientist C

Dr. P A Desingu graduated (BVSc&AH) from Madras Veterinary College, Chennai, MVSc, and PhD from Indian Veterinary Research Institute, Bareilly. He received the DST-INSPIRE Faculty award and executed research on JEV at the Indian Institute of Science, Bangalore. He joined the Institute of Advanced Virology as Scientist C in the Department of Virus Epidemiology, Vector Dynamics & Public Health in 2023.

Dr. Jithesh Kottur

Scientist C

Dr. Jithesh Kottur earned his PhD in Biophysics and Structural Biology from the Regional Center for Biotechnology. His research focused on trans-lesion bypass mechanisms, phosphodiester bond formation, and the roles of polymerases in antibiotic resistance and cytotoxicity. Using X-ray crystallography, he elucidated the structural mechanisms of DNA polymerase IV (PolIV) and the impact of reactive oxygen species on antibiotic-induced lethality. In 2018, Dr. Kottur joined Prof. Aneel K. Aggarwal's lab at the Icahn School of Medicine at Mount Sinai, where he enhanced his expertise in structural biology and structure-based drug discovery. His postdoctoral work involved pioneering Proteolysis Targeting Chimeras (PROTACs), Fragment-Based Drug Discovery (FBDD), and Structure-Based Drug Discovery (SBDD) for treating viral infections and cancer. He developed potent WDR5 PROTACs and a dual WDR5 and Ikaros degrader for cancer treatment. During the COVID-19 pandemic, he determined the first high-resolution structures of the nsp14 N7-methyltransferase (N7-MTase) domain, facilitating SARS-CoV-2 drug development through a fragment-based discovery pipeline. In 2023, Dr. Kottur joined as Scientist C in Department of Antiviral Drug Research at Institute of Advanced Virology.

Scientific Staff

Dr. Priya P

DBT BioCARe Women Scientist

Dr. Priya completed her PhD in Biological Sciences with INSPIRE fellowship from CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram. She did her post-doctoral studies from Rajiv Gandhi Centre for Biotechnology and joined IAV as Project Scientist at Department of Virus Applications in 2022. She was awarded with Biotechnology Career Advancement and Re-orientation (BioCARe) funding for carrying out independent research work under the mentorship of Dr. E. Sreekumar in 2023. She is currently working on developing human monoclonal antibodies against various emerging viruses.

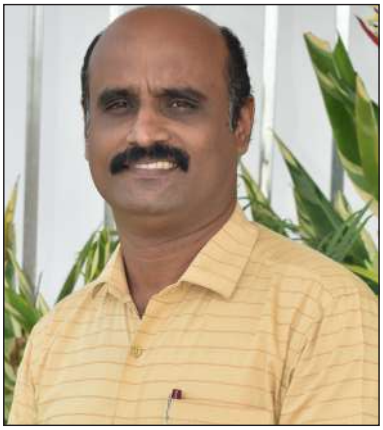
Dr. Ruby John Anto

Honorary Scientist

Dr. Ruby John Anto is working as an honorary scientist at IAV from 2023 onwards, after her superannuation from Rajiv Gandhi Centre for Biotechnology (RGCB) as Scientist G. She has been associated with the Cancer Research Program at RGCB, as a Scientist since 2000. Her research focuses on natural products having anticancer potential. She took her PhD from Amala Cancer Research Centre, Thrissur and did her post-doctoral studies at RGCB. She started her career as a Scientist at RGCB and later served as a visiting scientist at M.D. Anderson Cancer Center, USA. She is a recipient of National Woman Bio-Scientist Award, from Department of Biotechnology, Govt. of India and Keystone Symposia Global Health award by Bill & Melinda Gates Foundation. Dr. Anto is a Fellow of National Academy of Sciences, India and Kerala Academy of Sciences. At IAV, she is working on evaluating the efficacy of natural products against the viral aetiology of cancers.

Administrative Staff

Mr. Manoj Kumar S
Administrative Officer



Mr. Renjith R S Nair
Section Officer

Technical Staff

Mr. Nithin Besent N
Technical Officer-Engineering Support

Mr. Vinod S
Technical Officer-Technical Support

Mrs. Sreeja S
Technical Officer- Molecular Diagnostic Support

Mrs. Fathima Zahra C
Technical Officer- Laboratory and Project Management

Mrs. Shilpa Ravindran
Technical Assistant

Mr. Arun V Jose
Technical Assistant

Mr. Gopikrishnan K
Technical Assistant - Core Facility Support

Departments, Facilities & Flagship Research Activities

Department of Virus Applications

The success of monoclonal antibody (mAb) therapeutics in cancer and immune disorders underscores their potential as powerful tools in medicine. However, their efficacy against viral targets has indeed been limited. Neutralizing antibodies, which are crucial in combating viral infections, have not been as readily exploitable for mAb therapies. Recognizing this gap, the department focuses on developing a robust, cost-effective antibody discovery platform aimed at viral targets causing emerging infectious diseases like Zika virus, Rabies and Nipah virus. mAbs, thus developed offer potential benefits in terms of prophylaxis, treatment, and outbreak control, contributing to global health security and the pandemic preparedness efforts.

Scientist in Charge Details

Name of the Scientist in Charge	:	Dr. E. Sreekumar
Designation	:	Director
Qualification	:	MVSc, PhD
Area of research	:	*Host-directed antivirals; Viral Bioassays; Recombinant monoclonal antibodies*

Team Members

	Name	Designation	Qualification
1	Dr. Santhik S L	Project Scientist	PhD
2	Dr. Priya P	DBT BioCARe Women Scientist	PhD
3	Ms. Asha Lukose	Project Associate	MSc
4	Ms. Meenakshi Mohan	Project Associate	MSc

from left to right

Flagship and other Research Works

Recombinant Antibody Engineering & Therapeutic Centre (RAET) : Development of therapeutic modalities for Chikungunya, Zika, and other emerging viruses"

The laboratory focuses on generating monoclonal antibodies using phage display technology against emerging infectious diseases such as Nipah, Zika, and Rabies. This method allows for the generation and screening of immune libraries for antibodies for therapeutic and diagnostic interventions. For antibody display library generation, blood samples were collected from the disease-recovered subjects; or vaccinated subjects, in the case of Rabies Virus. The libraries generated will be used for screening against viral antigens that are in-house generated using mammalian and bacterial expression systems. The antigens are being used for selecting out high-affinity antibodies for therapeutic use and ELISA-based diagnostic kits development. The laboratory also focuses on developing a high-throughput cost-effective, rapid, and easy-to-perform BSL-2 neutralizing antibody screening assays for Rabies virus neutralizing antibody detection.

Objectives

- Development of antibody-based therapeutic modalities for Rabies virus.
- Construction of immune phage display antibody libraries from Rabies vaccinated subjects
- Development of high-throughput BSL-2 neutralizing antibody screening assays for Rabies virus
- Development of antibody-based therapeutic modalities for Zika virus.
- Design and validation of purified recombinant proteins for diagnostic assay development.
- Development of monoclonal antibodies against zika specific antigens using phage display library

Outcomes

- rVSV-based pseudovirion assay with SEAP detection system is superior to live virus-based RFFIT assay, especially in the use of live Rabies virus could greatly enhance the development of anti-rabies immunoglobulins and vaccines. In addition, pseudovirion-based neutralization assay is much easier to perform and high throughput adaptable as well as cost-effective compared to the traditional live virus assay.
- The generation of antibody libraries by phage display is considered one of the groundbreaking methods for antibody discovery and has economic importance. Once established, this technique can be used to screen target-specific neutralizing and non-neutralizing antibodies, which can be commercialized for diagnostic and therapeutic modalities.
- Knowledge enhancement regarding various antigen-antibody interactions can be achieved.

The studies can catalyze further research in recombinant antibody technology.

Publications/Books or Book Chapters/ Patents/ Awards

Dr Priya P, Project Scientist, Department of Virus Application was awarded with the 6th call of the Biotechnology Career Advancement and Re-orientation (BioCARe) Programme, a special scheme of the Department of Biotechnology (DBT), Ministry of Science & Technology, Government of India.

Collaborations

Dr. Santosh Kumar, Principal Scientist, Central Marine and Fisheries Research Institute, Thiruvananthapuram.

Conferences/Seminars/Workshops/Talks Participated By Faculty Or Students

Dr Priya P has participated in a 2-day training program on "the Basics of Flow cytometry and its application in modern biotechnology in BD FACS Aria III and FACS Diva software" conducted by Central Flow cytometry facility, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram.

Project Students/Trainees

	Name	Type of training	Status
1.	Ms. Gouri Narendran	Internship	Completed
2.	Ms. Gouri Mohan	Internship	Completed
3.	Ms. Salma Shibu	Internship	Completed
4.	Mr. Rajasekhar Sreenivasan	Hands on training	Completed

Molecular Bioassay Laboratory

The Molecular Bioassay Laboratory under Department of Virus Applications has developed pseudovirion based system against a panel of nine Flaviviruses. These include Dengue 1, Dengue 2, Dengue 3, Dengue 4, Zika, West Nile, Japanese encephalitis, Kyasanur Forest Disease, Yellow fever. This system can be used in the serological detection of neutralizing antibody titers against the pathogen of interest and will also facilitate the screening and evaluation of monoclonal antibodies and antiviral drugs. Antiviral assays for evaluating the efficacy of compounds against dengue virus can also be done using live dengue viruses.

Scientist In Charge Details

Scientist in Charge : Dr. E. Sreekumar

Designation : Director

Qualification : MVSc, PhD

Area of research : Host-directed antivirals; Viral Bioassays; Recombinant monoclonal antibodies

Team Members

	Name	Designation	Qualification
1	Ms. Aarya J Anil	Project Associate	MSc
2	Mr. Vivek Vijay	Project Associate	MSc
3	Dr. Geetu Rose Varghese	Project Scientist	PhD
4	Mrs. Sreeja S	Technical Officer	BSc MLT
5	Ms. Karthika S Nair	Project Associate	MSc
6	Dr. Sreelekshmi Mohan	Research Associate	PhD
7	Dr. Lekshmi J Das	Project Scientist	PhD

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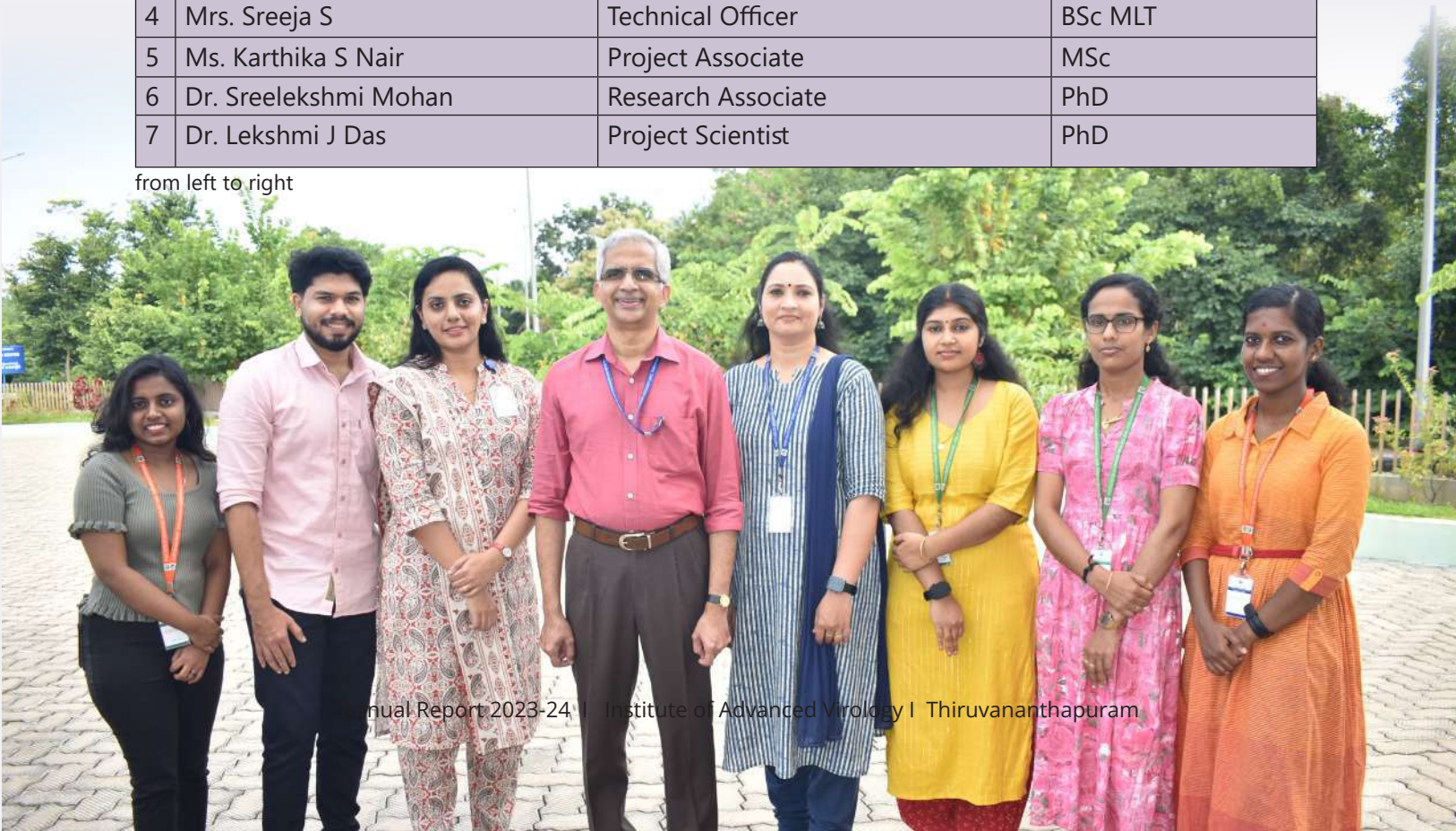


Flagship and Other Research Works

PROJECT 1

Development of broad-spectrum, host-directed antivirals against Emerging Viruses

In this study, we hypothesize that the phytoconstituents of the popularly used Ayurvedic formulations would activate the ISGs directly without switching on the IFN signalling. The study uses Biolayer Interferometry (BLI) assay which detects the interaction between the ISG DNA and the molecules in herbal formulations as change in optical wavelength that is recorded by the instrument in real-time. The BLI instrument, Octet RED96e used in this objective is completely automated and detects changes in the interference pattern of white light reflected off a biosensor tip. These biosensors provide a high- throughput alternative to the well- established surface plasmon resonance (SPR) and SPR imaging biosensors. Biosensors will be loaded with the biotinylated promoter DNA sequences, then introduced into a solution (herbal extracts commonly available in the market) containing macromolecules of interest. Any binding to the molecule of interest would create a change in optical wavelength that is recorded by the instrument in real-time. The target compound/ biotinylated DNA fragment/ streptavidin ternary complex will be isolated by adsorption to biotin-containing resin. This study will serve as a predictive tool in determining the bioactive ingredient in the commonly used herbal formulations that possess antiviral activity and hence can proceed to drug development.

Objectives

- Development of assays for identifying direct-acting ISG modulators.
- Development of antiviral assays to identify entry inhibitors using the pseudovirion-based system.
- Identification and characterization of direct-acting ISG modulators from screening of compound libraries.
- Synthesis of the pure molecules.
- Activity evaluation of the pure molecules against emerging viruses such as Dengue, Chikungunya, and Zika virus.

Outcomes

- Identification of isoflavone derivatives with significant antiviral and promoter activity.
- Synthesis and purification of small molecule modulators of ISG's.
- Activity evaluation of the pure molecules against Dengue.

Publications/Books or Book Chapters/ Patents/ Awards

Modak A, Mishra SR, Awasthi M, Sreedevi S, Sobha A, Aravind A, Kuppusamy K, Sreekumar E. Higher-temperature-adapted dengue virus serotype 2 strain exhibits enhanced virulence in AG129 mouse model. FASEB J. 2023 Aug;37(8):e23062. doi: 10.1096/fj.202300098R.

Pradeep P, Sivakumar KC, Sreekumar E. Host Factor Nucleophosmin 1 (NPM1/B23) Exerts Antiviral Effects against Chikungunya Virus by Its Interaction with Viral Nonstructural Protein 3. MicrobiolSpectr. 2023 Aug 17;11(4):e0537122. doi: 10.1128/spectrum.05371-22. Epub 2023 Jul 6.

Collaborations

1. Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram.
2. CSIR-National Institute of Interdisciplinary Sciences and Technology (CSIR-NIIST), Thiruvananthapuram

Conferences/Seminars/Workshops/ Talks Participated by Faculty or Students

1. Invited talk on "Research in Virology: Opportunities & Challenges"; ResearchersFest; 20th June 2023, University of Kerala, Kariavattom, Thiruvananthapuram.
2. Invited talk on "Arboviruses and Viral haemorrhagic Fevers' ;9th TRIENNIAL CONFERENCE (TRICON 2023) ACADEMY OF CLINICAL MICROBIOLOGISTS; 1st & 2nd October, 2023; Thiruvananthapuram.
3. Invited Talk on "3Rs in High Containment Research: Surrogate Systems in Virology" in National Workshop on BSL-3 Practices & Molecular Virology Procedures (NWBMV-2023) 28th to 30th November 2023 DBT-ILS, NALCO Square, Bhubaneswar.
4. Invited talk on "Addressing Therapeutic Challenges in Dengue: Opportunities ahead" in VIROCON-2023; 1st - 3rd December 2023. "Advancements in Global Virus Research Towards One Health'' organized by Indian Virological Society (IVS), New Delhi, at Tiruchirappalli, Tamil Nadu.
5. Invited Talk on "Current understanding of the role of the Virome on gut health'. 14th INDIA PROBIOTIC SYMPOSIUM February 3rd & 4th, 2024, Thiruvananthapuram, Kerala.
6. Keynote address on "One Health & Emerging Infections" in Annual Researchers' Conference on 20th March 2024; Mar Ivanios College, Thiruvananthapuram.

Project Students/Trainees

	Name	Designation	Qualification
1.	Mr. Kishore R	Hands on training	Completed
2.	Mr. Arun Kumar	Hands on training	Completed
3.	Ms. Aleena P S	Internship	Completed
4.	Ms. AryaLakshmi V S	Internship	Completed
5.	Mr. B. Nithin	Internship	Completed
6.	Mr. Shinu S. Babu	Internship	Completed
7.	Ms. Gauri R Narendran	Internship	Completed
8.	Ms. Aksa Johnson	Internship	Completed

PROJECT 2

Development of high affinity human recombinant monoclonal antibodies against Nipah virus for therapeutic uses

Recurrent outbreaks of Nipah in the country is a major public health concern. The human-to-human transmission observed in re-emerging NiV outbreaks raise concerns about possibility of larger epidemics. Nipah virus is classified as a category C agent because of its high human infectivity. The need to do virus handling under biosafety level 4 conditions has hindered research on Nipah. Viral entry into host cells is mediated by the interplay between two glycoproteins at the viral surface: an attachment protein (G) and a fusion protein (F). They are the only viral antigens displayed on the surface of the virion and are, therefore, the main targets of virus-neutralizing Abs. Monoclonal antibodies (mAbs) are versatile biomacromolecules that can bind with high specificity to a wide range of protein and non-protein targets. Hybridoma development is the commonly used method for the generation of monoclonal antibodies but has various disadvantages.

The development of antibody phage display libraries represents an alternative technique that involves the isolation of fully human-derived mAbs from large Ig gene repertoires displayed on the surface of bacteriophages. M13 is one of the most widely used phages for antibody phage display due to its pIII structural flexibility and the ability to display large proteins without losing their function. A combinatorial scFv library on the surface of the M13 filamentous phage has been achieved by combining populations of VH and VL-domains, which are joined by a flexible, protease resistance glycine-serine linker (Gly4Ser)3, into a single DNA sequence. These antibody sequences are then introduced and cloned as a gene fusion with the bacteriophage pIII gene under the control of a weak promoter in a phagemid vector. Once a phage-displayed peptide has been selected by using the biopanning protocol using glycoproteins F and G as antigenic baits, the characterization can be done for downstream applications.

Objectives

- Amplification of immunoglobulin genes from the PBMC of Nipah recovered individuals and construction of phage display library.
- Isolation of Nipah-specific monoclonal antibody from human immune phage display libraries.
- Characterization of neutralizing mAbs for their affinity, spectrum of neutralization and stability for possible therapeutic applications.

Outcome

The project will generate an immune phage display library against Nipah Virus. It will also generate fully characterized and validated recombinant human mAbs of high affinity against Nipah Virus. The antibodies produced can be used to develop therapeutic and diagnostic applications against Nipah Virus.

Team Members

	Name	Designation	Qualification
1	Dr. Priya P	DBT BioCARe Women Scientist	PhD
2	Dr. Santhik S L	Project Scientist	PhD
3	Ms. Meenakshi Mohan	Project Associate	MSc
4	Ms. Asha Lukose	Project Associate	MSc

PROJECT 3

The laboratory focuses on learning viral aetiology of different cancers. Understanding how oncogenic viruses contribute to the initiation and progression of cancer is crucial. By identifying these viruses and elucidating the mechanisms of cancer development, we can devise targeted prevention strategies, enhance early detection methods, and foster advanced therapeutic developments against virus-induced cancers. Additionally, the study also helps to learn more on cancer epidemiology and further scientific advancements.

Scientist in Charge Details

Scientist In Charge : Dr. Ruby John Anto

Designation : Honorary Scientist

Qualification : PhD

Area of Research : Viral Etiology of Various Cancers

Team Members

	Name	Designation	Qualification
1	Ms. Rayginia P Tennyson	Senior Research Fellow	MSc
2	Ms. Shifana C Sadiq	Junior Research Fellow	MSc
3	Dr. Abhishek Ajmani	Research Associate	PhD

from left to right

Flagship and other Research Works

Elucidating the regulatory role of kaempferide on the viral aetiology of cervical cancer

The research project is mainly focusing on deciphering the viral aetiology of various cancers and evaluating the effect of natural products on regulating it. Studies have been initiated on evaluating the efficacy of Uttroside B, an anti-HCC molecule isolated and patented at RGCB, in regulating the viral aetiology of liver cancer and nonalcoholic steatohepatitis (NASH). The efficacy of tryptanthrin is also being explored, another molecule identified from the medicinal plant, Wrightia tinctoria and tryptanthrin analogues in regulating the viral aetiology of melanoma and non-melanoma skin cancer. Moreover, as an intramurally supported program, we are elucidating the regulatory role of kaempferide, a potent anti-cancer flavonoid isolated from Chromolaena odorata, on the viral aetiology of cervical cancer. It is observed that kaempferide down-regulates the expression of the E6 and E7 oncoproteins of HPV 18 and HPV 16 and up-regulates the tumor suppressor genes, p53 and pRb. This is the first report depicting kaempferide as an inhibitor of HPV oncoproteins and hence as a candidate drug molecule against cervical cancer. The findings of the present study will aid in developing an effective, safe and affordable treatment option for cervical cancer that can benefit patients in developing countries.

Objectives:

- Study the role of kaempferide in regulating the viral actiology of cervical cancer.
- Identify the mechanism of action of kaempferide against cervical cancer Expected outcome
- Establishment of anti-oncogenic potential of kaempferide, and the key oncorproteins regulating the process of HPV -mediated cervical tumorigenesis by establishing all the major hallmarks of cancer.

Publications with IAV Affiliation in Peer Reviewed Journals (2023-24)

1. Tennyson P Rayginia, Chenicheri K. Keerthana, Sreekumar U. Aiswarya, Sadiq C. Shifana, Jannet S, Sanjay Suresh Varma, Maria Joy P, Archana PayickattuRetnakumary, Kalishwaralal Kalimuthu, Vishnu Sunil Jaikumar, Sankar Sundaram, Nikhil Ponnoor Anto, Noah Isako, Ravi S. Lankalapalli and Ruby John Anto*. Uttroside B, a US-FDA-Designated Orphan Drug Against Hepatocellular Carcinoma (HCC), Impedes Non-alcoholic Steatohepatitis (NASH) and NASH -Induced HCC. Journal of Advanced Research (Under Review).
2. Shifana C. Sadiq, Maria Joy, Sreekumar U Aiswarya, Abhishek Ajmani, Chenicheri K. Keerthana, Tennyson P Rayginia, Noah Isakov and Ruby John Anto*. Unlocking Nature's Pharmacy: An In-Depth Exploration of Phytochemicals as Potential Sources of Anti-cancer and Anti-inflammatory Molecules. Exploration of Drug Science (Under Review).
3. Lekshmi R Nath, Chenicheri K. Keerthana, Sreekumar U Aiswarya, Vijai V Alex, Tennyson P Rayginia, Nair Hariprasad Haritha, Arun Kumar T. Thulasidasan, Sadiq C Shifana, Pellissery Joy Maria,Mundanattu Swetha, Ravi Shankar Lankalapalli, Ruby John Anto*. Pre-clinical evaluation of the anti-oncogenic potential of kaempferide, which attenuates the HPV oncoproteins, E6 and E7, leading to p53 and pRb mediated apoptosis in cervical cancer. Annals of Medicine (Under Revision)
4. Keerthana CK, Aiswarya US, Rayginia TP, Yadu V, Shirley J, Shifana CS, Sankar S, D.K. Induja, Ravi S. Lankalapalli, Kuzhuvelil B Harikumar and Ruby John Anto*. (2024). A novel combinatorial regimen involving sorafenib and uttroside B,

a US FDA-designated 'Orphan drug', for the treatment of hepatocellular carcinoma. Anti-Cancer Agents in Medicinal Chemistry,doi: 10 .2174/0118715206316190240527160242

5. AS Achutha, S Krishna, VL Pushpa, D Harshini, US Aiswarya, S Nagarajan, Ruby John Anto, BS Vinod, Praveen Prakash, SV Manoj, KB Manoj, S Sarithamol, Suchitra Surendran, V Divya. Designing JAK2 Inhibitors Beyond Myeloproliferative Neoplasms-Theoretical and Experimental Analysis for Solid Cancers. Chemistry Select 9 (19), e202400072
6. Kalishwaralal, K., Nazeer, A.A., Induja, D.K., Keerthana, C.K., Shifana, S.C. and Ruby John Anto, 2024. Enhanced extracellular vesicles mediated uttroside B (Utt-B) delivery to Heptocellular carcinoma cell: Pharmacokinetics based on PBPK modelling. Biochemical and Biophysical Research Communications, p.149648.
7. Faisal M Athikkavil, Sreekumar U Aiswarya, Remya Johny, Meghna Sudhesh, Amrutha A Nisthul, Ravi S Lankalapalli, Ruby John Anto* and Smitha V Bava*. A potent bioactive fraction against colon cancer from Plectranthus vettiveroides. Exploration of Targeted Anti-tumor Therapy 4 (2), 227, 2023
8. Rayginia TP, Keerthana CK, Shifana SC, Aiswarya SU, Archana RP, Lankalapalli RS, Harikumar KB, Ruby John Anto*. Evaluation of Uttroside B, a potent bioactive from Solanum nigrum Linn, as a candidate drug molecule against non-alcoholic fatty liver disease. Biomedicine. 2024 Mar 4;44(1).
9. Rayginia TP, Chenicheri K Keerthana, Sadiq C Shifana, Maria Joy P, Ajmani Abhishek, Ruby John Anto*. (2024). Phytochemicals as Potential Lead Molecules against Hepatocellular Carcinoma. Current Medicinal Chemistry, https://doi.org/10.2174/0109298673275501231213063902 (In Press)
10. Shahbazi, R., Kalishwaralal, K., Paul, M.K. and Ruby John Anto., 2023. Role of Extracellular vesicles (EVs) in pathogenesis, diagnosis, therapeutic delivery, treatment, and theranostic applications in Cancer. Frontiers in Bioengineering and Biotechnology, 11, p.1288806.
11. Pouliquen DL, TrošeljKgand and Ruby John Anto (2023) Curcuminoids as Anticancer Drugs: Pleiotropic Effects, Potential for Metabolic Reprogramming and Prospects for the Future. Pharmaceutics. May 29;15(6):1612.
12. Mohan Shankar Gopinatha Pillai, Sreekumar U. Aiswarya, Chenicheri K. Keerthana, Tennyson P. Rayginia, and Ruby John Anto* (2023). Targeting receptor tyrosine kinase signaling: Avenues in the management of cutaneous squamous cell carcinoma, iSciencehttps://doi.org/10.1016/j.isci. 2023.106816

*Corresponding author

Book Chapters with IAV Affiliation

1. Tennyson P Rayginia, Chenicheri K. Keerthana, Anwar Shabna, Sreekumar U. Aiswarya, Sadiq C. Shifana, Ruby John Anto*. (2024) Phytochemicals as potential lead molecules in cancer drug research and development, Traditional Medicines in Drug Discovery, , Cambridge Scholars Publishing (In Press).
2. Chenicheri Kizhakkeveettil Keerthana, Tennyson Prakash Rayginia, Sreekumar Usha Devi Aiswarya, Sadiq Chembothumparambil Shifana and Ruby John Anto*,(2024) Bioactive Compounds in Cancer Therapy and Chemoprevention, Bioactive Compounds from Medicinal Plants, Bentham Science Publishers Pvt. Ltd (In Press)
3. Kalishwaralal, K., Abhishek, A., Keerthana, C.K., Rayginia, T.P., Swetha, M., Aiswarya U.S., Arivalagan, J., Bava, S.V., Firer, M.A. and Ruby John Anto*, (2023). Selenium Metabolic Pathway in Ferroptotic Cell Death. In Ferroptosis in Health and Disease (pp. 369-382). Cham: Springer International Publishing.

Collaborations

External:

1. Dr. Ravi S Lankalapalli, Principal Scientist, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.
2. Dr.KB Harikumar, Scientist E-II , Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram.
3. Prof. Noah Isakov, The Shraga Segal Department of Microbiology, Immunology and Genetics, Faculty of Health Sciences, Ben-Gurion University of the Negev, Israel.
4. Dr. Sankar Sundaram, Head of the Department of Pathology, Government Medical College, Kottayam
5. Dr. Sreekumar Pillai- Professor and Head of the Department of Surgical Oncology, Jubilee Mission Medical College & Research Institute, Thrissur.
6. Dr. TD Babu, Associate professor, Department of Biochemistry, Amala Cancer Research Centre, Thrissur
7. Dr. Achuthan C Raghava Menon, Associate Professor, Department of Biochemistry, Amala Cancer Research Centre, Thrissur
8. Dr. Smitha V Bava, Assistant Professor – Department of Biotechnology, University of Calicut.
9. Dr. Sindhu ER- Assistant Professor – Department of Biochemistry – Malabar Cancer Centre, Thalassery.

Internal:

a. Dr. E Sreekumar, Director, Molecular Bioassay Laboratory

b. Dr. Aswathyraj S , Scientist C, Department of Virus Diagnostics

Conferences/Seminars/Workshops/ Talks Participated

Dr. Ruby John Anto has participated the following conferences/seminars/workshops/talks

i. Chief Guest and Invited speaker at Jubilee Centre for Medical Research on national conference on Collaborative Research Initiatives on Science and Technology (CRIST) held on July 1st 2023.

ii. Invited speaker in the National Conference on "Emerging Trends in Healthcare Biotechnology: Innovations, Challenges and Future Prospects" at Regional Cancer Centre, Thiruvananthapuram, 30th November – 02 December, 2023.

iii. Distinguished resource person in the workshop on 'Current Trends in Biotechnology-2024.' at Calicut University from January 17th- 19th, 2024.

iv. Invited speaker at the 6th International Conference on Nutraceuticals and Chronic Disease (INCD), held at Department of Biochemistry, Punjab University, Chandigarh, Feb 22-24, 2024.

Project Students/Trainees

	Name	Type of training	Status
1.	Ms. Nandana K	Hands on training	Completed

Department of General Virology

The Department of General Virology carries out high-end research in various aspects of basic virology including, viral disease mechanisms, virus-host cell interactions and viral immunology. Any advances in understanding biochemical and molecular events occurring within virus infected cells would yield important new insights into the causes of viral diseases. Presently, the department focuses on emerging and re-emerging viruses, such as Nipah and Kyasanur forest disease virus research. The department is also dedicated to providing opportunities to specialize in molecular virology for doctoral and post-doctoral researchers.

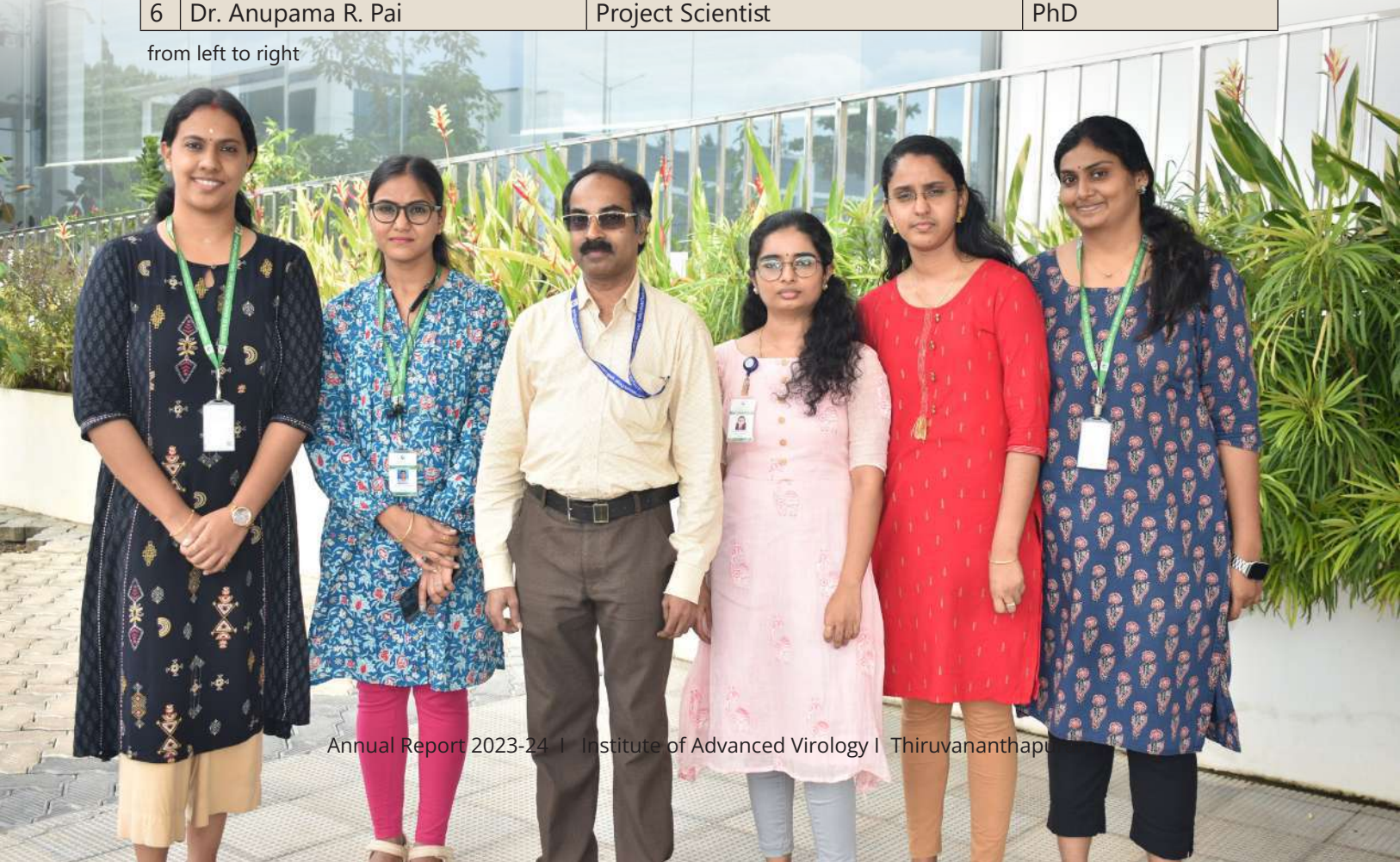
Scientist in Charge Details

Scientist in Charge	:	Dr. Mohanan Valiya Veettil
Designation	:	Senior Principal Scientist
Qualification	:	PhD
Area of Research	:	*Virus entry mechanisms,* *Virus-host cell interactions and Viral immunology*

Team Members

	Name	Designation	Qualification
1	Dr. Gayathri Krishna	Chief Minister's Navakerala Post-Doctoral Fellow	PhD
2.	Dr. Divyanshi Karothia	Research Associate	PhD
3	Dr. Arathi Rajan	Project Scientist	PhD
4.	Ms. Anju V.M	Junior Research Fellow	MSc
5.	Ms. Anuja S. Nair	Junior Research Fellow	MSc
6	Dr. Anupama R. Pai	Project Scientist	PhD

from left to right



Flagship and other Research Works

Development of neutralizing and diagnostic monoclonal antibodies for Nipah virus infection.

Objectives & Targets

- Generation, purification and characterisation of Nipah virus like particles (NiV-VLPs).
- Generation and characterization of monoclonal antibodies against the glycoproteins of Nipah virus (NiV).
- Characterisation of monoclonal antibodies for the detection and neutralisation of Nipah virus.

Outcomes

NiV-VLP production

- Gene blocks were synthesized and sub-cloned into mammalian expression vector.
- The expression of NiV structural proteins in in vitro cultured cells was evaluated using specific antibodies against NiV proteins.
- NiV-VLPs were produced by co-transfecting various NiV proteins.
- Purification and characterization of NiV-VLPs were done by immunoprecipitation, Western blot and immunofluorescence.
- Binding and infectivity of NiV-VLPs were evaluated in target cells.

NiV-monoclonal antibody production

- BALB/c mice were procured and immunized the experimental mice using Nipah viral glycoproteins
- Mice were sacrificed and splenocytes were fused with myeloma cells and proceeded with experiments for hybridoma production and monoclonal antibody production

1. Publications/Books or Book Chapters/Patents/ Awards

Sl No.	Authors	Name of the paper, journal, volume, page numbers, year	Research paper/review/ book chapter	Published/ communicated
i	Rajan A, Nair AS, Pillai VS, Kumar B, Anupama RP, Benny B, Valiya Veettil M	Highly sensitive and quantitative NanoLuc-tagged Nipah virus-like particles: a platform for rapid antibody neutralization studies. Volume 10, issue 11. E31905. 2024	Research paper	Published
ii	Krishnan D, Babu S, Raju, R, Valiya Veettil M, Keshava Prasad TS, Abhinand CS	Elucidating Epstein-Barr virus (EBV)-Human protein-protein interactions to uncover viral pathogenesis and therapeutic drugs. OMICS. (1):32-44. 2024	Research paper	Published
iii	Krishna G, Valiya Veettil M.	Marine Viruses and Their Impact on Ocean Bacterial Biomass.. In: Thomas, S., Hosur, M., Pasquini, D., Jose Chirayil, C. (eds) Handbook of Biomass. Springer, Singapore. pp. 1-27. 2023.	Book chapter	Published
iv	Gopi P, Krishna G, Valiya Veettil M	Biology of Variola Virus. Adv Exp Med Biol. 1451:139-149. 2024.	Book chapter	Published

Participation in Conferences/Seminars/Workshops

1. Mohanan Valiya Veettil. Resource Person for Refresher Course in Bioinformatics & Biotechnology for teachers, University of Calicut. Emerging and re-emerging viruses: Biotechnological approaches for developing antivirals and vaccines. March 2024.
2. Poornima Gopi, Gayathri Krishna, Vinod Soman Pillai, Mohanan Valiya Veettil. NHE 1 activity maintains an alkaline intracellular pH in EBV associated lymphoma cells. SBTI conference, RCC, Thiruvananthapuram. 2023

PROJECT STUDENTS/TRAINEES

	Name	Type of training	Status
1	Mr. Abhilash Jeas George	Internship	Completed
2	Ms. Tiya Mathai	Internship	Completed
3	Ms. Lakshmi S	Internship	Completed
4	Ms. Silpa Sasi	Hands on Training	Completed
5	Ms. Samhitha	Hands on Training	Completed
6	Ms. Anjala	Hands on Training	Completed
7	Ms. Goury	Hands on Training	Completed

Department of Viral Vaccines

The Department of Viral Vaccines aims to develop new generation vaccines against emerging viruses, viruses of critical concern as well as endemic viruses of regional importance. The vaccines thus developed will be validated in suitable animal models, which will further undergo efficacy, safety and immunogenicity studies prior to clinical use. The department is equipped with a cell culture facility and molecular biology lab where extensive molecular and immunology-based research activities are being performed.

Scientist in Charge Details

Scientist In Charge	:	Dr. Anismrita Lahon
Designation	:	Scientist C
Qualification	:	PhD
Area of Research	:	*Development of new generation vaccines against emerging viruses*

Team Members

	Name	Designation	Qualification
1	Mr. Ananthu Chandran J.M	Project Associate	MSc
2	Dr. Athira AP	Project scientist	PhD
3.	Ms. Smrithi Sreekanth	Junior Research Fellow	MSc
4.	Ms. Sreya Sherin Biju	Junior Research Fellow	MSc
5	Ms. Shilpa Ravindran	Technical Assistant	MSc

from left to right

Flagship and other Research Works

Development of DNA vaccine for Zika and chikungunya virus.

Objectives of the Project:

- Synthesis of DNA vaccine candidate for Zika Virus, Chikungunya Virus and a bivalent vaccine candidate against both Zika and Chikungunya Virus and its in vitro evaluation.
- Evaluation of humoral responses generated by these vaccine/s candidates in the presence of different adjuvants in vivo.
- Evaluation of cellular and cytokine responses elicited by three DNA vaccine candidates in vivo.
- Establishment of lipid nanoparticle-based carrier for DNA vaccine delivery.

Outcomes

- Synthesized DNA vaccine candidates for Zika virus and bivalent vaccine candidate for Zika and Chikungunya Virus.
- Evaluated the expression of respective antigens produced by these DNA vaccine candidates in vitro.
- Synthesized and characterized lipid nanoparticles to encapsulate DNA vaccines for its non-invasive delivery.
- Production of recombinant envelop proteins of CHIKV and ZIKV for further use.
- Development of safe and effective individual DNA vaccine candidates for Zika and Chikungunya viral infection, and a combined vaccines against these two virus infections.
- Developing an alternative non-invasive methods for the delivery of DNA vaccines using Lipid Nanoparticles or Extracellular Vesicles

Other Research activities:

1. Study on the role of both host and viral factors in megakaryocyte development, maturation, and platelet production in DENV infection.
2. Uncovered the mechanism of dysregulation of crucial molecules (PI3K/AKT/mTOR and terminal maturation factors, i.e., GATA-1, GATA-2, NF-E2) responsible for megakaryocyte development and maturation during dengue virus infection.
3. Research on involvement of trim family proteins in megakaryocyte development.

Publications/Books or Book Chapters/ Patents/ Awards

1.Ravindran S, Lahon A. Tropism and immune response of chikungunya and zika viruses: An overview. Cytokine. 2023 Oct; 170:156327. doi: 10.1016/j.cyto.2023.156327. Epub 2023 Aug 12. PMID: 37579710.

Conferences/Seminars/Workshops/ Talks Participated by Faculty or Students

Workshop on Mass Spectrometry-based Proteomics conducted at RGCB.

PROJECT STUDENTS/TRAINEES

	Name	Type of training
1.	Ms. Neeraja PM	Hands on Training
2.	Ms. Harikrishnan J	Hands on Training
3.	Ms. Varsha Vinod M	Internship
4.	Ms. Arsha Hariprakash	Internship
5.	Ms. Ardra Muraleedharan	Internship
6.	Ms. Souparnika KS	Internship
7	Ms. Goury	Hands on Training

Department of Viral Diagnostics

The Department of Viral Diagnostics is primarily focusing on the development of new diagnostic tools for emerging viruses and improving diagnostics for already existing virus infections. Another area of research carried out in the department is the genetic characterization of pathogenic viruses circulating in Kerala. The department also maintains a virus repository of pathogenic viruses from the clinical samples from the Advanced Molecular Diagnostics Facility for their future use in laboratory assays, animal experiments, the development of challenge viruses, and the development of vaccines.

Scientist in Charge Details

Scientist in Charge	:	Dr. Aswathyraj S
Designation	:	Scientist C
Qualification	:	PhD
Area of Research	:	*Development of new diagnostic tools for emerging viruses and improving diagnostics for already existing virus infections*

Team Members

	Name	Designation	Qualification
1	Ms. Chippy P. S.	Project Associate	MSc
2	Mrs. Minju Sara Simon	Project Associate	MSc
3	Dr. Aneesh B.	Project Scientist	PhD
4.	Ms. Megha Chandran	Project Associate	MSc

from left to right

Flagship and other Research Works

New Generation Multiplex Diagnostic Platforms against Viral Syndromes Causing Acute Febrile Illness in Kerala

The flagship research project entitled 'New Generation Multiplex Diagnostic Platforms against Viral Syndromes Causing Acute Febrile Illness in Kerala' is being implemented in the department. As part of this project, research activities are progressing towards the development of a multiplex diagnostic kit for Flavivirus infections. The non-structural protein-1 (NS1) of Zika virus, as well as Dengue Viruses (DENV1, DENV2, DENV3 and DENV4), were cloned, over expressed, and purified to use as antigenic bait for producing monoclonal antibodies. The purified proteins were characterized by Mass Spectrometry and CD Spectroscopy. The Dengue NS1 proteins of the four DENV serotypes were pooled together and used for the development of an indirect ELISA test for the detection of DENV IgM. The initial results are promising, further optimization is progressing. The genes coding for the attachment glycoprotein (G) and the fusion (F) glycoprotein of the Respiratory Syncytial Virus were amplified from an RSV-A isolate and cloned in the pET vector system. The F and G protein expression and purification are progressing.

Another area of research carried out in the department is the genetic characterisation of pathogenic viruses circulating in Kerala. All the virus samples were collected from the clinical samples received at the Advanced Molecular Diagnostics Facility. Respiratory Syncytial virus (RSV) infections among children in southern Kerala were studied to assess the genetic diversity of RSV circulating in the population. Among the 28 RSV RT-PCR positive cases tested, three different genotypes (RSV A ON1, RSV B, and RSV B BA) were identified by the Glycoprotein (G) gene sequencing. Full-length G and F protein sequencing of RSV-A is progressing actively; G protein sequences from 7 RSV isolates are completely sequenced, and F protein gene sequencing of 4 isolates has been completed. A preliminary analysis of the amino acid sequence revealed that one samplehad several amino acid substitutions at the mucin-like domain II of the G protein. The substitutions L274P, L298P, Y304H, and L310P observed in this study have been previously reported to be important for the development of antiviral immunity to the virus. As part of the influenza surveillance program of IAV, more than 100 clinical samples are being sequenced at present. NA gene was characterized from 35 H1N1 isolates, HA gene from 3 isolates, HA and NA genes from 12 influenza B isolates, and 3 H3N2 isolates also. Measles virus strains circulated in Kerala are being characterized based on the N-450 region sequence. Among the 95 positive cases reported, 33 samples were sequenced, and all of them were identified as the D8 genotype.

The Department also has established a virus repository of pathogenic viruses from the clinical samples from the Advanced Molecular Diagnostics Facility for their future use in laboratory assays, animal experiments, the development of challenge viruses, and the development of vaccines. We have established virus cultures of Adenovirus, HSV1, Measles virus, RSV A, RSV B, Influenza A, B viruses, Varicella-Zoster virus, DENV2 and DENV3 viruses in appropriate cell lines and were isolated. The RNA samples are being purified for whole genome sequencing of these viruses.

In order to reduce the dependence on expensive commercial multiplex real-time PCR kits, the department has made an initiative for the development and standardization of in-house multiplex PCR systems for the detection of virus infections. The following Multiplex RT-PCR tests have been standardized in the lab:

a) Dengue -Chikungunya -Zika viruses
b) Influenza A-Influenza B- Rhino virus -SARS CoV-2

c) HSV-1&2-Varicella Zoster Viruses

d) Human coronavirus 229E- Human coronavirus HKU1- Human coronavirus OC43- Human coronavirus NL64

Objectives

- To determine the aetiologies of acute febrile illness in children and adults admitted to selected hospitals and/or attending selected community health facilities in Kerala.
- To determine molecular epidemiology of different aetiologies of acute febrile illness throughout Kerala.
- To develop rapid multiplex assays for the detection of etiological agents of AFI.
- To conduct metagenomic-based next-generation sequencing for pathogen discovery among acute febrile illnesses cases.

Outcomes

- ELISA kit detecting Dengue IgM/ Zika IgM will be developed and commercialized.
- Development of rapid detection kit for the diagnosis of RSV & Influenza viruses.
- In-house real-time PCR tests will reduce the dependence on the respective commercial kits.
- A repository of pathogenic viruses will be established.
- The information on the various virus strains (Measles virus, Respiratory syncytial virus, Nipah virus, etc.) will be available for the public health system to depend on.

Publications/Books or Book Chapters/ Patents/ Awards

- Aneesh B, Swapna K Pillai, Chippy P S, Megha Chandran, Arun V Jose, Lalitha Kailas, Neziya M, Aswathyraj S, E Sreekumar. Monophyletic Human Bocavirus Lineage Infections in Paediatric Patients in a Tertiary Care Hospital in Kerala, India. Archives of Virology (Under Review)

Collaborations

- Micro/nanofluidics Research Laboratory, Department of Mechanical Engineering, College of Engineering, Thiruvananthapuram
- Department of Paediatrics, Sree Gokulam Medical College & Research Foundation, Venjaramoodu, Thiruvananthapuram
- Department of Paediatric Neurology, SAT Hospital, Thiruvananthapuram
- Department of Medicine, Govt. Medical College Hospital, Kottayam
- Institute of Child Health, Govt. Medical College Hospital, Kottayam

Project STUDENTS/TRAINEES

	Name	Designation	Qualification
1.	Mr. Jobin K. Paul	Internship	Completed
2.	Mr. Muhammed Noor	Internship	Completed
3.	Ms. Sincy Mol N	Internship	Completed
4.	Ms. Emil Theresa Edmund	Hands on training	Completed
5.	Ms. Amalendu	Hands on training	Completed

Molecular Diagnostic Facility

The Molecular Diagnostic Facility (MDF) is well equipped and fully functional with all classical virological systems and the state-of-the-art molecular diagnostic virology facility. Presently the facility has the capacity to diagnose 83 types of infectious agents such as vector-borne disease viruses; viruses transmitted by the respiratory route, by intestinal route, by body fluids; acute encephalitis syndrome causing viruses, zoonotic disease viruses and viruses of travel & tourism significance, employing both conventional and molecular methods.

The facility has tested more than 5000 clinical cases for various virus diseases (About 7600 clinical samples). The laboratory provides support to almost all districts in Kerala. The laboratory is closely associated to PHC/CHC /FHC/ Medical college level hospitals in the state health department. It maintains a good link with the district surveillance program and provides useful information to initiate public health action. Results of all samples received at the molecular diagnostic facility are being communicated to the treating clinician as well as Integrated Disease Surveillance Programme (IDSP).

Scientist in Charge Details

Scientist in Charge : Dr. Aswathyraj S
Designation : Scientist C
Qualification : PhD

Team Members

	Name	Designation	Qualification
1	Ms. Anjana V	Lab Technician	Bsc MLT
2	Mr. Arun V. Jose	Technical Assistant	BSc MLT
3	Ms. Ardhra sooraj	Lab Technician	Bsc MLT
4	Mrs. Rakhi S.	Lab Technician	BSc MLT
5.	Ms. Sreelaksmi. S	Lab Technician	BSc MLT

from left to right

Other Research Works

Apart from routine diagnosis reports generation and communication, the facility conducts early outbreak detection and implementation of effective control measures in close collaboration with the state health department, thereby aiming to help strengthen the public health system and pandemic preparedness. The facility is also equipped to conduct a variety of scientific activities such as molecular epidemiology research, validation as well as the development of diagnostic kits, advanced virus diagnostic training, and medical virology research in collaboration with clinical departments of medical colleges and other research centres. The facility provides diagnostic support to the government and private hospitals and is envisaged to become a referral facility in the state.

Main objectives of this facility:

- Diagnostics virology support - To strengthen the public health system and pandemic preparedness of the State by detection of emerging and re-emerging viruses
- Strengthen viral disease surveillance and outbreak investigations in the State

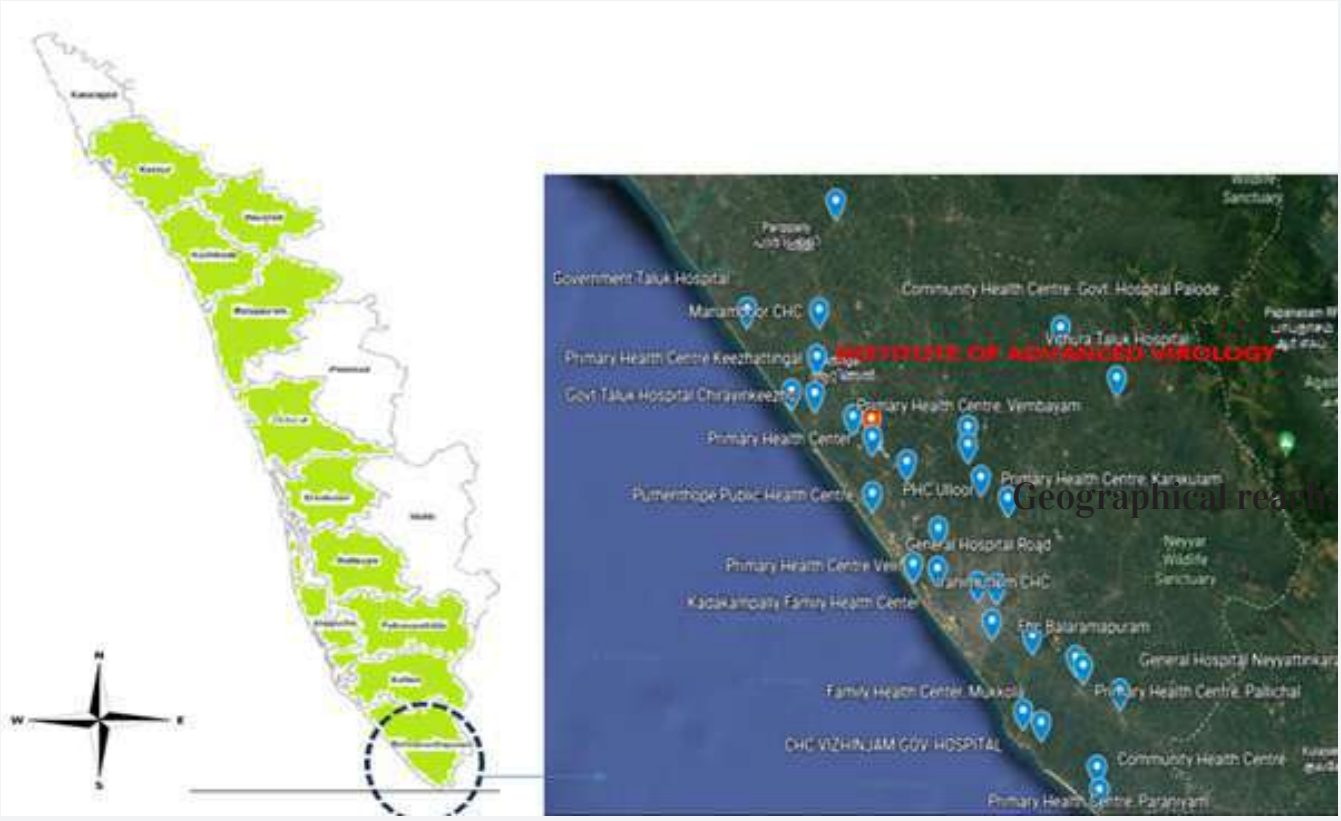


Fig. 1: Geographic distribution of Hospitals in Kerala associated with Molecular Diagnostic Facility

During the short period since the establishment, the facility has tested around 5144 clinical samples, and 1606 of them tested positive. An illustration of the representation of total number of cases Fig 2 and different pathogens diagnosed at the MDF is given in the Fig 3

Fig 2: Graphical representation of overall pathogens

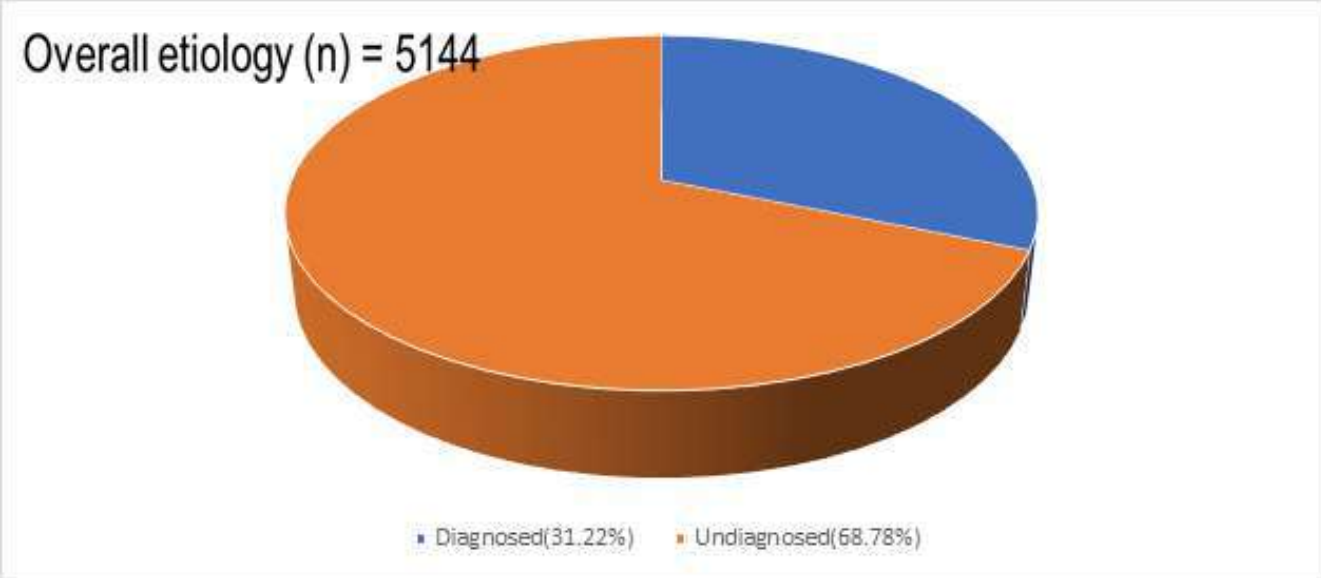
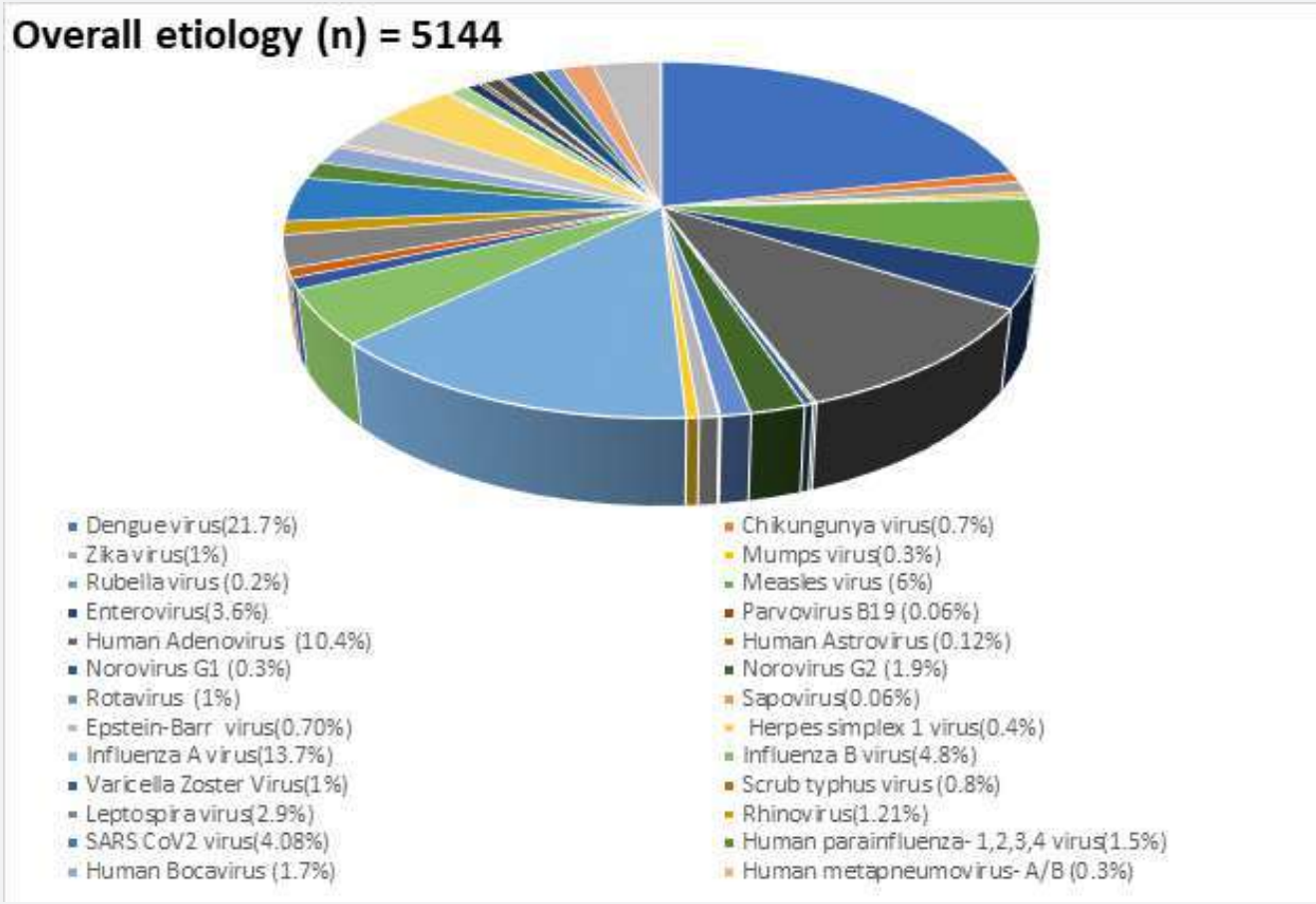


Fig 3: Representation of pathogens diagnosed from the clinical samples



Outbreak Investigations and containment responses

Nipah Virus outbreak in Sept. 2023:

The facility was instrumental in supporting the state during the current Nipah outbreak by testing suspected cases (four secondary contacts) from the Trivandrum and Kollam districts. Molecular diagnosis Nipah by real time PCR is being practiced for the diagnosis, in which samples are first inactivated and made non-infectious.

All four secondary contacts were negative for Nipah virus. These specimens were also tested for other respiratory pathogens and they were positive for Influenza and Rhinovirus. The results were communicated to Integrated Disease Surveillance Programme (IDSP) within 12 hours.

തോന്നക്കൽ ഇൻസ്റ്റിറ്റ്യൂട്ടിൽ ആദ്യ പരിശോധന; തിരുവനന്തപുരത്ത് നിപ സംശയിച്ച വിദ്യാർത്ഥി നെഗറ്റീവ്

Nipah test result of TVM student negative

Thiruvananthapuram: The Nipah test results of a student who sought treatment here returned negative on Wednesday. The preliminary test results from Institute Of Advanced Virology, Thonnakkal confirmed that the student has not contracted Nipah virus.

The Thiruvananthapuram Dental College student who sought treatment with symptoms of Nipah virus infection has been put under observation at

Influenza like illness at Trivandrum (June 2023)

In the view of emerging and re-emerging vector borne disease the increase in fever cases, Medical Officer from CHC Kulakkada requested for a field level Outbreak Investigation. A team from Molecular Diagnostic Facility visited the place on 08-06-2023 .50 samples (Nasopharyngeal swab & Blood) were collected from patients with ILI and DLI. 21 samples were positive for Influenza A (H1N1) and 6 cases were positive for Dengue virus.

Zika virus cases at Trivandrum (June 2023)

On the basis of a Zika virus positive case reported in the area of Navayikulam, Medical Officer in charge requested for field level investigation in that area. A team from Molecular Diagnostic Facility visited the place on 19-06-2023. Samples were collected from patients with DLI.25 samples were collected ,4 cases were positive for Zika virus ,4 cases were positive for Dengue,2 cases were positive for Chikungunya and 2 cases were positive for Influenza.

- **Implementation of Comprehensive Laboratory Management system in the Molecular Diagnostic Facility**

A Laboratory Information Management System (LIMS) is software that helpsus to effectively manage samples and related data in diagnostic laboratory. LIMS is very important in integrating laboratory operations within the laboratory itself. One of the most important aims of a LIMS is the integration different process, bringing together and consolidating the efforts of potentially many individuals and consequently speeding up the whole process. In addition, you can generate reliable results more quickly, share with treating clinicians and track date in future.

- **To prepare molecular diagnostic facility for NABL accreditation**

The NABL accreditation of the facility will enhance the visibility, reliability of the facility and authenticity of the results provided and will be helpful to establish the molecular diagnostic facility as a referral

laboratory. NABL accreditation denotes existence of sound quality assurance system and technical competency

- **Generation of income:The Molecular Diagnostic Facility has started charging nominal service fees for all tests since August 2023.**

Collaborations

1. Govt. Medical College Thiruvananthapuram, Govt. Medical College Kottayam and Sree Gokulam Medical College & Research Foundation, Thiruvananthapuram.
2. SRM Medical College Hospital and Research Centre, Trichy.

Project Students/Trainees

	Name	Type of training	Qualification
1.	Ms. Anjana. V	Technician Apprentice	BSc MLT

Department of Virus Epidemiology, Vector Dynamics & Public Health

Department of Virus Epidemiology, Vector Dynamics & Public Health studies virus discovery-based virus epidemiology, vector dynamics, and public health mainly through One-Health aspects of virus evolution and host-pathogen interaction. Western Ghats is one of the world's eight "hottest hot spots", whereas information about the viruses responsible for the short chain of outbreaks spread in these areas is very limited. The studies in this department focuses on identifying the viruses in the area through virus discovery approaches and determining their evolutionary development, mutations, prevalence, pathogenicity, and host range to prepare for future large outbreaks/pandemics, preventing the ongoing short chain of infection and providing effective treatment, and prioritizing risk factors, risk areas and pathogens for policymaking.

Scientist In Charge Details

Scientist in Charge	:	Dr. P A Desingu
Designation	:	Scientist C
Qualification	:	MVSc, PhD
Area of Research	:	*Virus discovery-based virus epidemiology, vector dynamics, and public health mainly through One-Health aspects of virus evolution and host-pathogen interaction.*

Team Member

Flagship and other Research Works

Virus-Metagenomics-based Virus Discovery from Symptom-specific Human Clinical Samples.

Objectives

- Identification of the novel viruses in the symptom-specific human clinical samples using virus-metagenomics.
- Complete genome sequencing and understanding of the evolutionary origin and relationships of the identified viruses.
- Virus isolation and identification of pathogenicity in the human/primate/animal/ insect cells lines.
- Identification of the novel viruses in insect vectors collected in Kerala will be carried out using virus-metagenomics.

- Complete genome sequencing and understanding of the evolutionary origin and relationships of the identified viruses will be carried out.

Outcome

The genetically diversified viruses such as Metapneumovirus hominis, Human mastadenovirus C, Cytomegalovirus human beta 5, Human parvovirus 4, Vesiculovirus, Chandipura virus, Gammapapillomavirus 22, Human polyomavirus 1 (BK virus), Human polyomavirus 2 (JC virus), and SV40, were first time detected in South Asia using virus-metagenomic approach in human clinical samples received at Institute of Advanced Virology.

Further, we also identified multiple bacterial pathogens with virulent genes from the human clinical samples received at the Institute of Advanced Virology, as follows: Corynebacterium striatum, Corynebacterium accolens, Pseudoxanthomonas z9, Pseudomonas p818, Sphingopyxis A083, Dolosigranulumpigrum, Hydrogenophaga sp., Serratia marcescens, Achromobacterxylosoxidans, Gordoniahongkongensis, Bose asp., Streptococcus pneumoniae G54, Lactobacillus, jensenii, Chryseobacterium sp., Acinetobacter sp., Gardnerella leopoldii, Gardnerella vaginalis, Fannyhesseavaginae, etc.; We first time documented these bacterial sequences from India.

Next, we first time documented multiple bacteriophages in India, in the human clinical samples received at the Institute of Advanced Virology, as follows: Escherichia virus DE3, Lambdavirus lambda, Jouyvirus ev207, Traversvirus p27, Tetraselmis virus 1, Paclarkvirus ARI04684, Wadgaonvirus wv5004651, Streptococcus phage SpGS1, Cyviruscyprinidallo 1, etc.

Department of Anti Viral Drug Research

The Department of Antiviral Drug Research (DAV) is dedicated to pioneering research for the identification and development of antiviral drugs. These drugs either directly target essential viral components or modulate host components to combat viral infections. The department also investigates virus-host interactions to uncover mechanisms of viral entry, trafficking, assembly, egress, and related cellular signalling. This research aims to identify crucial drug targets and develop broad-spectrum antiviral strategies against a variety of emerging and re-emerging viral infections. Currently, the department boasts a well-established cell culture laboratory equipped with essential tools such as centrifuges, BSL2 cabinets, a CO2 incubator, a conventional PCR machine, and additional minor equipment. Additionally, the department is equipped with heterologous protein expression capabilities for antiviral drug discoveries.

Scientist in Charge Details

Scientist In Charge	:	Dr.Jithesh Kottur
Designation	:	Scientist C
Qualification	:	PhD
Area of Research	:	*Identification and development of antiviral drugs.*

Team Members

	Name	Designation	Qualification
1.	Ms. Abhila Asi	Project Associate	MSc
2	Ms. Krishnalekha J.	Junior Research Fellow	MSc
3	Dr. Lekshmi V.S.	Project Scientist	PhD
4	Ms. Farha Salim	Project Associate	MSc

from left to right

Flagship and Other Research Works

Discovery and Optimization of Pan-Coronavirus Inhibitors for Nsp14 Guanine N7-Methyltransferase through a Structure-Based Drug Discovery Approach.

Objectives

- Standardization of expression and purification of truncated nsp14 from SARS-CoV-2 and RSV Methyltransferase (RSV-MTase) for the high-throughput screening and structural studies.
- High-throughput screening of inhibitors against SARS-CoV-2 nsp14 and RSV-MTase using various drug library and also using Fragment-Based Drug Screening.
- Validation of the selected compounds using various biochemical and biophysical studies.
- Structural elucidation of mechanistic basis of the inhibition and structural-based optimization of inhibitors for increased efficacy and potency.
- Testing of antiviral potential of identified/ optimized inhibitors in vitro/in vivo systems.

Technical Progress So Far

- Expression and purification of nsp14 from SARS-CoV-2 has been standardized, progressing towards the discovery of inhibitors against various existing and emerging corona viruses.
- Optimization of expressing and purification of RSV-MTase has been achieved.

Other Research Activities:

- Studies on virus-host proteome interactions and discovery of antiviral targets against severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) (Continuation of Dr. Binod Kumar's flagship project)

To address the challenge of emerging and re-emerging viral infections, we have focused on antiviral strategies targeting host factors rather than viral enzymes, aiming for broad-spectrum antiviral action against SARS-CoV-2 and other coronaviruses. We developed a highly sensitive and quantitative SARS-CoV-2 VLP system for use in a BSL 2 laboratory. These VLPs have been purified, validated, and characterized using various molecular and microscopic techniques and are now employed to study antiviral compounds. Our research demonstrated that only spike-containing SARS-CoV-2 VLPs can bind to and enter hACE2-transfected cells, confirming the spike protein's role in cell entry. We also found that these VLPs trigger inflammatory responses and ROS production in host cells within 24 hours, driven mainly by the SARS-CoV-2 N protein. Using this VLP system, we screened natural antiviral compounds for their host-mediated anti-inflammatory efficacy. Selected compounds showed potent activity in anti-inflammatory studies on A549/ACE2/TMPRSS2 cell lines. mRNA and protein expression studies indicated that these compounds reduce NF-κB levels and increase pNrf2 production compared to Nrf2. Our study concluded that SARS-CoV-2 VLPs provide a safe platform for screening antiviral compounds in a BSL II facility. The compounds we identified may serve as lead drug candidates to combat coronavirus infections through anti-inflammatory activity and modulation of virus entry.

A preliminary research work on antiviral drug discovery targeting CHIKV nsP1 MTase has been initiated.

Publications/Books or Book Chapters/Patents/ Awards

Sl No.	Authors	Publication details	Research paper/ review/book chapter	Published/ communicated
i	Kottur J*#, Malik R*#, Aggarwal AK#.	Nucleic Acid Mediated Activation of a Short Prokaryotic Argonaute Immune System. Nature communications. 15, 4852 (2024)	Research paper	Published
ii	Quintana-Feliciano R*, Kottur J*, Ni M, Ghosh R, Salas-Estrada L, Rechkoblit O, Filizola M, Fang G, Aggarwal AK.	Burkholder ia cenocepacia epigenetic regulator M.BceJIV simultaneously engages two DNA recognition sequences for methylation. Nature communications	Research paper	Under Final Review
iii	Karakus U, Mena I, Kottur J, El Zahed S, Krammer F, de Vries RP, Aggarwal AK, Boyce W, Coffey L, Garcia-Sastre A.	A novel influenza A virus HA subtype discovered in wild diving ducks exhibits MHC class II receptor specificity. Cell Host & Microbe	Research paper	In press
iv	Kottur, J. #,White, K. M., Rodriguez, M. L., Rechkoblit, O., Quintana-Feliciano, R., Nayar, A., et al.	Structures of SARS-CoV-2 N7-methyltransferase with DOT1L and PRMT7 inhibitors provide a platform for new antivirals.PLoSPathog. 19(7): e1011546.	Research paper	Published
v	Rechkoblit O, Sciaky D, Kreitler D, Buku A,Kottur J, Aggarwal AK.	Activation of CBASS-Cap5 endonuclease immune effector by cyclic nucleotides. Nature Struct Mol Biol. 31, 767–776 (2024)	Research paper	Published
vi	V. S. Lekshmi, Kumari Asha, Melvin Sanicas, Abhila Asi, U. M. Arya and Binod Kumar	PI3K/Akt/Nrf2 mediated cellular signaling and virus-host interactions: latest updates on the potential therapeutic management of SARS-CoV-2 infection ", Front. Mol. Biosci., Sec. Molecular Diagnostics and Therapeutics, 2023: 10	Review	Published

Collaborations

Prof. Aneel K Aggarwal, Icahn School of Medicine at Mount Sinai, New York.

PROJECT STUDENTS/TRAINEES

	Name	Type of training	Status
1	Ms. Neenu Sunil	Internship	Completed
2	Ms. Ruksana Rasheed	Internship	Completed
3	Mr. DasaraiJayaramesh	Internship	Completed
4	Ms. Angelina Marie Santhosh	Internship	Completed
5	Ms. Sadiya N.S.	Internship	Completed
6	Ms. Adithya Praveen	Internship	Completed
7	Ms. Fahima M	Internship	Completed
8	Ms. Elda Sheeba Raju	Internship	Completed
9	Ms. Adithya Joseph	Hands on training	Completed
10	Mr. Abhijith G.	Hands on training	Completed
11	Ms. Unnimaya	Hands on training	Completed
12	Ms. P Vasantha Prabha	Hands on training	Completed
13	Mr. Athul P	Hands on training	Completed
14	Ms. Vaishnavi	Hands on training	Completed
15	Ms. Gouri Nair	Hands on training	Completed

Synthetic Chemistry Laboratory

Scientist in Charge Details

Scientist In Charge : Dr. E. Sreekumar
Designation : Director

Discovery and development of new natural or synthetic organic compounds of biomedical utility is a critical component of antiviral drug research. Organic synthesis thus occupies a central role in antiviral drug discovery. In this context a synthetic chemistry laboratory is established to focus on the synthesis of small molecule organic compounds.

TEAM MEMBERS:

	Name	Designation	Qualification
1	Ms.Anjali C. J	Project Associate	MSc
2.	Dr. Nanditha Nair G	Principal Project Associate	PhD

from left to right

Research Activities

Creation of small molecule modulators of Interferon-stimulated genes as host-directed antiviral agents.

Host-directed antiviral agents that augment intrinsic antiviral activities of the host innate immune system is a new strategy in development to fight off emerging viruses. Initial immune response against a viral infection involves the Interferon 1(IFN 1) mediated activation of Interferon-Stimulated Genes (ISGs). Direct administration of IFN1 to boost the host immunity presents several side effects to the host. Hence, research efforts aiming at the modulation of the ISGs without the intervention of IFN is of great importance in antiviral drug development process. Among the ISGs, several studies have reported that Interferon induced transmembrane (IFTTM-1,2&3) proteins are broadly acting antiviral ISGs that prevent entry of several viruses. Our research focuses on development of a series of small molecule antiviral compounds that directly bind to the promoter regions of IFITM-1,2&3 proteins and activate them to enhance the protein expression.

During our preliminary investigation various classes of small molecules were biologically screened for antiviral and promoter activity. Our results show that certain phenyl substituted chromenone derivatives (flavone/isoflavone) shows significant antiviral activity as well as promoter activity in in vitro antiviral analysis. We have carried out the binding studies of isoflavone derivatives with pre-determined ISG promoter DNA sequences by various spectroscopic methods. Binding studies by UV-Vis and fluorescence spectroscopy indicate significant interaction between the promoter regions of IFITM proteins and isoflavone derivatives.

Based on our preliminary result we propose to synthesize nitrogen analogues of flavone/ isoflavone as potential ISG inducing antiviral compounds. In addition to chromenone derivatives, we are also exploring the antimalarial compound Rufigallol, as antiviral agents. We will be developing a combinatorial library (figure 1) of each class of compounds using synthetic chemistry laboratory facilities at IAV.

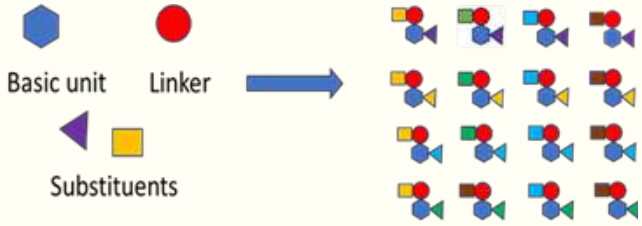


Figure 1: A combinatorial approach of synthesis

So far, we have standardized synthetic methods for one combinatorial library and achieved the synthesis of three of the final compounds, Propyl-quinolinone (PQT) triazoles, Benzyl-Quinolinone triazoles (BQT), Rufigallol and several precursors (figure 2). The compounds PQT and BQT are new compounds which have not been reported in the literature till to date. The compounds are characterized by analytical facility at CLIF, Kerala university. The synthesized compounds are currently under investigation for their antiviral properties.

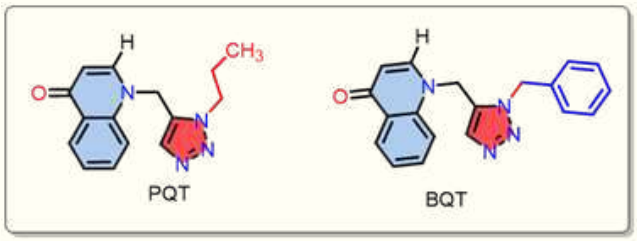


Figure 2: The synthesized small molecule organic compounds. PQT and BQT are unprecedented compounds.

Core Instrumentation Facility

The core instrumentation facility of IAV houses high-end and unique machines required for cutting edge research in various domains of Virology. The facility provides necessary technical support for the internal and external users, Training programmes on high end equipment is also provided. The equipments available in the facility are also accessible to the researchers, students from other institutions and start-ups/industries on chargeable basis.

Scientist In Charge Details

Scientist In Charge : Dr.P A Desingu
Designation : Scientist C

TEAM MEMBER:

	Name	Designation	Qualification
1.	Mr. Gopikrishnan K	Technical Assistant	B. Tech

The high end equipment available in the core instrumentation facility are as follows:

CONFOCAL LASER SCANNING MICROSCOPE

MODEL : STELLARIS 5

MAKE : LEICA BIOSYSTEMS

The LEICA STELLARIS 5 Confocal Laser Scanning Microscope provides high-resolution, three-dimensional images of fluorescently labelled samples. It uses laser beams to scan the sample and generate detailed images layer by layer. This microscope is crucial for studying the spatial distribution of molecules within cells and tissues, as well as for live-cell imaging.

DNA SEQUENCER

MODEL : 3730XL

MAKE : INVITROGEN BIOSERVICES

The 3730 XL DNA Sequencer is an automated capillary electrophoresis genetic analyser used for DNA sequencing and fragment analysis. This high-throughput system is capable of sequencing large numbers of DNA samples efficiently. It operates by separating DNA fragments by size through a capillary filled with a polymer, then detecting the fragments as they pass through a laser beam, which excites fluorescently labelled nucleotides.

FLUORESCENCE ACTIVATED CELL SORTER

MODEL : BD FACS ARIA FUSION

MAKE : BECTON DICKINSON

The BD FACSAria Fusion is a flow cytometry system that sorts cells based on their fluorescent properties. It can identify, quantify, and separate cell populations by directing a stream of cells through a laser beam and detecting the emitted fluorescence. This sorter is essential for applications in Virology, immunology, cancer research, and stem cell research, allowing for the isolation of specific cell types from heterogeneous samples.

BIOLAYER INTERFEROMETRY (BLI) BASED SYSTEM

MODEL : OCTET R8

MAKE : SARTORIOUS

The OCTET R8 Biolayer Interferometry (BLI) System is used for real-time, label-free analysis of biomolecular interactions. It measures the interference pattern of light reflected from an optical layer and a biolayer, providing insights into binding kinetics, affinity, and concentration. This system is widely used in drug discovery, antibody characterization, and protein-protein interactions studies.

INVERTED FLUORESCENCE MICROSCOPE

MODEL : AXIOVERT

MAKE : CARL ZEISS

The CARL ZEISS AXIOVERT Fluorescence Microscope is an inverted microscope designed for observing fluorescently labelled specimens. It utilizes fluorescence illumination to excite fluorophores in the sample, which then emit light at a different wavelength. This microscope is essential for live-cell imaging, studying cellular structures, and tracking the behaviour of proteins within cells.

HIGH PRESSURE HOMOGENIZER

MODEL : PANDA PLUS 2000

MAKE : GEA NIRO SOVAI

The PANDA PLUS 2000 High Pressure Homogenizer is used to create uniform particle size in suspensions, emulsions, and dispersions. It operates by forcing the sample through a narrow gap at high pressure, causing shear forces and turbulence that break down particles. This homogenizer is widely used in Research, pharmaceuticals, food processing, and biotechnology for applications like cell disruption, nanoparticle production, and emulsification.

ULTRA CENTRIFUGE

MODEL : OPTIMA XPN 100

MAKE : BECKMAN COULTER

The OPTIMA XPN 100 Ultra Centrifuge is a high-speed centrifuge capable of achieving extremely high centrifugal forces for separating components of a mixture based on density. It is used for applications requiring precise temperature control and programmable protocols, such as pelleting of subcellular organelles, viruses, proteins, and nucleic acids.

AUTOMATED PROTEIN PURIFICATION SYSTEM

MODEL : AKTA PURE 25M

MAKE : CYTIVA

The AKTA PURE 25M automated Protein Purification System is a technique used for the purification of proteins, peptides, and other biomolecules. It employs liquid chromatography columns with various resins to separate proteins based on properties like size, charge, and hydrophobicity. FPLC systems are highly automated, enabling precise control over the purification process and collection of fractions.

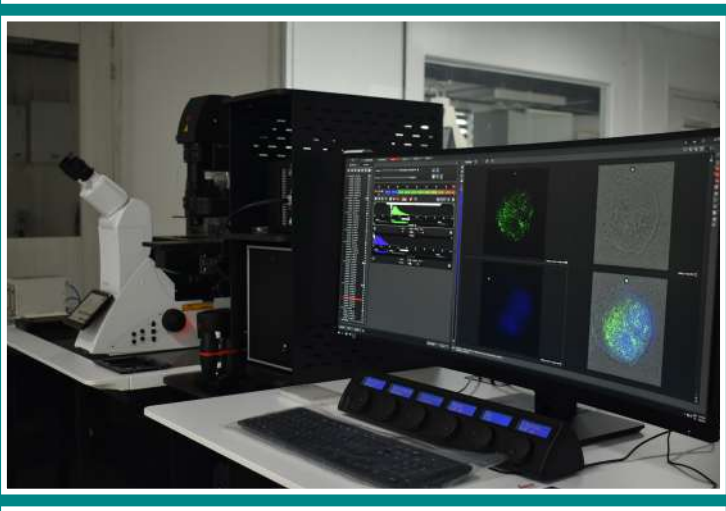
UV-VIS SPECTROPHOTOMETER

MODEL : UV 2600I

MAKE : SHIMADZU

The Shimadzu UV-2600i UV-Vis Spectrophotometer is used to measure the absorbance of UV and visible light by a sample. It can determine the concentration of substances in solution by analysing their absorbance at specific wavelengths. This spectrophotometer features a wide wavelength range, high sensitivity, and precision, making it suitable for applications in chemistry, biochemistry, and environmental science.

These instruments are pivotal in modern research, offering precise and reliable methods for analysing biological and chemical samples in advanced research.



CORE INSTRUMENTATION FACILITY

TRAININGS & DEMONSTRATIONS CONDUCTED BY CORE INSTRUMENTATION FACILITY

Electrofusion & Electroporation

BD FACS Aria fusion

Carl Zeiss Inverted Florescence Microscope

TRAININGS & DEMONSTRATIONS CONDUCTED BY CORE INSTRUMENTATION FACILITY

Automated Protein Purification System

High Pressure Homogenizer

DNA Capillary Sequencer

TRAININGS & DEMONSTRATIONS CONDUCTED BY CORE INSTRUMENTATION FACILITY

Biolayer Interferometry Based System

Nanodrop

Confocal Laser Scanning Microscope

TRAININGS & DEMONSTRATIONS CONDUCTED BY CORE INSTRUMENTATION FACILITY

Digital Transmitted Light Microscope

UPCOMING FACILITIES

- **Gas Chromatograph-Mass Spectrometer**
- **Nanolitre-volume dispensing protein crystallization Robot**
- **Probe sonicator**
- **Cold rooms**
- **Fermenter**
- **Elispot reader**

GOVERNING COUNCIL

The composition of the Governing Council of the Institute are as follows:

1	**Hon'ble Chief Minister of Kerala**	Chairperson
2	**Hon'ble Minister for Health & Family Welfare**, Govt. of Kerala	Vice Chairperson (Ex Officio)
3	**Chief Secretary**,Govt. of Kerala	Ex Officio Member
4	**Secretary**, Department of Biotechnology, Govt. of India	Ex Officio Member
5	**Secretary**, Department of Science and Technology, Govt. of India	Ex Officio Member
6	**Director General**, Indian Council of Medical Research (ICMR), Govt. of India	Ex Officio Member
7	**Additional Chief Secretary** (Finance), Govt. of Kerala	Ex Officio Member
8	**Principal Secretary**, Science & TechnologyDepartment , Govt. of Kerala	Ex Officio Member
9	**Principal Secretary** (Health), Govt. of Kerala	Ex Officio Member
10	**Secretary**, Animal Husbandry, Govt. of Kerala	Ex Officio Member
11	**Director**, National Institute of Virology (NIV), Pune	Ex Officio Member
12	**Director,** Vector Control Research Centre (VCRC), Puducherry	Ex Officio Member
13	**Director,** Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram	Ex Officio Member
14	**Director**, Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram	Ex Officio Member
15	**Director**, Health Services, Govt. of Kerala	Ex Officio Member
16	**Director**, Medical Education, Govt. of Kerala	Ex Officio Member
17	**Chairperson**, Research Advisory Committee, Institute of Advanced Virology (IAV)	Ex Officio Member
18	**Director,** Institute of Advanced Virology (IAV)	Convenor (Member)

GOVERNMENT NOMINEES IN THE FIRST GOVERNING COUNCIL OF IAV

1	**Dr. William Hall** Senior Advisor, IAV & Professor of School of Medicine, University College, Dublin	Member
2	**Shri. M.C. Dathan** Mentor (Science), Govt. of Kerala & Former Director, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram	Member
3	**Prof. M Radhakrishna Pillai** Former Director, Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram	Member
4	**Prof. Suresh Das** Emeritus Professor, Indian Institute of Science Education and Research (IISER), Thiruvananthapuram	Member
5	**Prof S. Murty Srinivasula** Professor (Biology); Indian Institute of Science Education and Research (IISER), Thiruvananthapuram	Member
6	**Dr. B Ekbal** Former Member, Planning Board	Member
7	**Dr. Jacob John** Retd. Professor, Clinical Virology Christian Medical College (CMC), Vellore	Member

The Governing Council was constituted during January 2023 and the 1st meeting of the Governing Council was convened on 3rd January 2024.

EXECUTIVE COMMITTEE

The composition of the Executive Committee of the Institute are as follows:

1	**Principal Secretary** Science & Technology Department, Government of Kerala	Chairperson
2	**Director** Institute of Advanced Virology (IAV)	Convenor (Ex Officio)
3	**Secretary** Finance Department, Govt. of Kerala or an officer authorised by the Secretary	Member (Ex Officio)
4	**Additional/Joint Secretary** Science & Technology Department, Govt. of Kerala	Member (Ex Officio)
5	**Head of Administration/ Administrative Officer,** Institute of Advanced Virology (IAV)	Member (Ex Officio)
6	**Member Secretary** Kerala State Council for Science, Technology & Environment (KSCSTE)	Member (Ex Officio)
7	**Dr. T R Santhosh Kumar** Scientist G, Rajiv Gandhi Centre for Biotechnology (RGCB), Thiruvananthapuram	External Nominee
8	**Dr. G Srinivas** Scientist G & Acting Head, Department of Biochemistry, SCTIMST	External Nominee
9	**Dr. Mohanan Valiya Veettil** Senior Principal Scientist, IAV	Nominee Scientific staff
10	**Mr. Nithin Besent N** Technical Officer, IAV	Nominee Technical staff

As per the approved rules and regulations of the institute. The meetings of the Executive Committee were held on 08.02.2023, 31.07.2023 and 21.02.2024.

RESEARCH COUNCIL

The composition of the Research Council of the Institute is as follows:

1	**Dr. N K Ganguly,** Former Director General (DG), ICMR	Chairman
2	**Dr. T Jacob John**, CMC, Vellore	Member
3	**Dr. G Arun Kumar**, Manipal Academy of Higher Education	Member
4	**Dr. Saumitra Das**, Director, NIBMG	Member
5	**Dr. S Murthy Srinivasula**, IISER, Thiruvananthapuram	Member
6	**Dr. Manju Bansal,** INSA Senior Scientist, Indian Institute Science (IISC), Bangalore	Member
7	**Dr. Amit Dutt**, Tata Memorial Centre (TMC), Mumbai	Member
8	**Dr. Rangarajan P.M,** IISC, Bangalore	Member
9	**Dr. Subash Vasudevan,** Duke- National University of Singapore (NUS), Singapore	Member
10	**Dr. Swaminathan**, International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi	Member
11	**Dr. Naveen Khanna**, ICGEB, New Delhi	Member
12	**Dr. Shyama Sundaran Kottilil**, Director, Institute of Human Virology, Baltimore, University of Maryland, USA	Member
13	**Dr. Debashis Mitra,** Director, Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad	Member
14	**Dr. K. Dharmalingam**, Research Director, Aravind Medical Research Foundation, Madurai	Member
15	**Dr. Koen K. A. Van Rompay,** Full Research Virologist, California Primate Research Institute, California, USA	Member
16	**Director**, IAV	Member - Convenor

The 3rd Research Council meeting was held on 20.11.2023.

TECHNICAL COMMITTEE

The composition of the building works committee of the Institute is as follows:

1	**Director** Institute of Advanced Virology	Chairman
2	**Dr. Mohanan Valiya Veettil** Senior Principal Scientist Institute of Advanced Virology	Member
3	**Shri. M. Sathyan** Executive Engineer PMSSY Project Division CPWD, Thiruvananthapuram	Member -Civil
4	**Shri. Ravindran M** Retd. Executive Engineer (Electrical), CPWD & Project Engineer (E), IIT Palakkad	Member Electrical
5	**Shri. Shaj Upendran** Engineer "F" & Acting Head Division of Clinical Engineering, SCTISMT	Member Bio-Medical
6	**Shri.Manoj Kumar S** Administrative Officer Institute of Advanced Virology	Member Secretary

INSTITUTIONAL BIOSAFETY COMMITTEE (IBSC)

IBSC members of IAV are as follows:

1	**Dr. E Sreekumar** Director, Institute of Advanced Virology	Chairman
2	**Dr. John Bernet Johnson,** Scientist E-I, RGCB, Thiruvananthapuram	DBT Nominee
3	**Dr. Aswathyraj S** Scientist-C, IAV	Member Secretary
4	**Dr. Sathish Mundayoor** Honorary Consultant, Inter University Centre for Biomedical Research (IUCBR), Kottayam	ExternalExpert
5	**Dr. Sarada Devi K L** Professor & Department, Microbiology, Government Medical College, Thiruvananthapuram	Biosafety Officer
6	**Dr. Binod Kumar** Scientist-EII, IAV	Internal Expert
7	**Dr. Mohanan Valiya Veettil** Senior Principal Scientist, IAV	Internal Expert

INSTITUTIONAL HUMAN ETHICS COMMITTEE (IHEC)

The Department of Health Research, Ministry of Health & Family Welfare approved IHEC of IAV on 22.02.2023 with the following members.

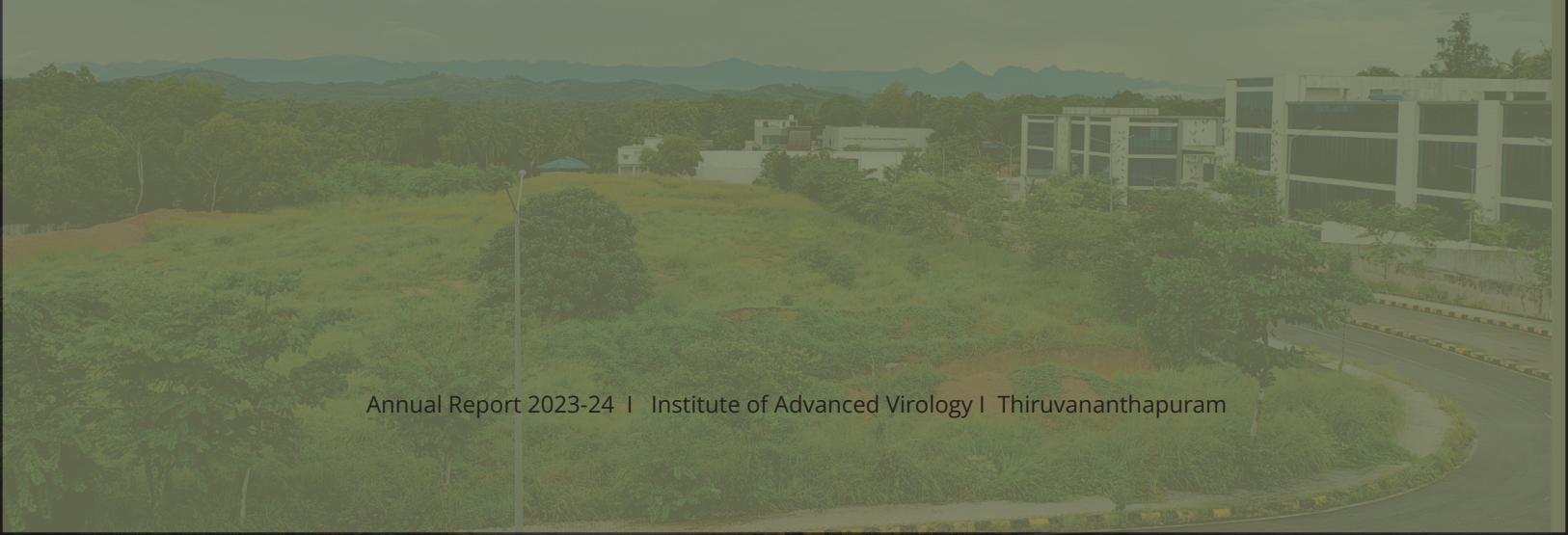
1	**Prof. (Dr.) Lalitha Kailas** Sree Gokulam Medical College and Research Foundation, Thiruvananthapuram	Chairman
2	**Dr. Rajesh Kumar,** Scientist E II IAV	Basic Medical Scientist
3	**Prof. (Dr.) Sankar V H** SAT Hospital, Govt. Medical College, Thiruvananthapuram	Clinician
4	**Prof. R Lekshmi** University of Kerala (UoK), Thiruvananthapuram	Social Scientist
5	**Prof. Jameela Begam** UoK, Thiruvananthapuram	Lay Person
6	**Mr. Pramod J Dev** Dev and Dev Legal Consultants, Ernakulam	Legal expert
7	**Mr. Vinod S,** Technical Officer IAV	Supporting staff
8	**Mrs. Shilpa Ravindran,** Technical Assistant IAV	Supporting staff
9	**Dr. Binod Kumar,** Scientist E II IAV	Member Secretary & Basic Medical Scientist (Dual Role)

INSTITUTIONAL ANIMAL ETHICS COMMITTEE (IAEC)

1	**Dr. E Sreekumar**, Director Institute of Advanced Virology	Biological Scientist	Chairman
2	**Dr. Mohanan Valiya Veettil** Senior Principal Scientist Institute of Advanced Virology	Scientist in charge of Animal House facility	Member
3	**Dr. Binod Kumar**, Scientist E II Institute of Advanced Virology	Scientist from different biological discipline	Member
4	**Dr. AnismritaLahon** Scientist C Institute of Advanced Virology	Scientist from different biological discipline	Member
5	**Dr. P A Desingu**, Scientist C Institute of Advanced Virology	Veterinarian	Member Secretary

ADMINISTRATION TEAM

AUDIT REPORT 2023-2024



BACKGROUND

We, Santhosh Alexander & Associates were appointed as the internal auditors of INSTITUTE OF ADVANCED VIROLOGY for the financial year 2023-24. The purpose of this report is to provide the management of INSTITUTE OF ADVANCED VIROLOGY (hereinafter referred to as "IAV" or the Institute") with main observations arising out of internal audit carried out for the period April 2023 to March 2024. This report should be read with the following aspects:

a. When performing our work, we have relied on Books of Accounts of the Institute, documents and information provided to us and discussions with concerned personnel. Analysis included in the report is based on the information provided to us by the management.

b. Our observations and recommendations stated in this report are with respect to adherence to compliance with regulations, operational controls, policies and procedures based on our review/test check of various transactions during the period, which have been mentioned in the report.

SCOPE OF WORK

In accordance with our agreed engagement scope, we have undertaken reviews on the following areas that the management had highlighted for our attention.

Audit Scope

General assessment of:

1. Business and operational risks and their management by the Institute.
2. Adequacy of Internal Control Measures in place.
3. Adequacy of information systems in place and reporting of important matters to the top management.
4. Adherence to accounting standards and justification of deviations if any.
5. Financial Records/ Statement of Accounts of the Institute and true and fair reporting of the transactions /operations of the Institute.
6. Safeguarding of Fixed Assets of the Institute.

Audit Period

- 1st April 2023 to 31st March 2024

ABOUT THE INSTITUTE

INSTITUTE OF ADVANCED VIROLOGY

The Institute of Advanced Virology was established in 2019 at Bio 360 Life Sciences Park, Thonnakkal, Trivandrum by the Government of Kerala as an institute of global standards with most modern laboratories focusing research, diagnosis and management of emerging and re-emerging infectious viral diseases. It is envisioned as a centre of excellence to work in collaboration with national/international institutions for training and education in the context of research covering basic science and translational research, providing sufficient scientific inputs to enable the prevention and control of viral infections. The Institute currently have all the infrastructure and human resources required to carry out high end research needed to study the virus and viral infections in a multifarious approach. The Institute also carryout activities to strengthen epidemic preparedness, rapid response and risk communication to the public. The Institute have the required bio-safety measures to handle high-risk viruses and is in the process of establishing a High Containment Bio-safety Level 3 laboratory.

The Phase I of IAV functions from two buildings of 107000 Sq. Ft area. The Human Resources comprises of 06 scientists, 11 project scientists, 11 project support staff and about 25 technical and administrative support staff. The Institute have 14 functional BSL 2 level laboratories, an Advanced Molecular Diagnostic Facility with capacity to detect 80+ viral parameters, Core Instrumentation Facility with ultra-modern equipment, Small Animal Experimental Facility and other support systems required for research activities. IAV also have active collaborations with medical colleges and research institutions within the state and outside to expand its research activities. Institute also provided academic and short-term training programmes in various domains of Virology.

As of now the institute runs with the help of the aid from Government of Kerala, operating with a mission to develop state-of-the-art infrastructure, skilled scientific & technical personnel, and services & products in virology to serve local, national and global needs.

INSTITUTE OF ADVANCED VIROLOGY

(An autonomous institution under Science and Technology Department, Government of Kerala)
Bio 360 Life Sceinces Park, Thonnakkal, Thiruvananthapuram, Kerala - 695317

Balance Sheet for the year ended 31st March, 2024

LIABILITIES		NOTES	AMOUNT	ASSETS		NOTES	AMOUNT
CAPITAL ACCOUNT				**Fixed Assets**			
Excess of expenditure over Income				Opening Balance	-		
Deficit FY 21-22	-16,01,905.79			Add: capitalised during 23-24	23,98,30,177.00		
Surplus FY 22-23	21,198.00		-15,80,707.79	less:Adjusted against Grand in Aid FY 23-24	16,37,28,046		7,61,02,131
			-				
GOVERNMENT GRANT		1					
Grant (Plan Fund)	19,76,10,786.00			**Current Assets**			
Grant (Plan Fund)-SALARY	1,62,24,634.00			Fixed Deposit		9	97,46,630.00
Grant set apart to SBI Pool A/C for GEM	5,24,03,910.00			Loans & Advances (Asset)		10	10,030.00
Grant Adjusted 21-22 for Building WIP	4,79,46,352.00			Security Deposit		11	15,000.00
TOTAL	**31,41,85,682.00**			Cash in Hand			-
Less: Grant adjusted against FA during 23-24	**16,37,28,046.00**			Bank Accounts		12	5,02,01,537.21
Less: Grant adjusted during 21-22	**4,79,46,352.00**			TDS Refundable			16,835.00
less: grant utilised for revenue expense 23-24	**6,04,99,804.45**		**4,20,11,479.55**	Employees Health Insurance Premium			3,92,852.00
				UGC fellowship-Recievable From Gov			30,000.00
CER Fund	30,00,000.00						
Less: Fund adjusted against FA(Ambulance)	17,85,558.00						
less: Fund utilised for revenue expense	60,858.00						
Less:Advance to JNTBGRI	2,71,000.00		8,82,584.00				
Current Liabilities							
Duties & Taxes		2	73,853.14				
Sundry Creditors		3	7,70,70,691.00				
Advance payment of GST TDS Collected			12,002.00				
Gov Plan Fund-Refundable			67,201.00				
Salary & Allowances Payable		4	22,48,832.00				
Security Deposit & EMD received		5	25,74,331.00				
Retention Money & Other Deductions		6	61,03,128.00				
External Fund For Projects		7	49,97,811.00				
Other Current Liability		8	20,53,810.31				
Total			13,65,15,015.21	Total			13,65,15,015.21

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Income & Expenditure Account for the year ended 31st March, 2024

Expenditure	Amount(₹)	Income	Amount(₹)
To Laboratory Consumables	11,263,871.00	**By Grant in Aid Adjusted for Revenue Expenses**	**60,499,804.45**
To Salary & Allowances - Scientist	6,640,798.00		
To Salary & Allowances - Director	3,484,136.00	By Academic receipt	1,475,367.12
To Salary & Allowances - Admin Staff	2,671,290.00	By CER fund utilised for revenue expense	60,858.00
To Salary & Allowances - Technical Staff(Regular)	3,578,082.00	By Deductions and liquidity damages	367,761.00
To Salary & Allowances - Flagship Prgm, Contract Staff etc.	10,887,795.00		
		By Interest Income	511,047.00
To Salary & Allowances - Daily Wages Staff	766,883.00	By Molecular diagnostic testing charge	751,657.43
To Academic Expenditure	1,028,115.00	By other miscellaneous Income	15,603.00
To Advertisment & Promotion Charges	1,156,070.00	By Overhead Income From project	445,343.00
To Affiliation & Other Registration Expenses		By Tender Fee received	30,015.00
To Annual maintenance charge - Diesel Generator & electrical	2,884,558.00		
To Bank Charge	119.00		
To Cleaning/House Keeping Charges	255,323.00		
To Electricity Charge	3,992,515.00		
To Employer Provident Fund Contribution	25,200.00		
To Festival Allowance	47,750.00		
To Flagship Program consumables	6,892,019.00		
To Gratuity Contribution	100,624.00		
To Group Gratuity Scheme premium	281,144.00		
To Internal Audit Fee	82,600.00		
To Leave Salary Contribution	200,475.00		
To Meeting/ Seminar/ Conference related expense	159,649.00		
To Office Expenses/ Miscellaneous Expenses	480,293.00		
To Postage & Courier Charges	6,142.00		
To Printing & Stationery	605,908.00		
To Professional/ Consultancy Charges	441,515.00		
To Refreshment and Other Related Expenditure	140,629.00		
To Repairs & Maintenance - Building & Campus	1,652,558.00		
To Repairs & maintenance - Electrical & plumbing	352,740.00		
To Repairs & maintenance - Office Assets/ Equipment	464,324.00		
To Repairs & maintenance - Others	68,351.00		
To Revenue expense met out of CER Fund	60,858.00		
To Security Service Charges	1,235,840.00		
To Telephone & Internet Charges	320,670.00		
To Traveling Allowance/ Honorarium/Seminar Others	256,833.00		
To Vehicle Hire Charge	1,401,064.00		
To Water Charges	124,690.00		
To Website Expenses, IT Network Expenses etc.	146,025.00		
Total	**64,157,456.00**	**Total**	**64,157,456.00**

Notes to Financials 2023-24

Note - 1

	GOVT.GRANT (PLAN FUND)	Amount (₹)
Opening Balance		10,00,000.00
Add:		
	Received During the year	30,48,93,078.00
	Fund Transferred to GeM Pool during 22-23	5,24,03,910.00
Less:		
	Utilised against capital expenditure During the year	16,37,28,046.00
	Utilised against revenue expenditure During the year	6,04,99,804.45
	Amount Resumed by Government of Kerala	9,20,57,658.00
	fund Transferred to GeM Pool during 23-24	3,82,17,814.00
	Fund included in internal Income	27,93,665.55
	Balance as on 31-03-2024 in Treasury A/C	10,00,000.00

Note - 2

	Duties & Taxes	Amount (₹)
Add:		
	Output CGST-9%	26,700.57
	Output SGST-9%	26,700.57
	TDS on SGST	13,101.00
	TDS on CGST	13,101.00
	TDS on IGST	51,272.00
	TDS on Profession	33,264.00
	Total (A)	1,64,139.14
Less:		
	Input Tax CGST-9%	181.00
	Input Tax SGST-9%	181.00
	Input Tax IGST 18%	89,924.00
	Total (B)	90,286.00
	Balance as on 31-03-24 (A-B)	73,853.14

Note - 3

	Sundry Creditors	Amount (₹)
	Creditors for expenses	9,68,560.00
	Kerala Life Science Park (P) Ltd.	7,47,47,050.00
	C-DIT	13,55,081.00
	Balance as on 31-03-24	7,70,70,691.00

Note - 4

	Salary & Allowances Payable	Amount (₹)
	Salary Payable	21,98,432.00
	Provident Fund Employer Contribution Payable	25,200.00
	Provident Fund Employee Contribution Payable	25,200.00
	Balance as on 31-03-24	22,48,832.00

Note - 5

	Security Deposit & EMD Received	Amount (₹)
	Security Deposit	18,64,128.00
	EMD Received	6,90,203.00
	PHD-Caution Deposit	20,000.00
	Balance as on 31-03-24	25,74,331.00

Note - 6

	Retention Money & Other Deductions	Amount (₹)
	Deduction Instead of Bank Guarantee	26,39,654.00
	Retention Money: Uralungal (ULCCS)	34,63,474.00
	Balance as on 31-03-24	61,03,128.00

Note - 7

	External Fund For Projects	Amount (₹)
	CSIR-Dr Ruby John	94,178.00
	Bio Care- Dr. Priya	19,65,516.00
	ICMR- Dr. E. Sreekumar	2,02,279.00
	SERB- Dr. Anismrita	17,05,945.00
	DST SERB Project Dr. Mohanan VV	10,29,893.00
	Balance as on 31-03-24	49,97,811.00

Note - 8

	Other current liabilities	Amount (₹)
	Payable For equipment-SERB project	16,00,000.00
	CM Nava Kerala PDF	40,000.00
	earlier opening balance not tallied	3,02,170.31
	DBT PHD Contingency and fellowship	1,11,640.00
	Balance as on 31-03-24	20,53,810.31

Note - 9

	FIXED DEPOSIT	Amount (₹)
	Canara Bank 38017/1	10,37,558.00
	Canara Bank 53500/1	15,31,466.00
	Canara Bank 71609/1	15,24,155.00
	Canara Bank 74999/1	7,36,808.00
	Canara Bank 7977/1	10,34,712.00
	Canara Bank 84620	2,21,310.00
	Canara Bank 86433/1	15,25,219.00
	Canara Bank 87566/1	15,25,219.00
	State bank of India 19969	3,07,463.00
	State Bank of India 860264	3,02,720.00
	Balance as on 31-03-23	**97,46,630.00**

Note - 10

	Loans & Advances (Asset)	Amount (₹)
	Advance to officials	100,30.00
	Balance as on 31-03-24	10,030.00

Note - 11

	Security Deposit	Amount (₹)
	SD to Supplyco for Diesel Supply	15,000.00
	Balance as on 31-03-24	15,000.00

Note - 12 Bank Accounts

Sl.No:	Particulars	Closing Balance (₹)
1	Treasury Account	10,00,000.00
	Major Bank Accounts	
	Canara Bank Pallippuram 3216	18,30,390.21
	Canara BankPattom-2363	12,29,651.00
	Canara Bank EASY FEE A/C-110063988092	61,234.00
	SBI-E-Tender A/C -41430501536	68,596.00
	SBI-GeM Pool A/C -41442694591	3,98,17,814.00
	Bank Accounts - Projects	
	Canara Bank-DBT Bio Care	19,65,516.00
	Canara Bank -DST	163.00
	Canara Bank ICMR	2,02,279.00
	Canara Bank -SERB Dr MVV	10,29,893.00
	Canara Bank -CSIR-Dr. Ruby John	94,178.00
	Canara Bank- SERB Dr. Anismrita	17,05,945.00
	Bank Accounts - Other	
	SBI-Fee Collect -20168	9,08,826.00
	SBI- MDF-609883	2,87,052.00
	Total	**5,02,01,537.21**

FIXED ASSETS For the Financial Year 2023-2024

SL.NO	PARTICLUARS	Recognised During 21-22	Adjusted against grant during 21-22	Recognised During 22-23	Adjusted against grant during 22-23	Recognised during the Year2023-24	Adjusted against Grant during the Year	Balance
A	**Building & infrastructure**							
	Phase 1A -Building & Infrastructure	8,907,922.00	8,907,922.00	5,086,597.00	5,086,597.00	9,377,945.00	8,022,864.00	1,355,081.00
	Phase 1B- Building &Infrastructure			4,484,016.00	4,484,016.00	163,607,444.00	88,860,394.00	74,747,050.00
					-		-	-
B	**Computer & Accessories**				-		-	-
	Printer & Accessories	94,900.00	94,900.00	247,802.00	247,802.00	79,245.00	79,245.00	-
	Computer & Accessories	508,800.00	508,800.00	1,460,907.00	1,460,907.00			-
	LCD Projector BENQ EW 600	54,900.00	54,900.00		-			-
					-		-	-
C	**Electronic Items**				-		-	-
	Audio visual Equipment			295,209.00	295,209.00	50,000.00	50,000.00	-
	Electric Items	28,387.00	28,387.00		-	13,200.00	13,200.00	-
			-		-		-	-
D	**Furniture &Fixtures**		-		-		-	-
	Furniture &Fixtures	249,249.00	249,249.00	8,379,245.00	8,379,245.00	5,557,864.00	5,557,864.00	-
	Laboratory furnishing	5,380,624.00	5,380,624.00		-		-	-
E	**Intangible Assets**		-		-		-	-
	Computer Software	68,000.00	68,000.00	762,100.00	762,100.00	460,200.00	460,200.00	-
	software license		-	134,980.00	134,980.00	3,800.00	3,800.00	-
			-		-			-
F	**Lab Equipments**		-		-		-	-
	Flagship programme equipment	25,868,317.00	25,868,317.00	88,921,137.00	88,921,137.00	3,794,167.00	3,794,167.00	-
	Major/minor Lab Equipments		-	2,831,366.00	2,831,366.00	56,879,887.00	56,879,887.00	-
			-		-			-
G	**Other Fixed Asset**	3,575.00	3,575.00	70,266.00	70,266.00	6,425.00	6,425.00	-
H	**Leasehold Land- Phase 1B**			54,747,050.00	54,747,050.00			-
	TOTAL	**41,164,674.00**	**41,164,674.00**	**167,420,675.00**	**167,420,675.00**	**239,830,177.00**	**163,728,046.00**	**76,102,131.00**

PERFORMANCE ANALYSIS

The review of operations of the Institute for the financial year 2023-24 in monetary terms is given below.

1. Total grant received from the Government of Kerala by the institute during the FY 23-24 is ₹30.48crores.
2. The grant utilized by the institute for the capital expenditure during the FY 23-24 is ₹16.37crores and the grant utilized for revenue expenditure during the said financial year is ₹6.32crores.
3. The Institute set apart an amount of ₹3.82crores from Grant-in-Aid to SBI Pool A/c for GEM Purchase purpose during the FY 23-24.
4. An amount of ₹9.20crores resumed by the government of Kerala from the treasury account of the institute on 31-03-24 thus the balance in the grant is ₹10 lakhs (Treasury account) as on 31-03-24.

OBSERVATIONS

1. As per the registered Rules and Regulations of the Institute, the Governing Council of the Institute shall be responsible for the overall administration of the Institute. As per clause 5.4 of said Rule, the Governing Council of the Institute shall meet at least once in a year and as per clause 6.4 of the Rules, the Executive Committee of the Institute shall meet not less than three times in a Financial Year. But it is noticed that the Governing Council of the Institute not yet convened and not approved the takeover of the existing business. The Executive Committee of the Institute convened only once till this day.

   Management Response:

   The meeting of the Governing council was held on 03.01.2024. The EC meetings were held on31.07.2023 & 21.02.2024.

2. As per the registered Rules and Regulations of the Institute, Clause 18.2, it is said that 'the accounts of the Institute are to be maintained in such manner as prescribed by the Governing Council by framing appropriate financial rules as byelaws with the approval of the Government.' But the Institute has not yet framed any financial rules for the accounts.

   Management Response:

   The draft financial rules of the Institute were approved by the Governing Council during its 1st meeting held on 03.01.2024. The same is awaiting the concurrence of the Government.

3. An amount of ₹2 lakh was deposited as FD on 24-04-22 with Canara Bank Pattom branch, for a period of 10 years to obtain corporate credit card. But the Institute has not yet obtained such a corporate credit card.

   Management Response:

   Due to administrative reasons of Canara Bank, they were unable to issue a corporate credit card to the Institute. As on 31.03.2024, Institute is maintaining the said FD and cumulative interest earned is Rs. 10,401/-

4. The Institute has 2 buildings named Phase 1A and Phase 1B for its operations as on 31st March, 2024.As per the information and explanations provided by the management and as per lease agreement available, the Lessee shall pay the Lessor during the said term of the lease a yearly rent of Rs.100/- (Rupees

Hundred only) per acre payable in advance on or before 30th day of April every year for that financial year , if not paid within the said period the same shall carry interest at 12% per annum or such rate as may be fixed by the lessor from time to time. Institute not paid rent amount till 31.03.2024

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Management Response:

The building mentioned are not on lease. However, the land is obtained on lease from M/S Kerala Life Sciences Industries Park Limited (KLIP) for which yearly rent is fixed. However, M/S KLIP has not raised the bill for the rent and hence payment was not made. The Payment will be made as and when the bill is raised by the lessor.

5. As per the information and explanation provided by the management and as per documents available, Building Asset register did not mention any details regarding Phase 1B.

   Management Response:

   The Phase 1B Building was handed over to the institute during the FY 2023-24 and establishment of facilities in the same is in process. M/S KLIP is yet to give the actual cost of construction of the building and hence the details could not be updated in the Asset Register. The details of Building and facilities being created and will be updated once the work is completed and the final cost is arrived.

6. It is noticed that Institute has not yet framed any purchase policy for the ease of purchase procedures.

   Management Response:

   The Institute follows the purchase rules as per the Government of Kerala/ India norms. The Governing Council of the Institute during its first meeting has approved the draft purchase rules of the Institute and the same was forwarded to Government for the concurrence. The concurrence is still awaited.

7. As per the General as well as GEM contract terms, there are provision for liquidation damages (LD) provided @ 0.5% per week or part of the week of delayed period as pre-estimated damages not exceeding 10% of the contract value.

   Management Response:

   Levying of Liquidation damages (LD) @ 0.5% of the contract value per week has been initiated in cases where the supply is delayed beyond the prescribed delivery period/ extensions granted.

8. Most of the transactions of the Institute are accounted on payment basis rather than accrual basis.

   Management Response:

   As the institute receives majority of operating income in the form of grant in aid from Government of Kerala, Institute needs to submit real-time component wise expenditure details in the form of Utilization certificates for further allotments. Furthermore, due to treasury restrictions on high value payments there is a delay in actual payment, sometimes beyond the financial year. However, the suggestion is noted for compliance.

9. As per the GO(Ms)No.1/2018/S&TD dtd. 05-03-2018, the Government of Kerala constituted a Research Council for IAV. There are 15 members in the first Research Council as per the said GO. The scope, responsibilities, rights and duties of the council with respect to the operations of the IAV are not available. No details observed in the constitutional documents of IAV about the Research Council.

   Management Response:

   The scope, responsibilities, rights and duties of the Research Council is incorporated in the proposed bye-laws and the same is under consideration of the Government.

10. There is no proper Gate Pass system exists in the Institute for the entry and exit of people, vehicle and materials. Administration permission is not obtained to take materials (especially equipment's) out of campus. Gate pass is not generated properly in the case of entry outward of any material. Gate pass details are not available with administration department. Gate pass are not properly numbered.

    Management Response:

    Gate pass is issued for every item being taken out of the Institute and necessary registers are maintained at main entrance for recording the movement of materials.

11. As per general Supply Order terms of the Institute, a copy of the order is to be duly signed and returned by the supplier to Institute as an acceptance of such terms and conditions in the supply order. In a scrutiny, in some cases nothing observed in relation to such acceptance by the supplier.

Management Response:

The purchase orders are emailed to the concerned vendors to reduce the postal expenses. The suppliers also confirm the receipt of the PO through e-mail to the purchase department.

12. As per the information and explanations provided the management, even though the Institute deals with a large number of high value assets like building, laboratories, research and diagnostic apparatuses, consumables etc.., including hazardous materials, the Institute has not yet taken any initiative to assess the potential risk to its assets and not taken any insurance against such risks. No safety audit reports available for verification.

    Management Response:

    The security measures have been increased by deploying additional security guards, especially during the non-working hours. Biometric and RFID based access control system is implemented at main entrance and Bio tech area to restrict entry to the institute and laboratories for authorised personnel only. Security audit of the Institute is undertaken by the SISF and the confidential report in this regard is submitted to the Government for consideration.

    Steps are being taken to obtain insurance coverage for the high value assets of the Institute.

13. Legal Consultancy charges paid to Adv. M.R Bindhu amounting 40,000. TDS not deducted and GST as per Reverse Charge Mechanism has not paid.

    Management Response:

    Out of the total payment of Rs.40,000/- made, the consultancy charges were Rs.25,000/- only. The remaining amount was for other contingent expenses incurred. Hence, TDS was not affected. The point is noted for future compliance.

For **Santhosh Alexander & Associates**

UDIN:24207251BKEPKW4900

Institute of Advanced Virology

Bio 360 Life Sciences Park, Thonnakkal, Trivandrum, Kerala- 695 317
www.iav.kerala.gov.in I info@iav.res.in