

Antimicrobial Research (AMR) Laboratory

Department of Biotechnology, University of Mumbai

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The Antimicrobial Research (AMR) Lab, Department of Biotechnology, University of Mumbai is located in the Vidyanaigari campus. The primary research interest of the **AMR lab** is in the analysis of Antimicrobial Resistance associated with food and the environment. Specifically, we are studying antimicrobial resistance patterns from One Health Perspective, at the molecular level in the microbial population using conventional culture techniques as well as metagenomics. Another area of research that is being explored is to exploit inherent defense mechanisms of microbes to counteract antibiotic resistance. Other interests include the use of Bioinformatics, Metagenomics and AI for surveillance of AMR, and using Nanotechnology to counteract AMR. Co-relation between CRISPR systems & AMR, and use of CRISPR technology for AMR detection is an area of interest for translational research. The AMR lab is generously funded by several Major Research Project Grants from various government agencies like DST-SERB & DAE-BRNS.

Achievements of the AMR Lab

Process Patent: Biological Synthesis Process of Silver Nanoparticles and Application as Antimicrobial Agent against Multiple Antibiotic Resistant Bacteria. **Patent No. 458867**



Copyright Award for Literary work entitled “FEAMR: Food and Environment associated Antimicrobial Resistance Database”, **ROC No. L-99624/2020**. FEAMR is a first-of-its-kind database on AMR from non-clinical samples made by students. It can be accessed at <https://feamrudbt-amrlab.mu.ac.in/home.aspx>.



RSTV: The research work of AMR Lab appeared in the “**Science Monitor**” televised show on “**Rajya Sabha TV**”, Vigyan Prasara, an autonomous Institute of the Department of Science & Technology on August 2017, which can be accessed at <https://www.youtube.com/watch?v=SPnSDrVqACc>.





Special Reviews on Research work of the AMR lab:

1. “Hindustan Times” <https://www.hindustantimes.com/cities/fish-bacteria-can-resist-drugs-used-to-treat-tb-malaria-reveals-mumbai-university-study/story-RKEezTi65fzchtZA2YQieN.html> published on 23rd April 2018.
2. “The Hindu” <http://www.thehindu.com/todays-paper/tp-national/tp-other-states/mumbai-study-shows-drug-resistant-bacteria-in-chicken-moong-beans/article19213505.ece> published on 5th July, 2017.
3. “Outlook” <https://www.outlookindia.com/website/story/scientists-discover-antibiotic-resistant-bugs-in-raw-chicken-sprouts/299659> published on 20th July, 2017.
4. “Biotech Times” <https://biotechtimes.org/2017/07/20/study-finds-antibiotics-bugs-chicken-sprouts/> published on 20th July, 2017.
5. “Indian Science Journal” <http://www.indiansciencejournal.in/health-news/raw-chicken-and-sprouted-beans-in-mumbai-unhealthy-206806> published on 20th July, 2017.
6. “India Science Wire” http://vigyanprasar.gov.in/isw/antibiotic_sea_fishes_story.html published on 20th December, 2017.
7. “India Water Portal” <http://hindi.indiawaterportal.org/node/66772> published on 20th December, 2017.
8. “Mongabay” <https://india.mongabay.com/2018/01/11/mumbai-fish-harbour-high-levels-of-antibiotic-resistant-bacteria/> published on 11th January, 2018.

Student Outreach Programs – The AMR Lab regularly organizes visits to the lab for College/School students to see the research facility available in the lab. Glimpses of one such visit of UG/PG Students to AMR Lab, supported by **Scientific Social Responsibility (SSR) initiative of the DST-SERB Project, Government of India.**



Completed/On-going Major Research Projects at the AMR Lab:

Title of the Project	Funding Agency	Duration
A study on the prevalence and molecular profiling of virulence genes in multiple antibiotic resistant <i>Escherichia coli</i> isolated from retail food	SERB, DST	May 2019-March 2023

Isolation and molecular characterization of antibiotic resistance in non-pathogenic organisms from food	BRNS, DAE	April 2013- December 2016
Isolation and Molecular Characterization of Antibiotic Resistant Microorganisms from Different Water Bodies	DST-PURSE Scheme, UoM	April 2017 - March 2020

JRF/SRF/Ph.D. Students of the AMR Lab:

Sr. No.	Name of Student	Fellowship availed	Title of Thesis	Status
1.	Onkar A. Naik	JRF & SRF (BRNS-DAE)	A study on prevalence of antibiotic resistant microorganisms in food and molecular characterization of their antibiotic resistant traits	Degree awarded (2019)
2.	Amruta A. Dhawale	UGC Non-Net	A study on Oxidative Stress Adaptations in <i>Escherichia coli</i>	Degree Awarded (2021)
3.	Maitri Mishra	JRF & SRF (DBT)	Elucidation of Size and Structural Dependence of Silver Nano and Microstructures on their Interaction with Antibiotics for Antimicrobial Activity	Degree Awarded (2026)
4.	Devika M. Ghadigaonkar	PF (DST-PURSE) (till March 2020)	A Study on the Assessment of Anti-Microbial Resistant Bacteria from coastal waters of Mumbai, India and Molecular Characterization of their Antibiotic Resistance Genes	Synopsis submitted
5.	Ruchi Kadam	Joined January 2025	A study on the correlation between Anti-microbial resistance and CRISPR-anti-CRISPR elements in food associated AMR micro-organisms	Work ongoing

- **NCBI Submissions by the AMR Lab:** There are a total of **214** submissions from our lab till date.

The NCBI BioProject Accession no: PRJNA639905 contains submissions of the AMR Lab to NCBI (<https://www.ncbi.nlm.nih.gov/>) till date, which can be accessed at <https://www.ncbi.nlm.nih.gov/bioproject/PRJNA639905>

1. Gene sequences of Antibiotic Resistant microorganism isolated from food samples:

Sr. No.	Food source	No. of isolates	Accession Numbers	Publication date on NCBI
1	Chicken	50	KX355642 – KX355691	26-JUNE-2016
2	Mung sprout	50	KX355692 – KX355741	26-JUNE-2016
3	Marine fish	50	KX300038 – KX300086 KY432753	26-JUNE-2016 14-JULY-2017

2. Antibiotic Resistant gene sequences amplified from metagenomic DNA:

No. of genes	Accession Numbers	Publication date on NCBI
13	KY798891-KY798897 KU573047-KU573052	09-MAY-2017 09-FEB-2017

3. Antibiotic Resistant gene sequences amplified from transconjugants:

No. of genes	Accession Numbers	Publication date on NCBI
3	KY924468-KY924470	12-JUN-2017

4. Antibiotic Resistant gene sequences amplified from isolates:

No. of genes	Accession Numbers	Publication date on NCBI
11	KY867437-KY867447	19-APR-2017

5. Protein Sequences:

No. of proteins	Accession Numbers	Publication date on NCBI
27	AQA99679-AQA99684 ARO70929-ARO70935 ARI46012-ARI46022 ARW72050- ARW□	27-JUL-2020

6. BioSample Submissions:

No. of samples	Accession Numbers	Publication date on NCBI
03	SAMN15297851-SAMN15297853	17-JUN-2020

7. PopSet Submissions: 07

Expertise available with the AMR Lab:

Molecular Biology Techniques, Microbiological techniques, Bioinformatics, Nanotechnology, Metagenomics, Oxidative stress and DNA Repair study related techniques.

Services available with the AMR Lab:

Sample Testing: antimicrobial activity testing/Efficacy studies/Validation studies of drugs/APIs/antimicrobial agents etc. based on AST/MIC/disc diffusion/ Agar Cup/Zone of Inhibition/Fractional Inhibitory Concentration Test (*FIC test: It is the test to estimate the interaction between two or more drugs intended to be used in combination. The purpose of this method is to test two different antimicrobial agents or new antimicrobial agents in combination with existing for determining the Synergistic effect, Additive effect and/or Antagonism*) etc., in plate/tube/microtitre plate formats, on standard/reference microbial strains (like ATCC strains) or on our own repository of AMR microbial strains isolated from various ecosystems (especially from animal, food and environment samples).

Collaborative Research work : We welcome collaborations involving any aspect of AMR, including Isolation and detection of antibiotic resistant bacteria from environment and food samples, isolation of plasmid, genomic DNA, Isolation of metagenomic DNA from various sources (food, water, soil, sewage etc.), Identification of AMR microorganisms, identification and characterization of antibiotic resistance genes (ARGs), microbiological testing of nanoparticle samples etc.

Microbial Repository: pure, characterized AMR/ non-AMR microbial strains can be provided on a charged basis.

Outsourcing services: for various government & private agencies, for AMR based research work, short-term projects, analysis services on genomic and metagenomic samples, data collection, collation, database generation etc.

Consultancy Services: for various regulatory bodies/ private agencies etc.

Training: aimed at capacity building, skill development, internship, mentoring etc. for students, researchers, teachers, in-service & pre-service personnel (for government, public/private organizations and industries)

Courses: diploma/certificate/short-term/orientation & refresher programs and hand-on-workshops on AMR can be carried out.

Research Funding: Major research grant proposal writing for National /international government/private agencies.

Scientific Social Responsibility (SSR): free community outreach for school/college students or society is carried out for training and community sensitization & awareness about AMR, Health and Hygiene.

Techniques routinely carried out in the AMR Lab

Microbiology:

1. Antibiotic Susceptibility Test (AST) as per CLSI and EUCAST guidelines
2. Determination of MIC and FIC of antimicrobial agents (antibiotics, nanoparticles and other materials) as per CLSI and EUCAST guidelines
3. Microbial Growth curve experiments with/without stressors
4. Cytotoxicity studies on bacteria (using different dyes like MTT)

5. Biofilm formation and inhibition experiments on microtiter plates
6. Isolation, purification and identification of microbial strains from any sample
7. Maintenance & propagation of pure microbial strains

Molecular Biology:

1. Various formats of Polymerase chain reactions (PCR)
2. DNA isolation (plasmid and genomic)
3. Metagenomic DNA isolation
4. Agarose Gel Electrophoresis & purification of samples from gels
5. Polyacrylamide gel electrophoresis (native and SDS) and subsequent analysis

Bioinformatics:

1. Primer Designing
2. Amplification and 16S rRNA sequence
3. Identification of microorganism using 16S rRNA sequence (BLAST)
4. Analysis of metagenomic DNA sequence data (16S or WGS)

Biochemistry:

1. Measurement of total DNA/ RNA/protein concentration of sample
2. Sample purity checking (plasmid/genomic DNA/proteins spectrophotometrically/gel based)
3. Measurement of total sugar/ carbohydrate concentration of sample (DNSA method)
4. Spectrophotometric studies of samples (UV-Visible/ fluorescent/ luminescent), cuvette and microtitre plate formats

Materials Science/Bio-Nanotechnology:

1. Method standardization & Synthesis of metal nanoparticles (silver, zinc oxide etc.)
2. Stability testing of nanoparticles (measuring UV-Vis peak)
3. Characterization of nanoparticles w.r.t. size, shape etc.

Opportunities for Under-Graduate/ Post-Graduate Students:

1. **Dissertation Projects/Summer Projects/Internships/OJTs at AMR Lab:** applications should be emailed to drarath@mu.ac.in
2. **Lab Visit for College/ School students** in the PI's institution –for College/School students to come for a one-day visit to see the research facility available in the lab: request should be emailed to drarath@mu.ac.in
3. **Antimicrobial Resistance Database (FEAMR)** – The AMR lab has developed a unique, one-of-its-kind database for surveillance of Antimicrobial Resistance in food and the environment (<http://feamrudbt-amrlab.mu.ac.in/>) (<https://doi.org/10.1007/s12539-022-00534-y>, Copyright L-99624/2020).
4. **Metagenomics/Bioinformatics analysis of AMR-** The AMR lab has, over the years, generated several AMR based metagenomics datasets, that can be used for various bioinformatics analysis.

Students pursuing/completed B.Sc./ M.Sc. in Bioinformatics/Biotechnology/Life Sciences & allied fields, wishing to be a part of such projects can contact via e-mail.

Major Equipment available with the AMR Lab

Sr. No.	Name of the Equipment	Application
1.	PCR Gradient Thermal Cyclers	For any PCR related work. Used to exponentially amplify a specific target DNA sequence, allowing for the isolation, sequencing, or cloning of a single sequence among many.
2.	Cooling Shaker Incubator	Maintain a controlled environment so that biological samples can grow continuously. Applications include microbiology, bacteriology and cell and tissue cultures. Refrigerated incubator shakers can incubate samples 20°C below ambient temperature, making cooling incubator shakers important accessory in the laboratory.
3.	37 °C Incubator	Provides a controlled environment that promotes the growth for culturing microorganisms.
4.	Biosafety Cabinet	For study requiring aseptic work with microorganisms. Also for use with antineoplastic drugs, genetic material, carcinogens, allergens and other substances that may generate hazardous airborne particulates. Provide optimal protection for the operator, product, and environment.
5.	Cooling Centrifuge	For work with temperature sensitive samples. Used for samples that require a consistent range of temperature. This range makes them ideal for the analysis of DNA, RNA, PCR, antibodies etc.
6.	Micro-centrifuges	For low volume samples. Micro-centrifuges are typically used for Pelleting nucleic acids, Pelleting proteins from solutions and Microfiltration of small aqueous samples
7.	-36 °C & -20 °C deep freezers	Play important role in safe storage of microbial strains, reagents, lyophilised cultures, enzymes and other temperature sensitive specimens for research purposes that require freezing temperature up to -20 °C or -36 °C.
8.	Analytical Weighing Balances	Highly sensitive lab instruments designed to accurately measure mass. Their readability has a range between 0.1 mg to 0.01 mg.
9.	Autoclave	For sterilization of glassware, plasticware, reagents, samples etc.

<u>Temperature Gradient Thermal Cycler (PCR Machine)</u> 	<u>Analytical weighing balance</u> 	<u>37°C Incubator</u> 
<u>Cooling shaker incubator</u> 	<u>-36°C deep freezer</u> 	<u>Micro-centrifuge</u> 

Major Equipment available with the AMR Lab

Contact Us:

For queries related to OJT/Internships/Dissertations/JRF/SRF/RA etc. positions, please contact Dr. Archana Rath via email:

drarath@mu.ac.in

amrlab.udbt@gmail.com

Useful Links:

AMR Lab Website: <https://sites.google.com/view/amrlabudbtuom>

FEAMR DB: <https://feamrudbt-amrlab.mu.ac.in/home.aspx>