

CSIR IITR | Transforming Lives Through Research & Innovation



CSIR-INDIAN INSTITUTE OF TOXICOLOGY RESEARCH

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Navaratna Components of CSIR-IITR

Systems
Toxicology

Food Safety

GLP/NABL
Toxicity
Profiling

Environment &
Health Safety

Translational
Research

Research for
Policy

Nanotoxicology

Computational
Predictive
Toxicology

Service to
Industry



Transforming Lives Through Research & Innovation

CSIR-Indian Institute of Toxicology Research (CSIR-IITR), Lucknow, a constituent laboratory of the Council of Scientific and Industrial Research (CSIR), was established on November 4, 1965. It is the only institute of toxicology in the country contributing towards cutting-edge research and innovation in toxicology with the motto: “Safety to Environment and Health and Service to Industry”. CSIR-IITR has made an impact in addressing problems critical to human health & the environment as well as safety of chemicals/products.

Toxicology defines the domains of safety and is considered as a translational science encompassing various disciplines. Today, research in toxicology is at the crossroad of transformation from classical studies of animal experimentation in late sixties to state of the art omic and post-omic technologies in interdisciplinary areas of biology, chemistry, mathematics and physics.

CSIR-IITR has taken initiatives on predictive toxicology and risk assessment using the vast knowledge base in the areas of biomarker development, alternate to animal models, mathematical modelling, detection and development of methods for toxins /adulterants /environmental chemicals in different matrices to name a few. The institute has contributed significantly in understanding the mode of action of new chemical entities, engineered nanomaterials and genetically modified (GM) products on living systems for safe and sustainable development of new technologies.

CSIR-IITR has world class infrastructure and human resource in toxicology and providing one stop solution to address environment and health issues. The institute has contributed to the knowledge base in the domain of toxicology by publishing > 3800 research articles and in technology development (25 national and international patents). Ten know-how are available for commercialization along with and various monographs, books, copyrights, environmental air & water quality survey reports, awareness pamphlets (multilingual) and scientific contents in Hindi. More than five decades of contributions in the field of toxicology have globally positioned CSIR among top five in Food, Industrial and Nanomaterial toxicology.



CITAR | Centre for Innovation and Translational Research

To encourage young entrepreneurs/scientists for fast-track translational research and product development under the 'Make in India' and 'Startup India', CSIR-IITR has established a “Centre for Innovation and Translational Research (CITAR)” in February this year which was inaugurated by the Director General, CSIR (Figure 2). This ecosystem was created to provide researchers, innovators, and entrepreneurs from academia and industry for accessing state-of-the-art platform technologies and mentorship in a multidisciplinary collaborative environment to innovate, develop, probe, and translate the most important technological challenges facing health and the environment sectors. It plans to encourage impactful societal and industrial research and enable start-ups and also foster collaborations with researchers to fast track technological solutions. This facility is equipped with state-of-the-art instrumentations and laboratories such as Advanced Imaging Facility, Analytical Facility,

Computational Toxicology Facility (high performance computing for toxicology chemi/bioinformatics – The only facility for toxicology in India), Translational Research Facility and the Cell and Molecular Biology Facility and Industrial Labs. These facilities will also leverage the institute capabilities for nurturing innovative technology based solutions for startups and industries. Two companies are already housed at CITAR for collaborative research and product development.

CSIR-IITR has served many industrial sectors to enable them to bring new and safer products to national and international market. The institute has National Board for Testing and Calibration Laboratories (NABL) accreditation since 2000 and the only CSIR laboratory to have Good Laboratory Practice (GLP) certification from National GLP Compliance Monitoring Authority (NGCMA) for toxicity studies since 2014. The animal facility at the institute is also GLP compliant for rodents. The institute in



Dr Girish Sahni, DG-CSIR Inaugurating Centre for Innovation & Translational Research (CITAR) on February 06, 2017 in presence of Professor Alok Dhawan, Director, CSIR-IITR.



DG-CSIR interacting with students at CSIR-IITR.

consonance with its proactive policies towards safety to environment and health has taken initiatives to provide services to public and private sectors conforming to national and international guidelines such as, Organization for Economic Co-operation and Development (OECD), United States Environmental Protection Agency (USEPA), US Food and Drug Administration (USFDA), Schedule 'Y', Bureau of Indian Standards (BIS), International Organization for Standardization (ISO). It conducts research which helps regulators in policy planning and is meant for public goods.



Dr Harsh Vardhan, Hon'ble Union Minister for Science & Technology and Earth Sciences dedicated the State of the art Advanced Imaging Facility of the institute to the nation on April 20, 2016.

Translational
Research
Facility



CORE | Computational
Toxicology
Facility



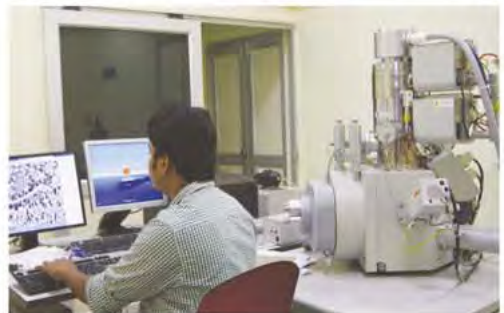
Cell &
Molecular
Biology
Facility



SAIF | Sophisticated
Analytical
Instrument
Facility



Advance
Imaging
Facility



Industry labs
for startups
& MSMEs
in niche areas





Thrust R&D Areas

Systems Toxicology & Health Risk Assessment

Scientists working in the Systems Toxicology and Health Risk Assessment group apply a system biology approach to describe and predict the effects of chemicals and other environmental stressors at different levels of biological organisation and identify key events leading to adverse health outcomes. The group aims to study the perturbation of biological systems by chemicals and stressors, monitoring changes in molecular expression and conventional toxicological parameters, iteratively integrating data to achieve a mechanistic understanding of the specific toxicity, and eventually develop and validate biomarkers for predicting these toxicological responses. Emphasis has been given on the development, assessment and application of methods for assessing the adverse effects of environmental chemicals.

Food, Drug and Chemical Toxicology

Food toxicology research at this institute has contributed significantly towards setting up

standards of food colours and additives (Table 1) that are implemented as research policy guidelines for National Regulatory Standards and further, methods developed for the detection of food contaminants and adulterants were later commercialized. Efforts are being made to develop novel, specific, sensitive technologies and methods for the detection of food contaminants, adulterants and microbial toxins. Moreover, several dietary factors are implicated in the emergence of many life style related disorders such as, heart disease, diabetes, obesity, stroke etc. Scientists of this group are conducting toxicokinetic studies to establish a co-relation between the exposure of a particular chemical entity through food and environment resulting in disorders. Based on our traditional knowledge, the beneficial effects of herbs are a promising area for alleviating several toxic manifestations. To solve the problem of food security, recombinant DNA technology for the production of GM food has to be exploited for adequate food supply or else the crisis shall keep on increasing. However, the safety of this GM food/crop has to be established before commercialization. This domain is being studied by the group.

CSIR-IITR's contribution in Research Policy and Guidelines for National Regulatory Standards

	National Regulatory Standards Guidelines
1	BIS standard for food grade silver foil (IS 3110: 2015)
2	BIS standard for pigments and colourants in plastics (IS 9833: 2015)
3	Nanotechnologies (environment & health; 11: ISO/T-229; MTD 33) (2015)
4	Ban on sale of loose food colours; ISI certification of food colours; Delisting of three food colours; limits of colours in food; limits of nickel in hydrogenated vegetable oils (still in force)

Regulatory Toxicology

Regulatory toxicology group is involved in the safety assessment of chemicals and products. This endeavor helps the regulatory agencies to take decisions for the production, marketing, and usage of a vast variety of industrial chemicals, agro-chemicals, pharmaceuticals, cosmetic products and food/feed additives, etc. GLP Test facility for regulatory toxicology studies is functional since 2014 and the existing facilities are being upgraded with the addition of "Environmental studies on aquatic and terrestrial organisms" to carry out ecotoxicology studies following certification. This facility has helped in supporting the cause of "Make in India" by doing safety assessment of chemicals, materials and products developed by small and medium enterprises for global positioning. Further, new and sensitive analytical methods have been developed and/or established for quantitative evaluation of environmental contaminants. CSIR-IITR is the first CSIR laboratory and second in the Government Sector to get GLP certificate for toxicity testing.

Nanomaterial Toxicology

The institute has been working in the area of nanotoxicology from the past decade and has been able to develop expertise, with a critical mass of 40 % of its scientific manpower contributing in this emerging area of toxicology. CSIR-IITR spearheaded two major network projects of CSIR on nanotechnology and was a partner in six international flagship projects of EU-FP7, UK, Spain and Japan. Due to the expertise available at CSIR-IITR in the area of nanotoxicology, an EU project was awarded under which scientists and students from seven EU countries were trained in hazard identification of nanomaterials. The institute took lead in the synthesis and characterization of engineered nanomaterials (ENMs), development of methodology/ assays/ techniques for toxicity assessment, guidelines for nanosafety, alternate models, mechanisms of action and interaction of ENMs with biological systems. The institute has created vibrant network in the area of nanotechnology with IITs,

IISc, universities, research institutes and industries. To assess the safety/toxicity of nanomaterials, some of the most critical issues that need to be addressed include: i) effect of shape and size; ii) dosimetry; iii) route of delivery and tracking; iv) development and validation of test models; v) in vitro vs. in vivo extrapolation; vi) ecotoxicity; vii) computational nanotoxicity and viii) life cycle analysis. The scientists of the Nanomaterial Toxicology Group aim to investigate the health and environmental effects of nanomaterials to delineate their toxicity and assure safe usage in consumer products, healthcare products and medical devices.

Environmental Toxicology

Environmental Toxicology research at CSIR-IITR has major focus on studying the fate and effects of chemicals in the environment, both naturally occurring or of anthropogenic origin. As environmental toxicologists, we determine what toxic impacts chemicals have and establish threshold limits to keep us and our environment healthy. Intensive industrialization and developmental activities in India and other countries generate hazardous wastes comprising organics, inorganics, heavy metals, solvents and dyes that need to be tackled in a safe and ecologically acceptable manner. Towards developing viable technology, eco-friendly bioremediation processes have been developed for organochlorine pesticides, polyaromatic hydrocarbons, distillery and paper pulp mill wastes. The progress includes biochemical investigations, biostimulation, bioaugmentation, field efficacy studies, etc applicable for onsite field remediation to reduce the toxic burden of hazardous wastes.

Once the chemical reaches the environment, it is bound to interact with organisms in the environment thus posing potentially risk of marine, freshwater and terrestrial environments. Organisms at risk from chemical exposures include plants, invertebrates, fishes, birds and mammals. Therefore, to assess their risk to chemicals, CSIR-IITR has developed whole organism (Daphnia, C. elegans, Zebra fish and earth worm) based tests under the framework and guidelines of OECD. A major

activity undertaken by the scientists of the group is "environmental impact assessment" (EIA) wherein environmental monitoring for air, water and soil quality of various industrial houses and biannual air and noise quality study of Lucknow city are carried out. The data generated help regulatory agencies in decision making relevant to public and environmental health protection.

Technology Development and Commercialization

The institute is already channelizing its efforts to develop new technologies for industries and

societal benefits by participating in Fast Track Translational projects funded by CSIR. The main objectives of these projects are to develop low cost affordable new technologies to fulfil emerging business needs in the market. CSIR-IITR already has some of its technologies in the pipeline and some of them are ready for commercialization. Technologies which are ready for commercialization are shown in Figure 6. Efforts are made by the institute to develop the business of already existing technologies by collaborating and signing MoU with business entities as well as National Research Development Corporation (NRDC).



Oneer- a novel solution for safe drinking water for domestic use



Oneer- a novel solution for safe drinking water for community use



Portable Water Analysis Kit



AO Kit (Argemone Oil Detection Kit)



MO Check (Mustard oil check)



Circular Electrophoresis

CSIR-Integrated Skill Initiative Programme

Realizing the importance of linking economic development with the human resource and the need to create opportunities, space and scope for the development of the talents of the Indian youth, CSIR-IITR is contributing to the CSIR Integrative Skill Initiative by conducting several Skill Development programmes. Emphasis is given on specialized courses related to environment, regulatory toxicology and computational biology where skill development is either inadequate or almost lacking. The objectives of these programmes are to skill the youths in such a way they get employment. CSIR-IITR successfully conducted two CSIR Integrated Skill Development Programmes on “Advanced instrumentation for monitoring and analysis of environmental pollutants” and Computational Predictive Biology and Bioinformatics” (Figures 7-9). These courses are designed to maximize the student capability in the respective area to attain immediate job/position in academics and industrial setup.

As a global leader in toxicology, CSIR-IITR aims to advance its R&D areas and add new expertise in upcoming area such as risk assessment. Overall, by pursuing cutting edge science in various aspects of human & environmental health and with GLP certification in place, the institute envisages to further strengthen its global presence while serving the common man of the country.



Participants of skill development programme on "Advanced instrumentation for monitoring and analysis of environmental pollutants" with the Chairman and Members of the CISR-IITR Research Council Members.



Participants of skill development programme on “Computational Predictive Biology and Bioinformatics” with the Director, CISR-IITR and resource persons.



CSIR-IITR, Lucknow is the only multidisciplinary research institute in the field of toxicology in South-East Asia with the motto:

"Safety to environment & health and service to industry".



R & D Areas

- Food, Drug & Chemical Toxicology
- Environmental Toxicology
- Regulatory Toxicology
- Nanotherapeutics & Nanomaterial Toxicology
- Systems Toxicology & Health Risk Assessment

R&D Partnership for Industries & Startup

- Centre for Innovation and Translational Research (CITAR)

Services Offered

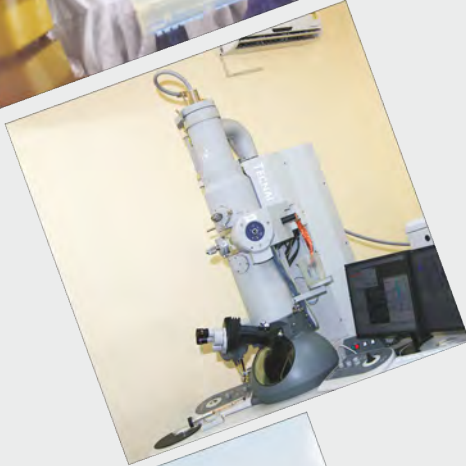
- GLP Certified Pre-clinical Toxicity Studies
- NABL (ISO/IEC 17025:2005) Accredited
- Safety/ Toxicity Evaluation of NCEs
- Water Quality Assessment and Monitoring
- Analytical Services
- Environmental Monitoring and Impact Assessment
- Information on Chemicals/Products
- Computational Predictive Toxicity Assessment

Recognitions

- Scientific & Industrial Research Organizations (SIROs)
- UP Pollution Control Board (Water & Air)
- Indian Factories Act (Drinking water)
- Bureau of Indian Standards (Synthetic Detergents)
- Food Safety & Standards Authority of India (FSSAI)

Technologies Developed/ Available

- Oneer- A Novel Solution for Safe Drinking Water
- Portable Water Analysis Kit
- Mobile Laboratory for Environment and Human Health
- AO Kit for Rapid Screening of Argemone in Mustard Oil
- MO Check for Detection of Adulterant Butter Yellow in Edible Oils



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एनएबीएल द्वारा रासायनिक एवं
जैविक परीक्षण हेतु प्रत्यायित
Accredited by NABL for chemical
and biological testing



विषाक्तता परीक्षण: जीएलपी अनुरूप सुविधा
Toxicity Testing: GLP Test Facility