BHARATHIDASAN UNIVERSITY

TIRUCHIRAPPALLI - 620 024, INDIA

National Centre for Alternatives to Animal Experiments (NCAAE)

I. About the Centre

THE DOERENKAMP ENCLAVE - FRONT VIEW

The recent developments in molecular biology techniques have revolutionized the toxicological risk assessment of chemical entities with rapid, less expensive and highly relevant systems even at low concentrations in a manner very precise. Under these circumstances, the use of vertebrate models in toxicity testing and drug development has raised concern across the global level, in view of its scientific and ethical issues. In this backdrop, Prof. M. A. Akbarsha successfully founded the Mahatma Gandhi – Doerenkamp Centre (MGDC) for Alternatives to Use of Animals in Life Science Education in 2009 at Bharathidasan University, Tiruchirappalli, Tamil Nadu, with full fund support from Doerenkamp-Zbinden Foundation (DZF), Switzerland.

The center promotes the concept of 3Rs (Replacement, Reduction, and Refinement) and plays a pivotal role in changing the attitude of stake-holders in favor of alternatives to use of animals in academics and research across the country. The centre conducts research and outreach programs and provides training to achieve the vision of making India a leader in modern tools of learning and research.

Thus, after expiry of the tenure of DZF support, in order to continue the brilliance of the centre, the Bharathidasan University endeavored to expand the activity of MGDC by bringing the expertise of faculties from various departments to enrich its multi-disciplinary activities. The idea of establishment of a national facility named National Centre for Alternatives to Animal Experiments (NCAAE) was approved and funded by the UGC under CPEPA (Centre with

Potential for Excellence in Particular Area) scheme. The main aim of NCAAE is to promote excellence in education by launching modern tools in the field of alternatives to animal experiments. The primary focus of NCAAE is to establish the country as a leader on par with International Institutes in Humane Science by adopting alternative methods to animal experiments

II. Research

The advantages of adopting the key Concept of 3Rs or "Alternatives" into experimental biology, represented mainly by the fields of neurobiology, physiology, toxicology, cancer biology and biomechanics is the main motto of NCAAE. The stand-alone facility of NCAAE has specialized in three domains viz., *in vitro*, *in silico* and alternative model organisms (animals belonging to lower taxonomic hierarchy).

The research activities are being carried out at NCAAE are improvements over the conventional 2D cell culture system in screening of chemicals for risk assessment and drug discovery, multiple organ co-culture models to mimic the disease conditions, development of low-cost materials for 3D culture, non-mammalian model organisms based toxicological assessments, and bioinformatics and systems biology approaches for prediction of toxicity and their expertise can be useful in progressing the animal alternatives initiative in India

1. *In-vitro* Cell Culture

PRIMARY CULTURE FACILITY

SECONDARY CULTURE FACILITY

- The centre is focusing on the use of monolayer based *in vitro* cell culture techniques, to spare the animal studies for toxicological research, thereby highlighting the significance and application of *in vitro* techniques in the field of toxicology and drug discovery. The cancer cell lines are adopted to explore the cytotoxic potential of large number of chemical complexes/compounds on adopting *in vitro* assays, such as MTT, for assessing the anti-proliferative activity, staining techniques for morphological assessment of cells, DNA laddering, COMET assay and karyotyping for genotoxicity, immunocytochemistry appropriate for intracellular localization of proteins, and venturing into signaling pathways associated with the cell death by adopting molecular techniques such as PCR, western blot, etc. This approach will provide the basic toxic profile of drug candidates as well as environmental chemicals and will substantiate that animal experiments are not required at least for the initial screening.
- The centre is actively engaged in development of 3D based newer models. 3D cell culture has become the state of the art in *in vitro* technology. 3D cell culture techniques can accurately re-create *in vivo* behavior in important applications where 2D cell cultures fail. This new approach is being applied with great success in cell biology, developmental biology and drug screening. NCAAE makes progress in *in vitro* technology by developing its own 3D cell growth techniques with efficient scaffolds that better represent

the geometry, chemistry, and signaling environment of natural extracellular matrix which are missed out in the conventional 2D system.

- The other area of research of NCAAE is on the advanced technology of 2D cell culture, known as Co-culture. The issue in basic 2D cell culture models is lacking complexity (only focusing on one organ/ tissue specific). This complex concern, to tackle adopting *in vitro* tools, requires a special *in vitro* technology that associates the key functional cells from two or more organs. Currently, the centre is focusing on the theme of co-culture to unravel the techniques as novel applications.

2. *In-silico* Toxicology

The mode of operation of *in silico* toxicology (IST) lab focuses on implying the advantages and applications of IST methods/approaches in toxicology and animal alternatives. The dogma of IST approaches i.e., dealing from the molecular level to system level will be emphasized with appropriate tools. IST approaches ranging from Q-SAR, Expert system, Molecular modeling and targeting, Network biology, Systems biology and Dose- response modeling will be adopted to study the molecule in detail.

3. Small Model Organism for Aquatic Toxicity Testing

The research objectives of the facility is to establish non-mammalian animals such as *Hydra magnipapillata*, *Caenorhabditis elegans*, *Drosophila melanogaster* and *Danio rerio* as model organisms for aquatic toxicity testing and to decipher the molecular mechanisms in chemical toxicity. In this context, we have made a humble beginning with culturing, rearing and carrying out experimental work on *Hydra*. The objective of the unit is to establish and popularize *Hydra* as an alternative model organism for aquatic environmental toxicity testing and, more importantly, to establish it as a repository and referral centre of *Hydra* research.

III. Research Collaborations

Other than providing research and training, NCAAE has established research collaboration with various Universities and Research Institutes across the country, and elsewhere. NCAAE has established research collaborations with a view to providing skilled manpower and research facilities for evaluating the possible toxicological hazard of chemical compounds and analyzing the toxicological endpoints involved.

Importantly, the separate cell culture facility has been established and made available for the use of researchers from various parts of our country, who can be admitted to carry out their research in NCAAE. Thus, the centre is sharing/providing the facilities and aims to

popularize the use of *in vitro* models as alternatives to animal experiments.


IN VITRO TRAINING LABORATORY

On the other hand, the centre entertains outside samples to determine the toxicological effects on hydra, our small model organism, motivates young research minds to take up alternative models and offer a training program. The centre offers research scholars/students from the collaborative departments of University and another institute to utilize the laboratory to work on small model organisms.

IV. Networking of Institutions and Experts Engaged in Propagation of Alternatives

To bring together stakeholders in 3Rs, academicians and regulatory authorities under one roof in order to raise awareness facilitate the exchange of information / ideas on alternatives; NCAAE has launched Society for Alternatives to Animal Experiments (India). This provides platform for the authorities to work in harmony with the different regulatory bodies and government agencies for the propagation and implementation of 3Rs in India

V. Repository of *in-silico* and Digital Alternatives

Sensitization, propagation and implementation of alternatives to use of animals in life science and biomedical science education are the primary objective of NCAAE. The Centre targeted to achieve total replacement of animal use in education from schools to basic science institutes to pharmacy institutes to medical and veterinary colleges. To achieve this goal we strategically planned that the end users and practitioners are first brought into a mind-set to accept a change from dissections and animal experiments to total replacement with digital alternatives. We have established our own repository with appropriate digital/virtual dissection tools and bioinformatics software for undergraduate and

Post-graduate students. The centre will also conduct workshops, offer training and provideprovision to access the repository for anyone across the country.

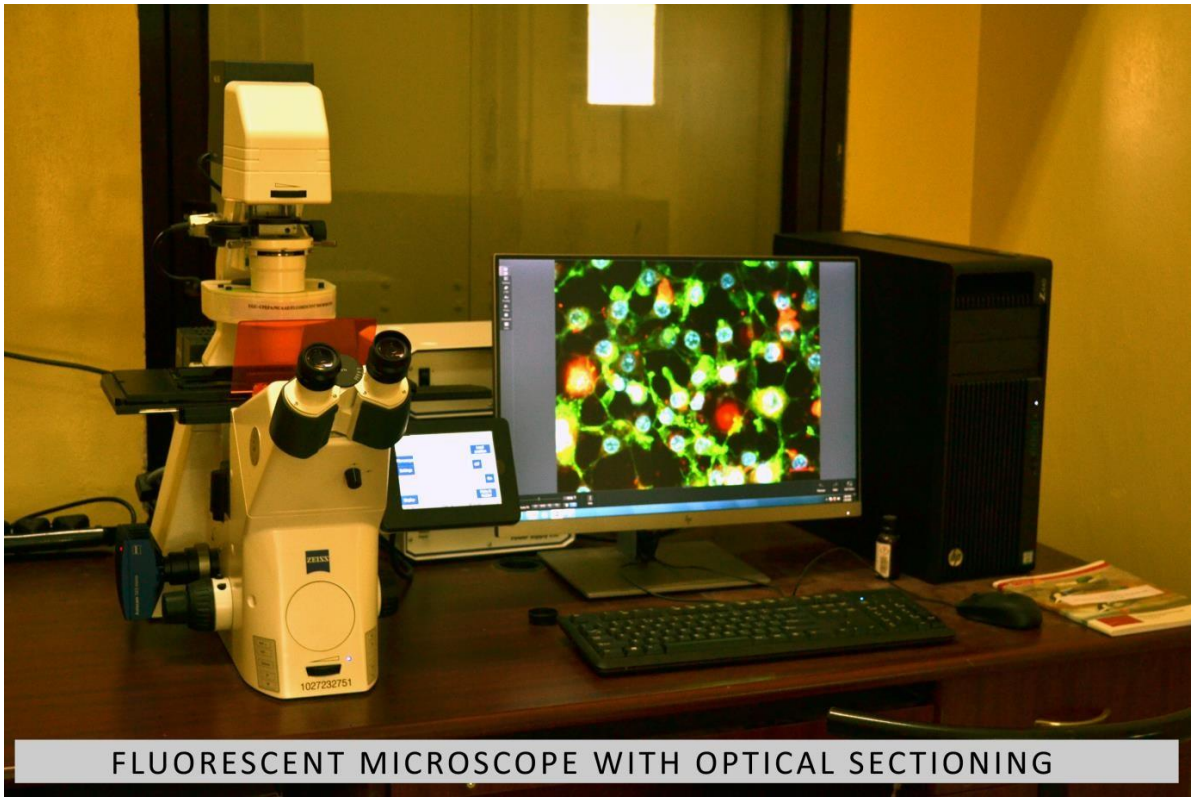
VI. Facilities

1. Cell Culture and *In-vitro* Toxicology Facility

1. Laminar Air Flow
2. Biological Safety Cabinet Class- II Type (Thermo Scientific1300 series A2 Class II, Type A2)
3. Co_2 incubators – (Thermo Scientific, Hera cell vios160i)
4. Live Cell Imaging System (EVOS)
5. Phase Contrast Inverted Microscope (Carl Zeiss)
6. Fluorescent Cell Imager (Bio Rad, ZOE)
7. Centrifuge
8. Deep Freezer
9. Autoclave
10. Hot Air Oven
11. Ultra Sonic Bath
12. Water Bath
13. Vortex Stirrer

2. Instrumentation Facility

INSTRUMENTATION FACILITY



FLUORESCENT MICROSCOPE WITH OPTICAL SECTIONING

1. RT-PCR (Roche, USA)
2. Fluorescent Microscope (Carl Zeiss, Germany)
3. Chemiluminescence Gel Documentation Unit (Bio Rad)
4. Western Blotting Apparatus (Bio Rad)
5. UV Transilluminator
6. Sartorius Weighing Balance
7. Cooling Centrifuge
8. Double Distillation Unit
9. 2D gel Electrophoresis and UV Spectrophotometer
10. 96 well Plate Reader
11. Magnetic Stirrer
12. Thermocycler
13. Nano Drop (Thermo Scientific)
14. Fluorescent-cum-Luminometer (Thermo Scientific)
15. Electro Spinning Device

3. Small Model Organism Facility

1. Stereo Zoom Dissection Microscope
2. Fluorescent Cell Imager (Bio Rad)
3. BOD Incubator

4. *In-silico* Facility

1. Computers with Updated OS
2. Workstation (HP Z640)
3. Network Sharing Server (Lenovo x series 3650 MS Rack server)
4. *In-silico* Toxicology Software's:-
    i. StarDrop
    ii. ADME Module
    iii. FlexX
    iv. ADMET Predictor

5. Digital Repository - Alternatives to Animal Dissection

Our aim is to promote digital alternatives for dissection of animals to save the lives of a number of animals. To experience the feel of learning through dissecting live animals can be obtained from the following list of software and CDs

1. Virtual Dissection Lab Application for 7 animal Specimen:
   Rat, Pigeon, Frog, Starfish, Shark, Earthworm and Cockroach.
2. 3D Anatomy Software of vertebrates and invertebrates:
   Human, Pig, Fish, Horse, Bird, Dog, Rat, Cat, Frog and Virtual Cell.
3. Virtual Physiology Laboratories:
   SimMuscle, SimNerv, SimNeuron, SimHeart and SimVessel
4. Virtual Animal Dissection CDs

VII. Faculties

1. Co-Ordinator

- **Dr. B. Kadalmani**
  Professor & Co-Ordinator
  Department of Animal Science
  National Centre for Alternatives to Animal Experiments
  Bharathidasan University, Tiruchirapalli-620024
  http://www.bdu.ac.in/schools/life-sciences/animal-science/docs/faculty/dr_b_kadalmani.pdf

2. Faculties – Collaborative Departments

- **Dr. K.Emmanuvel Rajan**
  Professor
  Department of Animal Science
  Bharathidasan University, Tiruchirappalli - 620 024
  http://www.bdu.ac.in/schools/environmental-sciences/environmental-biotechnology/docs/faculty/dr_s_achiraman.pdf

- **Dr. R. Thirumurugan**
  Professor
  Department of Animal Science
  Bharathidasan University, Tiruchirapalli-620024
  http://www.bdu.ac.in/schools/life-sciences/animal-science/docs/faculty/dr_r_thirumurugan.pdf

- **Dr. R. Babu Rajendran**
  Professor
  Department of Environmental Biotechnology
  Bharathidasan University, Tiruchirappalli - 620 024
  http://www.bdu.ac.in/schools/environmental-sciences/environmental-biotechnology/docs/faculty/dr_r_babu_rajendran.pdf

- **Dr. K. Thamaraiselvi**
  Professor
  Department of Environmental Biotechnology
  Bharathidasan University, Tiruchirappalli - 620 024
  http://www.bdu.ac.in/schools/environmental-sciences/environmental-biotechnology/docs/faculty/dr_k_thamaraiselvi.pdf

- **Dr. S. Achiraman**
  Professor
  Department of Environmental Biotechnology
  Bharathidasan University, Tiruchirappalli - 620 024
  http://www.bdu.ac.in/schools/environmental-sciences/environmental-biotechnology/docs/faculty/dr_s_achiraman.pdf

❖ **Dr. K. Jeganathan**
Professor
Department of Physics
Bharathidasan University, Tiruchirappalli - 620 024
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❖ **Dr. K. Nataraja Seenivasan**
Professor
Department of Microbiology
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http://www.bdu.ac.in/schools/life-sciences/microbiology/docs/faculty/dr_k_natarajaseenivasan.pdf

❖ **Dr. D. Dhanasekaran**
Assistant Professor
Department of Microbiology
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http://www.bdu.ac.in/schools/life-sciences/microbiology/docs/faculty/dr_d_dhanasekaran.pdf

VIII. Publications (From 2016)

✓ Khamrang T, Kartikeyan R, Velusamy M, Rajendiran V, Dhivya R, Perumalsamy B, Akbarsha MA, Palaniandavar M. Synthesis, structures, and DNA and protein binding of ruthenium (II)-p-cymene complexes of substituted pyridylimidazo [1, 5-a] pyridine: enhanced cytotoxicity of complexes of ligands appended with a carbazole moiety. RSC Advances. 2016;6(115):114143-58.

✓ Rajesh D, Muthukumar S, Saibaba G, Siva D, Akbarsha MA, Gulyas B, Padmanabhan P, Archunan G. Structural elucidation of estrus urinary lipocalin protein(EULP) and evaluating binding affinity with pheromones using molecular dockingand fluorescence study. Scientific Reports. 2016 Oct 26;6:35900.

✓ Khan RA, Usman M, Dhivya R, Balaji P, Alsalme A, AlLohedan H, Arjmand F, AlFarhan K, Akbarsha MA, Marchetti F, Pettinari C. Heteroleptic Copper (I) Complexes of "Scorpionate" Bis-pyrazolyl Carboxylate Ligand with Auxiliary Phosphine as Potential Anticancer Agents: An Insight into Cytotoxic Mode. ScientificReports. 2017 Mar 24;7:45229.

✓ Gopinath PM, Ranjani A, Dhanasekaran D, Thajuddin N, Archunan G, Akbarsha MA,Gulyás B, Padmanabhan P. Multi-functional nano silver: A novel disruptive andtheranostic agent for pathogenic organisms in real-time. Scientific Reports. 2016 Sep 26;6:34058.

✓ Saibaba G, Rajesh D, Muthukumar S, Sathiyanarayanan G, Padmanabhan P, Akbarsha MA, Gulyás B, Archunan G. Proteomic analysis of human saliva: A approach to find the marker protein for ovulation. Reproductive Biology. 2016 Dec 1;16(4):287-

✓ Rajmohamed MA, Natarajan S, Palanisamy P, Abdulkader AM, Govindaraju A. Antioxidant

and cholinesterase inhibitory activities of ethyl acetate extract of Terminalia chebula: Cell-free In vitro and In silico studies. Pharmacognosy magazine.2017 Oct;13(Suppl 3):S437.

- ✓ Praveen PA, Babu RR, Balaji P, Murugadas A, Akbarsha MA. Laser assisted anticancer activity of benzimidazole based metal organic nanoparticles. Journal of Photochemistry and Photobiology B: Biology. 2018 Mar 1;180:218-24.
- ✓ Sheena TS, Balaji P, Venkatesan R, Akbarsha MA, Jeganathan K. Functional evaluation of doxorubicin decorated polymeric liposomal curcumin: a surface tailoredtherapeutic platform for combination chemotherapy. New Journal of Chemistry. 2018;42(20):16608-19.
- ✓ Musthafa M, Aneesrahman KN, Perumalsamy B, Ramasamy T, Ganguly R, Sreekanth A. Synthesis, crystal structure, DFT study, in vitro and in silico molecular docking of novel bis (aroyl selenourea) derivatives. Journal of Molecular Structure. 2019 Mar 15;1180:585-94.
- ✓ Balaji P, Murugadas A, Shanmugaapriya S, Akbarsha MA. Fabrication andcharacterization of egg white cryogel scaffold for three-dimensional (3D) cell culture. Biocatalysis and Agricultural Biotechnology. 2019 Jan 1;17:441-6.
- ✓ Murugadas A, Mahamuni D, Shrinithivihahshini ND, Thamaraiselvi K, Thirumurugan R, Akbarsha MA (2019) *Hydra* as an alternative model organism for toxicity testing: Studyusing the endocrine disturbing chemical Bisphenol A. Biocatalysis and Agricultural Biotechnology.
- ✓ Boovaragamoorthy, G. M., Anbazhagan, M., Piruthiviraj, P., Pugazhendhi, A., Kumar, S. S., Al-Dhabi, N. A., ... & Kaliannan, T. (2019). Clinically important microbial diversity and its antibiotic resistance pattern towards various drugs. *Journal of Infection and Public Health*, *12*(6), 783-788.
- ✓ Gowdhami, B., Jaabir, M., Archunan, G., & Suganthy, N. (2019). Anticancer potential of zinc oxide nanoparticles against cervical carcinoma cells synthesized via biogenic route using aqueous extract of Gracilaria edulis. *Materials Science and Engineering: C*, *103*, 109840.
- ✓ Manojkumar, Y., Ambika, S., Arulkumar, R., Gowdhami, B., Balaji, P., Vignesh, G., ... & Akbarsha, M. A. (2019). Synthesis, DNA and BSA binding, in vitro anti-proliferative and in vivo anti-angiogenic properties of some cobalt (III) Schiff base complexes. *New Journal of Chemistry*, *43*(28), 11391-11407.
- ✓ Balaji, P., Murugadas, A., Ramkumar, A., Thirumurugan, R., Shanmugaapriya, S., & Akbarsha, M. A. (2020). Characterization of Hen's egg white to use it as a novel platform to culture three-dimensional multicellular tumor spheroids. *ACS omega*, *5*(31), 19760-19770.
- ✓ Das, S., Diyali, S., Vinothini, G., Perumalsamy, B., Balakrishnan, G., Ramasamy, T., ... & Biswas, B. (2020). Synthesis, morphological analysis, antibacterial activity of iron oxide nanoparticles and the cytotoxic effect on lung cancer cell line. *Heliyon*, *6*(9).

- ✓ Dey, D., Al-Hunaiti, A., Gopal, V., Perumalsamy, B., Balakrishnan, G., Ramasamy, T., ... & Biswas, B. (2020). CH functionalization of alkanes, bactericidal and antiproliferative studies of a gold (III)-phenanthroline complex. *Journal of Molecular Structure*, *1222*, 128919
- ✓ Sheena, T. S., Devaraj, V., Lee, J. M., Balaji, P., Gnanasekar, P., Oh, J. W., ... & Jeganathan, K. (2020). Sensitive and label-free shell isolated Ag NPs@ Si architecture based SERS active substrate: FDTD analysis and in-situ cellular DNA detection. *Applied Surface Science*, *515*, 145955.
- ✓ Krishnasamy Sekar, R., Sridhar, A., Perumalsamy, B., Manikandan, D. B., & Ramasamy, T. (2020). In vitro antioxidant, antipathogenicity and cytotoxicity effect of silver nanoparticles fabricated by onion (Allium cepa L.) peel extract. *BioNanoScience*, *10*, 235-248.
- ✓ Gowdhami B, Manojkumar Y, Vimala RTV, Ramya V, Karthiyayini B, Kadalmani B, Akbarsha MA [2021] Cytotoxic cobalt (III) Schiff base complexes: in vitro anti-proliferative, oxidative stress and gene expression studies in human breast and lung cancer cells. BioMetals.
- ✓ Gowdhami B, Ambika S, Karthiyayini B, Ramya V, Kadalmani B, Vimala RTV, Akbarsha MA (2021). Potential application of two cobalt (III) Schiff base complexes in cancer chemotherapy: Leads from a study using breast and lung cancer cells. Toxicol in Vitro, 105201.

IX. International and National Level Trainees from Other Institutes

- **Ms. Thikshani Somarathna**
  Ph.D. Research Scholar, Faculty of Graduate Studies
  Sri Jeyawardhanapuri University, Nugegoda
  Sri Lanka.
- **Mr. Ankit Dilware**
  Ph.D. Research Scholar,
  Pondicherry University,
  Pondicherry, India.
- **Mr. Milda C. David**
  M.Sc., Pondicherry University,
  Pondicherry, India.

X. Events

a. Workshops in "Methods in Cell Culture and *In Vitro* Toxicology"

The *in vitro* workshop was designed to enlighten the participants to design their research on toxicity screening of entities adopting various cell-based assays. It also helps to minimize the use of animals in research. Starting from maintenance and culturing of established and

primary cell lines, the participants are exposed to several *in vitro* cytotoxicity assays and molecular techniques. Hands-on training on all these techniques is also provided. Several of these *in vitro* methods can greatly replace the classical *in vivo* toxicity testing. It was observed from their remarks that they understood the importance of the alternatives in research and appreciated the steps taken by NCAAE in propagating the alternatives tools. Theworkshops conducted are as follows:

i. May 22-28, 2017 (No. of Participants- 17)
ii. December 13-19, 2017 (No. of Participants- 17)

i. MAY 22-28, 2017

The workshop was held on May 22-28, 2017. The workshop was formally inaugurated by Dr. R. Babu Rajendran, Registrar in-charge Bharathidasan University, and the keynote address was given by Dr. K. Ruckmani, Director, Centre for Excellence in Nano-Bio Translational Research, Anna University-BIT campus Tiruchirapalli. Dr. K. Ruckmani in her keynote address elaborately explained about why alternatives to animal experimentation are emphasized and lectured on formulation on herbal and synthetic drugs targeting nuclear receptors. The valedictory function was presided by Dr. R. Thirumurugan, Coordinator, NCAAE, Bharathidasan University, India. He enlightened the participants about the recent

advances in alternative methods, global change and status of India in the scenario of alternatives. He also briefed the participants about the vision of NCAAE in development of new methods as a replacement for animal models.

ii. DECEMBER 13-19, 2017

The workshop was formally inaugurated by Dr. M. Ravichandran, Professor and Head, Department of Environmental Management, Syndicate member, Bharathidasan University. The presidential address was given by Dr. R. Babu Rajendran, Registrar in- charge, Bharathidasan University. Dr. R. Thirumurugan, Coordinator, NCAAE, presided over the valedictory function and distributed certificates to the participants on successful completion of the workshop. He elaborated the participants about the achievements of NCAAE in alternatives scenario and motivated the participants to practice the techniques what they learned during the workshop.

During the valediction, the participants were given a chance to share their experience of the workshop where a maximum number of positive comments were given by the participants as well as some requests were put forward by them.

b. Industry-Academia Training Workshop: Light Microscopy - "From Basics to Optical Sectioning"

Industry-Academia Training Workshop entitled Light Microscopy - "From Basics to Optical Sectioning" was conducted at NCAAE, Bharathidasan University, in collaboration with Carl Zeiss India (Bangalore) Pvt Ltd., on May14-15, 2018.

Imaging technologies are promising alternative methods that enable researchers to investigate the disease through human scanning rather than animal experimentation. It helps us to enhance our knowledge of anatomy, physiology and functions of the human body. It also helps us to understand how the body metabolizes and responds to drugs and prevent diseases without the use of animals. These types of research are cost-effective, improve the quality of research and certainly reduce/replace the use of animals in toxicity testing. This workshop helped researchers to inculcate imaging technologies to investigate the underlying mechanism

of action and responses of the cells and the tissues to drugs which will ultimately project the conditions of humans.

A workshop of this kind was conducted for the first time in India. Fifty participants from different parts of the country took part in the workshop. The participants included University and College teachers, research scholars and students from basic Life Sciences and engineering & technology. The resource person of the workshop was Dr. T. Amarnath, Assistant Manager, Microscopy Division, Carl Zeiss India (Bangalore) Pvt. Ltd.

The workshop was formally inaugurated by Dr. G. Gopinath, Registrar, Bharathidasan University. Dr. M.A. Akbarsha, Founder, MGDC, Bharathidasan University, delivered the valedictory address. The workshop was sponsored by Carl Zeiss India (Bangalore) Pvt. Ltd. The workshop program was designed keeping in view to inculcate all the basic as well as advanced imaging technologies.

XI. Beneficiaries

- Bharathidasan University, Tiruchirappalli (Various departments)
- Alagappa University, Karaikudi
- Anna University, BIT Campus, Tiruchirappalli
- National Institute of Technology (NIT), Tiruchirappalli
- KSR College of Technology, Tiruchengode
- North-Eastern Hill University, Shillong
- Bharathiar University, Coimbatore

Workshop on

Trends in Animal Models, *In Vitro* Tools, and *In Silico* Approaches in Scientific Research

February12to16,2024

Sponsored by

RUSA2.0 Biological Sciences

Mahatma Gandhi-Doerenkamp Centre(MGDC)
For Alternatives to Use of Animals in Life Science Education

National Centre for Alternatives to Animal Experiments (NCAAE) &
Society for Alternatives to Animal Experiments-India (SAAE-I).

The workshop, titled *"Workshop on Trends in Animal Models, In Vitro Tools, and In Silico Approaches in Scientific Research"* was sponsored by RUSA 2.0 Biological Science and co-organized by MGDC, UGC-NCAAE, SAAE-I, and the Department of Animal Science at Bharathidasan University in Tiruchirappalli. Attracting scholars from throughout India, 22 participants were chosen from a pool of 27 applicants from various States and districts in Tamil Nadu. The workshop explored the most recent advancements in these three critical fields of scientific research: animal models, *in vitro* tools (cell-based techniques), and *in silico* approaches (computer modeling and simulation). This rigorous program encouraged information sharing, the investigation of new approaches, and collaboration, with the ultimate goal of advancing scientific research.

Day 1:

The workshop began with an inauguration ceremony featuring a welcome address by Prof. K. Emmanuel Rajan, an Inaugural address was delivered by Hon'ble Vice Chancellor Prof. M. Selvam, where a keynote address was delivered by Prof. M.A. Akbarsha, and a vote of thanks was proposed by Prof. B. Kadalmani. Following this, Prof. M.A.Akbarsha presented an overview of the three domains of 3R's. In the afternoon sessions, participants were divided into 3 Batches. Batch-I got hands-on training on cell culture, while Batch-II and III were given hands-on training on *Hydra*, and Zebrafish models, respectively.

Day 2:

Day 2 featured with an invited talk by Dr. H.P. Gurusankara (Central University of Kerala) on "*Drosophila melanogaster as a Model"* followed by hands-on training in *Drosophila melanogaster* determination of sex and mutant varieties. In the afternoon session, participants from different batches were shuffled to get hands-on training in respective model system.





Day 3:

On Day 3 Prof. K. Balamurugan (Alagappa University) delivered an invited talk on "*Caenorhabditis elegans:* An Overview," followed by demonstrations. In the afternoon session, participants continued hands-on training in the respective model systems.




Day 4:

On day 4: Dr. M. Rajalakshmi (Holy cross college, Trichy) gave a lecture on "Overview of Bioinformatics," and Dr. S. Kiran Kumar (SRM Institute of Technology) presented on "Overview of Zebrafish Model." Participants were then divided into two groups for hands-on sessions on staining procedures and MTT assay, RNA isolation, purification, c-DNA synthesis and also an *in silico* demonstration were provide to the participants.

Day 5:

The final day included an invited talk by Prof. Gopinath Packirisamy (IIT Roorkee) on "3D and 4D Cell Culture," followed by a demonstration on carbon dots and interpretation of gene expression in the afternoon.

In the valedictory ceremony, Prof. B. Kadalmani, welcomed the gathering. The valedictory address was delived by Registrar (i/c) Prof. R. Kalidasan and by Prof. Gopinath Packirisamy. Prof. M.A. Akbarsha offered felicitation. The workshop report was presented by Prof. S. Achiraman, and the vote of thanks was proposed by Dr. Mahesh Kandasamy followed by certificate distribution.

Beneficiaries

- Southwest University (China)
- Ramaiah University of Applied Sciences, Bangalore
- Alagappa University, Karaikudi
- National College (Autonomous), Trichy
- Tamil Nadu Open University, Chennai
- Karpagam Academy of Higher Education, Coimbatore
- Jamal Mohamed College, Trichy
- Bharathidasan University, Trichy

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