

## **Technologies developed at the Institute for Stem Cell Science and Regenerative Medicine (DBT-inStem), Bengaluru (Until Dec 2023)**

### **1. Blue fluorescent protein monomers and the uses thereof**

**Summary:** Bilin pigments, when associated with proteins, exhibit a wide variety of photophysical properties, i.e., intense fluorescence, photochemical interconversions, and radiation-less de-excitation. The monomeric variants of Sandercyanin fluorescent protein (SFP) including those monomeric SFP variants set forth in SEQ ID NO:2-6 and SFP variants with increased brightness have identified. The methods of making and using fluorescent probes comprising such monomeric variants, where the fluorescent probes have specificity for desired targets have been developed.

*(Developed in 2015* by S. Ramaswamy lab at inStem in collaboration with Wayne Schaefer at Wisys Technology Foundation, Inc.)

**Status of the technology:** The patent application has been filed, and this technology is ready to license to biotech companies.

### **2. Small molecules for inhibiting for protein-protein interactions**

**Summary:** A series of small molecules have been developed to disrupt protein-protein interactions making undruggable targets druggable. These molecules may be used as anticancer therapeutics.

*(Developed in 2017* by Ashok Venkitaraman and the team Program of Chemical Biology and Therapeutics (PCBT) at inStem)

**Status of the technology:** The patent application has been filed, and this technology is ready to license to biotech companies.

### **3. Prophylactic technologies to neutralize pesticides to protect farmer**

**Summary:** Agricultural and industrial workers are repeatedly exposed to pesticides in the fields or during manufacture. Mainly, organophosphate pesticides are acetylcholinesterase (AChE) inhibitors. AChE is found in the nervous system of humans, and its inhibition can lead to the accumulation of acetylcholine, subsequently resulting in neurological disorders, suffocation, paralysis, and death in severe cases.

Two categories of first-in-class technologies were developed. 1) Topical gels to apply on the skin to deactivate pesticides, and 2) protective cloth which can deactivate pesticides. Both technologies may have a beneficial effect on protecting farmers.

*(Developed in 2018* by Praveen Kumar Vemula lab at inStem)

**Status of the technology:** Patent applications have been filed based on these technologies. Recently, these patents have been licensed and transferred to Sepio Health Pvt. Ltd.

### **4. New Chemical Entities as potential drugs for the treatment of inflammatory bowel diseases**

**Summary:** A series of small molecules, which were inspired by gut microbial metabolites, have been developed. These molecules have the ability to restore the epithelial and endothelial leaky barriers through overexpressing the tight junctional proteins. Additionally, these molecules have efficient anti-inflammatory properties. Therefore, cumulatively these molecules are efficient in the treatment of inflammatory bowel diseases such as ulcerative colitis and Crohn's disease.

*(Developed in 2018 by Praveen Kumar Vemula lab at inStem in collaboration with Venkatakrishna Rao Jala, from University of Louisville, USA)*

**Status of the technology:** Patent applications have been filed based on these technologies. Recently, these patents have been licensed to Artus Therapeutics Inc.

## **5. Fluorescence probes for detecting the protein activity**

**Summary:** A wide range of small molecules-based fluorescence probes have been developed which can measure the intracellular protein activity.

*(Developed in 2018 by Akash Gulyani lab at inStem)*

**Status of the technology:** The patent application has been filed, and this technology is ready to license to biotech companies.

## **6. Bone Morphogenetic Protein (BMP) inhibitor molecule analogues as a disease modifying therapy for Osteoarthritis**

**Summary:** A new role of BMP inhibitor to prevent/treat osteoarthritis has been identified. Additionally, a novel hydrogel that can be injected into the joint and have a sustained release of a BMP inhibitor has been developed.

*(Developed in 2019 by Praveen Kumar Vemula lab at inStem in collaboration with Amitabha Bandyopadhyay lab at Indian Institute of Technology, Kanpur)*

**Status of the technology:** A provisional patent and PCT applications have been filed based on this technology. This technology is ready to license for biotech companies.

## **7. Microneedles for painless injections**

**Summary:** A specially designed microneedles-containing novel adaptor device has been developed, which will enable us to administer drugs without causing pain even in case of repeated injections. This technology will be highly beneficial for diabetes patients and paediatric injections.

*(Developed in 2019 by Praveen Kumar Vemula lab at inStem in collaboration with Manjunatha Nayak & Dinesh Narasimhaiah Subramanyam labs at Indian Institute of Science, Bengaluru, and Joseph Mathew lab at Post Graduate Institute of Medical Education & Research, Chandigarh)*

**Status of the technology:** The patent application has been filed, and this technology is ready to license to biotech companies.

## **8. Insect venom derived anti-aging peptide for dermal application**

**Summary:** A non-toxic, anti-inflammatory molecule from insect venom was known to have cosmetic benefits for human skin, particularly in improving aging skin. Insect venom products have been isolated and used to formulate a dermal cream. The topical application of the cream reduces wrinkle formation associated with aging by aiding in improving the elasticity of the skin.

*(Developed in 2019 by S. Ramaswamy lab at inStem)*

**Status of the technology:** This technology is being licensed to a Bangalore-based biotech company. Negotiations are in progress.

## **9. Novel markers for microtubules**

**Summary:** A new cell line has been made to screen potential small molecules that can influence microtubules.

*(Developed in 2020 by Minajuddin Sirajuddin lab at inStem)*

**Status of the technology:** This technology has been licensed to a biotech company.

## **10. A biosensor, a kit and application thereof**

**Summary:** A RNA-based diagnosis kit has been developed to identify pathogens, including SARS-CoV-2. This is a naked eye detection kit.

*(Developed in 2020 by Akash Gulyani lab (at inStem and University of Hyderabad) and Arati Ramesh lab (National Centre for Biological Sciences))*

**Status of the technology:** The patent application has been filed, and this technology is ready to license to biotech companies.

## **11. Germicidal fabric technology to create antiviral/antibacterial masks, PPEs and cloths**

**Summary:** A novel germicidal molecules have been developed that can be immobilized on the fabric to develop germicidal fabric. Germicidal fabric has the ability to deactivate a wide spectrum of bacteria and enveloped viruses upon contact. This technology could have a huge impact on reducing the risk of spread of infection.

*(Developed in 2020 by Praveen Kumar Vemula lab at inStem).*

**Status of the technology:** This technology has been licensed to a medical textile company, Color Threads Pvt. Ltd. Based on this technology, a series antiviral products, including reusable face masks, apparel, travel wear and gym wear have been commercialized.

## 12. Robust gene editing techniques for treatment of major hemoglobin disorders

**Summary:** Targeted genome editing approach to reactivate developmentally silent gamma globin for the treatment of patients with sickle cell disease and  $\beta$ -thalassemia, without causing any major genetic rearrangement.

**Application:** Gene therapy of thalassemia major and sickle cell disease

(Developed at the Centre for Stem Cell Research, Vellore, a Centre of inStem)

**Status of the technology:** The technology is at preclinical development stage. A patent with the title "COMPOSITIONS AND METHODS FOR REACTIVATING DEVELOPMENTALLY SILENT GENES" (*Application number: 202041020165*) has been filed and suitable licensing to be done based on the results of clinical trial.

## 13. Compact liposomal vehicle for delivery of large molecules

**Summary:** Lipid nanoparticle system doped with plant chemical armoury demonstrated efficient delivery of CRISPR components.

**Application:** Lipid nanoparticle system is as efficient as delivering CRISPR plasmids when compared to commercial control Lipofectamine 3000. The nanoparticle system can be used to deliver multiple components of the CRISPR system such as CRISPR plasmids, sgRNA, Cas9 mRNA and Cas9 protein with one lipid nanoparticle system.

(Developed at the Centre for Stem Cell Research, Vellore, a Centre of inStem)

**Status of the technology:** The technology has been developed at preclinical stage. A patent with the title "COMPACT LIPOSOMAL VEHICLE FOR DELIVERY OF LARGE MOLECULES" (*Application number: 202041010160*) has been filed.

## 14. Liver directed lipid nanoparticles system for nucleic acid delivery

**Summary:** Lipid nanoparticle mediated nucleic acid delivery can overcome the challenges associated with viral vectors such as scale-up and immunogenicity which limit their application.

**Application:** Non-viral vector-based gene delivery method for gene therapy applications.

(Developed at the Centre for Stem Cell Research, Vellore, a Centre of inStem)

**Status of the technology:** The technology has been tested for therapeutic efficiency in animal models. A patent with the title "FORMULATION, LIPID COMPOUNDS AND METHODS THEREOF" (*Application number:202141033290*) has been filed.

## 15. Formulations for enriching gene modified HPSCs for gene therapy

**Summary:** A formulation for ex vivo culture of HSPCs that enriches the frequency of gene-modified long-term hematopoietic stem cells for transplantation.

**Application:** Hematopoietic stem cell gene therapy applications involving both lentiviral vector and gene editing.

(Developed at the Centre for Stem Cell Research, Vellore, a Centre of inStem)

**Status of the technology:** The formulation for *ex vivo* expansion of CD34 expressing hematopoietic stem and progenitor cells (HSPCs) in a biological sample is complete and has been tested on NGS mouse. A patent with the title "A COCKTAIL FORMULATION FOR SELECTIVE ENRICHMENT OF GENE-MODIFIED CELLS" (*Application number:202141000921*) has been filed.

#### **16. Products and compositions for the treatment of viral infections.**

**Summary:** A novel compositions of plant extracts and small molecules were developed that can potentially treat viral infections.

(*Developed in Aug 2022* by Colin Jamora lab at inStem)

**Status of the technology:** Based on this technology, Indian Provisional Patent application has been filed (application number: 202211048425), subsequently a PCT application has been filed (PCT/IN2023/050806).

#### **17. Citric acid cycle and lactate transport inhibitors for prevention and/or treatment of skin disorders**

**Summary:** Small molecular inhibitors were found to inhibit citric acid cycle and lactate transports. This intervention could be used for preventing or treating skin disorders.

(*Developed in Dec 2022* by Srikala Raghavan lab at inStem)

**Status of the technology:** Based on this technology, a PCT application has been filed (PCT/IB2022/061996).

#### **18. A nucleo-cytoplasmic form of protein lysine methyltransferase – EHMT1N/C**

**Summary:** A novel form of EHMT1 was identified, and discovered that inhibition of this novel form could be used as potential antiviral therapy.

(*Developed in Mar 2023* by Shravanti Rampalli Deshpande lab at inStem)

**Status of the technology:** Based on this technology, Indian Provisional Patent application has been filed (application number: 202341043660).

#### **19. Scaffolds for selective scavenging of storage lesion from biological material**

**Summary:** A novel nanofibrous scaffolds based technology has been developed to selectively scavenge damage associated molecular patterns from stored blood to enhance the quality and shelf-life of stored blood. Using this technology, potentially novel blood bags can be manufactured

(*Developed in Mar 2023* by Praveen Kumar Vemula lab at inStem).

**Status of the technology:** Based on this technology, a PCT application has been filed (PCT/IB2023/052628). To commercialize this technology, an inStem spin-off company, CaptureBio Pvt Ltd being formed. Methods license this technology are being discussed.

## **20. Therapeutic agents for enhancing epithelial and/or endothelial barrier function**

**Summary:** Through systematic medicinal chemistry, new chemical entities were developed that can enhance epithelial and/or endothelial barrier function. This technology will have huge impact on treating barrier dysfunction associated diseases, such as Inflammatory Bowel Diseases.

(This technology jointly *developed in Mar 2023* by Praveen Kumar Vemula lab at inStem and Artus Therapeutics, Inc.).

**Status of the technology:** Based on this technology, a PCT application has been filed (PCT/US2023/077699). This technology has been licensed to Artus Therapeutics, a pharma startup company, which is further conducting clinical development to take to the human clinical trials.