

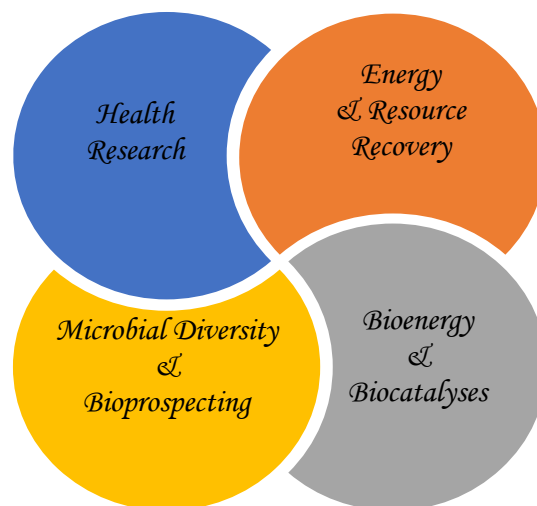
Welcome to Department of Microbiology at Central University of Rajasthan (*Micro@CURAJ*)



Microbiology is the crossroad to many domains like biology, chemistry, biotechnology and biochemistry. Microbes may be responsible for infectious diseases but, at the same time plays an important role in life cycle. This is evident by the fact that number of microbial cells outnumber the number of body cell in a healthy individual.

There is no realm of biosphere which remain untouched by microbes from the deep strata oil reservoirs until upper altitudinal limit of earth's stratosphere. Survival requires tolerance to high salinity, pressure, temperature, radiation, desiccation, and other extremes. This adaptation makes microbes the fittest organisms to sustain across all domains of life.

Our department encompasses faculties studying a broad range of fields, including Molecular medicine, Infection biology, Virology, Petroleum microbiology, Bioenergy, Biometallurgy and Cyanobacterial diversity etc. Master's degree holders go on to jobs in a wide variety of fields, including health care, public health, science policy, food safety, industrial microbiology, and scientific research at academic and government institutions. Broadly, the *Micro@CURAJ* is a multidisciplinary department working in four interconnected areas of microbiology.



The research groups working in the department of Microbiology are as follows:

(1) Microbial Diversity, CyanoTech & CyanoTox (MDCC)

Prof. Pawan K Dadheech is the group leader for the MDCC. This research group is actively working on conventional and molecular diversity of microorganisms inhabit extreme environments of northwestern county of India particularly Thar Desert (Great Indian Desert) and Sambhar Lake (a saline-alkaline lake, also Ramsar site).



Cyanobacterial Culture Facility of MDCC

Heterotrophic prokaryotes and cyanobacteria are being characterized using "polyphasic approach" to describe new species/genus. Besides systematics study of extremophiles, research works on bioprospects of isolated strains are undertaken to find out their potential applications. Studies on multidisciplinary aspects ranging from raw water monitoring, investigating the cyanobacteria and their connection with cyanotoxins production.

(2) Bioprocess and Bioenergy laboratory (BPBEL)

Prof. Pradeep Verma is the Group leader of BPBEL. BPBEL focuses on developing scientific process and technologies to produce various economically important products by waste biomass valorizations. Major thrust area of the BPBEL laboratory is Microbial Diversity, Bioremediation, Bioprocess Development, Lignocellulosic and Algal Biomass based Biorefinery. In last 3 years BPBEL contributed mainly in below mentioned research topics.

- I. Cost efficient process development for laccase, cellulase, xylanase enzymes production purification.
- II. Biomass pretreatment via microwave assisted systems.
- III. Bioremediation of textile dye effluents, heavy metals, and hazardous chemicals and bioelectricity generation.
- IV. Algal based bioremediation and biofuel/value added product generation

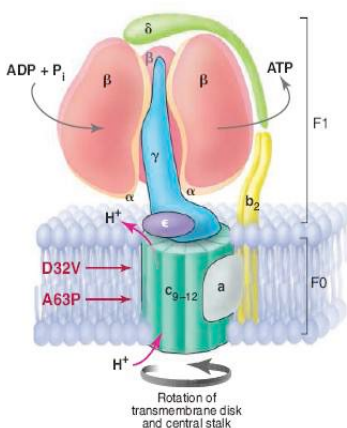


Bioprocess and Bioenergy laboratory

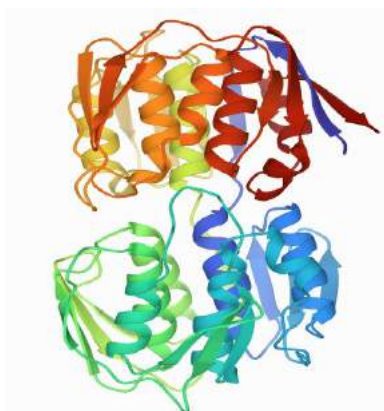
The work by BPBEL laboratory has been presented in form of research paper (42+), book chapter (30+), books (01+) by peer reviewed journals and publishers such as Elsevier, Springer, Wiley, Taylor and Francis etc. BPBEL laboratory has collaboration with various national/international research organizations from Asian and European countries.

(3) Infectious Diseases Drug Discovery Laboratory

Prof. Inshad Ali Khan is the group leader of the Infectious Diseases Drug Discovery Laboratory, which is working in the area of modulation of bacterial resistance through inhibition of bacterial efflux pumps and identifying novel therapeutic candidates against Gram negative bacteria and Mycobacterium tuberculosis. His pioneering work in the area of bacterial efflux pump inhibition led to the identification bacterial inhibitory potential of piperine, capsaicin and boeravinone B. His group is working on lead optimization of novel scaffolds identified through whole cell screening of 50,000 compounds library against *M. tuberculosis*. His group has established a number of target based assays such as GlmU, MurA, shikimate kinase and ATP synthase to screen these libraries to drive target based drug discovery program.



ATP synthase

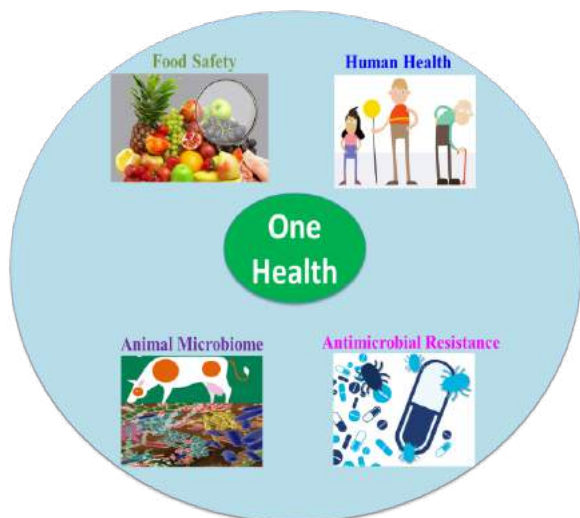


Crystal structure of MurA enzyme

Prof. Khan brings with him a 24 years of experience in the area of anti-infective research, which includes 6 years in leading Indian Pharmaceutical companies and 18 years with CSIR. Dr. Khan is the recipient of DHR fellowship and prestigious NASI-Reliance Platinum Jubilee award (2017).

(4) Genomics and Public Health Laboratory (GPHL)

Dr. Arvind Pratap Singh is the Group leader for GPHL. The research interest of GPHL are One Health approach, Animal Microbiome, Food Safety, Antimicrobial Resistance. GPHL's research focuses on "One Health" approach, in which our One Health research group is investing the interaction of Animal, Humans, and the Environment by understanding their determinants such as Antimicrobial Resistance, Zoonosis, Food Pathogens, and Animal Microbiome, on a local and global level to achieve the optimal health of people, animals and our environment.

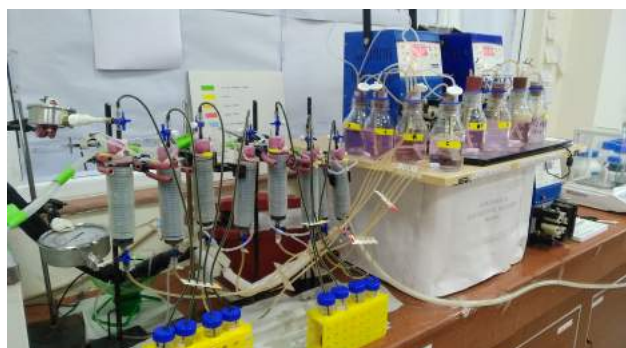


One Health Research Group used basic classical as well as modern scientific approaches such as Next-Generation Sequencing tools to i) to understand the ecology of foodborne pathogens in food plants/animals, ii) to understand the function of antimicrobials used in food plants/animals, and iii) to explore the diversity of the animal microbiome.

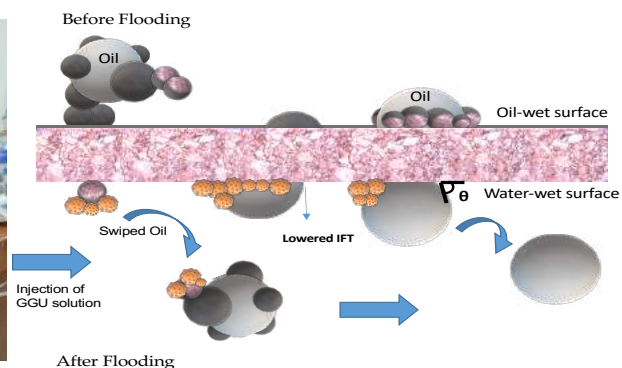
(5) Energy and Environment Research Laboratory (EERL)

Dr. Akhil Agrawal is a Group Leader for EERL. The EERL research focus are Oil field souring and **Enhanced oil recovery (EOR)**, **Cyanobacterial Sunscreens** and **Desert Soilification**. Currently EERL is working on four Govt. Funded Projects worth about **Rs. 250 lacs** (2.5 Crores).

Industries like ONGC, Oil India Assam, Cairn India Ltd, Enercosm Pvt. Ltd and Innotech Intervention are collaborating with EERL in development of new process and products for oil and gas sector. In addition, the research funding is also given by several Govt. agencies like MHRD-IMPRINT2, DBT and DST. The current research focus on “Development of novel Biochemical Enhanced oil Recovery (BcEOR) technology for oil fields of India” have recently attracted many industries and won awards like REIL Energy Innovation Award, JKLU Water and Environment Award and Best Business Plan Award.



Laboratory setup for Polymer Flooding



BcEOR Technology for Enhanced Oil Recovery

The work done at EERL have generated 30 publications in peer-reviewed journal, several conference proceedings and keynote lectures. The work done in MHRD-IMPRINT2 project resulted in novel polymer formulation- Wetalter for EOR which have been applied for an Indian **Patent**. The BcEOR technology and novel Wetalter formulation will be ready for field trials with ONGC-TERI Biotech Ltd. Four PhD students and three project fellows are working in the laboratory. EERL aim to generate viable technologies with huge market potential and business feasibility. The ultimate aim of each technology will be to grow as self-sustaining “**Startup Company**” led by our project and PhD fellows.

(6) Microbial Catalysis and Process Engineering Laboratory (MCPEL)

Dr. Nidhi Pareek is the group leader of MCPEL and the research is focused towards production of industrially important biocatalysts through microbial systems pertaining to polysaccharide biodegradation. More specifically the group is engaged in the derivation of chitinolytic enzyme systems from microbial sources and their further exploitation for the production of chitin-based biopolymers leading to the development of alternate strategies for value addition to chitin wastes. As already evident from high quality publications; the research findings have generated new knowledge and process innovation for an efficient and robust integrated bioprocess that serves as an excellent entry point for bioconversion of chitin residues. The work has generously been funded and supported by different funding agencies viz., DST (INSPIRE), DBT (BioCARE) and SERB (ECR) etc. worth INR 9.4 millions. There is another feather in the cap that the group is also a linked partner with IIT Kharagpur for Indo-EU wastewater project under HORIZON 2020 scheme due to its proactive scientific aptitude and outcomes. Being productive the group already have >42 peer reviewed international publications in reputed journals and >40 conference papers and book chapters. The group leader is very popular and delivers invited expert lectures on the subject in different reputed organizations, IITs, NITs, Indian Institution of Chemical Engineers etc. Additionally, the group is also working on the development of phyco-mediated remediation processes for industrial and domestic effluents.

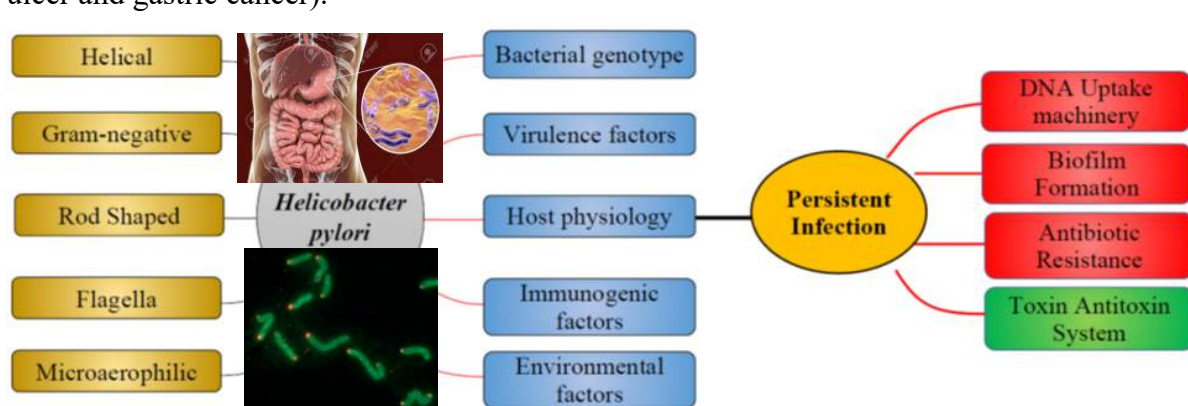
(7) Microbial hydrometallurgy Laboratory

Dr. Chandra Sekhar Gahan is the team leader for Microbial hydrometallurgy Laboratory. Research area is Biohydrometallurgy and Recycling of Wastes. All these studies utilize chemolithotrophic iron and sulfur oxidizing microorganism's for both fundamental and applied aspects using batch, fed batch and continuous reactors. Recycling of several Industrial waste for the recovery of base metals (Mo, V, Co, Ni) from Petroleum refinery spent catalyst is one of primary work. The objective is to recycle the spent catalyst prior to its disposal for landfill by an innovative approach of combining Biohydrometallurgy (Microbial leaching) – Pyrometallurgy (Roasting) – Hydrometallurgy (Alkali Leaching) to ensure a zero waste technology by proper environmental testing. Apart from that I have been also working on copper recovery from copper slag from the smelters which is a waste but can be recycled to enrich copper from it. The work is dedicated to grinding time versus copper recovery by both chemical leaching and bioleaching. Waste of Electrical and Electronic Equipment's (WEEE) is another prime area to carry out research on recovery of base metals (Cu, Ni, Zn etc) from Electronic waste of Mobile phones, PCB's, TV, Calculator, Computer PC, Laptops etc. followed by Non-cyanide (Thiosuphate, Thiourea and Halide) leaching of precious metals such as Gold and silver. The other area of research is Bioleaching of zinc from Zinc sulphide ore or sphalerite focusing on zinc recovery enhancement

a controlled redox potential system important for zinc sulphide leaching. However it is observed that the diffusion controlled leaching occurring in zinc sulphide bioleaching can be improved to chemical controlled leaching by removing the passivation layer. Sulphur removal from coal is an important part in coal industry where the coal contains huge sulfur and we use biological methods for sulphur removal. Biosorption of metal ions from waste water is another area of research.

(8) Human Pathogen Research Laboratory (HPRL):

Dr. Vijay K. Verma, is the group leader of the Human Pathogen Research Laboratory (HPRL), which is working in the area of persistent infection, biofilm formation of infectious bacterial pathogens. *Helicobacter pylori*, *Mycobacterium tuberculosis*, *Salmonella typhi* are among the slow growing bacteria with persistent infections and having major public-health problems. The biological mechanism behind persistent infection of *M. tuberculosis* and *S. typhi* is partially known, while biological mechanism of persistent infection, biofilm formation is not well known in human pathogen *H. pylori*. As it infects more than half of the human population, and is of growing concern today because of its crucial roles in the pathogenesis (chronic gastritis, peptic ulcer and gastric cancer).



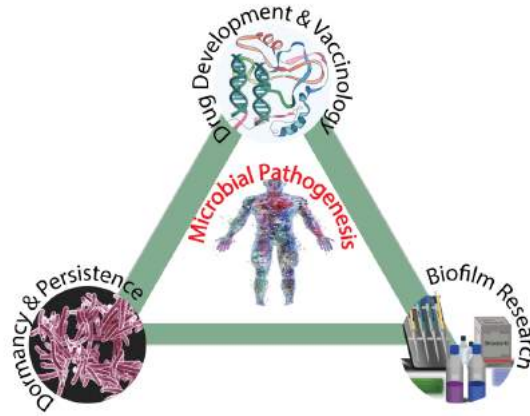
His lab is primarily focusing on the possible mechanism by which this pathogen resides in side human gut for a longer period of time known as Asymptomatic Bacterial Persistent Infections (ABPI). Currently our group, is exploring the role and mechanism of toxin-antitoxin modules in biofilm formation and persistence infection or long term survival in the host. Recently, bacterial toxin-antitoxin systems have been received great attention of scientists because of their potential drug targets and now they are under intense investigation. It would be very interesting to establish the association of the presence of toxin-antitoxin with long term bacterial infection and their pathogenesis. The lab is continuously putting efforts to develop the drugs against human pathogen *H. pylori*. In this line, we are searching innovative peptides/drug molecules which can target the genes involve in various process like biofilm formation, persistent infection, virulence and stress responsive genes.



Human Pathogen Research Laboratory (HPRL)

(9) Microbial Pathogenesis and Microbiome Research Laboratory

This lab started working in December 2016 at Department of Microbiology, Central University of Rajasthan and lead by Dr. Deeksha Tripathi. It has been focusing on many different aspects of microbial pathogenesis of *Mycobacterium tuberculosis* and other infectious pathogens. The lab works on host mycobacterium interaction and related stress adaptation mechanisms. This includes chaperone-like functions of Cyclophilins (peptidyl-prolyl isomerase) of *Mycobacterium tuberculosis* and their immune-modulatory potential.



Other avenues of research here is designing novel inhibitors against many kinases, phosphatases and other targets that are imported for persistence, survival and stress adaptation of *Mycobacterium tuberculosis*. Also, potential of many candidate genes as subunit vaccines is also under investigation. Further, the lab is aiming to extend the work on human microbiome, dysbiosis of which creates the aggravation disease symptoms.