Refresher Course on ‘Animal Tissue Culture’
Held at
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Pune
11-23 May, 2009
Sponsored by
Indian Academy of Sciences, Bangalore; Indian National Science Academy,
New Delhi; Academy of Sciences, India, Allahabad

A report

Preamble:

Biotechnology is comparatively a new branch of biological sciences with a thrust on use of advances in biological sciences towards betterment of plant & animal life and environment. Considering its importance in applications in bio-industry, it has become a frontline area of studies all over the world. Almost all Universities in India and affiliated colleges have introduced this discipline in their curricula. Animal tissue culture (ATC) is an important branch of animal biotechnology. ATC technology is rather fastidious and requires a fairly well equipped laboratory and technical know how. Many colleges teaching ATC do not have required infrastructure and well trained teaching staff.

Rajiv Gandhi Institute is a young institute, teaching ATC at UG as well as PG level, for the last 5 years. We have a fairly good laboratory set up with knowledgeable teaching staff. Considering the need to spread the technology to needy colleges in the country we ventured to apply to the Education panel of the three Academies of India, viz. Indian Academy of Sciences, Bangalore; Indian National Science Academy, New Delhi; Academy of Sciences, India, Allahabad for financial support to hold the course. Application was sent to IASc in Jan. 2009, which was approved by the committee and we were informed about acceptance of the proposal for funding on 3rd Feb.2009.

Announcement of the Refresher course:

We are grateful to IASc for giving a prominent back page announcement of the course in Current Science, the most popular science journal. We also sent the announcement by post to 146 selected colleges teaching Biotechnology, and 39 Universities (Annexure I- Copy of the announcement). We had an overwhelming response to the announcement. By last date of application we received 161 applications, about 20 after the last date was over, and several phone calls (List of applicants available if required). State wise distribution of applicants is given as annexure II.
Selection of candidates:

We formulated a selection committee of senior professors of RGI to select candidates, which met twice, on 23rd and 24th March 2009, and selected candidates with 3 names on wait list. The committee had difficult time, specially in rejection of candidates. We gave consideration to candidates who are from colleges in isolated places where near by institutes having approachable ATC facility for in house training was not available. Minutes of the meeting of selection committee (Annex III), List and addresses of selected candidates (Annex. IV) and their biodata are enclosed (Annex V).

Resource persons:

As per the requirement of the Education panel of the Academies, we finalized the list of local resource persons and tried to have invited faculty mostly from amongst the Fellows of the Academies. Since the area covered in ATC course is quite focused, we had limitations in selecting the invited resource persons. List of local and invited faculty is given in Annexure VI. All the resource persons readily agreed to participate in the course by way of lectures and demonstration of specialized technique. However, due to some unavoidable circumstances, Dr. A. Kolaskar could not come, and was replaced by Dr. R. M. Kothari, who would be taking over the charge as Principal of RGI from 1st June 2009.

Course structure:

Course structure (Annex. VII) was formulated in such a way as to include basic technology as suggested by the Education panel and few advanced techniques by way of hands on as well as demonstrations.

Requirements of participants:

Staying arrangement of outstation participants (No.14) was made in the BVU guest house, which is very good. The guest house is at a walking distance from RGI. Two outstation participants preferred to stay with their relatives although rooms were kept for them. Normally the accommodation in the BVU guest house is quite expensive. We are very grateful to the Hon. Vice Chancellor of BVU for making the rooms available for the participants from 10th May to 24th May (15 days) at 50% concession. Participants were given 3 tier AC sleeper travel allowance, and local travel to and fro railway station. Arrangements were made for breakfast, lunch (packed lunch) and afternoon tea for all participants at the Institute, while dinner was served for those staying in the guest house.
Participant's Kit:

On arrival participants were given a folder with 2 books, protocol manual prepared by Dr. Gangal & Dr. Moghe, a note pad, pen, pencil for their daily use (copy of the manual enclosed as Annex VIII). Following books were given:


Book 2. In vitro Cultivation of Animal Cells. Authors: Dr. D Gor, Royal Free Hospital & School of Medicine, London, UK, Dr. E. Lucassen, University of Greenwich, UK. Publishers: Elseviers India, Pvt. Ltd, Published on behalf of Open Universiteit, Nederland & University of Greenwich, UK

Inauguration:

Inauguration cards were distributed to heads of Institutions, a few Fellows from Pune & Mumbai, interested scientists in institutes like NCCS, ARI, Pune University, NARI, NIV, ACTREC Mumbai, colleges in Pune (Invitation cards for Inaugural function and Dinner on 22nd May are enclosed as Annex IX). All heads of colleges and institutions affiliated to Bharati Vidyapeeth University, and Resource persons, who would be participating in the course, were invited. Unfortunately, Hon. Vice chancellor of Bharati Vidyapeeth University, Dr. Shivajirao Kadam was unable to attend the inauguration function due to some unforeseen last minute engagement. However he requested the Principal of RGI, Dr. Prabhakar Ranjekar to read out his address on his behalf. Dr. Ranjekar welcomed the participants and invitees talked about the general set up of RGI and wished the course a success. Dr. Gangal, the course Director talked about the outline of the course. She mentioned about the overwhelming response received from teachers from all parts of India and thanked the Academies for financing the course, Resource persons and all others who have helped in organization of the course. Dr. Ranjekar read out the inaugural address, in which Hon. V.C. dwelt upon the philosophy on which the Bharati Vidyapeeth University functions, that is, imparting knowledge for the benefit of lower strata of the society. He brought out lucidly, the importance of Biotechnology in modern era and expressed his happiness that BVU had already visualized these developments and had already developed good infrastructural facilities to accommodate the modern trends. He expressed his satisfaction that RGI could undertake such a vast task, congratulated the organizers, thanked the Academies for financial support, and expressed his good wishes for the course. Dr. Alpana Moghe, Head, Cell & Molecular Biology, RGI, and the Course Coordinator proposed the vote of thanks. Tea and snacks were served to all.

Scientific programme of the course:

In the morning before inauguration participants gave an objective test on general information on ATC technology. This test was meant for the faculty to know as to the level of information they have about the subject, so that the lectures can be catered accordingly. A similar test was given at the end of the course. The difference in the performance of pre and post tests was quite evident.
Both the question papers and a graphical representation of their performances are given as Annex. X.

The course program began immediately after the inauguration. After introductions of participants and faculty, the participants were divided into 2 batches of 10 each. Within each batch they worked in pairs (5 pairs per batch).

The program generally consisted of a lecture in the morning followed by practicals, one batch did the sterile work in the hoods, while other batch did non-sterile work as per the schedule given in annex VII, with small variations depending upon the availability of cell cultures.

**Lectures:**

The lectures were of two types, routine lectures on theoretical and practical aspects of ATC technology were mostly given by Course Coordinator Dr. Moghe (theory lectures), Mrs Snehl and Mrs. Prachi (practical lectures) while Dr. Gangal, gave a couple of lectures. The invited resource persons gave lectures on specific topics and emphasized the advances in the areas. Two demos were also given by invited resource faculty. In general, all lecture sessions were very interactive.

On first day, Dr. Gangal gave a lecture on overview of ATC. She talked about differences in cells in vivo, and those grown in vitro. She explained the requirements of cells for their growth in culture. She explained different methods used to culture tissues like primary explant cultures, organ cultures and cell culture and stated the importance of each one of these systems. She touched upon the phenomenon of cell transformation and establishment of continuously growing cell lines. She elaborated upon the uses of cell cultures in every aspect of basic and applied research, such as study the effect of drugs and other agents on cells, developing viral vaccines, for large scale production of biomolecules of importance and producing unlimited supply of monoclonal antibodies.

Dr. Gangal also gave a lecture on Hybridoma technique for development of monoclonal antibodies. She described the methodology giving emphasis on procedures adopted for selection of hybrids. She talked on problems in the use of mouse monoclonal antibodies in therapy. She described production of genetically engineered antibodies, and elaborated uses of monoclonal antibodies in basic research and in medicine. She touched upon different procedures used for upscaling of hybridomas to get large quantities of monoclonal antibodies.

Dr. Moghe gave lectures on following topics:

1. **Media:** She emphasized on physico – chemical properties of media such as pH, temperature, gaseous phase requirements of cells; different buffering systems used; ingredients of media including inorganic salts, their different formulations, amino acids, vitamins, metabolites, glucose, hormones, growth factors; importance of serum in media. She touched upon serum free media and introduced different commercially available media formulations.
2. Maintenance of cell culture: This lecture covered typical growth characteristics of cells growing in vitro; concept of contact inhibition; density dependent inhibition of mitosis; anchorage dependent growth, confluent growth etc. Definitions of primary cultures, cell line, cell strain, continuous cell line, suspension cultures were covered. Importance of routine observation of cells, feeding & subculturing of cells using split ratio, importance of viable cell counting, maintenance of proper records were emphasized.

3. Cryopreservation: Reasons for cryopreservation of cells, principle of cryopreservation, method, different tissue culture grade cryoprotectants used, different models of liquid nitrogen cylinders and protocol for revival of cells were covered in this lecture.

4. Cytotoxicity: Testing toxicity drugs in vitro employing cell culture is one of the most important applications of animal tissue culture. Different methods of testing drug toxicity using cell culture system were introduced. Special mention was made of complexities involved in interpretation of data, limitations in mimicking of pharmacokinetics and drug distribution, tissue penetration and metabolism in in vitro conditions, which are the important features in in vivo studies. Different in vitro cytotoxicity assays such as viability (dye exclusion and dye uptake tests), cell survival (plating efficiency test, growth curve analysis), metabolic assays using MTT, XTT, SRB, testing for allergy were described.

5. Upscaling: This lecture was framed to give information on another most important application of tissue culture, i.e. production of vaccines and obtaining large quantities of cell products. Methods used for upscaling of suspension culture, models of bioreactors, biostats; methods for upscaling of diploid cells like nunc cell factory, roller culture, cell cube, membroferm and hollow fibre reactor; uses of beads as microcarriers to increase the surface area were elaborated.

**Lectures delivered by guest faculty:**

Dr. A. N. Bhisey, former Director, Cancer Research Institute, Mumbai, gave a lecture on characterization of cells grown in culture. He showed beautiful slides on keratin expression, chromosomes, cell morphology, expression of cell surface markers and emphasized that cells grown in culture should be characterized every few months to detect cross contamination of cell lines.

Dr. Bhisey gave another lecture on cytogenetics wherein he talked about different cytogenetic abnormalities shown by cells, especially by transformed cells in culture. He emphasized on importance of karyotyping, and stated that FISH techniques can be used to detect molecular changes even on interphase nuclei. He talked about uses of recently developed SKY technique.

Dr. Mrs Rajani Bhisey, formerly, Head of Carcinogenesis Division, Cancer Research Institute, Mumbai, discussed the importance of mutagenesis assays using tissue culture systems. In a well illustrated manner, she talked about Ames assay, micronuclei formation, sister chromatid exchanges, chromosome gaps and breaks as obvious markers of genetic insult to cells.

Dr. R. R. Bhone, formerly Scientist G at NCCS, now a Technical Director at STEM Peutic Inc Manipal hospital, gave an excellent account of stem cell biology, especially adult stem cells which
have a great promise in regenerative medicine and in cell replacement therapy. He talked about plasticity of adult stem cells and how autologous adult stem cells will circumvent the use of oocytes to obtain stem cell growth and differentiation, and problems of allogeneic rejection. His talk was much appreciated by the participants.

Dr. Kalyan Banerjee spoke about how viruses can be grown in simple explant cultures without sophisticated equipments, attenuated and used for vaccine preparation. He emphasized the importance of monkey kidney cells to grow viruses. He showed beautiful slides of cytopathic effects of various viruses on different cell lines.

Dr. Savita Datar, gave a lecture on development of a culture system in which growth of chick embryo can be observed for 19 days in vitro outside the egg. This method was developed by her along with Dr. Bhone. This is an excellent model to study development of chick embryo in vitro in bowls, which I referred to as 'shell less embryo culture'. This model is very useful for developmental biologists to study organogenesis, morphogenesis, and most importantly, to study effect of external agents on growth and development of embryos.

Dr. R. M. Kothari stated that even if tissue culture systems can be used for many studies to replace animals, there are some limitations to their uses. He exemplified this from his studies of neuropathological effects on submarine operator trainees during long durations of stay under 900 feet sea water pressure. Changes in their brain enzymes could not be studied in cultured cells at that water pressure. The studies had to be conducted on eels whose natural habitat is in deep sea.

Dr. U. V. Wagh, who is a key person in popularizing use of cell culture in India, was initially the Director of National Facility of Animal Tissue Culture Collection (NFATCC). This lab supplied cell cultures to all labs in India. Eventually he built up National Center for Cell Sciences (NCCS) and retired. He gave an excellent account of the use of cell cultures from a variety of wild animals which cannot be used as whole animals for studies. He talked about various surface and intracellular markers to identify cells using example of cytoskeletal proteins.

**Experiments conducted by the participants:**

Every day participants were divided in two batches one batch working in sterile area and other conducting experiments in un-sterile area in the morning. In post lunch practical sessions the batches were switched. This had to be done because of constrains in sterile area with 5 laminar flow hoods.

**The total practical work was as follows:**

1. All participants were first apprised of aseptic conditions which have to be observed strictly while conducting ATC. They were also introduced to basic equipment used in ATC.

2. Feeding of cell cultures: Cultures were provided to the participants. They first made careful observations of cultures for cell morphology, cell density, contamination under inverted phase contrast microscope and fed the cultures in hoods in aseptic condition.
3. Preparation of synthetic medium used in ATC and its sterilization by filtration was demonstrated.

4. Subculturing of cells & counting of viable cells: This experiment was the basis of all further experiments. Participants were given fully grown cultures they were shown how to trypsinize cells and make a viable cell count on hemocytometer using trypan blue dye exclusion test. Most of them did both experiments properly.

5. Staining of cells with Giemsa: Participants were given cell cultures grown on coverslips for staining with Giemsa. They did the staining well, they were taught to calculate mitotic index.

6. Primary cultures of Chick embryo fibroblasts: Dissection of chick embryo was demonstrated. Participants did skeletal muscle and heart fibroblast explant cultures. They conducted cold trypsinization of skeletal muscle fibroblasts and made monolayer cultures.

7. Sterility test medium: The participants prepared fluid thioglycolate medium used to check the sterility of solutions, and its sterilization.

8. Virus titration assay: A demo of virus titration assay was given. After 5 days, they observed the cytopathic effect of virus in cultures.

9. Clonogenic assay: All participants set up replicate cultures for clonogenic assay. Unfortunately quite a few cultures got contaminated, therefore they were supplied with ready made cultures for staining with Crystal violet. They measured the plating efficiency.

10. Chromosome preparations: Both batches did chromosome preparations. About 50% participants got good chromosome spreads, and stained them with Giemsa. Because of time constrain, G banding technique could not be shown.

11. Growth curve analysis: Participants set up replicate cultures for growth curve analysis. They were supposed to take viable cell count every day. Cultures of few participants were overgrown by 3rd day. The remaining could count viable cells every day, plotted growth curve and calculated population doubling time.

12. Cytotoxicity assays: Both batches set up microwell plates for cytotoxicity studies using MTT and SRB assays. Next day they added dilutions of drugs and after 2 days, conducted both the assays themselves. They plotted the graphs and calculated IC<sub>50</sub>. About half of them could get good curve.

13. Tracheal organ culture: Participants were demonstrated dissection of freshly hatched chick embryos. They did tracheal cultures themselves and observed ciliary movement.

14. Shell less chick embryo cultures: Participants had set up cultures of 1 day old chick embryos. A few of them got growth of embryo and vascularization. After 4 days they were shown the mounting of whole embryos on microscope slides. They also mounted their embryo cultures.

Thus, in general participants handled a large spectrum of experiments. Most of the experiments were done by the participants themselves, while a few had to be set up as demos.
Additional experiment:

Participants wanted to know setting up of human peripheral blood lymphocyte cultures. A practical demonstration was given for separation of human peripheral blood lymphocytes on Ficol-Hypaque gradient, collection of lymphocytes from the gradient and culturing.

Visit to Serum Institute, Pune:

This was an unscheduled program planned after the course was sanctioned. Serum Institute of Pune is an internationally reputed organization involved in production of vaccines for many viral diseases, which are supplied all over the world. It is said that every third child in the world gets anti Rabies vaccine produced by The Serum Institute of India.

On arrival to the institute, Dr. Rajeev Dhere, Director Vaccines, appraised the participants about the cell types used for virus culture, methods used for upscaling of cultures, and strict quality control measures, which are mandatory for vaccine preparations. The upscaling methods used by them are Nunc cell factories, bioreactors using microcarriers, and a new technology of upscaling using cell cubes. Cell cubes simulate in vivo conditions of cell perfusion like blood circulation system. Participants were taken to one of the labs preparing anti Rabies vaccine, were shown 100 liter reactor where cells are grown on microbeads producing large quantities of virus. Methods of isolation of virus and preparation of vaccines were described. Participants were extremely happy for getting the opportunity to visit one of the best bio-industry in India, using cell cultures.

Visit to IRSHA:

Interactive Research School for Health Affairs is one of the institutes of Bharati Vidyapeeth University, devoted for research. Participants had a couple of hours visit to the institute, and got acquainted with the Research going on in the Institute. They were very impressed.

Excursion:

On Sunday 17th May one day excursion was arranged for the participants for Pune Darshan (Sight seeing of Pune city). Pune is a historic place, with full of exciting places giving a glimpses of Maratha history, which was really a beginning of independence movement. Besides the places of historical importance, there are a number of old structures, temples, museums gardens etc worth visiting. Participants went around the city in air-conditioned bus with an English speaking guide. Breakfast and lunch were provided for the participants on board. One of the Pune based participant (Dr, Puranik) volunteered to join the trip to look after participants. The outstation participants enjoyed the trip.

Valedictory function:

On 23rd May the participants gave their post course exam, and filled up feed back forms (annex XI). They liked the idea of pre & post course exams a great deal. All participants did significantly well in second test. They were very happy that they were allowed to take their answer home. Dr. U. V. Wagh was the chief guest for the valedictory function. Principal, Dr. Prabhakar Ranjekar was also present. Certificates of participation were distributed to the participants. All participants
expressed their satisfaction on proceedings of the course and also expressed their gratitude. Each one of them gave an account of the way they would utilize the training in improving their teaching and introducing practical exercises in their curricula. A copy of the certificate and few photographs are enclosed with the report.

A few participants carried cultures with them so that they can start practicing ATC work.

A few photographs of the refresher course are enclosed herewith

News paper reports:

News about the course appeared In Times of India, Indian Express, Lokmat (Marathi) and Sakal (Marathi).

Acknowledgement:

The organizers are extremely grateful to the Education Panel of the three academies, Chairman Dr. N. Mukunda, and Coordinator Dr. G. Madhavan for giving us financial help to conduct this workshop. Dr. G. Madhavan was our liaison with the Academies, whom we constantly pestered with queries. We respectfully thank Hon. Vice Chancellor of Bharati Vidyapeeth University, Dr. Shivajirao Kadam for his constant encouragement and support. Kind help from Mr. G. Jayakumar, Registrar BVU is acknowledged. Special thanks to Dr. DeSouza and his colleagues for excellent guest house arrangements. We are thankful to authorities of Serum Institute of Pune for showing us the Institute. We are grateful to the Resource persons for spending their valuable time with the participants.

During this period the Institute went through major administrative changes, however we were lucky to have had whole hearted co-operation by all the three Principals, Dr. D. P. Nerkar, Dr. Prabhakar Ranjekar and Dr. R. M. Kothari. The office staff of RGI has been very helpful and is duly acknowledged. The staff of Cell & Molecular Biology Department of RGI has worked day and night for the course, in spite of the fact that this is a vacation period. Myself, and the course co-ordinator Dr. Moghe sincerely thank them. Finally, all our senior colleagues, especially Dr. Singh, have helped us a lot, and we are thankful to them.

(Dr. Sudha Gangal)
Course Coordinator
ANNEXURE VII
Day wise programme for the Refresher Course

Monday, 11\textsuperscript{th} May 09
10 AM: Inauguration
12 Noon: Lecture 1
Hands on session:
Preparation of Media & other reagents
Observervation of monolayer culture and feeding

Tuesday, 12\textsuperscript{th} May 09
9.30 AM: Lecture 2
Practical session:
Preparation of sterility test medium
Staining cultures with Giemsa
Subculturing and viable cell counting
Setting up of microtest plate for MTT assay
5.30 PM: Lecture 3

Wednesday, 13\textsuperscript{th} May 09
9.30 AM: Lecture 4
10.30 AM: Lecture 5
Practical session:
Drug toxicity contd.
Chromosome preparation

Thursday, 14\textsuperscript{th} May 09
9.30 AM: Lecture 6
Practical session:
Virus titration assay (Demo)
Primary culture of chick embryo fibroblasts

Friday, 15\textsuperscript{th} May 09
9.30 AM: Lecture 7
Practical session:
Continuation of primary culture
MTT assay

Saturday, 16\textsuperscript{th} May 09
9.30 AM: Lecture 8
Practical session:
Set up cultures for growth curve analysis
Clonogenic assay (Demo)
Staining of clones with crystal violet

Sunday, 17\textsuperscript{th} May 09
Excursion: Pune Darshan
Monday, 18th May 09
9.30 AM: Lecture 9
Practical session:
Setting up microtest plates for SRB
Chick embryo tracheal organ culture
Counts for growth curve analysis

Tuesday, 19th May 09
9.30 AM: Lecture 10
10.30 AM: Lectures 11 & 12
Practical session:
SRB assay continued
Cell counts for growth curve analysis
Shell less chick embryo culture

Wednesday, 20th May 09
9.30 AM: Lectures 13 & 14
Practical session:
Staining of primary cultures
Cell count for growth curve analysis
Cryopreservation of cells (Demo)

Thursday, 21st May 09
9.30 AM: Lecture 15
Practical session:
SRB assay
Growth curve analysis
Virus titration assay: observations

Friday, 22nd May 09
2.30PM: lecture 16
Practical session:
Staining of primary cultures
Mitotic index
2.30 PM: Visit to serum Institute, Pune
7.30 PM: Dinner Guests and participants

Saturday, 23rd May 09
9.30 AM Filling feed back forms
Discussion with faculty
1.30 PM Lecture 15
Valedictory function
List of Lectures

Lecture 1. Introduction to animal cell culture Dr. Sudha Gangal
Lecture 2. Tissue culture media Dr. Alpana Moghe
Lecture 3. Guest lecture: Markers of cultured cells Dr. A. N. Bhisey
Lecture 4. Guest lecture: Cytogenetics Dr. A. N. Bhisey
Lecture 5. Guest lecture: Mutagenesis Dr. Rajani Bhisey
Lecture 6. Maintenance of cell cultures Dr. Alpana Moghe
Lecture 7. Characterization of cell cultures Dr. Alpana Moghe
Lecture 8. Methods of quantitation Dr. Alpana Moghe
Lecture 9. Cryopreservation of cells Dr. Alpana Moghe
Lecture 10. Guest lecture: Stem cells and regenerative medicine Dr. R. R. Bhonde
Lecture 11. Guest lecture: Shell less chick embryo culture in developmental biology Dr. Savita Datar
Lecture 12. Guest lecture: Use of tissue culture in virology Dr. K. Bannerjee
Lecture 13. Upscaling & Applications of animal tissue culture in industry Dr. Alpana Moghe
Lecture 14 Alternative approach to tissue culture for Solutions Dr. R. M. Kothari
Lecture 15 Hybridoma technique Dr. Sudha Gangal
Lecture 17 Culture of specialized cells Dr. Ulhas Wagh
ANNEXURE IV

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Res.: 10-A Swamy Samarth Nagar
Laxmi Nagar, Link Road, Chinchwad, Pune 411033
Tel.: 020-27508016, M.: 9881716874
ANNEXURE VI
Resource Persons

Dr. Prabhakar Ranjekar
Acting Principal (upto 31st May)
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043

Dr. R. M. Kothari
Principal
Rajiv Gandhi Institute of IT and Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043

Dr. Sudha Gangal
Emeritus Professor
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043

Dr. Alpana Moghe
Head, Department of cell & Molecular Biology
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043

Ms. Snehil Jaiswal
Lecturer, Department of cell & Molecular Biology
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043

Ms. Prachi
Lecturer, Department of cell & Molecular Biology
Rajiv Gandhi Institute of IT & Biotechnology
Bharati Vidyapeeth University
Katraj, Pune 411043
Invited Resource Persons

Dr. A. N. Bhisey  
Former Director  
Cancer Research Institute  
Mumbai (Now Actrec, Kharghar, New Bombay)

Dr. Rajani Bhisey  
Head, Carcinogenesis Division  
Cancer Research Institute  
Mumbai (Now Actrec, Kharghar, New Bombay)

Dr. A. S. Kolaskar  
Former Vice Chancellor, Pune University  
At present: Advisor, National Knowledge Committee New Delhi  
Managing Director, DSK Global Education Research Pvt. Ltd

Dr. K. Banerjee  
Former Director  
National Institute of Virology, Pune  
At present: President, Maharashtra Association of Cultivation of Sciences  
Agarkar Research Institute  
Pune

Dr. U. V. Wagh  
Former Director, National Facility for Animal Tissue Culture Collection (Now NCCS) &  
Former Director, Interactive Research School for Health Affairs (IRSHA), BVU  
Pune

Dr. R. R. Bhonde  
Technical Director  
Stem Peutic research Pvt. Ltd.  
Manipal Hospital  
Bangalore

Dr. Savita Datar  
Reader, Department of Zoology  
Sir Pershuram Bhau College  
Pune