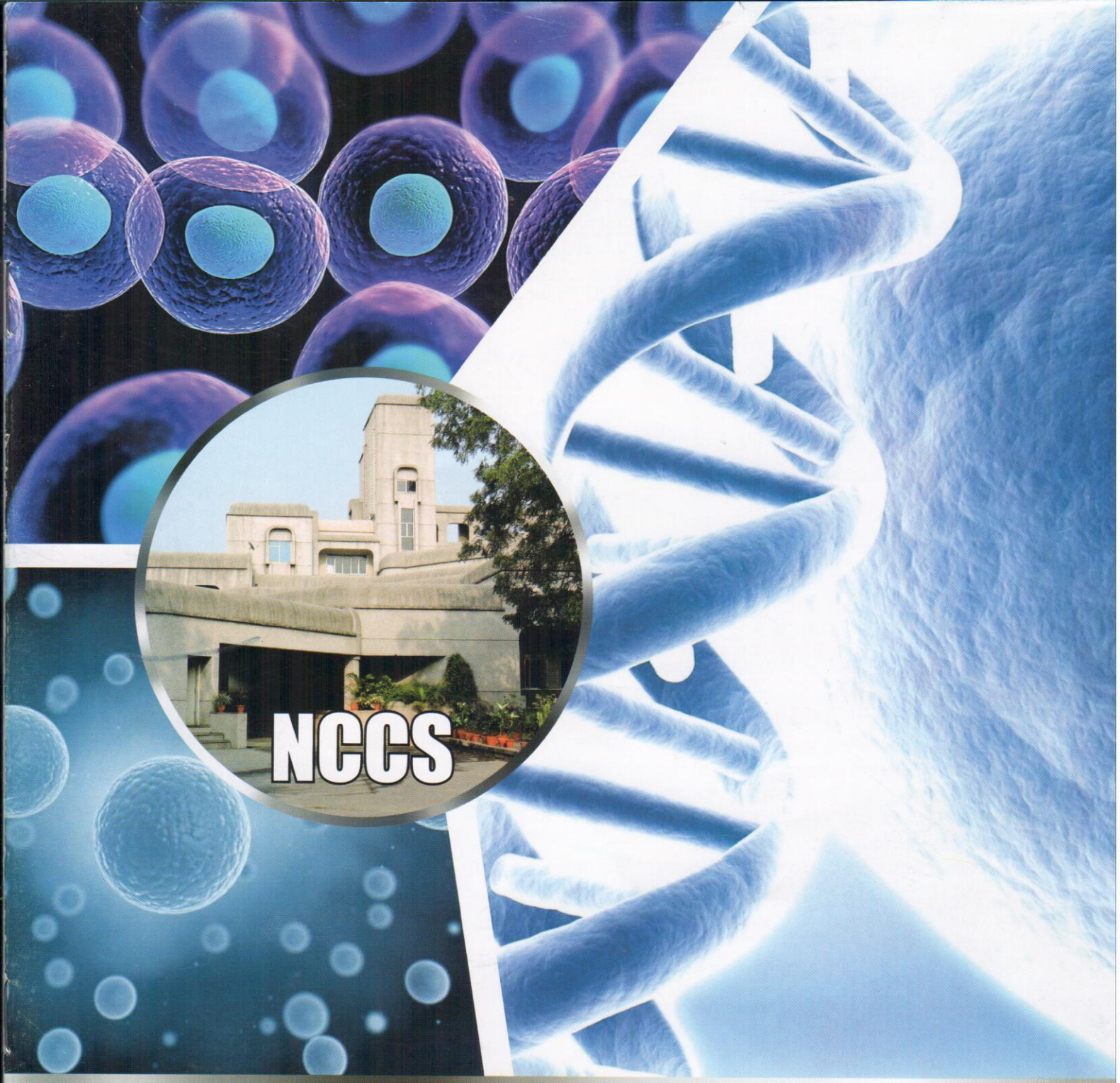

OPPORTUNITIES FOR PARTNERSHIP

www.nccs.res.in
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Email : director@nccs.res.in

NATIONAL CENTRE FOR CELL SCIENCE

An autonomous institution aided by the Department of Biotechnology, Government of India

Cell Bandages for Tissue Repair in Diabetic Wounds

Wound healing in diabetic conditions is severely impaired and is a major cause of extremity amputation. A cellular, tissue engineered, wound-healing product comprising of a novel matrix of electro-spun Polycaprolactone-Gelatin nano-fiber scaffold (PCG) with embedded Bone Marrow or Peripheral Blood-derived endothelial progenitor cells (BMPC) system has been developed by scientists at NCCS, for accelerated and fibrosis-free wound healing in diabetic conditions.

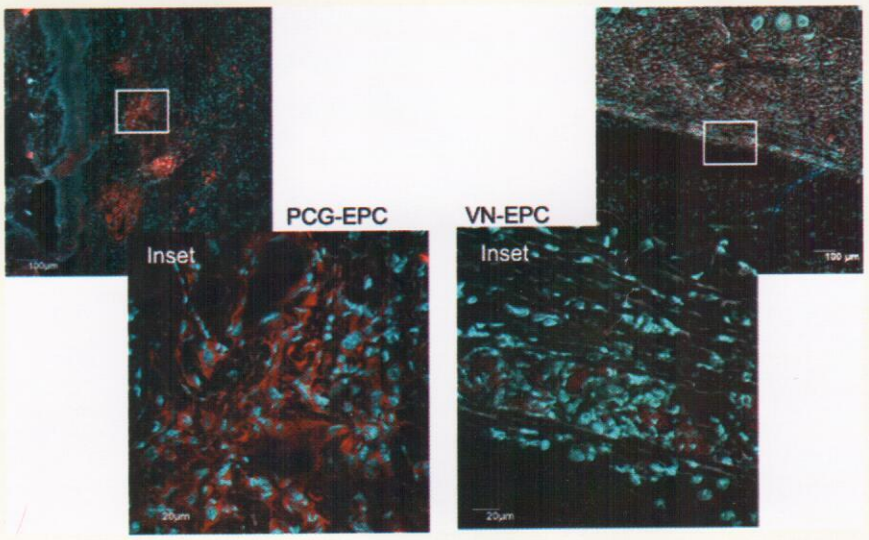


Figure 1: PCG-EPCs (Left) show efficient incorporation into wounds as compared to Vehicle VN-EPCs (Right)

This system promotes selective growth of BMPCs in the wounded area and works as a combined growth and delivery system for direct application onto wounds. This system can be developed into bandage style scaffolds for a ready-to-use cell therapy product. It has several advantages including:

- Treatment of non-healing ulcers in diabetic or burns patients,
- Fibrosis-free healing,
- Direct application onto skin repair sites including diabetic wounds,
- Bio-compatible,
- Easy handling in clinical settings,
- Cryopreserved for long shelf life; and
- Autologous cells can be used in the scaffold to reduce risk of rejection.

References:

1. Enhanced Growth of Endothelial Precursor Cells on PCG- Matrix Facilitates Accelerated, Fibrosis-Free, Wound Healing: A Diabetic Mouse Model, PLOS One July 2013, Vol 8, Issue 7 (Article).

Technology Readiness: TRL B2

Technology Status: Patent Filed in India.

Technology Availability: Know-how available for transfer/ co-development with partners.

Technology Category: Stem Cells

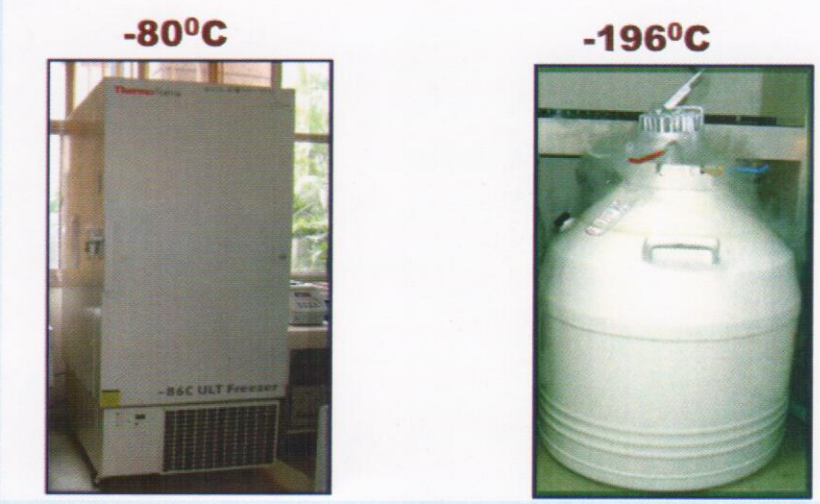
Product Category: Medical Device

Tags: Dr. Vaijayanti Kale

Indigenous Technology for Cryopreservation of Cord Blood

Umbilical cord blood (UCB)collected from umbilical cord and placenta following child birth, is a rich source of stem cells which are preserved and harvested for treatment of many diseases and stem cell research . Efficient preservation of cord blood cells is crucial for availability of viable stem cells at the time of need.Scientists at NCCS have developed a unique technique for cryopreservation of UCB cells for banking and research. This technology includes three stage approaches of processing, quality check and finally cryopreservation of the UCB samples collected from local hospitals.

STORAGE OF CELLS AT ULTRA LOW TEMPERATURES



This technology addresses various issues related to cryopreservation of cord blood cells including prevention of cryoinjury, improving migration, adhesion and homing of cells, and protecting functionality of hematopoietic cells that are important for clinical applications such as growth factor responsiveness, preservation of surface molecules and long-term culture-forming ability.

Technology Readiness: Technology tested and demonstrated in field trials .

Technology Status: Available for Technology Transfer.

References:

- Prevention of Apoptosis as a Possible Mechanism behind Improved Cryoprotection of HematopoieticCells by Catalase and Trehalose, Transplantation Vol 80, Number 9, November 15, 2005 (Article).
- Bone Marrow Cryopreservation: Improved Recovery Due to Bioantioxidant Additives in the Freezing Solution, Stem Cells1997;15:353-358 (Article).
- A combination of catalase and trehalose as additives to conventional freezing medium results in improved cryoprotection of human hematopoietic cells with reference to in vitro migration and adhesion properties, TRANSFUSION, Vol 45, April 2005 (Article).
- Supplementation of Conventional Freezing Medium with a Combination of Catalase and Trehalose Results in Better Protection of Surface Molecules and Functionality of Hematopoietic Cells, Journal Of Hematotherapy& Stem Cell Research 2003, 12:553–564 (Article).

Technology Category –Stem Cells, UCB

Tags – Dr. LalitaLimaye

Endocytosis in deciding fate of Embryonic Stem Cells

Scientists at NCCS are investigating the role of endocytosis and vesicular transport in deciding the future state of a undifferentiated embryonic stem cell. Using experimental techniques like large scale siRNA screening, reprogrammin assays and biophysical manipulation of mouse embryos, they are studying how modifications to cellular or vesicula transport determines whether an embryonic stem cell maintains pluripotency or differentiates into a specific cell type.

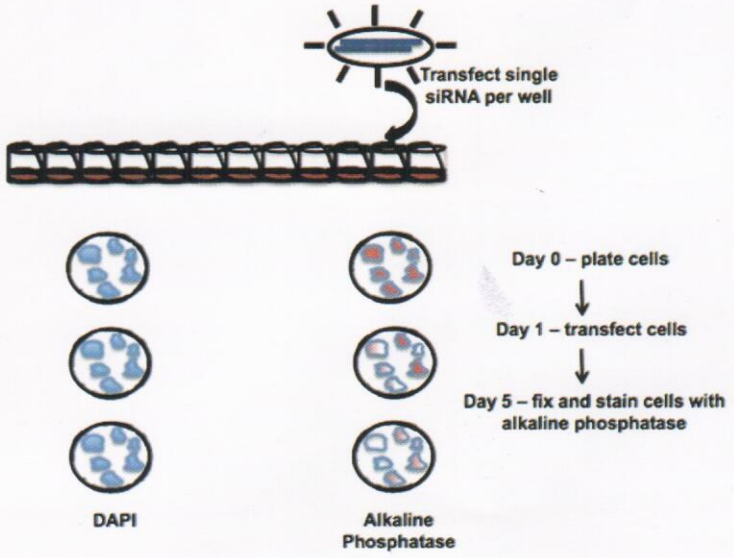


Figure 1: Schematic of siRNA screen to knockdown genes involved in endocytosis in mouse embryonic stem cells.

Further studies are ongoing to learn how cellular or vesicular transport differs in embryonic stem cells and differentiate cells. Potential application of this research is in understanding early embryonic development.

Reference:

1. Cellular reprogramming – Turning the clock back. Resonance, June 2013; 514-521 (Article).
2. Regulation of epithelial–mesenchymal and mesenchymal–epithelial transitions by microRNAs. Current Opinion i Cell Biology, 2013; 25(2): 200- 207 (Article).
3. Multiple targets of miR-302 and miR-372 promote reprogramming of human fibroblasts to induced pluripoten stem cells. Nature Biotechnology, 2011 May; 29(5): 443-448 (Article).
4. From microRNAs to targets:pathway discovery in cell fate transitions. Curr Opin Genet Dev. 2011 Aug; 21(4):498 503 (Article).

Technology Readiness: TRL A

Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development.

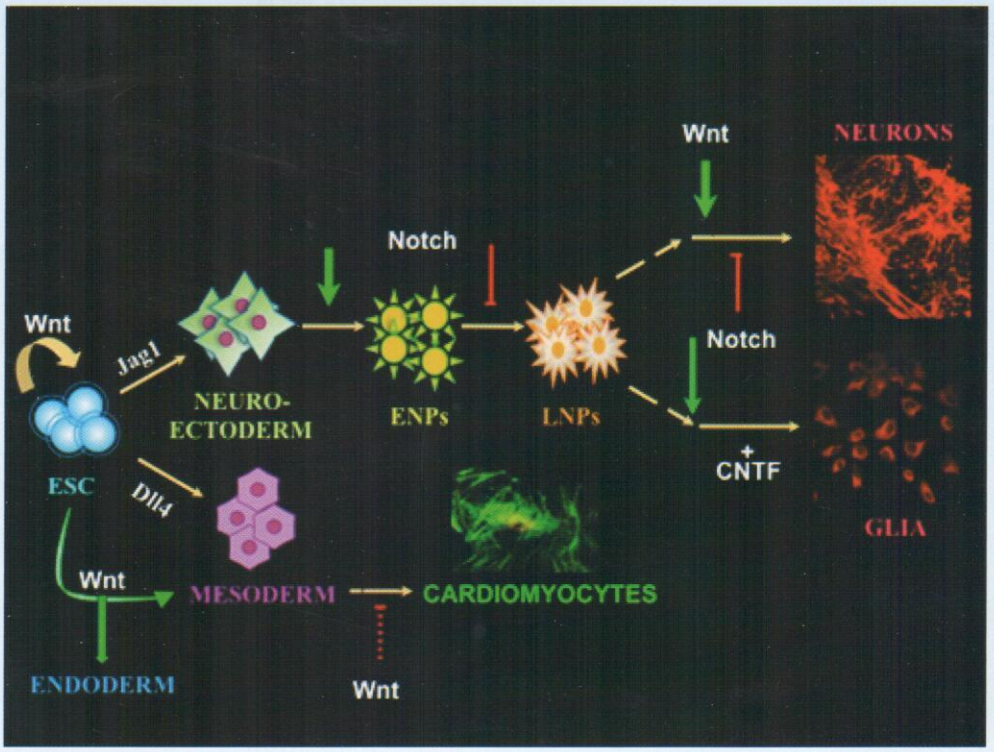
Technology Category: Stem Cells, Cell Biology

Products and Services: Biopharma, Cell Therapy

Tags: Dr. Deepa Subramanyam

Tapping into Pluripotent Differentiation Potentials of Embryonic Stem Cells

Using the pluripotent embryonic stem cells as a model system, scientists at NCCS are investigating the epigenetic factors and molecular determinants which are involved in deciding and controlling differentiation of stem cells into specific cellular lineages. They are using a live reporter based cell trapping approach for monitoring the development of embryonic stem cells into cardiac and neuronal cells.



Some of the potential applications envisioned are drug screening, pharmacogenomics, gene therapy, cell therapy and tissue engineering applications.

References:

1. Temporal and Contextual Orchestration of Cardiac Fate by WNT-BMP Synergy and Threshold, J Cell Mol Med, 2010 Aug; 14(8): 2094–2108 (Article).
2. Notch Exhibits Ligand bias and Maneuvers Stage Specific Steering of Neural Differentiation in ESCs. Cell. Biol. 2010 Apr; 30(8):1946-1957 (Article).
3. Neural induction from ES cells portrays default commitment but instructive maturation, PloS One 2007 Dec 19;2(12):e1349 (Article).

Technology Readiness Level: TRL B1

Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development and for conducting sponsored research.

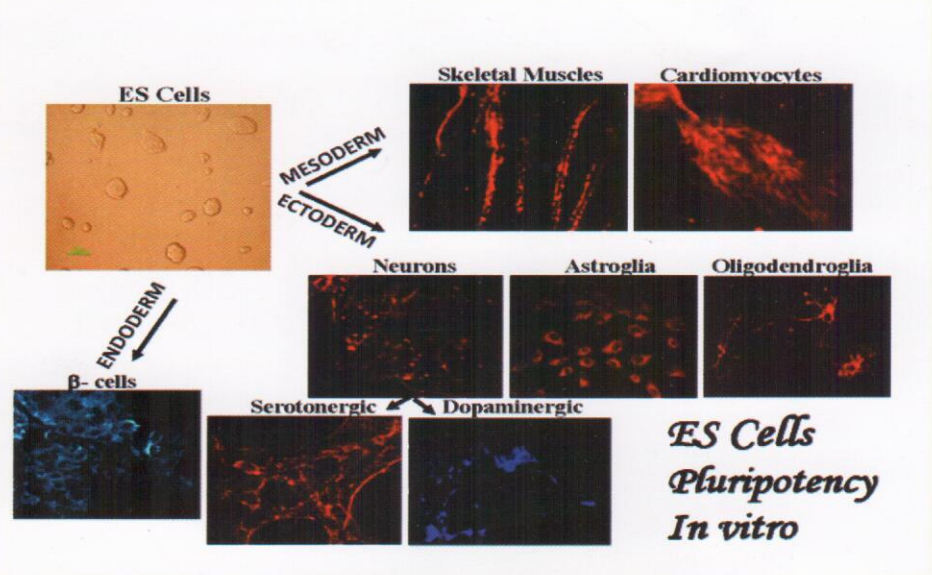
Technology Category: Genetics, Stem Cells

Product Category: Biopharma, Cell Therapy, In-vitro Platform, Regenerative Medicine

Tags: Dr. Nibedita Lenka

An Elegant Model for Studying Early Embryonic Development

Scientists at NCCS are studying the early embryonic development using embryonic stem cells derived from the blastula stage embryo. These embryonic stem cells possess unique characteristics of indefinite self renewal and pluripotency; and are capable of precisely recapitulating the early embryogenic development, thereby serving as an elegant model for studying the developmental events occurring during embryogenesis.



Potential applications of this research are in exploring biological activities in cell commitment and differentiation; maintenance and control of differentiation of embryonic stem cells into various cell types; and developing stem cells and gene therapies for fetal anomalies.

References:

1. Exploiting the power of LINE-1 retrotransposon mutagenesis for identification of genes involved in embryonic stem cell differentiation. Stem Cell Rev. 2014 Jun; 10(3): 408-416 (Article).
2. Temporal and Contextual Orchestration of Cardiac Fate by WNT-BMP Synergy and Threshold, J Cell Mol Med, 2010 Aug; 14(8): 2094–2108 (Article).
3. Notch Exhibits Ligand bias and Maneuvers Stage Specific Steering of Neural Differentiation in ESCs, Cell. Biol. 2010 Apr; 30(8):1946-1957 (Article).
4. Enhancement of Vertebrate Cardiogenesis by a Lectin from Perivitelline Fluid of Horseshoe Crab Embryo, Mol. Life Sci. 2008 Oct; 65(20): 3312-3324 (Article).
5. Neural induction from ES cells portrays default commitment but instructive maturation, PloS One 2007 Dec 19;2(12):e1349 (Article).

Technology Readiness Level: TRL B1

Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development and for conducting sponsored research

Technology Category: Genetics, Stem Cells

Product Category: Biopharma, Cell Therapy, In-vitro Platform

Tags: Dr. Nibedita Lenka

Ready-to use Cell-free Secretomes for Wound Healing

Secretomes are protein molecules that are secreted or released from cells and are actively involved in control and regulation of biological processes in the body like wound healing, skin formation etc. Scientists at NCCS have created a novel skin repair product using these secretomes. Their invention includes novel composition of secretomes for wound healing, which are derived from electro-spun nano-fiber scaffolds seeded with bone marrow and peripheral blood derived cells (BMPCs); and a method of manufacturing these secretomes into ready-to-use salves. These salves can be directly applied onto the skin repair site for accelerating the wound healing process.

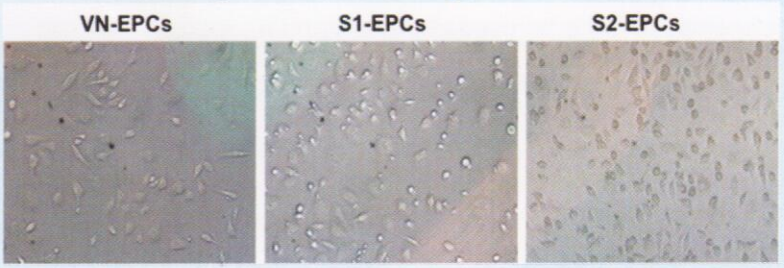


Figure 1: Migration of Endothelial Progenitor Cells (EPCs) to the wound site is key in wound healing process. S1 and S2 are two compositions of secretomes and both promote EPC proliferation and migration as compared to VN control.

This cell-free wound-healing product can be manufactured using secretomes derived from both autologous as well as allogeneic cells without any risk of rejection. It can be made into cryopreserved salves, which are reusable after thawing and have long shelf life of couple of months to half a year when stored at 4°C to -20°C respectively.

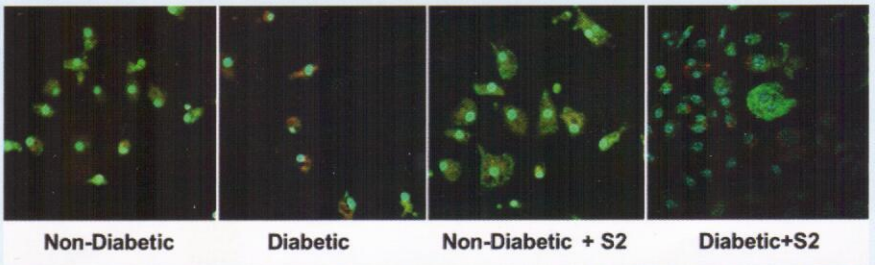


Figure 2: In-vitro study showing potency of secretomes composition (S2) in enhancing EPC proliferation in EPCs derived from diabetic as well as non-diabetic human subjects.

This novel product facilitates wound healing even in diseased conditions like Diabetes, where the skin repair function is impaired and provides a scar-free healing. It can be used for healing wounds caused by burns, cuts, scratches, surgical procedures, non-healing diabetic ulcers etc. Further, this product has been observed to establish normal glucose levels in diabetic conditions promote hair growth in injured area, aid in growth of fat tissue, and stimulate bone growth along with wound-healing in in-vivo animal models.

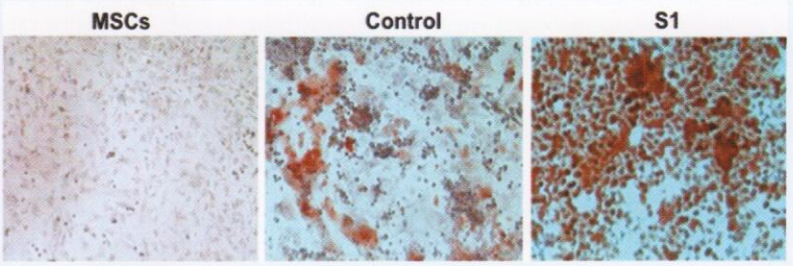


Figure 3: S1 actively promotes bone growth (osteogenesis) as compared to controls, in-vitro.

Technology Readiness: TRL B2

Technology Status: Patent filed in India.

Technology Availability: Know-how available for transfer/ co-development with partners.

Technology Category: Stem Cells

Product Category: Medical Device

Tags: Dr. Vaijayanti Kale

In-vitro Bone Marrow Niche Platform and Pre-clinical Screening Kit

An artificial bone marrow microenvironment (ABME) platform for enhancing and regulating in-vitro as well as in vivo formation of stem cells has been created by scientist at NCCS, Pune. This technology can be incorporated into high throughput and micro-fluidic devices for drug screening and in-vitro toxicology testing. Unlike CFU based toxicity assays which only quantify the number of progenitor cells, the ABME technology can determine the quality and potency of stem cells. It can also detect toxic effects of test molecules on very primitive stem cells, which are responsible for production of all cellular blood components and lineage of cells in the body. Further, this patented technology can also be used as a platform for rapid quality control testing of human cord blood cells in umbilical cord blood (UCB) banking for progressive quality monitoring of cryopreserved stem cells.

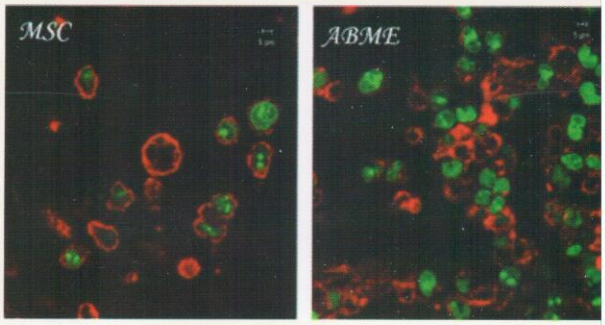


Figure 1: Infusion of ABME helps in enhanced formation of stem cell pool

Currently this technology is at lab-scale, with safety in animals established and many in-vitro studies verifying the claimed potential of the ABME platform technology have been conducted. This technology is ready for further development for use in clinical settings for various state-of-the art therapeutic applications including:

- Stimulation of endogenous stem cell pool in bone marrow failure syndromes;
- Accelerating engraftment of stem cells in Stem Cell & Bone Marrow Transplant therapies;
- Rejuvenative therapy for aging stem cells and tissues;
- Regenerative Medicine; and
- Identification of bone marrow niche defects in various disorders.

References: 1. Mimicking the functional hematopoietic stem cell niche in vitro: recapitulation of marrow physiology by hydrogel-based three-dimensional cultures of mesenchymal stromal cells. Haematologica, 2012 97(5):651-660 (Article).

2. Simvastatin improves hematopoietic stem cell engraftment by preventing irradiation- induced marrow adipogenesis and radio-protecting the niche cells. Haematologica Jan 2015 (Article).

Technology Readiness: TRL B2

Technology Status: PCT filed, Patented in Europe, USA, Canada, Brazil, Israel and China; and Granted in India, Japan, Singapore, Korea, Australia, New Zealand and ARIPO.

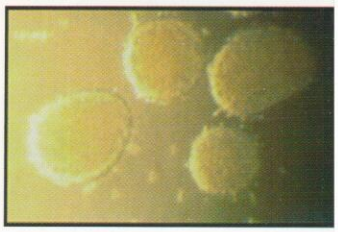
Technology Availability: Know-how Available for transfer/ co-development with partners.

Technology Category: Stem Cells

Novel Cancer Drug Screening Platform

Scientists at NCCS have developed a novel platform for screening of potential anti-tumor agents, compounds and extracts, based on 3-dimensional Multi-Cellular Spheroids derived from tumor cells and prostate apoptosis response (PAR)-4 indicator that is linked to cell death.

PAR-4 is identified to aid in drug-induced death in resistant glioma stem cells and has potential application in overcoming problems of drug resistance in cancer treatment.



References:

- Secretory prostate apoptosis response (Par)-4 sensitizes multicellularspheroids (MCS) of glioblastoma multiforme cells to tamoxifen-inducedcell death. FEBS Open Bio 5 (2015) 8–19 (Article).
- Expression and Regulation of Prostate Apoptosis Response-4 (Par-4) in Human Glioma Stem Cells in Drug-induced Apoptosis, PLoS ONE 9(2): e88505, doi:10.1371/journal.pone.0088505 (Article).

Technology Readiness: TRL B1

Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development with partners.

Technology Category: Cancer Biology, Stem Cells

Product Category: In-vitro Platform, Biopharma

Tags: Dr. Padma Shastry

Platform for Identifying Heterogeneity of Cancer Cells

Cancer cells remaining undetected in the body following treatment regimens can cause recurrence. Recent studies suggest that this debilitating issue could be a result of heterogeneous characteristics of cancer cells; thus residual cells are likely to be drug resistant and/or not targeted by the initial treatment. Scientists at NCCS believe that identifying the heterogeneity of the cancer cells and providing a targeted therapy specific for different cell fractions can resolve this issue. Consequently, they have developed a novel flow cytometry-based tumor deconstruction platform that operates by simultaneous identification, quantification and analysis of components of cancer stem cell hierarchies, genetically instable clones and differentially cycling populations within a tumor, all of which represent differential capabilities in a tumor.

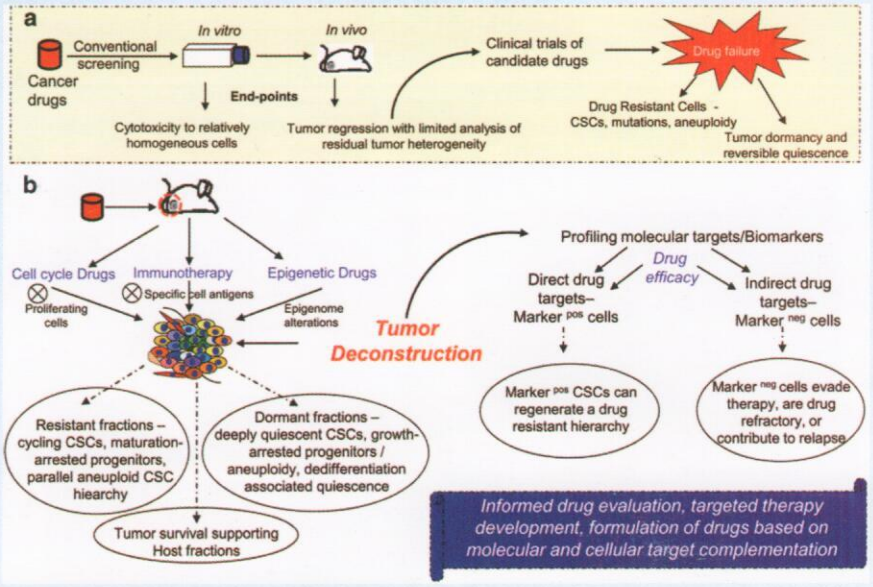


Figure 1: Overview of conventional vs tumor deconstruction-based drug evaluation. (a) Conventional drug screening pipeline often results in incomplete evaluation of efficacy. (b) Tumor deconstruction platform based evaluation presents an informed approach to drug screening, formulation and targeted therapy.

This patented platform technology redefines the drug discovery methodology for cancer drugs. It can be used for multiple applications in cancer treatment including:

- Drug screening
- Development of personalized cancer therapy,
- Formulation of new combination regimens; and
- Drug repositioning.

References:

1. Cancer stem cells and aneuploid populations within developing tumors are the major determinants of tumor dormancy, Cancer Res 2009; 69:9245–1953(Article).
2. A tumor deconstruction platform identifies definitive end-points in the evaluation of drug responses, Oncogene, 27 April 2015 (Article).
3. Tumour heterogeneity and cancer cell plasticity, Nature 2013; 501:328-37 (Article).
4. Therapeutic Implications of Cellular Heterogeneity and Plasticity in Breast Cancer, Cell Stem Cell 2015; 17:260-71 (Article).

Technology Readiness: TRL B2

Technology Status: Patented in India and PCT filed.

Technology Availability: Technology available for co-development with partners.

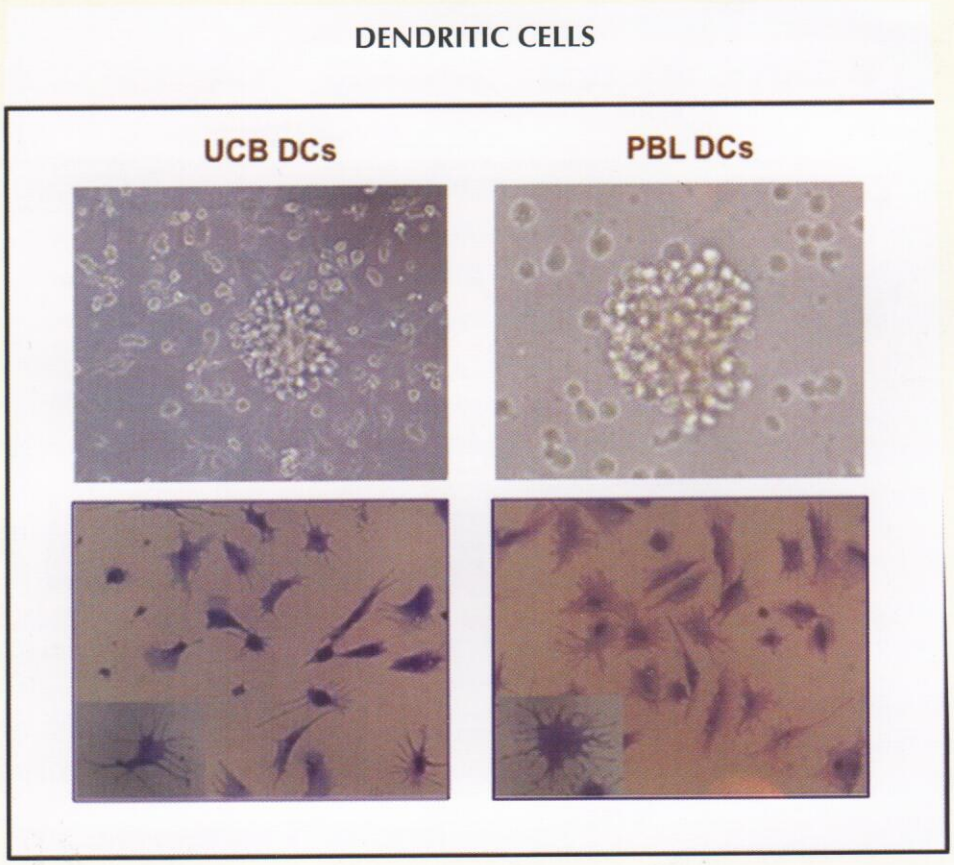
Technology Category: Cancer Biology, Stem Cells

Product Category: In-vitro Platform, Biopharma

Tags: Dr. Sharmila Bapat

Dendritic Cells for Vaccines in Cancer Immunotherapy

Scientists at NCCS have developed a novel two-step method for large-scale generation of mature, functional Dendritic Cells (DC) from both autologous and allogeneic sources. This technology will aid in development of dendritic cell based vaccines for cancer immunotherapy. Unlike conventional method of generating DCs, which only uses peripheral blood (PBL) monocytes, this technology enables use of various sources including umbilical cord blood (UCB), UCB mononuclear cells and PBL monocytes.



References:

1. A simple two-step culture system for the large-scale generation of mature and functional dendritic cells from umbilical cord blood CD34+ cells, Transfusion 2009; 49:2109-2121 (Article).
2. Exogenous Addition of Arachidonic Acid to the Culture Media Enhances the Functionality of Dendritic Cells for Their Possible Use in Cancer Immunotherapy, PlosOne Nov 2014, Vol 9:11 (Article).
3. Umbilical cord blood-derived CD11c+ dendritic cells could serve as an alternative allogeneic source of dendritic cells for cancer immunotherapy, Stem Cell Research & Therapy (2015) 6:184 (Article).
4. A large number of mature and functional dendritic cells can be efficiently generated from umbilical cord blood–derived mononuclear cells by a simple two-step culture method, Transfusion 2010, 50:2413-2423 (Article).

Technology Readiness: TRL B1

Technology Status: Proprietary know-how

Technology Availability: Know-how available for transfer and/or co-development with partners.

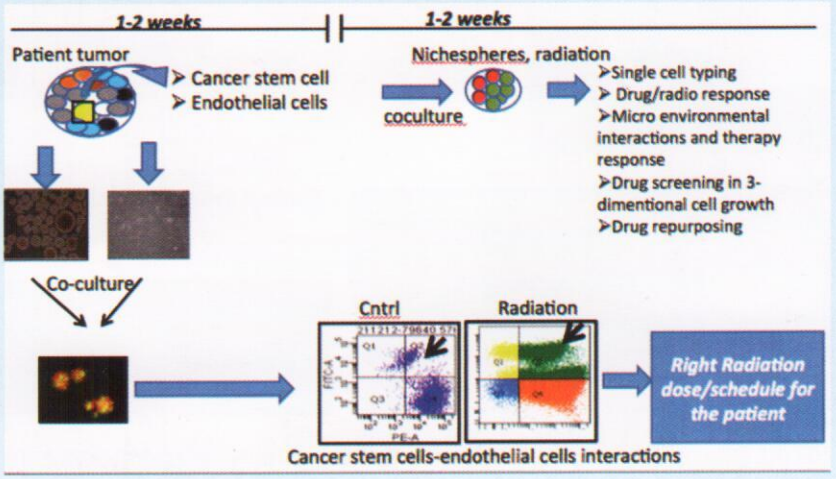
Technology Category: Stem Cells

Product Category: Bio-Pharma, Cell Therapy

Tags: Dr. Lalita Limaye

Self-propagating Glioblastoma Model in a Petri-dish

Scientists at NCCS have developed a novel tumor cell co-culture protocol and system for understanding the role of glioma stem cells (GSC) in mediating tumor functions in Glioblastoma (GBM). GBM is a highly invasive malignant tumor with high incidence of therapy resistance and tumor relapse after surgery. This relapse is due to repopulation of tumor by GSCs and is characterized by existence of GSCs in close proximity with endothelial cells (EC). In order to study the GSC-EC interactions, this innovative self-propagating GSC-EC co-culture system was developed as a highly replicating in-vitro model of GBM. This novel co-culture system is a homogenous system as both GSCs and ECs are derived from same tumor tissue and has the flexibility to be used interchangeably as 2-dimensional adherent monolayers or as 3-dimensional self-propagating neurospheres without loss of any inherent properties of the GSCs.



This patented co-culture system uses a unique flow cytometry based high throughput analysis platform termed as IMAGES (Identification and Multi parametric analysis of GICs-HuGEC subpopulations in glioma) for understanding and quantifying GSC-EC interaction. This analysis method facilitates functional identification of multiple cell populations and understanding of novel niche specific signalling mechanisms in the GBM tumor.

Potential applications include:

- Studying cell-cell interactions,
- Understanding niche specific signaling interactions between GSCs and ECs
- Assessing effects of radio/ chemo therapy on GSCs under perivascular niche conditions and ECs under angiogenic conditions,
- In-vitro and in-vivo identification of inhibitory molecules of GSCs associated with endothelial niche,
- Screening of novel drug candidates in 3-dimensional cell culture,
- Single cell typing,
- Developing personalized GBM therapy and
- Drug Repurposing.

Technology Readiness: TRL B1(In-vitro efficacy/ results demonstrated)

Technology Status: Patents filed in India.

Technology Availability: Know-how available for transfer/ co-development with partners.

Technology Category: Cancer Biology, Stem Cells

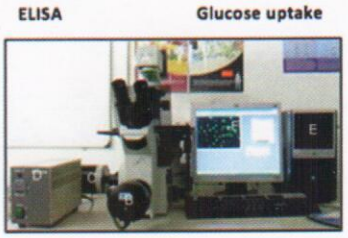
Product Category: Bio-Pharma, In-vitro Platform

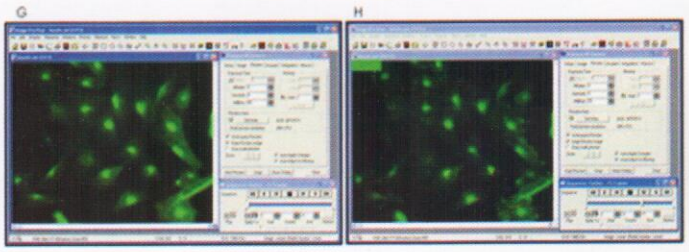
Tags: Dr. Anjali Shiras

Glut-4 Activity based Anti-Diabetic Drug Screening System

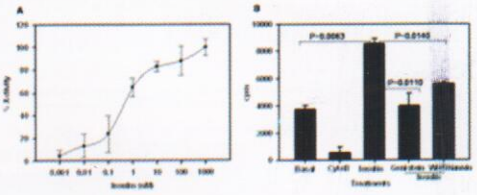
Scientists at NCCS have developed an in-vitro anti-diabetic drug screening system based on glucose transporter 4 (GLUT4) activity in a novel cell line (CHO-HIRc-mycGLUT4eGFP). Using this system, GLUT4 translocation under stimulation can be visualized by live cell imaging and captured real-time for qualitative and quantitative analysis of GLUT4 on the cell membrane.

Method 1: Live cell imaging and analysis

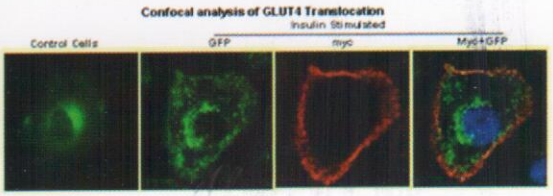




Method 2: ELISA and radiolabeled glucose uptake



Method 3: Confocal microscopy analysis



This real time, visual, cell-based, qualitative and quantitative system can be used for screening large number of natural products, synthetic compounds or derived products for Glut4 translocation modulation (or anti-diabetic) activity.

References:

- Real Time qualitative and quantitative GLUT4 translocation assay,*Methods in Enzymology:* Volume:505, 2012 (Article).
- Demonstration of a visual cell-based assay for screening GLUT4 translocation modulators in real time, *Journal of Biosciences,* 2010, 35: 525-31 (Article).
- The hypoglycaemic activity of fenugreek seed extract is mediated through the stimulation of an insulin signaling pathway, *British Journal of Pharmacology,* 2005, 146:41-45 (Article).

Technology Readiness: TRL B1 (In-vitro efficacy/ results demonstrated)

Technology Status: Proprietary know-how

Technology Availability: Know-how available for transfer/ co-development with partners.

Technology Category: Metabolic Diseases

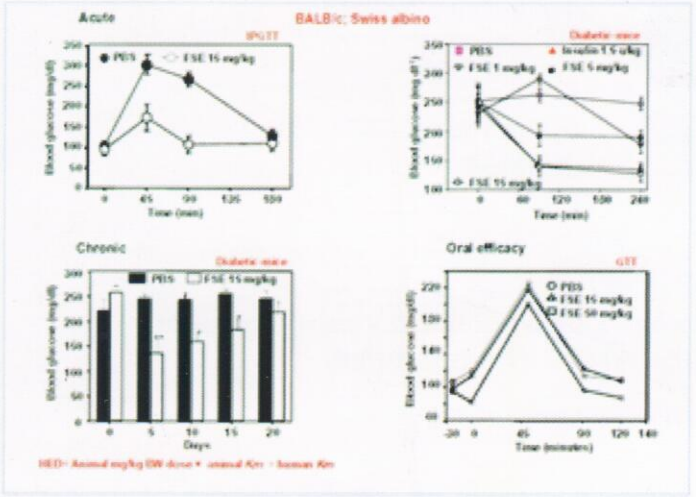
Product Category: In-vitro Platform

Tags: Dr. Manoj Kumar Bhat

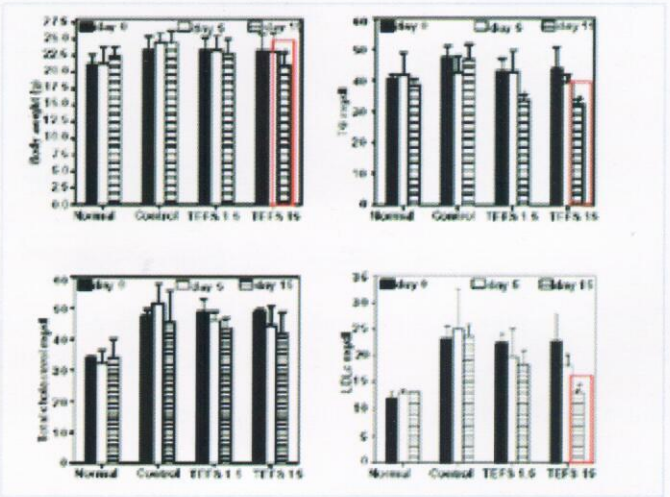
Herbal Extracts for Metabolic Diseases in ready-to-market Formulation

Fenugreek seeds are well known in Indian traditional medicine for use in the management of Diabetes and Obesity. However, the therapeutic dose of 25-50 g/day of Fenugreek seeds is not feasible for human consumption due to its bitter taste and pungent odour. Scientists at NCCS have designed and patented novel methods for preparing aqueous extracts of fenugreek seeds that would be reasonably convenient for human consumption. These extracts exhibit glucose and lipid lowering and weight lowering effects in animals at human equivalent dose of 75-150 mg/day. Preclinical studies have been performed to establish the safety of the extracts.

In vivo hypoglycaemic studies



In vivo hypolipidemic studies



References:

1. The hypoglycaemic activity of fenugreek seed extract is mediated through the stimulation of an insulin signaling pathway. *British Journal of Pharmacology*, 2005, 146:41-45 (Article).
2. Hypoglycemic effect of dialyzed fenugreek seeds extract is sustainable and is mediated, in part, by the activation of hepatic enzymes. *Phytotherapy Research*, 2008, 22:500-525 (Article).
3. Hypolipidemic effect of fenugreek seeds is mediated through inhibition of fat accumulation and upregulation of LDL receptor. *Obesity*, 2010, 18:667-674 (Article).

Technology Readiness: TRL B3

Technology Status: PCT Filed (PCT/IN/2008/000877) Patents filed in India and Granted in USA (US8865237) and EU (2,323,676).

Technology Availability: Know-how available for transfer/ co-development with partners.

Uploads: Scientist-pitch-format Presentation Dr MK Bhat 13-10-2015

Technology Category: Metabolic Diseases

Product Category: Nutraceutical

Tags: Dr. Manoj Kumar Bhat

Structure Function Analysis of Proteins in M. Tuberculosis

Exploiting the state-of-art technology for increasing the knowledge base on micro organisms, scientists at NCCS are studying the structure and functional correlation of proteins derived from *Mycobacterium tuberculosis*. Using crystallography and *in-silico* methods, they are analyzing the heat shock responses mediated by proteins such as GroEL chaperonin, oxidative stress induced redox reactions and enzymatic reaction mediated electron transport mechanisms in the cell.

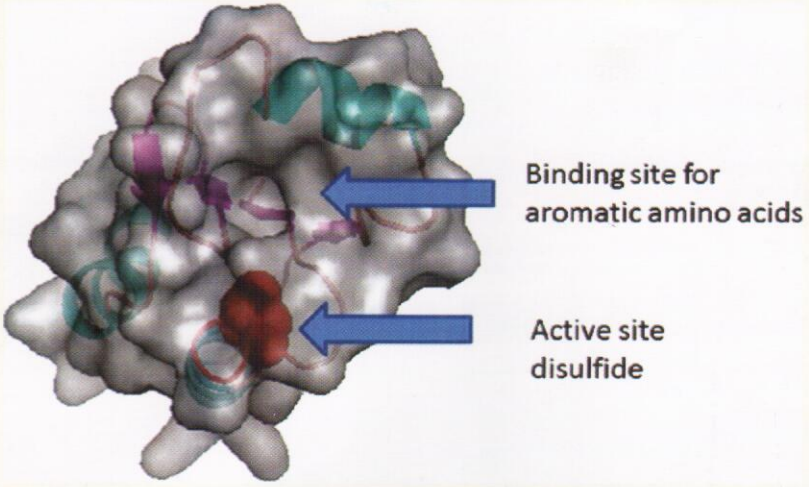


Figure 1: Crystal structure of NrdH from *M. tuberculosis*, refined to a crystallographic R factor of 14.02% (Rfree = 15.53%) at 0.87 Å resolution.

Potential application of this research is for developing better therapeutics for tuberculosis.

Reference:

1. GroEL2 OF *tuberculosis* Reveals The Importance Of Structural Pliability In Chaperonin Function, J Bacteriol. 2015 Nov 9. pii: JB.00844-15 (Article).
2. The Crystal Structure of *Mycobacterium tuberculosis*NrdH at 0.87 Å Suggests a Possible Mode of Its Activity, Biochemistry 2013, 52, 4056–4065 (Article).
3. Identification of the INO1 Gene of *Mycobacterium tuberculosis* H37Rv Reveals a Novel Class of Inositol-1-phosphate Synthase Enzyme, J. Mol. Biol. (1999) 291, 531-536 (Article).

Technology Readiness: TRL B

Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development.

Technology Category: Microbial biology

Products and Services: Biopharma

Tags: Dr. Shekhar Mande

Computational Method for Mapping Protein Interactions

In order to assimilate large data sets generated by high throughput experiments, scientists at NCCS have developed a novel algorithm solving an NP (non-deterministic polynomial) hard problem and have used it effectively for mapping potential protein interactions. This computational approach can be used for studying organisms at systems level by integrating high throughput differential expression data and information on regulatory networks. This method can also be used to infer functional linkages and constructing genome-wide interactomes.

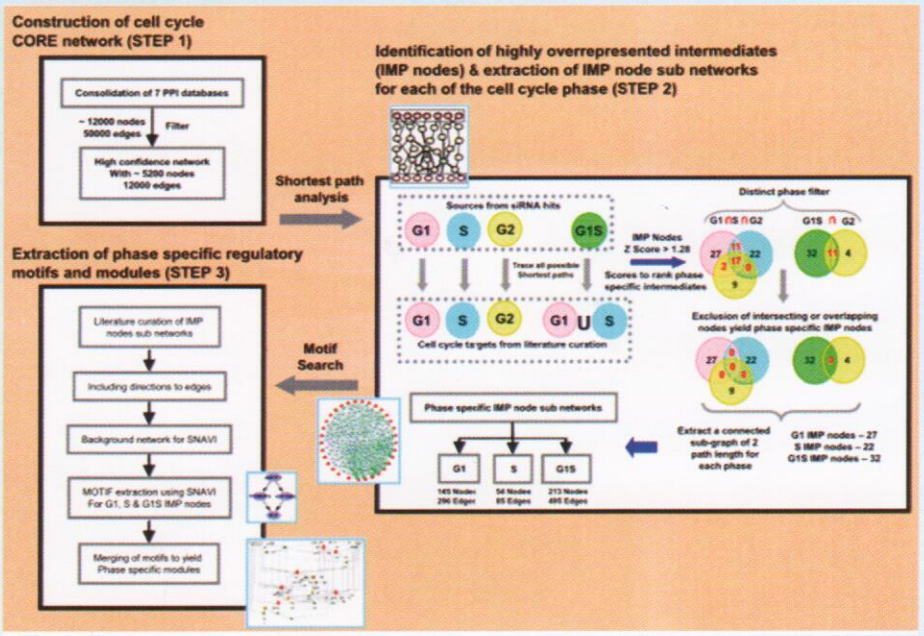


Figure 1: A systems approach for analysis of cell cycle regulation and the identification of phase-specific regulatory modules.

Some of the applications of this algorithm include mapping dynamics of protein-protein interaction namely signalling between protein kinases and transcription factors, identifying substrate for kinases, predicting transcription factors responsible for gene expression and identifying potential active sites of proteins. A web-based server PAR-3D has also been created for predicting the active site of proteins.

Reference:

1. Understanding Communication Signals during Mycobacterial Latency through Predicted Genome-Wide Protein Interactions and Boolean Modeling, PLoS One. 2012;7(3):e33893 (Article).
2. Delineation of key regulatory elements identifies points of vulnerability in the mitogen-activated signaling network, *Genome Res.* 2011 21: 2067-2081 (Article).
3. Exploiting 3D structural templates for detection of metal-binding sites in protein structures, Proteins 2008;70:1206–1218 (Article).
4. PAR-3D: a server to predict protein active site residues, Nucleic Acids Research, 2007, Vol. 35, Web Server issue W503–W505 (Article).

Technology Readiness: TRL B

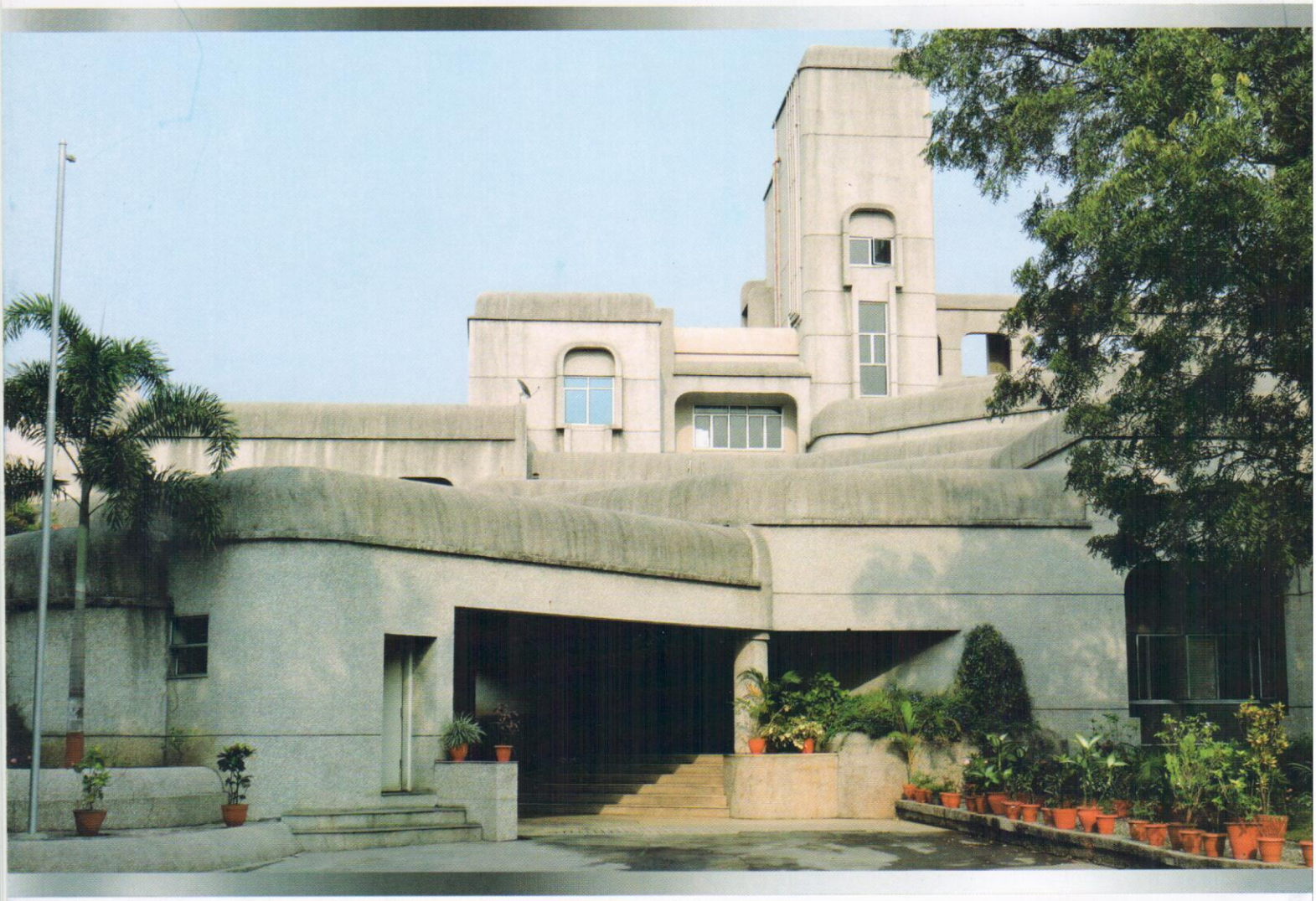
Technology Status: Proprietary Know-how

Technology Availability: Know-how available for co-development.

Technology Category: Computational biology

Products and Services: Biopharma

Tags: Dr. Shekhar Mande



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