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Biotechnology Industry Research Assistance Council (BIRAC)
(A Govt. of India Enterprise)

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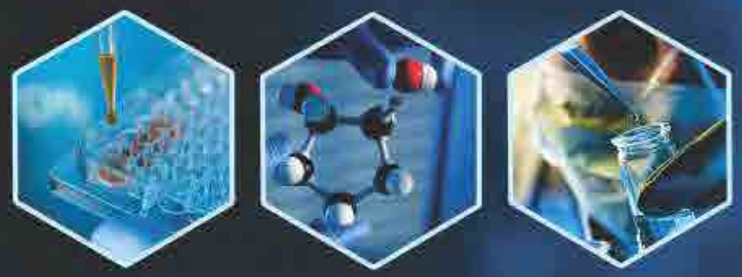
BIOTECHNOLOGY INNOVATION *eco-system*

STRATEGIZING THE NEXT LEAP



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Grand Challenges India

Way Forward

Foreword

Over the last four years, since its inception, BIRAC has been at the forefront of a mission to transform the innovative index of the country especially in the exciting fields of biotechnology, life sciences and its related areas such as medtech and agriculture. Through an optimal mix of funding, infrastructure support, collaborative platforms and mentorship it has aimed at building the capabilities and capacities of the country to conduct cutting edge R&D in the aforementioned areas.

One of the main outcome of this fast paced activity of BIRAC is that it has led to creation of a vibrant bio-entrepreneurial culture where a new 'can do'approach has taken roots. BIRAC has contributed and leveraged several other national programmes such as 'Make in India', 'StartupIndia'andSwachh Bharat Mission. The ecosystem, therefore, is now primed to take the next leap and BIRAC would aim to play a catalytic role in this transformation.

I am pleased that through this Compendium, as in the previous years, details of the Bio-innovations which are supported by BIRAC are highlighted. The focus is on innovative products that are extremely affordable thereby increasing the accessibility of new products to all Indians especially impacting the disadvantaged sections of our nation- for better health, improved nutrition and cleaner energy and environment. We must remember that innovative products from India will also positively impact the wider world.

I would like to wish all our Innovators good luck for their future endeavours.

Prof. K. Vijay Raghavan
Secretary DBT and Chairman BIRAC

Preface

BIRAC, in a short span of time, has been able to contribute to the rapid positive changes that have taken place in the Indian Biotechnology landscape- spurring a growth of innovation driven R&D, through its pioneering programmes, at every level of the ecosystem including biotech startups, SMEs and research institutes.

Our programmes such as BIG and SPARSH have immensely contributed to the change in the biotech entrepreneurship milieu and have inspired many young minds to be entrepreneurial. Our dual contribution programmes such as SBIRI and BIPP have set a high benchmark in the country for delivery of PPP programmes and they continue to impact the larger ecosystem. We have supported nearly 600 projects, 500 Entrepreneurs, Startups, SMEs and Biotech Industries. Additionally, we have been able to create 20 world class incubators, 5 pre-incubation centres at universities (called University Innovation Cluster), a regional innovation centre in partnership with IKP Knowledge Park (called BIRAC Regional Innovation Centre-BRIC) and numerous platforms and workshops that bring the stakeholders together. We also continue to build new partnerships such as with WISH Foundation India, Nesta UK, Tekes Finland and HIA Australia besides strengthening our partnership with DeitY, Government of India, ICMR India, Bill & Melinda Gates Foundation, Wellcome Trust and CEFIPRA. The outcomeof our efforts has been 35 products in the market, more than hundred IPs generated and many other tangible benefits- as reflected in this Compendium.

BIRAC's continued efforts and its multiple approaches have grown the community of biotech/life sciences and medtech in India. We can sense that a stage has reached from where we can now strategize for the next leap.

The present edition of the Compendium showcases our achievements, the work done by our Innovators that bring excellent and cutting edge solutions to challenges that we face nationally and globally. We congratulate our Innovators for their pioneering work and wish them greater success in their endeavours. We will continue to work with all in the community so that Indian Biotechnology can now rapidly scale and take the leap to the next level.

Dr. Renu Swarup
Senior Adviser, DBT and MD, BIRAC

About BIRAC

Biotechnology Industry Research Assistance Council (BIRAC) is a not-for-profit Section 8, Schedule B, Public Sector Enterprise, set up by Department of Biotechnology (DBT), Government of India as an Interface Agency to strengthen and empower the emerging Biotech enterprise to undertake strategic research and innovation, addressing nationally relevant product development needs.

BIRAC is a new industry-academia interface and implements its mandate through a wide range of impact initiatives, be it providing access to risk capital through targeted funding, technology transfer, IP management and handholding schemes that help bring innovation excellence to the biotech firms and make them globally competitive. In its three years of existence, BIRAC has initiated several schemes, networks and platforms that help to bridge the existing gaps in the industry-academia Innovation research and facilitate novel, high quality affordable products development through cutting edge technologies. BIRAC has initiated partnerships with several national and global partners to collaborate and deliver the salient features of its mandate.

Vision

"To Stimulate, foster and enhance the strategic research and innovation capabilities of the Indian biotech industry, particularly start-ups and SME's, for creation of affordable products addressing the needs of the largest section of society"

Key Strategies

- Foster innovation and entrepreneurship
- Promote affordable innovation in key social sectors
- Empowerment of start-ups & small and medium enterprises
- Contribute through partners for capability enhancement and diffusion of innovation
- Enable commercialization of discovery
- Ensure global competitiveness of Indian enterprises

BIRAC's Core Values

- Integrity
- Transparency
- Team work
- Excellence
- Commitment

BIRAC's aim is to play a transformative and catalytic role in building a US$ 100 billion Indian bioeconomy. We believe that the agents of change for building the Indian bioeconomy would be biotech start-ups & SMEs & hence our focus is on raising their capabilities

Thinking Aloud: Strategizing for the Next Leap

Introduction

In 2012, BIRAP- the stand alone specialised programme of the Department of Biotechnology, was spun out as a not for profit (Section 8) public sector unit to enable, empower and catalyse the transformation of a innovation driven Indian biotech ecosystem. In the last four years, through sustained effort and deep commitment it has helped to grow the ecosystem along with its partners- both national and international. The question that floats now is how do we strategize such that we- the biotech ecosystem of the nation- can take the next leap. Our thoughts in this line emerge out of the dynamism that we have seen in the ecosystem. Our conviction that the next leap is possible is borne out of several factors that are the key ingredients for taking the next leap which are outlined in this introduction.

Ingredients for the 'Next Leap':

A. A large base of Bio-innovations: Cutting edge, Affordable and Best in Class

Over the last decade and especially in the last 4 years, BIRAC has been able to create a substantial base- that is not only broad but also deep- for innovation research in the country. This is delivered through pioneering programmes such as Biotechnology Ignition Grant (BIG), Small Business Innovation Research Initiative (SBIRI), Biotechnology Industry Partnership Programme (BIPP), Contract Research Scheme (CRS),Social Innovation programme for Products Affordable & Relevant to Societal Health (SPARSH) and Industry Innovation Programme on Medical Electronics (IIPME) to name a few. Cumulatively, BIRAC has invested INR 749 crores in the innovation programmes and the industry has committed INR825 crores- hinting that, given the right environment, the appetite for the Indian industry to invest in risky projects is growing.

As mentioned earlier, this large base is deep and broad. BIRAC has supported 583 projects in all areas of biotechnology- from innovations that aim to derive value out of silk industries, protect shrimp farming through disease detection to vaccines, drug delivery systems, medical technologies, agricultural innovations to improve human health. This panoply of innovative R&D is critical for our strategy for the next leap.

Deep diving into the projects reveals that BIRAC has supported about a third (31%) of the projects in medtech, 21% in industrial biotech and 16% in drugs including drug delivery. BIRAC has also supported vaccines and clinical trials of drugs, innovations in agri sector and in systems biology including bioinformatics and data analytics.

One measure of confidence that the ecosystem is ready for the next leap is borne out of the fact that through the funding received from BIRAC, the industry has been able to propel several technologies/products forward towards commercialisation. There are now at least 35 products in the market- those which have received funding support from BIRAC. These are high quality and affordable products that are best in class and range from drugs for diabetic foot ulcers, detection and diagnosis of several chronic and infectious human conditions, new production facility for biofuels, new and improved crops for nutrition and bioinformatics tools for deciphering and analyses of genomic data. BIRAC support has also helped in securing intellectual property (IP)- a total of 105 IPs have been generated indicating the growing innovative depth of the Indian biotech industry.

B. A rapidly evolving culture of Entrepreneurship through funding & infrastructure: A new 'can do'culture

India is a young nation which has two-thirds of the population below the age of 35. There is an immense untapped entrepreneurial energy. BIRAC has been able to galvanise the biotech entrepreneurial culture in the country. Its flagship entrepreneurial programme BIG has become a major input factor for this transformation supporting close to 192 early stage idea to proof of concept (POC) by startups and entrepreneurial individuals. In addition, BIRAC has initiated several other programmes that feed into the pipeline of innovations such as SPARSH (in social innovation) including its Social Innovation Immersion Programme (SIIP), IIPME, University Innovation Cluster (which attempts to instil innovation research in universities) and BIRAC SRISTI Gandhian Young Technology

Innovation (GYTI) Award. All of these programmes have helped create several 'seedlings'that have expanded the bioinnovation funnel. This growing pipeline of around 250 startups and entrepreneurial individuals is the resource for the future leap. Through these innovative early stage funding programmes, BIRAC is also facilitating creation of new enterprises. For example, through BIG, BIRAC has catalysed formation of 60 new biotech startups i.e individual entrepreneurs who have established a new startups through BIG support. They are creating new unexplored paths in bio-innovations and changing the culture of doing things- a can do approach that is not risk averse.

These entrepreneurs are supported by a mentor network built by BIRAC and its partners such as IKP Knowledge Park Hyderabad, Venture Center Pune, C-CAMP Bangalore, FITT IIT Delhi, KIIT-TBI Bhubaneswar, Villgro Foundation, Judge Business School University of Cambridge and WISH Foundation to name a few.

Besides funding innovative startups, BIRAC has created new vibrant bio-innovation incubation infrastructure across the country. Through its BioNEST programme, BIRAC has extended support to 20 bio-incubators across the country that provide a nesting place for fledgling startups. BIRAC BioNEST partners provide incubation services to more than 200 startups in all areas and these top class incubators are spread across the country- nurturing and hand-holding startups, understanding their needs and finding real solutions to the challenges that the startups face. Together the funding programmes and the bioincubator support that BIRAC extends have laid the foundation of a biotech entrepreneurial culture in the country. These spaces are the future hubs of entrepreneurial activities.

C. A growing multiplicity of platforms for positive serendipity & collaborations: New beginnings & new frontiers for industry & academia

'Together we can'is a theme that has taken roots through BIRAC support. BIRAC has built and supported several platforms that increase the chances of collisions leading to positive collaborations amongst the ecosystem players. BIRAC has established several national and international partnerships that not only provide joint funding for new bioinnovations to emerge that provide cutting edge solutions to myriad challenges that the humanity faces. Our partnerships with Bill & Gates Foundation, Wellcome Trust UK, CEFIPRA (indo-French Agency), Tekes Finland, Nesta UK have created new possibilities for innovations to take shape which was not the case even a few years ago.

Our funding programmes such as BIPP, SBIRI, CRS and even BIG have created opportunities for different stakeholders to collaborate. The power of the collaboration will facilitate faster crystallization of new solutions. Through SBIRI, BIPP and CRS, 129 collaborative projects have been supported. Out of these 129, 122 have industry-academia partnerships, 7 projects have industry-industry partnerships. BIRAC is noticing a growing trend amongst startups such as that in BIG who have begun collaborating with other BIG startups and with academia and teaching hospitals.

Each year BIRAC puts into action several workshops, roadshows and supports many conferences that bring both national and global biotech players- providing our startups and SMEs to seek new business growth. Platforms such as Innovator Meet, BIG Conclave and Foundation Day help aggregate stakeholders to deliberate on important issues, interact and exchange knowledge with peers and other experts. We also actively participate in BioAsia, Bangalore India BIO, BIO US, Biotech Japan and many such national and international conferences.

The mix of these three factors have built a vibrant ecosystem which is now primed to leap to the next level.

5th BIRAC Compendium

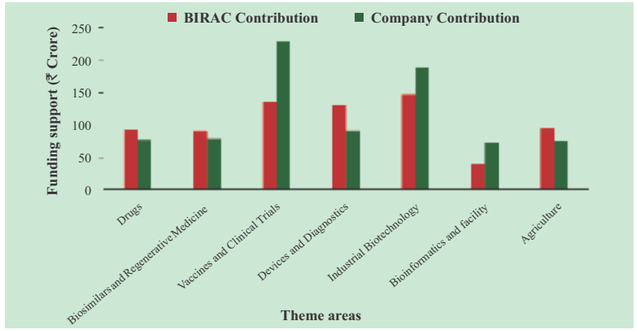
The 5th BIRAC Compendium, like its previous editions provides analysis of BIRAC's different funding programmes and glimpses of several of BIRAC projects in all domains of biotech/medtech/life sciences innovations. It highlights the areas where BIRAC has extended its support as well as points to several existing gaps. The previous compendiums have been source for information for several of our stakeholders.

Funding for the Next Leap : Affordable Technology & Product Development

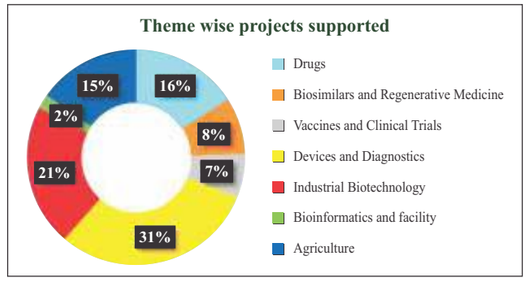
The Government of India has declared 2010-2020 as the "Decade of Innovation", which rightly emphasizes the importance of innovation in India. Since its inception, BIRAC also has been continuously supporting and expanding the gamut of affordable products and processes specifically catering to wide spectrum end-user applications and innovations in areas such as medicines, alternative energy sources, insect- and drought-resistant crops. Being a biotech development agency, BIRAC has been in the process of funding emerging technologies with translation potential and then nurturing and mentoring these new technologies for promoting the start-up ecosystem so as to align with the goals of "Make in India" and "start-up" India.

Covering the entire span of biotech arena right from pre-proof of concept till commercialization BIRAC has been supporting innovation through its pioneering schemes Biotechnology Ignition Grant (BIG), Small Business Innovation Research Initiative (SBIRI), Biotechnology Industry Partnership Programme (BIPP), Contract Research and Services Scheme (CRS) and Social Innovation programme for Products: Affordable & Relevant to Societal Health (SPARSH) and Industry Innovation Programme on Medical Electronics (IIPME). The funding support provided by BIRAC through these schemes to the biotech sector is approximately Rs. 749 crores with a commitment of Rs. 825 crores from the private sector. BIRAC, till date, has supported 384 companies, 104 academic institutes and 70 entrepreneurs for a total of 583 projects (the list of projects is available at **www.birac.nic.in/desc_new.php?id=145**).

BIRAC has an inherent system of grading the project into 7 theme areas in order to understand the research preferences of the companies and to decide if special attention needs to be given to any specific theme area in order to promote innovation in that sector. The Pharmaceutical and Healthcare sector has been categorized into 4 theme areas Drugs (including drug delivery), Biosimilars and Regenerative Medicine and Vaccines and Clinical Trials and Devices and Diagnostics, The rest of the theme areas being Agriculture (including Aqua culture and Veterinary Sciences), Industrial Biotechnology (covering Industrial Processes, Industrial Products and Secondary Agriculture) and Bioinformatics and Facilities.



Out of the 7 theme areas, Vaccine and clinical trials and the industrial biotechnology sectors involves heavy investment. This is expected as development of vaccine requires huge financial inputs whereas industrial biotechnology sector involves setting up of large manufacturing facilities.



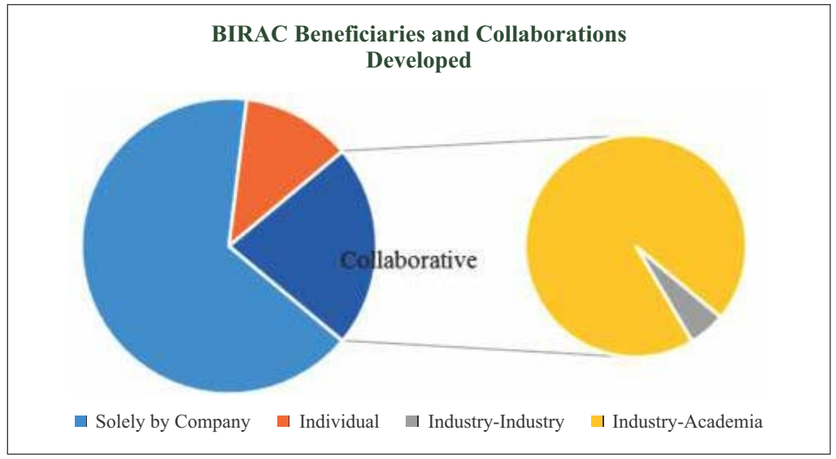
The theme wise break-up of the total projects supported by BIRAC shows that Devices and Diagnostics sector accounted for the largest number of projects being supported with a share of 31% of the total.

The medical devices and diagnostics sector is amongst the most rapidly growing sector as new devices have potential to shorten recovery times and make certain procedures less invasive and helps in disease management and improving treatments. The current product affordability of medical technology is a major barrier for the market to be able to achieve its anticipated potential growth and BIRAC is funding many enterprises just to overcome the barrier of high cost.

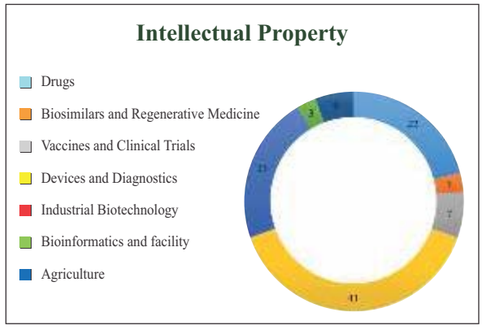
This was closely followed by the Industrial Biotechnology and Drugs (including drug delivery) sector accounting for 21% and 16% of the total project supported, respectively. The Industrial Biotechnology sector encompass a suite of technologies and processes catering to enzyme production, speciality chemicals, bio-based products and bio-energy which is resulting in enhanced interest of companies in this sector.

Although vaccine and clinical trial sector involves heavy investment but it accounts for only 2% of the total projects. This again an indication of the huge investments that go in development of a drug or a vaccine.

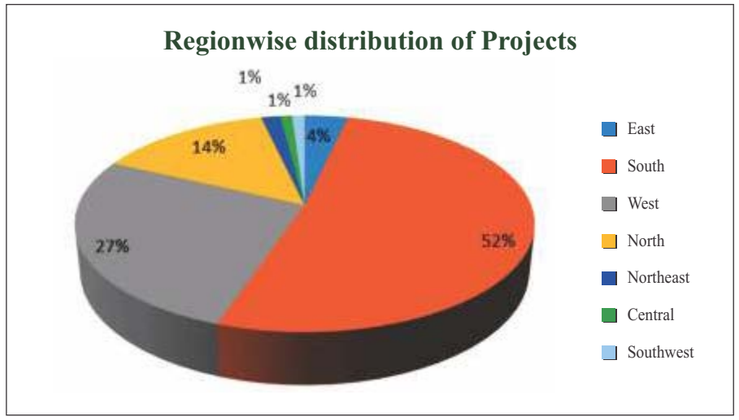
The main aim of BIRAC was to bridge the industry-academia collaborations as this has always been pointed out as the major bottleneck in technology development. BIRAC has been instrumental in tackling this problem to some extent. Out of all the projects supported, industry has been instrumental in taking forward 384 technologies/products through their own efforts as well as using viability funding from BIRAC. An early stage grant has been provided to 70 individuals for promoting entrepreneurship in biotechnology to help bridge the gap between idea and innovation. BIRAC has supported 129 collaborative projects till date out of which 122 projects had Industry-Academia collaborations and 7 projects had Industry –Industry collaborations.



Intellectual property is the essence of any nascent or established biotechnology industry. Strong patents covering all aspects of the technology can critically ensure a steady stream of capital to any industry engaged in research based developments. A critical analysis of the intellectual property in the different theme areas of BIRAC also tell the importance of IP fling in the Indian biotech arena. A total of 105 IP have been generated in the different theme areas.



The Area wise distribution for the number of Patent applications filed again shows that devices and diagnostics tops the list of IP filed. This was expected, as the development stage is comparatively short and new accomplishments can be quickly protected. This was followed by Industrial Biotechnology and Drugs area. The upstream and downstream processes in industrial biotechnology is the major focus of innovation. The increased patent filing in drugs shows that a large number of new molecules are being identified by Indian Pharma companies suggesting an increasing level of innovation being undertaken within the country .



According to geography, southern India emerged as the most innovative geographical region, accounting for 52% of the total awarded projects. It was followed by western India and northern India, accounting for 27% and 14% of the total awarded technologies, respectively.

Although the number of projects are very less, still BIRAC's presence is begining to be felt in North Eastern parts o f the country as well.

In a nutshell, success achieved

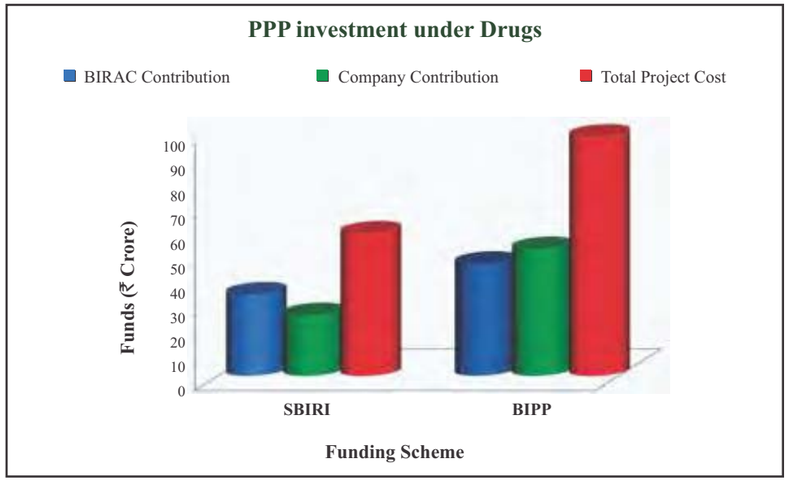
- Entrepreneurs and start-ups supported and scaled • **189**
- Small and medium enterprises strengthened • **260**
- Early Stage Technologies • **31**
- Affordable Products / Technologies Developed • **34**
- IP Generated • **105**
- Investments made on Innovation and Discovery Research • **₹ 1575 crores**

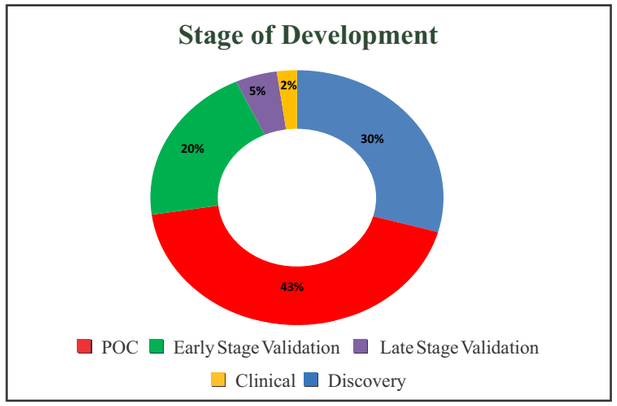
Theme wise assessment

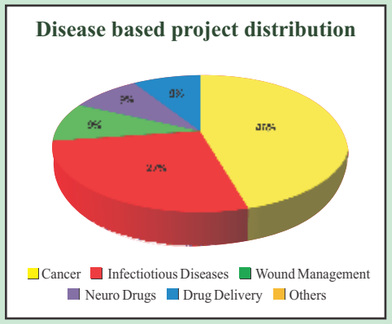
Drugs (including Drug Delivery)

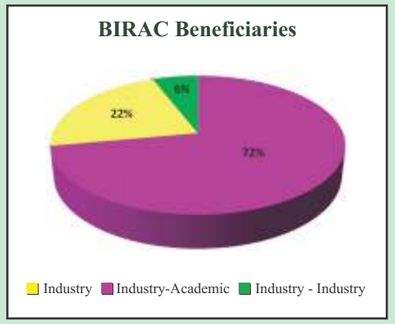
BIRAC supported projects for drug development, drug delivery and for the development of platform technologies in this sector. BIRAC's funding to Drugs sector focuses on development and validation of affordable technologies and products with a view to reduce their cost, increase their availability and accessibility to the society. The projects supported under drugs mainly deals with the indications such as Cancer, infectious diseases, inflammation and Neuro drugs etc. Many of the projects accomplished the objectives successfully and are ready to go to the next stage. Discovery and development of c-Met kinase inhibitors, clinical investigation of Galnobax® for the treatment of diabetic foot ulcer and novel inhibitors of fatty acid biosynthesis for the treatment of drug resistant S. aureus bacterial infections are some of the projects having potential to meet the objectives and to provide successful outcomes.

Total PPP investment under this area amounts to Rs. 154 crores wherein BIRAC has invested Rs. 78.72 crores for supporting 92 innovative projects. These 92 projects engaged 49 companies, 12 start-ups, 8 entrepreneurs and 16 academic institutes. Till date, a total of 3 products/technologies/PoC and 22 Intellectual property have been generated from this sector.



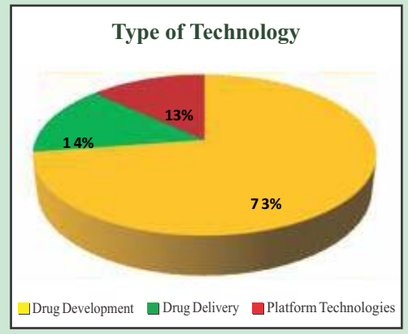






Analysis:

- BIRAC contribution is slightly more in SBIRI compared to BIPP whereas company contribution is more in BIPP indicating enabling role of BIRAC in catalyzing small business innovation and company interest in development in this area.
- Many of the projects are for developing proof of concept followed by discovery.
- Collaborations are not that evident and may be encouraged for successful outcomes in this area
- Maximum number of projects have been supported in the area of cancer followed by infectious, neurological diseases and drug delivery.
- Drug delivery and development of platform technologies are also taking some share in addition to drug development.



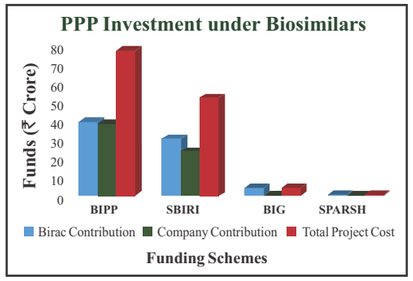
Biosimilars & Regenerative Medicines:

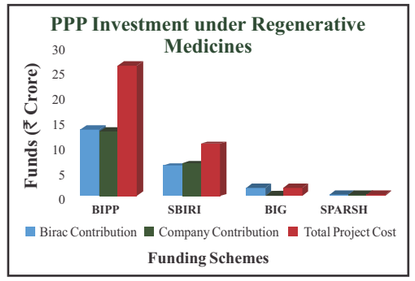
India has been one of the fastest growing economies (current growth rate of 7.5% in 2015). The Indian healthcare industry is also growing at a rapid pace (CAGR of 17%) and is expected to become a US $280 billion industry by 2020. Even so, nearly one million Indians die every year due to inadequate and inaccessible healthcare. The country's out-of-pocket spending rate is one of the highest in the world (about 86 per cent of the total health care expenditure in the country was borne by households out of their pockets in 2012). This puts additional pressure on the poor populations and failure to address this challenge could threaten the nation's economic stability.

The global Biosimilars market is expected to reach $6.22 Billion by 2020 from $2.29 Billion in 2015, at a CAGR of 22.1% from 2015 to 2020. Currently Indian Biosimilar market is 2-3% of Global. There is a huge opportunities to Capture Global market of Biosimilars. Similarly the worldwide stem cells market was valued at $26.23 billion in 2013, and is forecast to be worth $119.52 by 2019, expanding at a compounded annual growth rate of 24.2%. In India it has grown exponentially with total investment is estimated to be about $540 million in 2010 with an annual growth rate of 15%.

BIRAC has supported a total of 48 projects, for developing novel biologicals & Regenerative medicines and for the process development of existing products in this area for increasing the present market share/output in the country. The projects supported in these areas addresses diseases like Cancer, Diabetes, Inflammatory diseases, Alzheimer's and platform technologies for producing monoclonal antibodies and different kind of Stem cells. Preparation of Stem cell Bank has also been funded.

Total PPP investment under this area amounts to Rs. 170 crores wherein BIRAC has invested Rs. 91 crores for supporting 48 innovative projects. These 48 Projects engaged 29 companies, 7 Start-up, 5 entrepreneur and 4 academic institutes. Till date, a total of 11 products/technologies/PoC and three Intellectual properties has been generated in this sector.



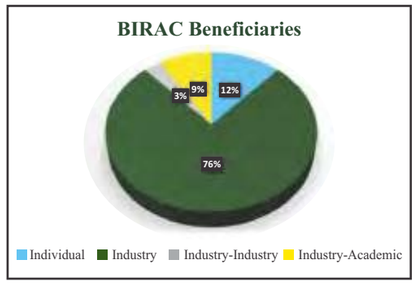


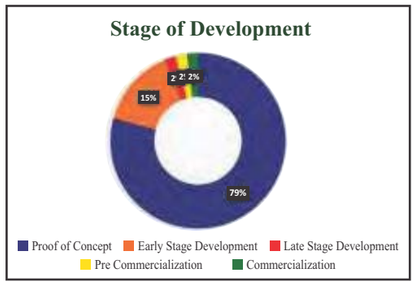
Foligraf for reproductive Technology is the first recombinant FSH product developed, manufactured and sold by an Indian Company (BHART SERUM & VACCINES).

Rasburicase to control Hyperuricemia under trade name TULY is a recombinant Uricase to control hyperuricemia in cancer patients undergoing chemotherapy developed by VIRCHOW BIOTECH.

To nurture indigenous innovation BIRAC initiated a Mission Program for Accelerating Biopharmaceutical innovation in INDIA.

BIRAC has also announced a Special call on affordable biopharmaceuticals





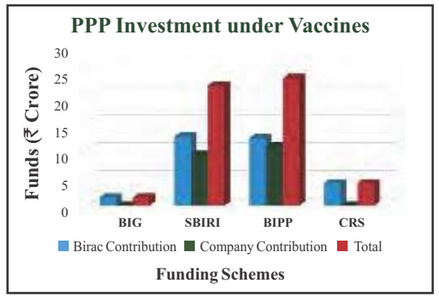
Analysis:

- BIRAC and Industry both are contributing equal for the projects under Biosimilars& Regenerative medicines.
- Industry alone is pursuing maximum number of projects in this area without any collaboration.
- Maximum number of projects funded are at Proof of Concept stages followed by early stage development.
- Collaborations (either Industry-Industry or Industry - academia) may be encouraged for successful and timely outputs.

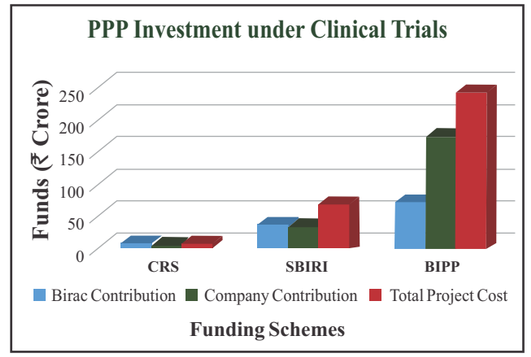
Vaccines & Clinical Trials

Vaccine development has played an important role in combating infectious diseases. By realizing this, BIRAC has supported a total of 30 projects in the area of Vaccine development and clinical trials encompassing Diabetes, Diarrhoea (Rotavirus), Cervical Cancer (HPV), Pneumococcal vaccine, Influenza, Vaccines for Cattle, Rabies and Meningitis.

Rotavirus vaccine (ROTAVAC), JE vaccine (JEEV) and H1N1 pandemic influenza vaccine



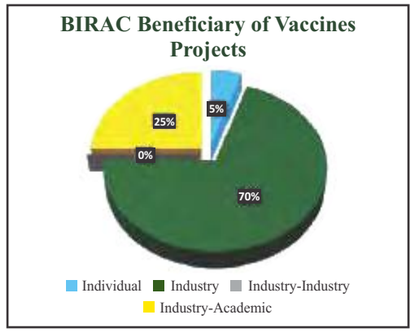
(Pandyflu) have resulted from BIRAC funded projects and are in market. ROTAVAC has also been included by Government of India in National Immunization program, market license has been obtained for JEEV in India for the age group of >1 year to < 3years and a total of 1,18,480 doses of Pandyflu vaccine have been supplied to Government of India in the year of 2011.

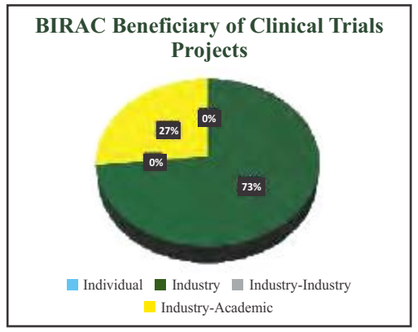


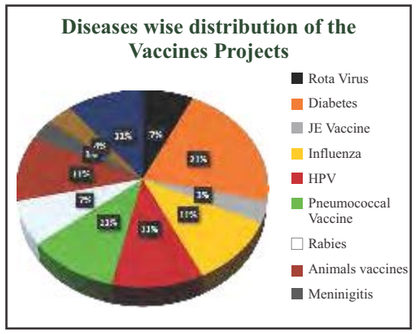
Total PPP investment under this area amounts to Rs. 363 crores wherein BIRAC has invested Rs. 135 crores by supporting 37 innovative projects. These 37 projects engaged 30 companies, one start-up, one entrepreneur and 6 academic institutes.

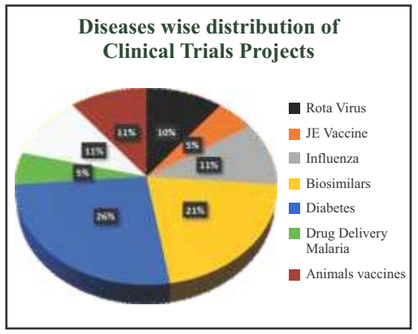
Three Vaccines, were commercialized. Two Products i.e. Influenza Vaccine (Cadila) & Vaccine for Marek's Diseases is ready for Commercialization. Four projects completed pre-clinical toxicology studies and are now ready for Phase I Clinical Trials. Seven IP have been generated as an outcome of projects funded in this area.

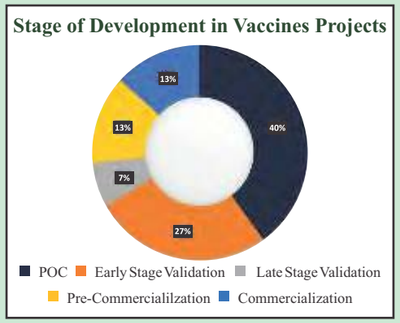
To nurture indigenous innovation BIRAC has initiated a Mission Program for Accelerating Biopharmaceutical innovation in INDIA. BIRAC has also announced a Special call on affordable biopharmaceuticals











Analysis:

- Industry is preferring to develop vaccines independently. Collaborations need to be encouraged.
- Few of the projects are at developing proof of concept while others are at early stage validation or late stage validation
- There is a good spread of projects among different indications although diabetes, pneumococcal, HPV, influenza and animal vaccines top the list while Diabetes & Biosimilars are supported more for Clinical Trials.

- Companies have invested more than Govt. for Clinical Trials of the products.
- Vaccines & Clinical trial projects may be supported more, through special calls, and monitored closely for successful outcomes.

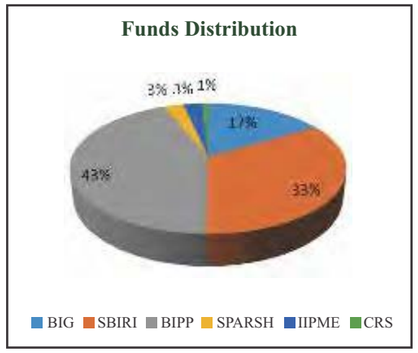
Devices & Diagnostics

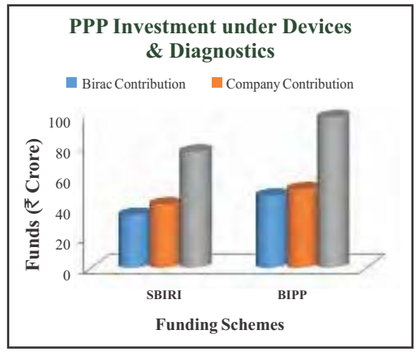
In 2008, the medical device market was valued at approximately $6.6 billion, and increased steadily to reach approximately $10.3 billion in 2014. It is one of the fastest-growing and most promising markets in the world due to India's strong economic growth, improving living standards and large population. The market grew at a CAGR of 7.7% between 2008 and 2014, and it is projected to reach $17.6 billion by 2020. (Source: Global Data)

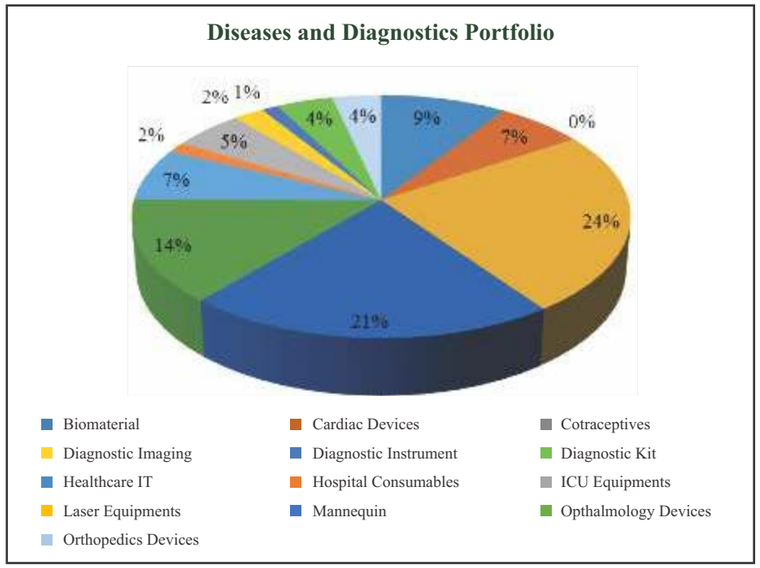
BIRAC along with the Country has witnessed a positive wave of developments in the devices and diagnostics sector over the year. Lot of young individuals have ventured into the sector and started their entrepreneurship journey. BIRAC also promoted the "Make in India" wave and Invested around INR 223 Cr in Devices and Diagnostics through its flagship schemes.

175 Individuals, Entrepreneurs, Start ups, SME and Companies are supported for development of Innovative Products/Technologies by BIRAC through its various schemes. Out of these 83 are from Diagnostics & 92 are from Devices sector. These projects/ technologies vary from handheld PoC devices to high end Diagnostic Imaging devices. The trend shows attraction of young entrepreneurs towards real-time monitoring devices for various health parameters like ECG, EEG and Blood Glucose.

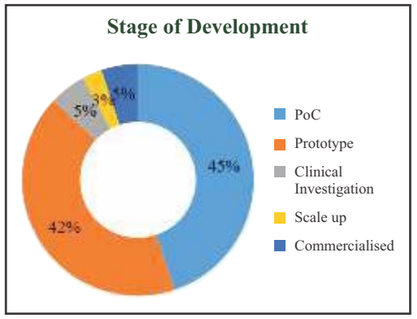
The analysis reflects that India has few companies working towards manufacturing of high end diagnostic imaging equipments like CT Scan and MRI.

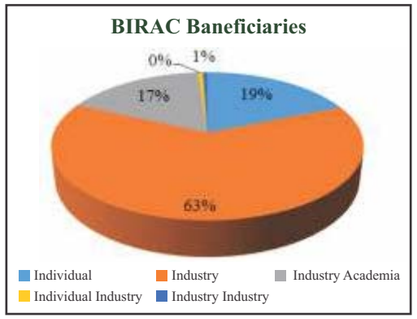






Till date 15 products / technologies are commercialized in the Indian market through BIRAC support. 7 projects are in Scale up phase and around 13 are going through clinical investigation. Most of the projects are under prototype development phase and going through initial stages of development. The area witnessed maximum number of successful projects as compared to other areas. This could be because of low gestational period and recent initiatives and policies of Government.





BIRAC is also trying to build the ecosystem of partnerships and collaborations through various schemes. It is encouraging to see that the academia and Industry are collaborating in many disciplines and complimenting each other for the success of project. The close look of the sector reflects positive growth in the upcoming years.

Analysis:

- BIRAC invested aroung INR 223 Cr. in Devices and Diagnostics through its various flagship schemes, within the sector Diagnostic imaging witnessed maximum funding.
- To strengthen the sector a special program "Industry Innovation Program on Medical Electronics" is started in Collaboration with DeitY, GoI.
- Aligning with National TB mission, special call in Collaboration with USAID and IKP was announced for developing affordable and innovative diagnostic platform technologies.
- This sector has generated around 41 Intellectual properties.

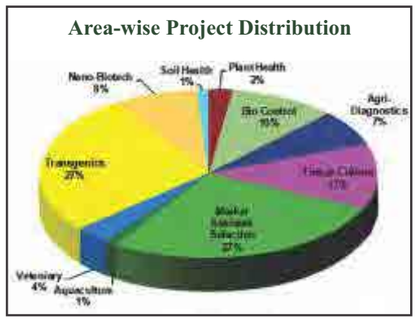
Agriculture (including Aqua culture and Veterinary Sciences)

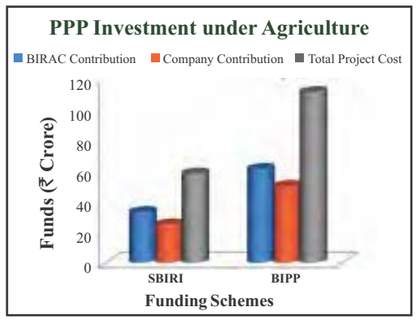
Biotechnology interventions in agriculture are being heralded as a powerful tool in pushing agriculture to keep pace with the ever burgeoning population for meeting the food and nutritional security and meeting challenges which are arising due to escalating biotic and abiotic stresses.

BIRAC is supporting agriculture both under technology as well as policy initiatives. Current R&D efforts being funded are primarily for crops that can contribute to higher & more stable yields, enhanced nutrition and are resistant to biotic and abiotic stress.

The current pipeline of BIRAC funded projects consists of the entire innovation chain from pre proof of concept to pre commercialization under key areas of agriculture ie Marker assisted Selection, Transgenic, Tissue culture etc. Some of the new areas supported are Nano biotech, Agri diagnostics and Bio control etc. Nurturing and mentorship is provided to projects to deliver tangible results in terms of products and processes like hybrid vigour, nano pesticide development, pathogen resistance and nutritionally improved hybrids.

Total PPP investment under this area amounts to Rs. 168 crores wherein BIRAC has invested Rs. 94 crores for supporting 88 innovative projects. Out of the 88 projects 39 of the projects has Industry alone as the stake holder, while 41 projects involve Industry Academia partnership. There are seven individual beneficiaries (6 start ups and 1 individuals) and 1 Industry-Industry partnership. Six IP have been generated as an outcome of the projects supported in this area.



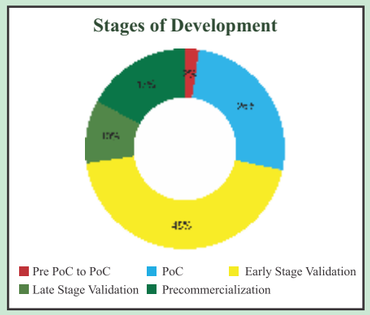


The successful outcomes are expected to be :

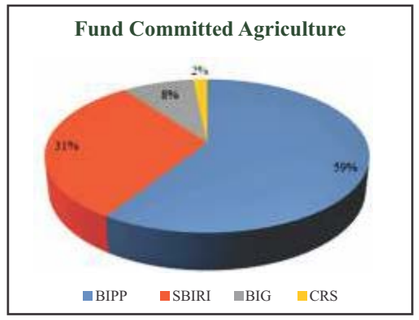
- Clonal propagation of elite genotype of orchid hybrids for commercial cultivation
- Development of nutritionally improved mustard having low Erucic acid and low Glucosinolate
- Bacteriophage based control of Vibrio harveyi infection in shrimp
- Engineered viral resistance in tomato

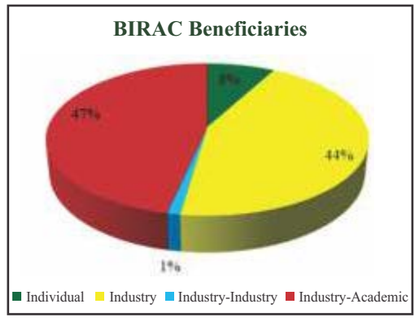
Analysis

- Development of nutritionally improved mustard (Brassica juncea) varieties/ hybrids having low erucic acid and low glucosinolate content using marker assisted selection which is at late stage of validation is the successful outcome in this area.
- Maximum funds have been disbursed under BIPP as compared to other schemes wherein BIRAC contribution is more compared to Industry
- Major projects have been supported for proof of concept under SBIRI scheme and early stage validation under BIPP. Very few projects have been supported for late stage validation, pre commercialization and product development.
- Projects belong to late stage validation stage mostly fall under marker assisted selection where regulatory guidelines are not that stringent. Projects under areas like plant health and agri diagnostics also show promise to reach late stage validation.



- Industry-academia collaborations are evident in this sector where robust technology development is possible. The next step in this direction may be the support of technology intensive using platform technologies Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) **for managing problems insect pests**
- Projects with futuristic and environmentally friendly vision like use of magnetopriming of high vegetable seeds for invigoration and productivity enhancement, Integrated Pest Management through Mating Disruption using Patented SPLAT Formulation are being favourably looked at as next generation technologies
- Both Industry and Academia have equally benefited in agriculture sector,Some of areas to be explored for encouraging entrepreneurship are agri nutrition, digital agriculture and precision farming
- Working with other ministries, by linking their objectives with the mandate of BIRAC will be a good way to attract more funds to encourage innovative and high potential proposal for platform technologies.





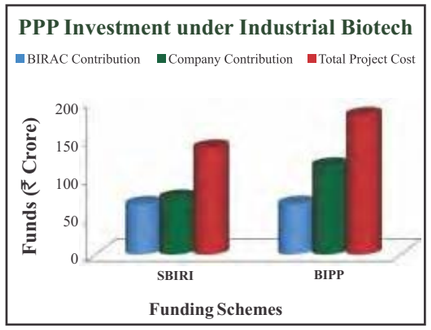
Industrial Biotechnology (including secondary agriculture)

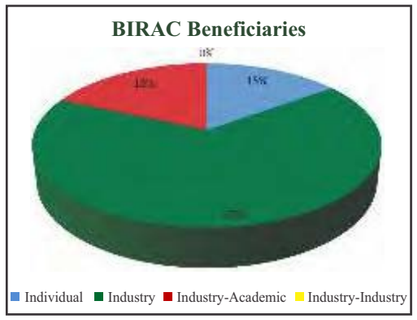
Industrial biotechnology holds great potential to solve global challenges, offering new prospective for meeting the world's demand for food, feed, fuel, materials, and more while reducing our impact on the environment. If developed to its full potential, industrial biotechnology may have a larger impact on the world than health care and agricultural biotechnology. It offers businesses a way to reduce costs and create new markets while protecting the environment.

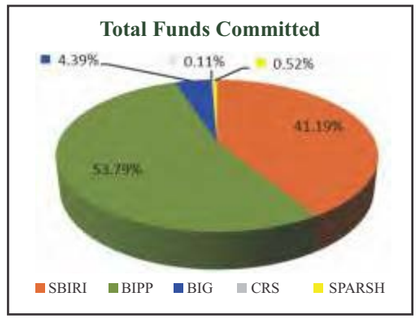
Nature of projects emphasizing on technologies and processes which are being taken care by BIRAC majorly includes biofuels, speciality chemicals, industrial enzymes, secondary agriculture, nutraceuticals, bioremediation and many other fine chemicals.

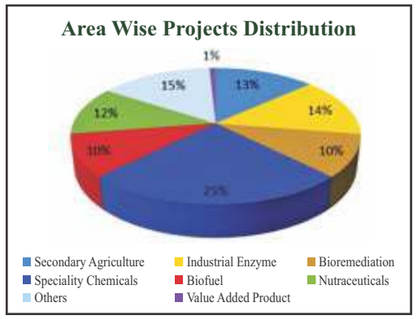
Total PPP investment under this area amounts to 336.28 crores wherein BIRAC has contributed 147 crores for supporting 120 innovative projects. These 120 projects engaged 80 companies, 20 start-ups, 18 entrepreneurs and 20 academic institutes. The major achievements of BIRAC in this area are 18 technologies/product/PoC and 23 intellectual properties have been generated.

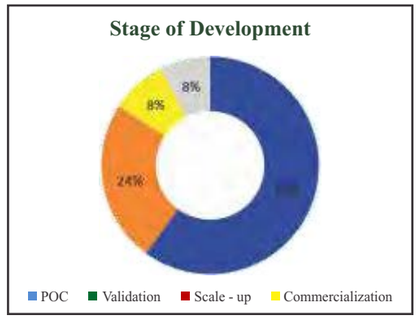
A pilot plant for production of 3000 L ethanol per day from 10 ton lignocellulose has been commissioned in the continuos mode of operation. A technology for the production of Phenyl Acetyl carbinol has been successfully scaled up to 4 KL. A PAC concentration of 9.73 g/l has been achieved at 4 KL. Further a technology for manufacturing effervescent granules (Both sodium and potassium) in a co - rotating Twin screw processor has been successfully validated.











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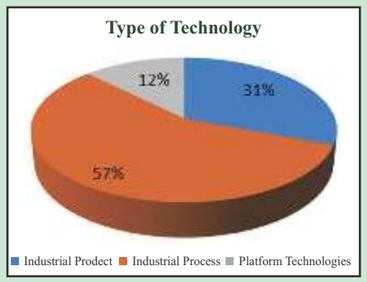


- Investment by BIRAC is same for projects supported under BIPP and SBIRI. However, the industry has heavily invested in large scale projects under BIPP.
- Maximum number of projects have been supported for development of PoC followed by validation. These include high risk proposals which were funded with a restricted scope in order to gain more confidence of the novel idea being proposed.
- Majority of the projects have been funded to industry alone. However, interest of young entrepreneurs for development indigenous process and product development is increasing.
- Maximum number of projects have been supported for technology development of speciality chemicals including import substitutes.
- BIRAC needs to consider building a national enterprise through sustained support to this sector. This sector can grow with highly intensive research and technological support which may be provided by BIRAC

Bioinformatics & Facilities

The Bioinformatics sector has transformed the way research is conducted today from a hypothesis driven based to data driven one based on focused method. Soon Indian Bioinformatics industries will play a key role in healthcare sector & BIRAC is encouraging Bioinformatics industries for frugal innovation mainly by transforming data into valuable information that will be useful for disease diagnosis and therapeutics.

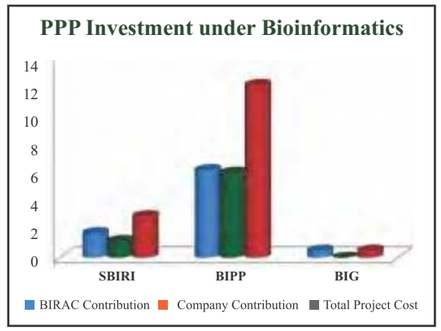
BIRAC supported Bioinformatics technologies:

A. Developed tools & pipelines:

- An In-Silico hepatotoxicity prediction platform to conduct toxicity studies of any lead compounds.
- A comprehensive NGS data analysis suite named "SanGenix" that offers a scalable and user friendly solution with predefined or custom workflows for seamless analysis of NGS data.
- A high performance computing infrastructure set up for NGS data Analysis with more than 16 NGS pipelines & providing 25% discount price to the Indian academics, institutions and BIRAC grantees.

B. Products/PoC in Pipeline:

- A Machine learning based tool on web for the early detection of diabetes retinopathy.
- An affordable multi onco diagnostic test kit
- A Cancer diagnostic NGS based gene panel (PoC)



BIRAC also Supports 'Make in India' program by promoting Infrastructure development with the vision to place India on the world map as a bio-manufacturing hub and give global recognition to the Indian bio economy. BIRAC has also supported self-use facilities to promote in-house R&D capabilities of the company which is useful for researchers & start-ups. This facility provides differential rental model for usage available foracademicians, researchers, SMEs and Start-up companies for developing process and pilot scale production based on their proof of concept and initial laboratory work.

BIRAC supported Infrastructures:

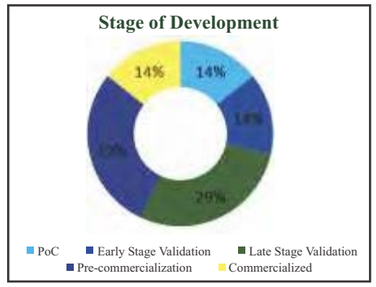
A. Developed for Manufacturing:

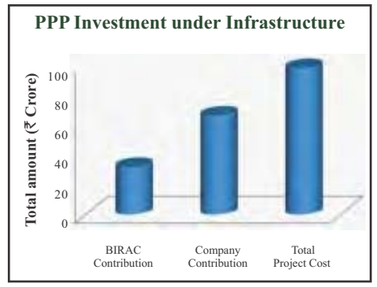
- Production of blood products Globucel (IVIG), Albucel (Albumin) &Factor VIII (is in process)
- Production of antigen & antibodies for infectious diseases
- Production of Phytochemical reference standards

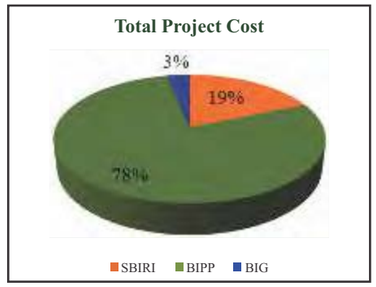
B. Developed Self-use Infrastructures:

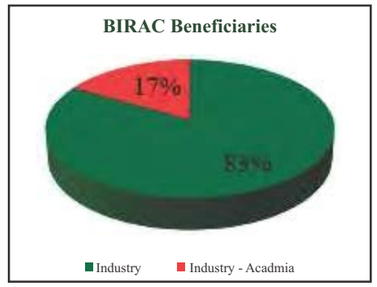
- Physiochemical characterization of biologics.

Total PPP investment under this area amounts to Rs. 113.30 crores wherein BIRAC has invested Rs. 39.75 crores for supporting 12 innovative projects. These projects engaged 11 companies, 1 start-ups and 3 academic institutes. Till date, a total of 2 products, 3 intellectual properties and 5 facilities have been developed in this sector and two more products are in pipeline









Analysis:

- BIPP funding for bioinformatics projects are 4 times high in comparison to SBIRI.
- 58% projects in Bioinformatics are at late stage validation and pre-commercialization stage.
- Few of the projects from this area involved Industry-academia collaborations though many are pursued by industry alone
- Industry contributed double amount in Infrastructure projects

Innovation Profiles

BIRAC Innovators

Healthcare

Therapeutics

September 2016

Bakul Finechem Research Centre

The Innovation

Development of Affordable Semi-synthetic Artemisinin for the Treatment of Malaria.

Development Stage

Discovery

Brief Description

Artemisinin based combination therapies (ACTs) are choice of treatment of malaria and may be used for chloroquine-resistant malaria by WHO. Aim is to develop an affordable alternative.

Innovative element

This proposal aims to implement a proven yeast-based fermentation coupled with synthetic chemical process to produce semi synthetic artemisinin. This can lead to abundant and timely supply of artemisinin and be more economical than the current plant-based extraction. This can lead to affordable access to every malaria patient in India as an effective medication.

Market Potential

The fermentation based process can provide stable price, consistent amount & can be scaled up. The price presently ranges from $250-$1000/kg.

National/Societal Relevance

Malaria has plagued India affecting ~2 million cases observed annually and ~50,000 deaths living in high-risk malaria areas. Artemisinin, the key ingredient of ACTs is isolated from plants in a long 14 month growth cycle and its price and availability varies based on seasonal fluctuations that affect crop yield. In years with low crop yield, the price of artemisinin is 3-4 times higher and the patients, most of whom earn less than a dollar a day, cannot afford the medication. Moreover, the plant harvest is not enough to treat every malaria patient in India and worldwide.

Project Deliverables

a. **Progress vis-à-vis objectives –** Fermentation derived intermediates to Artemisinin is being undertaken.

b. **Technology/Product developed –** Fermentation in yeast for the production of key intermediates has already been validated and adequate quantities of amorphadiene and artemisinic acid have been produced.

c. **TIP generated/ Potential for IP generation –** Development of a novel synthetic process could potentially generate IP

d. **Resources Generated –** NA

Plans to take innovation further

Partnership with USA-based non-profit Zagaya for fermentation-derived intermediates when the process is taken to commercial scale and in talks with industries in India who formulate Artemisinic-based therapies.

Risks Envisaged

None

Innovator Team

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Bharat Biotech International Ltd.

Collaborator: THSTI, KEM Hospital Research Centre, CMC

The Innovation

Phase III Testing and Evaluation of safety and Efficacy of oral Rotavirus Vaccine Candidate 116E

Development Stage

Commercialization

Brief Description

The live attenuated ROTAVACÂ® is orally administered to infants in a 3- dose schedule in the 6th, 10th and 12th week of age for control and prevention of rotavirus gastroenteritis.

Innovative element

ROTAVACÂ® is developed using the Rotavirus 116E strain which is naturally re-assorted and naturally attenuated and hence did not require a buffer prior to administration. Single dose of ROTAVACÂ (higher efficacy and immunogenicity) ensures easy administration and avoids spillage.

Market Potential

A significant population of children especially under the age of 2 years would be greatly protected by ROTAVACÂ®. With a birth cohort of ~25 million infants annually, India alone may require a vaccine production capacity of 100 million doses per annum. UNICEF has forecast 28 to 52 million courses of Rotavirus vaccine for the years 2017 to 2021.

National/Societal Relevance

India is the largest contributor for rotavirus mortality accounting for 23% of deaths in 2013. Rotavirus vaccine has been introduced as an additional vaccine into the Universal Immunization Programme of India.

Project Deliverables

a. **Technology/Product developed –** ROTAVACÂ® is manufactured by Bharat Biotech and developed through a Public-Private Partnership. The vaccine ensures protection against rotavirus gastroenteritis which affects children less than 2 years of age.

b. **IP generated/ potential for IP generation –** Several patents have been filed in different countries such as USPTO, European Patent Office, and China.

c. **Resources Generated –** A new GMP facility was established for the bulk production, formulation, filling, inspection, labeling and packing of Rotavirus 116E. The facility consists of state-of the art equipment and trained personnel.

d. **If Commercialized, Nos. of units sold –** ROTAVACÂ® was launched by the Prime Minister of India on 9th March, 2015. It is currently available on both domestic and international markets. Rotavirus Vaccine has been included in the Universal Immunization Programme of India and is currently in use in four States namely Andhra Pradesh, Odisha, Haryana and Himachal Pradesh.

Plans to take innovation further

Improving the packaging to reduce the number of doses in multi-dose containers. Developing a better system for vaccine delivery in order to deliver it conveniently.

Risks Envisaged

None

Innovator Team

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Biomoneta Research Pvt. Ltd.

The Innovation

Mapping of Prochiral Chemical Space covered by Ketoreductases

Development Stage

Proof-of-Concept

Brief Description

Engineered E. coli cells capable of producing chiral alcohols.

Innovative element

Design and construction of novel engineered bacterial strains that produce chiral alcohols.

Market Potential

Chiral alcohols are important intermediates in the synthesis of drugs and fragrances.

National/Societal Relevance

Fermentative production of chiral alcohols removes dependence on imports.

Project Deliverables

a. **Progress vis-à-vis objectives –** Designed a library of chemically diverse ketones for screening against the available set of ketoreductases. Screened the ketoreductase library to understand the chemical diversity of substrate ketones that can be reduced to chiral alcohols. Identified an industrially important chiral alcohol and designed a whole cell bio-transformation process for its production.

b. **Technology/Product developed –** An engineered *E.coli* strain that produces the important drug intermediate, Shikimic Acid is being developed.

c. **IP generated/ Potential for IP generation –** Patent will be filed for the best engineered strains that produce Shikimic acid.

d. **Resources Generated -** 3 scientists.

Plans to take innovation further

Stitching together a collaborative ecosystem for the fermentative production of Shikimic acid.

Innovator Team

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Biozone Research Technologies Pvt. Ltd.

The Innovation

Novel quorum sensing inhibitors against biofilm forming bacteria

Development Stage

Proof-of-Concept

Brief Description

This project is aimed at discovering novel quorum sensing inhibitors from plants and an innovative approach of finding analogs of AHL signal molecules to block the Lux R receptor by in silico approach.

Innovative element

Analogs of the AHL signal molecules that can control the biofilm forming bacteria, without killing it. The proposed approach involves only in disrupting the QS signaling mechanism with anti QS compounds which keeps bacteria in the planktonic form, even if cell density is high, and renders them harmless because of their inability to produce virulent factors. Henceforth they can be removed or controlled more easily by protective mechanisms thereby avoiding the use of antibiotics and being herbal based would be an added advantage.

Market Potential

Anti-biofilm agents have been considered a promising strategy for the development of novel therapeutics for the control of bacterial proliferation. Herbal Anti-biofilm molecules are one of the new strategies that may have a promising future in the market.

National/Societal Relevance

The societal importance from a public health perspective is the role of the biofilm in antimicrobial drug resistance. Biofilm forming bacteria pose threats by being prevalent in unhygienic food, medical apparatus, boats and ships, house-wall paints, mechanical blockages and impedance of heat transfer processes, shortening the lifetimes of modules in fermenters, and increase the corrosion rate of surfaces. A proper control of the biofilm forming bacteria, without killing it, will yield a better governance of the problem, since certain bacteria have been found beneficial as well.

Project Deliverables

a. **Progress vis-à-vis objectives –** Work is progressing as per the sanctioned objectives.

b. **Technology/Product developed –** Herbal Molecules/ Formulation with Anti-quorum sensing potential.

c. **IP generated/ Potential for IP generation -** No IP has been generated in this project so far.

b. **Resources Generated –** A researcher is employed to the team to carry out the project work.

Plans to take innovation further

Venture capitalists, bank loans whichever is applicable as per the company's status will be employed in bringing the product to the market. Mainly targeting the water purification industry for coating the membrane filters in the purification systems and also application in various pipelines and other industrial and medical instruments where water flow is constant and a threat of biofilm formation is more.

Risks Envisaged

None

Innovator Team

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Bugworks Research India Pvt. Ltd.

The Innovation

Novel antibiotics for gram negative bacteria: Structure based strategy to ameliorate antibiotic efflux and enhance compound efficacy

Development Stage

Proof-of-Concept

Brief Description

Novel chemical series has the following characteristics : MICs observed in *E. coli, P. aeruginosa* and MRSA. Compounds were bactericidal. Medicinal chemistry and structure based drug design culminated in the mitigation of efflux pump liability without altering the mechanism of action for these compounds. Representative compounds were *in vivo* efficacious in a mice thigh *E. coli* infection model.

Innovative element

A novel strategy to mitigate efflux pump liability in Gram negative bacteria. Approximately 3000 compounds from e-Molecules database were identified, procured and screened against E.coli wild type and tolC pump deletion mutant strains. Identified hits showed antibacterial activity against only *E. coli* to lC strain and no activity against the wild type strain. Using a computational modeling approach, the binding orientation of hit molecules with *E.coli* & AcrB was determined and the binding modes were utilized to drive the medicinal chemistry efforts to perturb the AcrB binding.

Market Potential

Globally, antibiotics registered sales of ~$50 billion in 2012. Antibiotics are one of the largest therapeutic categories from a revenue perspective. The emergence of resistance ensures the continuing need for new antibiotics.

National/Societal Relevance

India has one of the highest burden of anti-microbial resistance. Hence, the discovery of a novel antibiotic working *via* a novel mechanism, hence effective on all classes of drug resistance will make an enormous positive impact on the morbidity, mortality and economy of India.

Project Deliverables

a. **Progress vis-à-vis objectives -** Project is progressing well as per the sanctioned objectives.

b. **Technology/Product developed -** A novel chemical series was discovered.

c. **IP generated/ Potential for IP generation -** Patent application filed (Indian Application No: 1426/CHE/2015).

d. **Resources Generated -** The Company has grown from 3 to nearly 20 resources.

Plans to take innovation further

A second novel series has been discovered, which has the potential to reach Clinical trials in about 2 years.

Risks Envisaged

Potential safety risks

Innovator Team

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Chaitali Surve - KIIT

The Innovation

Design and evaluation of novel formulations of some anti- cancer drugs for metronomic chemotherapy

Development Stage

Proof-of-Concept

Brief Description

The aim is to formulate active and/or passive nano-targeted, orally disintegrating tablet of anti-cancer agents for improved bio-availability, site specificity, reduced toxicity and patient compliant metronomic cancer chemotherapy.

Innovative element

Metronomic chemotherapy is better alternative as it is repetitive, low dose oral chemotherapy designed to minimize toxicity. Results and various studies show that targeted chemotherapy is associated with less toxicity, increased efficacy and also reduction in dose. Oral disintegrating tablets, would be a promising alternative for such patients suffering from difficulty in swallowing.

Market Potential

Targeted therapies are currently the focus of much anti-cancer drug development. The targeted therapies e.g. monoclonal antibodies are expensive & lack patient compliance due to intravenous administration. The merger of oral targeted and low dose metronomic chemotherapy with less toxicity opens advancement in the field of cancer therapy.

National/Societal Relevance

According to WHO, annually, nearly 500,000 people die of cancer in India. This number is expected to rise to 700,000 by 2015 with maximum of lung, oral, lip, throat and neck cancers. The development of metronomic anti-cancer therapies is designed to maintain a stable disease situation for advanced cancer patients in a cost effective manner.

Project Deliverables

a. **Progress vis-à-vis objectives –** Experiments are ongoing for the construction of fluorescently labeled MN1 &MN2. Formulations are under optimization.

b. **Technology/Product developed –** In progress

c. **IP generated/ Potential for IP generation –** To develop a platform technology for oral anti-cancer agents for metronomic chemotherapy to maintain a stable disease situation for advanced cancer patients.

d. **Resources Generated –** Employment has been given for two people.

Plans to take innovation further

Discussions are ongoing with few market players for co-development options. Also, plans are to incorporate a Private Limited Company

Risks Envisaged

Variation in source of lipids in formulation can lead to batch to batch variability with respect to drug loading capability, scalability. Also, extensive animal studies are required to validate the proof of concept which will require a lot of funding.

Innovator Team

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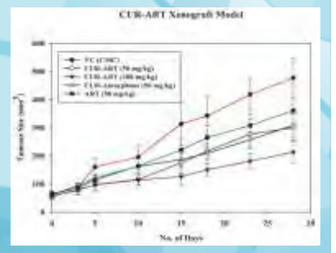

The Innovation

Preclinical testing of soluble curcumin Co crystals

Development Stage

Proof-of-Concept

Brief Description

This project aims to take advantage of the known biological activity of traditional herbal ingredients for pharmaceutical development.

Innovative element

Co-amorphous solid, CUR-ART, is prepared as a novel co-amorphous solid formulation

Market Potential

Curcumin has a high domestic and international market as a herbal natural ingredient. With Artemisinin added, it will classify more as fixed drug combination. The market of such combo drug products using herbal/ traditional medicine ingredients is growing. The present two drug FDC is explored for the treatment of cancer.

National/Societal Relevance

Cancer drugs derived from natural product sources and ingredients will be novel. Curc-Artm combo is inexpensive, domestic lead and will cure cancer. Preliminary in vivo bioavailability and PANC1 tumor xenograft studies are promising.

Project Deliverables

a. **Progress vis-à-vis objectives –** Completed

b. **Technology/Product developed –** Novel co-crystals and co-amorphous solids of insoluble bio-active ingredient curcumin with artemisinin have been prepared.

c. **IP generated/Potential for IP generation –** The platform technology of co-crystals/ amorphous solids is demonstrated with a POC. Further validation results will be known by the end of this year.

d. **Resources Generated –** Manpower is being trained in cell lab facility, preparation of co-crystals and amorphous solids and testing of drugs in animal models.

Plans to take innovation further

Looking for partners to take this herbal drug combo lead to further pre-clinical development

Risks Envisaged

The project is completed successfully.

Innovator Team

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ExCel Matrix Biological Devices Pvt. Ltd.

The Innovation

Novel Haemostasis Mechanisms

Development Stage

Proof-of-Concept

Brief Description

Hemostasis and wound closure/ coverage require multiple solutions depending on clinical situations. Developed novel gelling mechanisms of proteins as alternative haemostatic mechanism.

Innovative element

The cross linked protein gel formed is strong enough at a lower cross linkers/ protein concentration comparable to existing products, which is useful for hemostasis and wound closure/ coverage in emergency. Novel bio-material is proposed as hemostat foam and spray based product formulation for a range of clinical hemorrhage types.

Market Potential

Hemostasis and wound closure market is about 10 billion USD worldwide.

National/Societal Relevance

Other than gelfoam and chitosan foam based traditional generic hemostats of limited applications no advance technology is developed indigenously. First aid, hemostasis aid for surgical and acute wounds, burn wound coverage. Low cost, rapidly deployable by non-experts in remote locations.

Project Deliverables

Progress vis-à-vis objectives - Two novel bio-material based formulations are developed. These formulations are being tested for clinical situations

a. **Technology/Product developed –** Three functional prototypes are developed for pilot scale manufacturing and market trials.

b. **IP generated/ Potential for IP generation -** Two Indian patents have been filed.

d. **Resources Generated -** Three manpower is employed and trained in advance techniques of bio-materials.

Plans to take innovation further

Pilot scale manufacturing and market trials. Open to collaborative translation and equity investment.

Risks Envisaged

Lack of equity investment for further development of novel products. Slow regulatory approval, market validation and traction. Validation in clinical settings and field conditions.

Innovator Team

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Godavari Biorefineries Ltd.

Collaborator: SPP School of Pharmacy and Technology Management

The Innovation

Targeting therapy-resistant stem cell-rich cancers

Development Stage

Proof-of-Concept

Brief Description

The present proposal discusses the detailed plan of optimization of a molecule MSP004 which exhibits unique biological activity profile against cancer and cancer stem cells CSCs.

Innovative element

Preliminary studies have undoubtedly shown superior activity of MSP004 in the anti-cancer and anti-CSC assays when compared to Cisplatin, a leading chemotherapeutic drug which provides a unique opportunity to develop a specific anti-CSC agent when there is none available in the clinic.

Market Potential

Cancer is the leading cause of innumerable number of deaths worldwide. In 2012 alone, there were an estimated 14.1 million new cases of cancer in the world with 7.4 million in males and 6.7 million in females. A successful drug would have tremendous market potential for the developed molecule that targets cancer and CSCs which contravenes the chance of cancer re-occurrence.

National/Societal Relevance

Cancer is the second most dreadful disease in India killing more than 30 lakhs patients each year. It is important to develop CSC-specific therapeutics, which would effectively inhibit CSCs and work in combination with the standard therapies to provide effective treatment option for the cancer patients. Scientists around the globe are extensively looking to find CSC-targeted agents and unfortunately until today, there is none available in the market to specifically target CSCs. Since therapy-resistant CSCs are embedded within the tumor, these persist even after chemotherapy, and are mainly responsible for the relapse and metastasis. It is of utmost importance to develop an anti-cancer drug that would ideally eradicate both the differentiated cancer cells and the CSCs.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives.

b. **Technology/Product developed –** In progress

c. **IP generated/ Potential for IP generation –** The product is still in proof of concept stage.

d. **Resources Generated –** None

Plans to take innovation further

Keen to commercialize the molecules.

Risks Envisaged

Identified molecule may not work as mono-therapy.

Innovator Team

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Healthline Pvt. Ltd.

The Innovation

Silk Protein blend film Development and Commercialization for burn wound management.

Development Stage

Commercialization

Brief Description

The product is a medical device made out of specific fraction of silk protein reconstituted in the form of cast sheet with an objective of enhancing rate of wound healing with reference to burn, graft and chronic ulcer wounds compared to currently used wound healing devices

Innovative element

1. Design of the film as a bilaminate with one of the surfaces having hydrophilicity and other hydrophobicity, to ensure exudate absorption from the wound and inhibiting moisture entry from atmosphere.
2. Reconstitution of the silk protein fraction was done in such a way that it has right crystallinity to provide scaffolding capability
3. Asiaticosides as second key component in the formulation to provide synergistic effect.

Market Potential

Estimated market potential worldwide for advanced wound healing is US$30.4 billion by 2021. Indian market estimate stands 8 US$300 million.

National/Societal Relevance

In India it is estimated that:

- 4.5 out of 1,000 people suffer from chronic wounds
- 10.5 out of 1,000 suffer from acute wounds
- 2.7 out of 1,000 suffer from surgery induced wounds
- Several cases of burn wounds.

This makes the current project with high national/societal relevance

Project Deliverables

a. **Technology/Product developed –** Product developed and launched in the market.

b. **IP generated/ Potential for IP generation –** Product developed and launched in the market.

c. **Resources Generated –** Pilot production facility created. About 15 people have been employed for development, manufacture, testing and marketing of the product. The fund is currently being mobilized through internal sources.

d. **If Commercialized, Nos. of units sold –** In last three years little above 10,000 units have been sold with size ranging from 5X5 sq.cm to 20X25 sq.cm.

Plans to take innovation further

This aspect is currently under discussion.

Risks Envisaged

All possible risks have been evaluated and preventive actions incorporated.

Innovator Team

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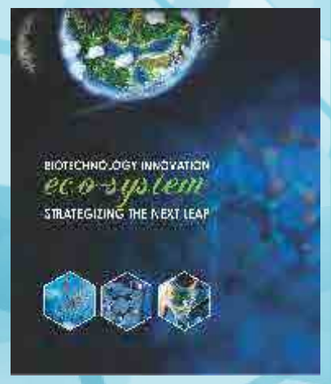

The Innovation

Production of human ESC-derived red blood cells in bio-reactor for Clinical use

Development Stage

Proof-of-concept

Brief Description

The process utilizes a novel technique of replicating the bone marrow micro-environment by adding bone marrow mesenchymal stem cells BM-MSC and further stimulating production by temporary induction of hypoxia in the bone marrow mesenchymal stem cells.

Innovative element

Creating Universal Donor RBC purely from stem cells.

Market Potential

The market size for universal donor red blood cell substitute is estimated to be $85 billion annually.

National/Societal Relevance

It would solve the problem of shortage, safety, timing of availability in trauma, incompatibility, high cost of blood supply in the world and reduce mortality and infection spreading. Also useful for thalassemia patients and for widely prevalent allo-sensitized sickle cell disease patients in India.

Project Deliverables

a. **Progress vis-à-vis objectives** -The company is on track to demonstrate product of Universal Donor RBC in the lab as a first stage

b. **Technology/Product developed –** Production of human ESC-derived red blood cells in bio-reactor for Clinical use is in progress.

c. **IP generated/ Potential for IP generation –** Expected to generate patents as the research progresses.

d. **Resources Generated –** None

Plans to take innovation further

ESC-derived red blood cells will be used for clinical use.

Risks Envisaged

Chances of failure of the stirred reactor to achieve desired hydrodynamics and mixing, failure to achieve the lab scale culture conditions in the reactor, spatial non-homogeneities inside reactor, difficulty to achieve a good rate of differentiation are existent. Plans to overcome or circumvent difficulties that may arise The reactor hydrodynamics will be modified by trying alternate stirrer types e.g. marine impeller or other blade¬turbines. The impact on the cell viability will be analyzed in great details. Rate of differentiation, if low, will be accelerated by changing the cytokine mix and other culture conditions.

Innovator Team

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Imgenex India Pvt. Ltd.

Collaborator: Institute of Life Sciences

The Innovation

Nanotechnology based delivery of peptide inhibitors for the treatment of Osteoporosis.

Development Stage

Proof-of-Concept

Brief Description

Osteoporosis, is a major health problem affecting 1.5 billion people worldwide & 300 million Indians. The increased activity of the osteoclasts results in bone loss without enough bone repair and growth, and causes osteolytic lesions. Our approach is to use PEGylation to deliver the identified peptides that can block osteoclast formation.

Innovative element

Although several drugs for osteoporosis and bone metastasis for example - parentheses, bisphosphonates, Acetonel, Aredia, Didronel, Fosamax etc. & Amgen's monoclonal antibody against RANKL Denosumab are available, to our knowledge, peptide inhibitors against RANK (Receptor Activator of Nuclear Factor κ B) have not been used to block oseteoclast differentiation.

Market Potential

Estimated world market for osteoporosis drugs is $11.5 billion per year. Approximately 300 million Indians are affected by this disease.

National/Societal Relevance

The study may help one out of 3 females and 1 out of 8 males in India who suffer from osteoporosis.

Project Deliverables

a. **Progress vis-à-vis objectives –** Completed.

b. **Technology/Product developed –** Nanotechnology based delivery of peptide inhibitors is being developed.

c. **IP generated/ Potential for IP generation –** PEGylated TRAF6 Inhibitory peptide showed prolonged *in vivo* stability compared to the native TRAF6, therefore further investigations are warranted to examine the effect of PEGylation on the biological activity of the TRAF 6 inhibitory peptide and a superior therapeutic approach.

d. **Resources Generated –** Four full-time persons were employed in this project. Flow cytometer and Akta Prime protein purification system have been procured.

Plans to take innovation further

To collaborate with a larger pharma company to bring this product in to the market.

Risks Envisaged

Toxicity of the proposed peptide.

Innovator Team

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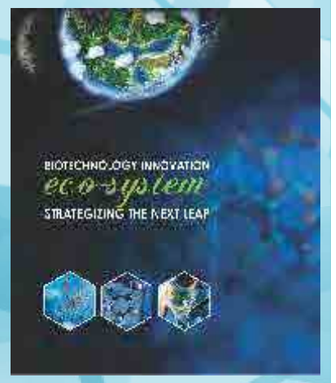
Collaborator: Anthem Biosciences Pvt. Ltd.



The Innovation

Development of New Class of Glycopeptide Antibiotics for Tackling Drug Resistant Bacterial Infections

Development Stage

Validation

Brief Description

A new therapeutic agent for the treatment of multi-drug resistant Gram-positive bacteria. This semi-synthetic glycopeptide antibiotic possess an increased cell wall biosynthesis inhibition and exhibited an additional strong membrane active mechanism of action & resulted in improved activity compared to the parent drug against VISA in a mouse thigh infection model and against VRE in kidney infection model.

Innovative Element

The newly developed antibiotic displays multi-modal mechanisms of action unlike the parent drug, vancomycin. Bacteria were futile in acquiring resistance against these newly developed antibiotics and this indicates the potential, long-lasting clinical utility of this class of compounds.

Market Potential

Contribution to treatment of multi-drug resistant Gram-positive bacterial infection caused by MRSA, VISA, VRSA, VRE has great market potential.

National/Societal Relevance

AMR has exacerbated the threat of infectious diseases with an estimated figure of 700,000 deaths annually. By 2050, AMR is predicted to cause 10 million deaths annually and cost the world $100 trillion, if left unchecked. The proposed molecule is capable of treating multi-drug resistant Gram-positive bacterial infections and the strategy does not induce any observable resistance and therefore would last for longer in the clinic as compared to the present products.

Project Deliverables

a. **Progress vis-à-vis objectives –** SAR Studies for the lead compound is ongoing for same series and identifying back-up molecules for dual activity and synthesis in 15-18 g quantities and revalidation of activities of compounds on drug-resistant field isolates.

b. **Technology/Product developed –** New Class of Glycopeptide Antibiotics are being developed.

c. **IP generated/ Potential for IP generation –** There is potential for IP generation.

d. **Resources Generated –** Hired a project-assistant and post-doctoral fellow for this project.

Plans to take innovation further

Looking forward to form a partnership with pharmaceutical companies to help in taking this innovation to the next level viz. clinical trials.

Risks Envisaged

Product must go through rigorous clinical studies before coming into the market.

Innovator Team

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Natural Remedies Pvt. Ltd.

The Innovation

Scale-up facilities for the production of phytochemical reference substances from Indian medicinal plants of national relevance as a business model

Development Stage

Commercialization

Brief Description

Major compounds found in analytical chromatographic fingerprints, HPLC or HPTLC, of selected medicinal plants would be isolated and characterized using chromatographic column/ flash chromatography, centrifugal partition chromatography and preparative HPLC and spectroscopic methods NMR and Mass spectrometry . Purity of the isolated constituents will be certified to a level of 95 to qualify them as Phytochemical Reference Substances (PRSs).

Innovative element

Unique technique for isolation of phytochemical reference substances in preparative scale using a blend of old and new chromatographic techniques.

Market Potential

It need a thorough market research on this business model.

National/Societal Relevance

Phytochemical Reference Substances (PRSs) form an important component in research and quality control aspects of medicinal plant products, one of the priority sectors of Indian government. This proposal is about generation and global commercialization of largest PRS repository in India. This project is expected to support herbal industry, national labs, Universities and research institutions in terms of improving scientific understanding of Indian medicinal plants.

Project Deliverables

a. **Progress vis-à-vis objectives –** Successfully completed

b. **Technology/Product developed –** Availability of phytochemical reference substances at commercial scale for customers from national research organizations, Government bodies and international customers.

c. **IP generated/ Potential for IP generation -** Nil

d. **Resources Generated -** New scale up facility has been set up through this project.

Plans to take innovation further

We are still exploring this option.

Risks Envisaged

Difficulty in purification, high cost of isolation of compounds and business related risks.

Innovator Team

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Nova Lead Pharma Pvt. Ltd.

(V Life Sciences Technologies Pvt. Ltd.)

The Innovation

Clinical investigation of Galnobax for the treatment of Diabetic foot ulcers.

Development Stage

Validation

Brief Description

GalnobaxÂ® is a cost effective novel formulation of an existing drug with a novel use in treatment of diabetic foot ulcers, DFU. Currently, it is undergoing phase I/II clinical trial. GalnobaxÂ® has shown excellent efficacy profile compared to control in animal studies.

Innovative element

GalnobaxÂ® a novel topical gel formulation of an existing intravenous drug would potentially be first small molecule chemical entity drug for DFU. The present DFU treatments are mainly biologics and devices. Use of GalnobaxÂ® in Diabetic Foot Ulcer (DFU) is itself an innovation, discovered by the company.

Market Potential

World over, more than 285 million people suffer from diabetes, expected to rise to 438 million in 2030. About 15% of diabetics suffer from DFU in their lifetime, with 25% of DFUs eventually requiring amputation. Presently, the only approved drug treatment for DFU is a biologic, with a black box warning.

National/Societal Relevance

India has a large ~45 million diabetic population and 15% of diabetics lead to diabetic foot ulcers in life time. Majority of limb amputations are due to diabetic ulcers. GalnobaxÂ® would not require any specialized storage arrangements. It also does not need any hospital setting to administer and could be available in normal pharmacy outlets. Thus, GalnobaxÂ® would not only be quite affordable but also easily administrable and simply available treatment option for the urban as well as the under served and un-served segments of society.

Project Deliverables

a. **Progress vis-à-vis objectives**- completed.

b. **Technology/Product developed –** Novel treatment for DFU is being developed.

c. **IP generated/ Potential for IP generation –** The program has progressed into clinical trial as per the project objectives .

d. **Resources Generated –** NA.

Plans to take innovation further

The company plans to explore use of GalnobaxÂ® in other disease conditions like pressure ulcers, venous leg ulcers and burn wounds.

Risks Envisaged

Efficacy in human population remains as a risk factor.

Innovator Team

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Sami Mukhopadhyay
Kundan Ingle

Contact

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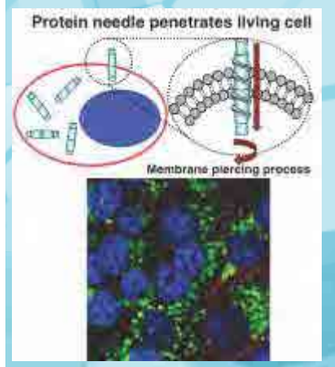
Nusrat J M Sanghamitra - KIIT



The Innovation

Development of a molecular needle as a novel platform for delivery of anticancer drugs.

Development Stage

Proof-of-Concept

Brief Description

Aims to develop a molecular needle that actively translocates through the plasma membrane by mechanical membrane piercing and carry/deliver anticancer drugs. Since this technique bypasses the classical endocytosis process & therefore expected to result in 20 times higher cell uptake, thereby at least 20 times less toxic side effects.

Innovative element

Membrane drilling theory of cell penetration, self delivery concept, drug delivery device developed using the above concepts will be first of its kind.

Market Potential

Given the burden of cancer worldwide 14 million new cases, 8 million death and 33 million people living with cancer and expected growth of Indian pharma market to 85 billion$ by 2020, drug delivery device is considered as super generics having lower development cost.

National/Societal Relevance

Cancer is one of the leading causes of mortality and morbidity worldwide leading to 8.2 million death, 14 million new cases and expected to rise by 70% in next two decades especially in the low- and middle-income countries. Proposal will advance the global fight against cancer and reduce the public health burden.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives .

b. **Technology/Product developed –** Drug delivery device based on unique concept of membrane drilling technology is being developed.

c. **IP generated/ Potential for IP generation –** None

d. **Resources Generated –** One Project Assistant is employed and cell culture and protein purification facility established.

Plans to take innovation further

Partnership with Dr S Banavli, Tata Memorial Hospital to take the innovation further into clinical trials. Collaboration with Genext genomics Pvt Ltd and Rohan Kamat, Viravecs to look into the gene delivery aspect

Risks Envisaged

Concept of self delivery and optimization of the reaction conditions to synthesize molecular needle.

Innovator Team

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Anindita Ganguly

Contact

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Plasmatech Solutions Pvt. Ltd.

The Innovation

Development and Validation of novel pseudo bio affinity based purification method for efficient recovery of coagulation factor VIII

Development Stage

Discovery

Brief Description

Plasmatech aims to establish a plasma protein purification facility to recover valuable proteins from human plasma. This facility would decentralize the system and make it more manageable in the Indian context

Innovative element

A rapid purification system using monolith based pseudo-bioaffinity column into a modular platform to process ~ 10L plasma per run with each run taking less than an hour and up to 5 runs per day, matching the capacities of conventional systems. Additionally, the employment of the pseudo-bioaffinity system of Histidine Ligand Affinity Chromatography HLAC with optimized binding and elution conditions at near-neutral pH has enabled a greater recovery of functional Factor VIII from the same starting material.

Market Potential

Prophylactic treatment of factor VIII deficiency costs US$ 30,000 per patient per year, which puts manufacturing costs of factor VIII at roughly one USD per IU. While the WHO recommended dose per patient is 20,000-30,000 IU/year, a typical registered Indian haemophilic patient receives 2,500-3,000 IU/year. The process being developed in this study would be efficient in a cost-effective recovery of factor VIII from plasma.

National/Societal Relevance

As availability and affordability of quality plasma components is a major bottleneck, modular plasma protein purification platform may improve the quality of the blood banks leading to quality life.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing is well as per the objectives.

b. **Technology/Product developed –** Plasma protein purification facility is being developed.

c. **IP generated/ Potential for IP generation –** Modular platform for the purification of coagulation Factor VIII from human blood plasma.

d. **Resources Generated –** None

Plans to take innovation further

To look for strategic partnerships with major players.

Risks Envisaged

High quality frozen plasma will require all network blood banks to undergo strict standardization and up gradation across the country.

Innovator Team

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Contact

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PNB Vesper Life Science Pvt Ltd

The Innovation

Clinical development of Novel CCK receptor antagonists for the treatment of inflammatory pain

Development Stage

Validation

Brief Description

PNB-001 is the lead molecule of PNB Vesper's Cholecystokinin CCK program. PNB Vesper has successfully synthesized the molecule with high purity and demonstrated both *in vitro* and *in vivo* preclinical studies and PK studies have been completed in GLP certified facilities to place the molecule in clinical Phase.

Innovative element

Successfully synthesized PNB-001 molecule, (lead molecule of PNB Vesper's Cholecystokinin CCK program) with high purity in large scale. The molecule has shown excellent efficacy in variety of animal models.

Market Potential

In 2009, the global market potential for pain medication was $50 billion (Global pain relieving drug market analysis 2010-2025, report publication date April 2010). Of this, inflammatory pain market alone is close to $15 billion.

National/Societal Relevance

Millions suffer from inflammatory pain, associated with various diseases including arthritis, and the pain affects tremendous increase in cost of health and rehabilitation, and lost worker productivity. According to a recent report, pain is a significant public health problem that costs society at least $560-$635 billion annually. Pain is currently treated with opioids, which are considered as a major reason for several deaths.

Project Deliverables

a. **Progress vis-à-vis objectives –** Successfully Achieved the objectives.

b. **Technology/Product developed –** Novel CCK receptor antagonist is being developed.

c. **IP generated/ Potential for IP generation –** The product has been granted US Patent, Patent No.: US 8,921,577 B2.

d. **Resources Generated –** The company mobilizes majority of fund for completion of various activities of the project from its own sources.

Plans to take innovation further

The Company has already initiated discussion with interested parties for partnership.

Risks Envisaged

PNB-001 was safe in both rodent and non-rodent species. It is most unlikely that the molecule will elicit undue toxicity in clinical trials.

Innovator Team

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Prof. Ajit Varma - FIIT

The Innovation

Interaction of Nano-embedded Piriformosporaindica with the plant of medicinal importance, *Brasiccaoleracea var. Botrytis* (Broccoli)

Development Stage

Proof-of-Concept

Brief Description

P.indica is a multi-functional fungus which helps as plant growth promoter, biofertilizer, metabolic regulator and bio-herbicide.

Innovative element

Novelty of the present work is the field trial on treatment of Broccoli with nano-embedded fungal *P.indica* biomass to promote plant growth and value addition. Use of nano-embedded fungal biomass as bio-fertilizer and plant promoter is not reported till date.

Market Potential

Besides enhancement in the productivity nanomaterial embedded *P.indica* also reduces the consumption of the harmful chemical fertilizers and pesticides. Enhanced crop yield and value addition to the medicinally important plants in a cost effective manner promises to fetch better market price for the product.

National/Societal Relevance

Development of such ecofriendly technology would help in improving the income of the farmers, hence, leading to more yield and enhanced per capital Income in a developing country like India.

Project Deliverables -

a. **Progress vis-à-vis objectives** - Project is progressing well as per the objectives.

b. **Technology/Product developed** – Development of ZnO-embedded P.indica for higher plant productivity and value addition.

c. **IP generated/ Potential for IP generation** - NA

d. **Resources Generated** - Two Junior research fellows, one field labour, one project coordinator and team leader.

Plans to take innovation further

1. Experimentation shall be carried out from seedling to the maturity level in green house to assess plant growth as an effect of the nano-material embedded fungus.
2. Impact of nano-particles embedded fungus on sulforaphane, an important active ingredient of Broccoli.
3. Technology will be transferred from lab to field

Risks Envisaged

None

Innovator Team

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Contact

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Robust Herbals Pvt. Ltd.

The Innovation

Development of Long Circulating Biodegradable Nanoparticle MRI Contrast Agents Based on Hydroxypropyl-beta-Cyclodextrin

Development Stage

Proof-of-Concept

Brief Description

MR based angiography using MRI contrast agents has tremendous potential in diagnostics, MR based angiography, cancer, staging, and for monitoring cancer therapy.

Innovative element

All FDA approved MRI contrast agents are based on small molecules, hence, resulting in a rapid clearance profile making them ineffective for MR angiography. This also results in a requirement of a high dose of the contrast agent for effective imaging. Nanogad has various advantages over traditional contrast agents such as long-circulating properties, rod-like morphology, higher Gd loading, bio-compatible and bio-degradable materials, hence, making it an attractive blood pool contrast agent. The project involves synthesis of a library of agents based on the Nanogad concept that will be evaluated in animal models for their efficiency as blood pool contrast agents.

Market Potential

The global market for imaging contrast agents is projected to exceed $15 Billion by 2017

National/Societal Relevance

First Indigenous Blood Pool MRI/MRA Contrasting agent

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives.

b. **Technology/Product developed –** Novel Blood pool MRI/MRA Contrasting agent being developed.

c. **IP generated/ Potential for IP generation –** None.

d. **Resources Generated –** Initiated new enterprising sector specialized in Molecular imaging and Diagnostic Reagents. Two research associates are being trained as skilled human resource.

Plans to take innovation further

New Blood Pool MRI/MRA Contrasting agent product development. To enable this technology for Blood pool contrast agent for PET Imaging.

Risks Envisaged

The absence of a GMP method for production of the Nanogad materials.

Innovator Team

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K.S. Sandesh

Contact

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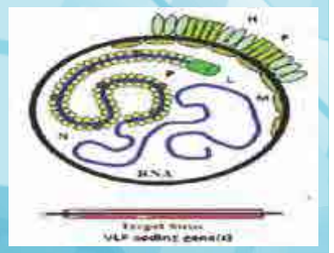
Seagull BioSolutions Pvt. Ltd



The Innovation

Optimization and characterization of a Virosome Vaccine for Dengue

Development Stage

Early stage Validation

Brief Description

A novel Virosome vaccine was produced and shown to induce cellular and humoral anti-dengue serotype 2 immune responses. This project compares the utility of prM, E & NS1 proteins as vaccinating antigens and then determine the ability of Dengue Virosomes expressing prM and E proteins and NS1 protein if found more effective to induce a tetravalent anti-dengue protective immunity in animals.

Innovative element

Virosomes are non-replicating Measles vaccine virus derivatives that code for & display exclusively selected Dengue virus proteins. They stimulate anti-dengue immunity by themselves and also express additional dengue antigen so that the vaccinating agent will be available for longer duration for more effective immunization. As vaccinating agents, Virosomes are gauranteed to be safe. They are also observed to be more effective at inducing immune responses.

Market Potential

All Indians are susceptible to Dengue. Global market for Dengue vaccine is estimated at 500 Million doses per year.

National/Societal Relevance

Dengue is a major health problem in India. An effective vaccine is currently not available. Similarly, Chikungunya, Japanese Encephalitis, Zika & other mosquito-borne viruses are critical healthcare problems in India. Virosomes will offer a simple & versatile means of producing safe vaccines against these diseases.

Project Deliverables

a. **Progress vis-à-vis objectives** - Characterization of Immunogenicity produced by Virosomes Den2+NS1 & Den2 alone

b. **Technology/Product developed –** Dengue virosome Vaccine.

c. **IP generated/ Potential for IP generation** - PCT/IN2016/00004 filed.

d. **Resources Generated** - Manpower : 3, Equipment purchased : PCR machine, Revenue generated : Rs 0.5 Cr.

Plans to take innovation further

Planning to go for further studies.

Risks Envisaged

Dengue Virosomes are already shown to induce protective anti-Dengue immunity. Induction of a balanced tetra-valent anti-dengue immunity is a challenge. This project aims at ascertaining this potential of Dengue Virosomes.

Innovator Team

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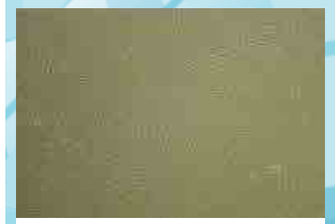
Sri Research for Tissue Engineering Pvt. Ltd.



Muscle derived stem cells (MDSCs) in culture in MDSC Growth Medium

The Innovation

Development of an injectable targeted cell therapy for the treatment of Stress Urinary Incontinence

Development Stage

Proof-of-Concept

Brief Description

Stress Urinary Incontinence is a distressing condition in 40 percent of Indian women aged 40 and over. Aim to develop a minimally invasive injectable targeted cell therapy for the treatment of SUI. A muscle biopsy will be harvested and MDSCs will be isolated and expanded in vitro. These MDSCs will be delivered to the sphincter in a biomaterial formulation. Upon injection, the biomaterial bulking agent will increase the resistance of the urethra and the injected MDSCs will engraft in the sphincter muscle and differentiate into myotubes, thereby augmenting the strength and contractility of the urinary sphincter in 6-12 months.

Innovative element

The innovation lies in developing a therapeutic drug that improves functional outcomes for the patient immediately after its administration and promotes sphincter muscle regeneration for long-term improvement in the symptoms of SUI.

Market Potential

SUI affects almost 40 percent women over the age of 40 in India. Therefore, the number of affected patients is very high and the market potential for this therapy in India and abroad is immense.

National/Societal Relevance

A therapy which manage urinary incontinence condition in middle-aged women could significantly improve their quality of life.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives.

b. **Technology/Product developed –** Injectable targeted cell therapy for the treatment of Stress Urinary Incontinence is being developed.

c. **IP generated/ Potential for IP generation –** None.

d. **Resources Generated –** Manpower employed/trained - 4.

Plans to take innovation further

SRTE will continue the research to develop a biocompatible bulking agent which can be combined with these MDSCs prior to injection. Additionally, pre-clinical studies involving an animal model of SUI will be carried out to evaluate the safety and efficacy of MDSC treatment.

Risks Envisaged

To produce large-scale cell cultures, to develop a suitable animal model for SUI and to prove safety of the MDSC therapy in laboratory animals.

Innovator Team

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Animesh Agrawal
Sujata Ravi
Kumar Chokalingam

Contact

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Stempeutics Research Pvt. Ltd.

The Innovation

A Randomized, Double Blind, Multicentric, Placebo Controlled, Phase II Study Assessing the safety and Efficacy of Intra-arterial (Hepatic) Ex-Vivo Cultured Adult Allogenic Mesenchymal Stem Cells in Patients with Liver Cirrhosis.

Development Stage

Late stage Validation

Brief Description

The only curative treatment available for advanced decompensated liver cirrhosis is Orthotopic Liver Transplantation (OLT). However, potential benefits are hampered by many drawbacks such as relative shortage of donors, operative risk, post-transplant rejection, recidivism of the pre-existing liver disease, high cost and several complications. Adult stem cell therapy may offer a cure or regression of the disease for such group of patients. But this type of novel stem cell technology based clinical trial may not have a drastic impact on the progression of the disease process when the disease is in advanced stage

Innovative element

Novelty of Stempeucel® product is based on pooling technology. The manufacturing process of Stempeucel® involves pooling of three master cell banks MCB, each from a single healthy donor, for creation of working cell banks WCB to achieve the desired therapeutic dose.

Market Potential

Liver Cirrhosis has no definitive cure as of now, and available treatment options are only symptomatic. If this therapy becomes successful, it will open up a novel treatment option for these patients, addressing the core pathology of the illness

National/Societal Relevance

Alcoholic cirrhosis develops in 10 to 15% of individuals who drink heavily for more than a decade. The standard treatments available do not offer a cure for the disease. Hence, if stem cell therapy is successful it will be a big boon for these patients.

Project Deliverables

a. **Progress vis-à-vis objectives –** The ongoing Phase 2 trial data showed that use of StempeucelÂ® in alcoholic liver cirrhosis at a dose of 2.5 million cells/kg body weight is safe and shows positive trend in some parameters like Child Pugh score and Quality of Life parameters.

b. **Technology/Product developed –** Stempeucel as a product will be developed for treatment of alcoholic cirrhosis patients once the phase 3 trial is complete and successful.

c. **IP generated/ Potential for IP generation –** Management Of Liver Disease Using Pooled Mesenchymal Stromal Cells (PCT/IB2015/054909, Filing Date: June 30, 2015)

d. **Resources Generated –** The existing resources of the company are being used

Plans to take innovation further

Planning to initiate Phase 3 trial using Stempeucel for alcoholic liver cirrhosis with the most efficacious dose. Looking for suitable partners to take it forward.

Risks Envisaged

The product may fail to show definitive efficacy in Phase 3 trial.

Innovator Team

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Sun Pharmaceutical Industries Ltd.

The Innovation

Bevacizumab upto Pre-clinical studies

Development Stage

Proof-of-concept

Brief Description

Bevacizumab is a full-length IgG1κ isotype antibody 93 human, 7 murine sequences composed of two identical light chains 214 amino acid residues and two heavy chains 453 residues with a total molecular weight of 149 kDa. Bevacizumab selectively binds with high affinity to all isoforms of human vascular endothelial growth factor VEGF and neutralizes VEGF's biologic activity. Bevacizumab is marketed by Roche under the trade name Avastin™ which is indicated for the treatment of Metastatic colorectal cancer, Non-squamous non-small cell lung cancer, Glioblastoma and Metastatic renal cell carcinoma with interferon alfa and Cervical Cancer.

Innovative element

The cell line is developed using the Proprietary expression vector of Sun Pharma.

Market Potential

The sale of the product in 2015 was $ 6.74 billion in India and abroad. The product recorded a very impressive sales growth in last 5 years.

National/Societal Relevance

Presently the treatment is too expensive to afford by the common mass. Sun Pharma is trying to develop the product, which could be cost effective and affordable by the common mass.

Project Deliverables

a. **Progress vis-à-vis objectives –**

Cell Line developed. Small scale and pilot scale process developed. The product was found physico-chemically and biologically comparable to the Innovator's product.

b. **Technology/Product developed –** The Product is under development.

c. **IP generated/ Potential for IP generation –** IP will be generated as the Project progresses.

d. **Resources Generated –** The existing resources of the company are being used.

Plans to take innovation further

Planning to go for further studies.

Risks Envisaged

Producing the Biosimilar comparable to the reference drug in terms of Physico-chemical, Biological, PK/PD, Immunogenecity.

Innovator Team

Rajat Kumar Ghosh
Nitin Nage
Nandkumar Bhagat
Santosh Pokalwar

Contact

Sun Pharmaceutical Industries Ltd.
Tandalja,
Vadodara-390020

Tania Paul - Venture Centre

The Innovation

To demonstrate proof of concept to develop a novel, cost effective, non-allergic herbal formulation for management of spontaneous bleeding and allied complications in multiple coagulation disorders.

Development Stage

Proof-of-Concept

Brief Description

A novel formulation for management of spontaneous bleeding and allied complications in coagulation disorders where body fails to clot the blood.

Innovative element

Formulating a herbal product with dual oral and topical mode of administration to help people with bleeding tendencies like Hemophilia, VWD.

Market Potential

As per World Pharmaceutical Industry and Market prediction for 2014-2024 - world drugs market for preventing hemorrhages will generate $13.5 bn in 2017.

National/Societal Relevance

People with bleeding disorders face life-long physical, psychological, financial and employment challenges. Deaths per year due to hemophilia is 77000, GIT Bleeding is 10000, Post partum hemorrhages is 136000, Intracranial Hemorrhages is 20000.

Project Deliverables

a. **Progress vis-à-vis objectives –**

   1st batch of proposed formulation in 25 bottles, 2nd batch of proposed formulation in 25 bottles and Quality Control and standardization of the formulation completed.

b. **Technology/Product developed –** The technology being developed is Oral Formulation and Topical Gels to manage hemophilia.

c. **IP generated/ Potential for IP generation –** The Technology developed will be patentable.

d. **Resources Generated –** Four manpower employed viz Principal Investigator, Co-Principal Investigator, Project manager and Project Assistant.

Plans to take innovation further

The formulation will be licensed out to manufacturers.

Risks Envisaged

Most of the coagulation disorders are genetic defects and external application or oral administration of an herbal product may not repair the genetic defect but will be helpful to provide symptomatic relief.

Innovator Team

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Mangesh Gurav

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Tergene Biotech Pvt. Ltd.

The Innovation

Development of an Affordable, Asia specific 15 valent Pneumococcal Polysaccharide - CRM 197 Protein Conjugate Vaccine.

Development Stage

Validation

Brief Description

Development of affordable vaccines against infectious diseases based on the polysaccharide-carrier protein conjugate platform.

Innovative element

Cost effective production of CRM 197. Cost effective production of Polysaccharides. Highly efficient conjugation protocol. Affordable, India Specific Vaccine formulation.

Market Potential

Pneumonia accounts for 18% of child deaths in developing countries, making it one of the leading causes of death among young children. Forecast during 2012 has indicated that by 2015, potential global demand of pneumococcal vaccine will approximately be 120 million doses, increasing to nearly 210 million doses by 2020, and reach just over 220 million doses by 2030.

National/Societal Relevance

India is witnessing the highest number of pneumonia-related child deaths in the world. The infection is killing 16 lakh children under five every year, more than 3.7 lakh in India alone. At present, there are no local manufacturing capabilities and the vaccine is imported.

Project Deliverables

a. **Progress vis-à-vis objectives –** Completed

b. **Technology/Product developed –** Technology developed for a commercially viable CRM 197 production. Technology developed for an affordable Pneumococcal Conjugate Vaccine.

c. **IP generated/ Potential for IP generation –** Production technology of CRM 197. Formulation and Production of a 15-valent Pneumococcal Conjugate Vaccine.

d. **Resources Generated -** A Pilot GMP Facility has been created for the production of clinical batches of PCV-15.

Plans to take innovation further

The Company has entered into a joint venture with M/s Aurobindo Pharma Ltd. for conducting human clinical trials and subsequent commercialization of PCV-15.

Risks Envisaged

The life cycle of bacterial vaccines are very high, exceeding 50 years as proved in the existing bacterial vaccines. However, there are possibilities of Protein antigens being developed as alternate vaccine candidates.

Innovator Team

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K. Sathyan
S. Sundar
P. Kapil

Contact

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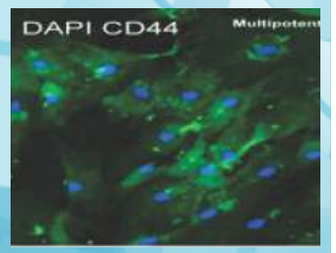
Total Potential Cells Pvt. Ltd.



The Innovation

A novel therapeutic modality using Adipose derived Mesenchymal Stem cells (ADMSCs) for treating Osteoarthritis patients & establishing clinical based evidence'.

Development Stage

Validation

Brief Description

The project with deal in a novel treatment for Osteoarthritis by use of stem cells.

Innovative element

The accomplishment of project will provide immense help to those who are advised for knee replacement, arthroscopy and other invasive and operative surgeries. The stem cell therapy is noninvasive, inexpensive, less time consuming and minimum hospitalization.

Market Potential

Because of low cost of the product compared to artificial imported stainless steel joints, minimum surgery and only a day of hospitalization, this product has a potential to outdate the present modality of joint replacement altogether.

National/Societal Relevance

With an increase in the life span of Indian population, there is a growing number of patients with age group that is more prone to be affected with Osteoarthritis. The only curative treatment option is joint replacement. A therapeutic modality that is less invasive, less expensive and requiring minimal hospitalization will have significant societal impact.

Project Deliverables

a. **Progress vis-à-vis objectives –** Isolation and culture of human ADMSC's with optimum yield and their characterization with specific markers CD73, CD 90, CD 105, CD 166 and CD 34, CD 45, HLA-DR. 25 patients with pre and post operation evaluated for biochemical factors responsible for induction of inflammatory process in O.A. Isolation of SVF containing ADMSCs standardized to take the product to the market.

b. **Technology/Product developed –** Adipose derived autologous human somatic stem cells with minimum manipulation for treatment of Osteoarthritis.

c. **IP generated/ Potential for IP generation –** Process of preparing Mesenchymal stem cells for the treatment of Osteoarthritis as regenerative medicine (Patent filling number : 2015/MUM/2015).

d. **Resources Generated –** Manpower - 4 scientists trained, Facility – GMP class V lab .

Plans to take innovation further

Looking for investment

Risks Envisaged

Sometimes Oncogenesis is said to be a risk for stem cell therapy.

Innovator Team

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Rajni Vyas
Anantmarathe
Umang Gandhi
Pradeep Mehta
JaymeshThadani

Contact

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Total Potential Cells Pvt. Ltd.

The Innovation

Differentiation of Human Adipose tissue Derived Stem Cells to Islet Cell mass Aggregates and its preparation for clinical application.

Development Stage

Proof-of-concept

Brief Description

ADMSCs are trans-differentiated to insulin secreting cells and they form Islet like cell aggregates, ICAs. This product will help to decrease the dosage of insulin to treat type I and II Diabetes.

Innovative element

The hypoglycemic properties of ADMSCs are utilised to decrease the insulin dosages. The innovation is thus minimally invasive, cost effective and do-able. There is no need for immuno-suppression

Market Potential

Many multi-speciality hospitals will be benefitted. The pharmaceutical companies will be benefitted if this product is further studied.

National/Societal Relevance

Diabetes is the topmost national priority for research. India is the largest contributor to regional mortality with 983,000 deaths caused due to diabetes in year 2012. Over the years, present therapeutic regimen becomes ineffective. Diabetes is also responsible for renal failure, blindness, hypertension and cardiovascular diseases. Many of the patients develop insulin resistance. Worldwide high blood glucose kills about 3.4 million people annually. The product reinforces the search for solution to cure diabetes type 1 as well as halt/ reverse the progression of its complications. Of the various cell sources for replacement, MSCs with their multi lineage capability are an ideal source.

Project Deliverables

a. **Progress vis-à-vis objectives –** Completed

b. **Technology/Product developed –** In vitro studies have proved that the differentiated cells are insulin secreting cells with Dithizone staining, C-Peptide Test and Glucose Stimulation Insulin Secretion Test. Clinical trial needs to be conducted to assess the effectiveness of the product.

c. **IP generated/ Potential for IP generation –** The IP has been filled and is under process.

d. **Resources Generated –** Manpower - 4 researchers are trained. Facility created - GMP Class V Lab.

Plans to take innovation further

To conduct clinical trial for type I & type II diabetes.

Risks Envisaged

The product may form tumors, however, the product is safe as no study has been reported yet

Innovator Team

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Rajni Vyas
AnantMarathe
Ansarullah
JaymeshThadani
Prashant Kshatriya

Contact

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Baroda - 390001

Unichem Labs Ltd.

Collaborator: Karnataka University, Dharwad

The Innovation

An integrated approach to develop recombinant Sclerotium rolfsii (SRL) antitumor lectins in *E. coli* as novel targeted anti-cancer drug and drug delivery system for human colon and breast cancer, providing affordable health care to cancer patients

Development Stage

Proof-of-Concept

Brief Description

The project aims to develop cost effective and commercially viable process for production of recombinant lectins in the required quantity and purity in *E. coli* by optimizing the already available preliminary laboratory protocols. The aim is to develop the recombinant lectins to explore their applications as cancer therapeutic agents

Innovative element

The project aims to exploit anti-cancer potential of recombinant Sclerotium rolfsii lectins. Two recombinant fungal lectins from Sclerotium rolfsii with similar carbohydrate specificity and cancer cell binding properties are produced and successfully expressed in E. coli.

Market Potential

New and emerging therapies will likely cast a shadow over conventional cancer therapies, such as chemotherapy, radiation therapy, hormonal therapy and surgery, and propel sales in global cancer therapies market.

National/Societal Relevance

Cancer is the second highest killer next to cardiovascular diseases and poor survival rate is either associated with late stage diagnosis or limited access to timely and standard treatment. Keeping this in mind, the aim is to develop recombinant fungal lectins as an anticancer drug for treating colon and breast cancer at an affordable cost.

Project Deliverables

a. **Progress vis-à-vis objectives –** Fermentation and downstream processes of *E. coli* BL21 strain expressing lectin has been established and found to be more than 98% purified. ELISA Protocol has been standardized for recombinant lectins with monoclonal antibodies against native lectins. Maximum Tolerable Dose MTD study has been completed. Daily dose of 60 mg/kg body weight till 6 days was showing toxicity.

b. **Technology/Product developed –** Under development

c. **IP generated/ Potential for IP generation –** Indian Patent Appln. No-30/MUM/2008 filed on 4th Jan 2008. Indian Patent Appln 350/MUM/2009 filing date June 12, 2009. International Application PCT Number PCT/IN2009/000306, filing date 27.05.2009, published on 26.08.2010. International Publication Number WO 2010/095143 A2. European Patent Application Number 09840273.8-2403/2430041, filing date 22.02.2010.

d. **Resources Generated -** The collaborator has recruited two SRFs to handle project related activities.

Plans to take innovation further

Once the POC is established, technology will be taken to preclinical and clinical phases to establish efficacy and non toxicity.

Risks Envisaged

Probable biological activity, stability and efficacy of recombinant lectins formulations against target cell lines.

Innovator Team

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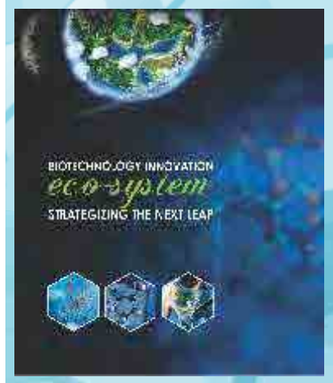

The Innovation

Development of a novel technology for generation of stable transgenic systems with no off-target effects.

Development Stage

Proof-of-concept

Brief Description

To develop a process to generate stable transgenic model systems which will have no off-target effects typically caused due to genetic perturbations.

Innovative element

The innovative element in this technology is "No off-target effects factor".

Market Potential

This technology fits majorly into two sectors: academia, wherein genetically altered model systems form the basis of research and pharmaceutical industry, wherein drug discovery platforms would utilize this technology.

National/Societal Relevance

The proposed project opens up indigenously developed Genome Editing platforms in India thereby adding a major feature to the Life Science industry in India.

Project Deliverables

a. **Progress vis-à-vis objectives -** A kit to make stable transgenic cell lines with no off-target effects.

b. **Technology/Product developed –** In process.

c. **IP generated/ Potential for IP generation –** Process patents may be filed.

d. **Resources Generated –** Incorporated Viravecs Labs LLP with 3 employees so far.

Plans to take innovation further

To grow further by partnering with other units which can provide with expertise in respective model systems.

Risks Envisaged

Market outreach.

Innovator Team

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Vital Bioscientific Solutions Pvt. Ltd.

The Innovation

Development of a novel monolayer based parallel artificial membrane permeability assay to determine permeability of new chemical entities and drugs

Development Stage

Validation

Brief Description

Designed and fabricated a prototype which helps to determine the permeability of compounds in the preclinical development phase. This helps to sort the lead molecules and reduces the high attrition rate involved in the drug discovery process. The technology is based on mono-layer coating and it is bio-mimetic, efficient, low cost when compared to the existing PAMPA models.

Innovative element

Bio-mimetic system uses lipid mono-layer which is not currently available in the market. The amount of lipid required for the assay is minimal and the material cost is 1/4th of currently available PAMPA system, thus, cost effective and increased high throughput.

Market Potential

The major customers are drug discovery pharma-companies and CROs. Currently PAMPA plates are imported from Europe. Our PAMPA system will cater to the ADME requirement in preclinical drug discovery.

National/Societal Relevance

By employing our PAMPA system the cost of Lead identification reduces and makes the process more efficient.

Project Deliverables

a. **Progress vis-à-vis objectives –** The parameter optimization for Indigenous PAMPA system has been completed.

b. **Technology/Product developed –** High throughput Permeability determination system

c. **IP generated/ Potential for IP generation –** Two patents are being filed.

d. **Resources Generated –** Secured funding from MSME, GOI for 7.5 Lakhs & 4 Internships offered for a period of 3 months each.

Plans to take innovation further

Partnership for co-marketing

Risks Envisaged

Competition from existing Multinational players & Customer acceptance

Innovator Team

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Vitas Pharma Research Pvt. Ltd.

The Innovation

Novel inhibitors of fatty acid biosynthesis for the treatment of drug resistant *S.aureus* bacterial infections

Development Stage

Validation

Brief Description

To identify and develop a novel class of compounds to treat infections caused by multi-drug resistant *Staphylococcus aureus*, the most commonly isolated Gram positive pathogen in hospital acquired infections.

Innovative element

Candidate with potent activity against drug resistant *S.aureus* have been designed *via* Structure Guided Drug Design. The chemical series is novel and the patent application covering this work has been granted in the US. The compound is orally bio-available and suitable for IV/oral use.

Market Potential

The peak sales for a compound emerging from this work is expected to be $ 100-200 million globally.

National/Societal Relevance

Staphylococcus aureus is the primary cause of lower respiratory tract infections and surgical site infections and the second leading cause of nosocomial bacteremia, pneumonia, and cardiovascular infections. Methicillin resistant *S.aureus* MRSA, can account for 30-50 of isolates in hospitals in India and worldwide with resistance to last line antibiotics such as Vancomycin, Linezolid and Daptomycin being reported. MRSA has been designated as a "serious threat" by the CDC in 2013. Thus new drugs for MRSA infections are urgently required.

Project Deliverables

a. **Progress vis-à-vis objectives –** Completed

b. **Technology/Product developed –** Optimized lead candidate with potent *in vitro* activity in global clinical isolates and *in vivo* efficacy has been identified. The optimized series has demonstrated low mutation frequencies, mutation prevention concentrations and minimal changes in MIC over continuous passage. The compound has demonstrated safety in rodent and non-rodent species in single as well as repeat dose studies.

c. **IP generated/ Potential for IP generation –** A PCT application was filed in 2012. It is in the national phase in Europe and Canada. It was granted in the US in April 2015.

d. **Resources Generated –** Two medicinal chemists and a biologist were trained.

Plans to take innovation further

Seeking funding to develop the compound in the clinic.

Risks Envisaged

Safety Pharmacology studies must be conducted to complete the safety assessment. Formulation development has to be undertaken to ensure i.v./oral switchability in clinical studies.

Innovator Team

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Vitas Pharma Research Pvt. Ltd.

The Innovation

Inhibitors of bacterial DNA Gyrase as novel drugs for multi-drug resistant infections

Development Stage

Proof-of-concept

Brief Description

A novel, non-fluoroquinolone class of compounds have been identified to treat multi-drug resistant infections, targeting DNA Gyrase. The lead series has shown broad spectrum activity, with particularly noteworthy activity towards Acinetobacter.

Innovative element

Novel chemical compounds targeting DNA Gyrase and intended for the treatment of infections resistant to last line antibiotics.

Market Potential

A drug emerging from this research has the potential to achieve peak sales of US$ 400-600 million covering worldwide markets.

National/Societal Relevance

The bacterial disease burden in India is among the highest in the world, consequently, the need for antibiotics is large.

Project Deliverables

a. **Progress vis-à-vis objectives –** Identified optimized lead candidate with activity against multidrug resistant Gram positive and Gram negative bacteria and established efficacy in animal models of infection with Gram negative bacteria.

b. **Technology/Product developed –** A lead and a backup candidate compound with potent activity against Gram negative species have been identified, in particular, the activity against Acinetobacter and highly resistant clinical isolates. The mutation frequency and mutation prevention concentration are low. Efficacy in the primary infection model has been demonstrated.

c. **IP generated/ Potential for IP generation –** A PCT application was filed in 2013 and is in the national phase in Europe, USA and Canada.

d. **Resources Generated –** Two medicinal chemists and one biologist have been trained.

Plans to take innovation further

Seeking partnerships with pharma companies to take the compounds further in the clinic.

Risks Envisaged

Although there are no overtly toxic features in the lead series, safety pharmacology and toxicity studies need to be undertaken.

Innovator Team

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Yasham P2D Lifesciences Pvt. Ltd.

The Innovation

Tumor Necrosis Factor - alpha (TNFα) inhibiting compound as a first in class drug treatment for neuroinflammatory diseases.

Development Stage

Validation

Brief Description

To develop a tumor necrosis factor alpha TNFα inhibiting first in class, orally bio-available, anti-neuro inflammatory small molecule PD2015 prototype drug treatment for neuro-cognitive dysfunction.

Innovative element

Proposed drug candidate (thiothalidomide drug,) an anti-TNFα specific, orally bioavailable small molecule drug targeting neuro-inflammation

Market Potential

Proposed first in class orally bioavailable low molecular weight thiothalidomides will overcome the drawbacks of available biologics, hence, have the potential to penetrate the market.

National/Societal Relevance

The risk of developing Alzheimer's appears to be increased by many conditions and risk factors that damage the heart and blood vessels, including heart disease, diabetes, stroke and high blood pressure or cholesterol all of which afflict the Indian population at an ever-increasing rate.

Project Deliverables

a. **Progress vis-à-vis objectives –** Process chemistry and optimized methods for large scale synthesis of PD2013, PD2015, and PD2016. Physico-chemical characterization, identification and formulation of most suitable salt forms. Rat PK profile and brain to plasma ratios for all three compounds. Efficacy studies at three dose level in *in vivo* models of AD.

b. **Technology/Product developed –** Extensive preclinical efficacy studies of novel thalidomide analogs made by NIH scientists in models of neuro-inflammation, AD, and TBI.

c. **IP generated/ Potential for IP generation –** 3 Patents - relates to thalidomide analogs, methods of synthesizing the analogs, and methods for using the analogs to modulate angio-genesis and tumor necrosis factor alpha activities in a subject.

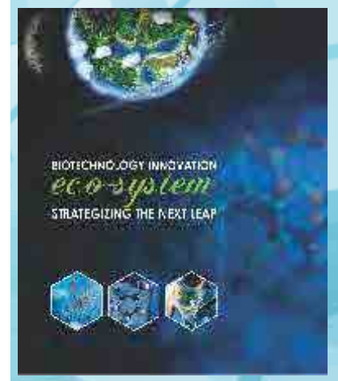
d. **Resources Generated -** Manpower trained: 2 Masters Candidates and 2 PhD students in Punjab University.

Plans to take innovation further

To conduct IND-enabling studies and advancing it into human clinical trials for treating AD.

Risks Envisaged

Potential teratogenicity associated with these compounds.



Innovator Team

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Innovation Profiles

BIRAC Innovators

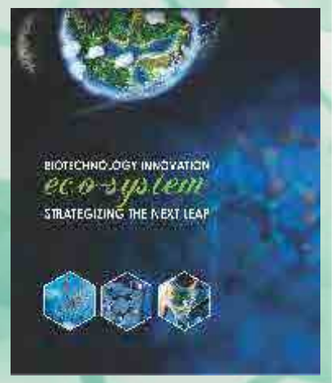
Healthcare

Devices & Diagnostics

September 2016

ABC Genomic India Pvt. Ltd.

Collaborator: King George Medical University, Lucknow



The Innovation

A Point of Care (POC) Genetic Testing Device for TB Markers Suitable for Primary Health Care Centers-Phase I

Development Stage

Development & Validation.

Brief Description

The goal is to develop and validate a rugged and low cost diagnostic tool for TB, suitable for use by personnel at primary healthcare centers, hospitals and diagnostic labs. The device will employ pre-validated genetic markers and state-of-the-art DNA amplification technology at a fraction of the cost incurred today. When developed, this low cost platform will also be equally useful for detecting other genetic markers.

Innovative element

(1) A low cost and rugged genetic assay platform and (2) A validated microfluidic chip to test for TB in low resource setting. In future, microfluidic chips that contain markers for other diseases will also be validated to work on the same platform.

Market Potential

With a growth rate of 20 for genetic screening market in India, our device has excellent commercialization potential. Internationally, the growth of POCs is at the top of genetic screening market. The benefits to the society, however, are obvious in terms of the patients diagnosed and treated

National/Societal Relevance

Various strains of Mycobacterium tuberculosis, can be stopped within 6 months with treatment costing as little as Rs 1,000. Yet, India ranks number 1 in disease burden with a prevalence of 299 TB patients per lakh of population and approximately 10 of the patients dying every year. This is a painfully large number and unacceptable for a nation that has led the way in low cost drugs and treatments. Most genetic screening approaches require sophisticated instrumentation and highly trained microbiologists or molecular biologists. Thus, there is a need to develop tools that are affordable at PHCs and can be operated by moderately trained personnel. Our low cost TB Tester for TB genotype will provide this ability.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing as per the objectives
b. **Technology/Product developed –** A Point of Care Genetic Testing Device for TB Markers
c. **IP generated/ Potential for IP generation** - TB tester has great IP potential.
d. **Resources Generated** - 3 personnel are employed in the project.

Plans to take innovation further

To be initiated soon

Risks Envisaged

The main challenge for the company will be to sustain the business at low margins.

Innovator Team

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Accuster Technologies Pvt. Ltd.

The Innovation

Proposal for Upgradation of Mobile Lab with Kinetic mode (Addition of highly recommended tests HbA1c, SGOT-Kin, SGPT-Kin, Microalbumin, CR Protein etc.)

Development Stage

Validation

Brief Description

Mobile Lab is a Compact Portable Clinical Laboratory in a suitcase which contains all essential instruments like Biochemistry Analyzer, Centrifuge, Incubator, Data Recorder/Mini Laptop with Patient Data Management Software, Micropipettes, other accessories and power back-up. It has a proper place for each and every component of the Lab and it is so rugged that it can be easily carried to the far flung and remote locations. Suitcase has Omni-directional mobility.

Innovative element

MOBILE LAB, LABIKE, ACCURATE ALL, ACCUKINE, BMI

Market Potential

Huge Market Potential

National/Societal Relevance

Mobile lab overcomes the problem of inaccessibility and affordability of diagnostic tests. The cost of performing the tests using mobile lab is low and hence it is opt for a country like India.

Project Deliverables

a. **Progress vis-à-vis objectives –** Applicant is adding SGOT, SGPT and HbA1c, GGT, Amylase to the present platform. They have already successfully added UV-kinetic 340 nm in the device. Presently, they are working on adding HbA1C , GGT and Amylase to the device.
b. **Technology/Product developed –** Health sector equipments.
c. **IP generated/ Potential for IP generation** - Yes
d. **Resources Generated** - Skilled manpower in the health care industry is being developed.

Plans to take innovation further

Yes

Risks Envisaged

Scale up the innovation to size it deserves in stipulated time. Fund raising is a critical step.

Innovator Team

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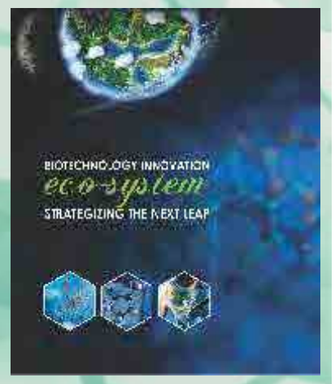
Advenio TecnoSys Pvt. Ltd.



The Innovation

Computer Assisted Reading Tool for Automatic Detection and Grading of Diabetic Retinopathy.

Development Stage

Validation

Brief Description

This innovation enables early diagnosis and can be scaled up for broader health care needs. Apart from ophthalmologist dialectologists, general physician and trained technicians can also use it enabling early intervention for many retinal diseases

Innovative element

An automated diagnostic software for end-to-end eye-care solution and point-of-care diagnostics.

Market Potential

The global market for diabetes diagnostics is forecast to reach US$32 billion by the year 2017. Principal growth drivers include increasing incidence of diabetes more specifically in the highly populated developing regions, technological innovations and increasing in aging population.

National/Societal Relevance

The automated diagnostic software detects and specifies the type of retinal abnormality and can be used at point-of-care by a non-trained personnel for mass screening and prevalence study providing a solution to meet with the growing disproportionate ratio of number of patients requiring attention of qualified clinicians.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives, Development of a web based system for the diagnosis of diabetes is in final phase.

b. **Technology/Product developed** – Technology is developed and validated on few samples. Development of a Web-based tele screening framework for the diagnosis of diabetes is in final phase.

c. **IP generated/ Potential for IP generation** - IP Applied: Devices for retinal imaging and analysis methods and systems

d. **Resources Generated –** Five technical resources are employed.

Plans to take innovation further

Apart from Telescreening Solution, Advenio is also pursuing the development of a smartphone based fundus camera. The diagnostic software is supposed to be deployed as an integrated mobile-based application and deployed in a client server mode.

We have already come up with a preliminary CAD design of the camera and identified design specifications and vendor for it.

Risks Envisaged

The main challenge anticipated is to integrate the solution in to the current work-flow and eye care practice. The other challenges would be customer acquisition, create end-user awareness for usage of the solution and making recognize the absolute need of the solution.

Innovator Team

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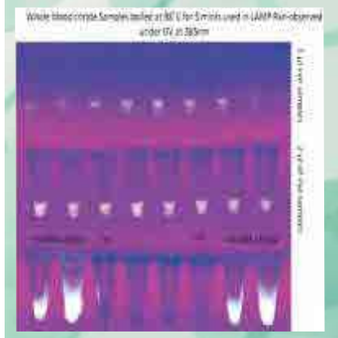
All India Institute of Medical Sciences

Collaborator: Dr. Khanna's Path Lab Pvt. Ltd.



The Innovation

Validation of a rapid diagnostic method for the detection of HLA allele and its association with cutaneous drug reactions in persons with epilepsy.

Development Stage

Validation

Brief Description

Screening of people with epilepsy for the presence of HLA allele may avoid the severe manifestations caused by the adverse reactions of the drugs. Diagnostic test kits like the LAMP reaction provide quick results so that the patient can be put on medication without delay in waiting for the results.

Innovative element

Quick Diagnostic test kits like the LAMP reaction are quick, cheap, reliable and can be easily carried out outside the laboratory. Since heated blood samples can be directly used, the LAMP-HB can ideally be developed into a test kit for use in both clinical and bedside settings. With this test design, the LAMP approach is expected to be capable of detecting all specific HLA genotypes.

Market Potential

Once developed this LAMP kit will be used as a point of care testing device for epilepsy patients. Before starting the medication, they may be tested for the HLA allele thus avoiding the serious cutaneous reactions and saving the patient's life.

National/Societal Relevance

Patients life may be saved from life threatening cutaneous reactions once HLA is tested with the help of this kit.

Project Deliverables

a. **Progress vis-à-vis objectives –** As per the objectives

b. **Technology/Product developed –** In progress

c. **IP generated/ Potential for IP generation** - None

d. **Resources Generated** - Manpower have been trained in this project for the development of the kit. They are working tirelessly for sample collection, data acquisition and storage and data analyzing.

Plans to take innovation further

Working with the collaborater Khanna Path care pvt. ltd.

Risks Envisaged

None

Innovator Team

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Amith Derek Mendonca

Collaborator: Asimov Robotics

The Innovation

Stereotactic Flexible Robot in Craniofacial Surgery

Development Stage

Proof of Concept

Brief Description

Proposal aims to reduce the morbidity in craniofacial surgery, by introducing a flexible robot via the skin. Pre-operatively a CT scan of the skull and face with 3-dimensional re-construction is obtained, demonstrating the entire craniofacial deformity. The surgeon plans the cuts on the bone of the skull and face, depending on what segment of the face requires correction and then draws the plan of the osteotomy on the computer model by dragging the cursor on the screen, starting from the entry point in the upper gum.

Innovative element

The invention addresses the unmet need : Minimal Access incision - Behind the ear, Early intervention- ability to cut bone at an age when the bones are soft, ability to cut bone extensively - hyper-redundant robot using stereotactic navigation technology, Ability to accurately cut bone- stereotactic navigation, with inbuilt sensors to confirm bone and visual feedback to the surgeon, Reduced blood loss - no bicoronal scalp incision and therefore reduced blood loss from the open scalp and Reduced morbidity or damage to structures - Robotic tissue retractors with multiple degrees of freedom for duramater and per-orbital tissue protection which are controlled by the surgeon.

Market Potential

This invention is targeted at tertiary level children hospitals and established neurosurgical centres. In India, the current cost of surgery is 3.5 lakhs. The benefit from a minimal invasive procedure is from its ability to address the deformity early in life with reduce overall cost of care.

National/Societal Relevance

Potential outcomes from a business standpoint are the successful uptake and penetration of the robotic medical device with the associated robotic technology platform as the primary medical device for primarily syndromic craniosynostosis and subsequent extension to all forms of non-syndromic/isolated craniosysnotosis.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives & milestones.

b. **Technology/Product developed –** CAD/CAM model and working prototype.

c. **IP generated/ Potential for IP generation –** Final patent filed in India and US.

d. **Resources Generated –** NA

Plans to take innovation further

Partnership with medical robotics companies.

Risks Envisaged

Stereotactic navigation, ability to cut abnormal bone in various curvatures and haptic feedback.

Innovator Team

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Anurag Meena

The Innovation

Test Strip free Glucometer and Diabetes prevention, management, care mobile application.

Development Stage

Discovery

Brief Description

Present work is focused on the development of a Test strip free personal glucometer which would be coupled with a multi-platform application aimed at prevention, management and care of diabetic patients or people at risk of becoming diabetic.

Innovative element

Their team is working on an innovative integration of reusable chemistry with electronics to develop a test strip free gluco meter that would cut down the costly consumable requirements associated with conventional glucose meters.

Market Potential

India's diabetic population is 60 million and an estimated 1 million users die of it every year. Worldwide Diabetic Population is 382 Million, out of which 46 million remain undiagnosed. An average diabetic patient spends about INR 25,000 per year on diabetes management out of which consumables in the form of test strips are a major portion. The proposed device can drastically reduce the consumable associated costs by eliminating the need for test strips

National/Societal Relevance

Technology developed by the applicant will help in reducing the financial burden associated with diabetes by providing affordable testing and management solution to people.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing as per the milestones.

b. **Technology/Product developed –** Currently working on the innovative reusable sensor and electronics integration to develop test strip-free glucose meter.

c. **IP generated/ Potential for IP generation –** Reusable Glucose Sensor, 2-Mechanism to reuse the sensor and 3-Integrated sensor and electronic as a device

d. **Resources Generated –** Manpower-electrical Engineer, biotechnologist and mechanical engineer, facility housed in a dedicated workspace, electronics development and testing instruments, Development Boards for prototyping.

Plans to take innovation further

Team will develop and commercialize the final product.

Risks Envisaged

Sample collection mechanism and development of mechanism to reuse the sensor.

Innovator Team

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Arthritis Research Development Pvt. Ltd.

The Innovation

Portable Surgical Navigation Device for Total Knee Replacement Surgery

Development Stage

Proof of Concept

Brief Description

This project is aims at developing an accurate, affordable, easy to use and portable surgical navigation tool for total knee replacement TKR surgery which will help to improve accuracy and consistency of the surgeons technique. This research will result in better patient satisfaction and outcomes after TKR surgery.

Innovative element

The product will showcase several innovative elements in surgical navigation technology which will include, innovative design, simplified software algorithm, novel method of integration of hardware and software, motion tracking system and sensor design.

Market Potential

Currently around 1,20,000 knee replacement surgeries are performed in India and around 710,000 TKRs are performed in USA for knee arthritis every year with a projected annual growth rate of 15-20 in the coming decade. The further innovations and technologies developed through the project can be applied and utilised to develop similar portable navigation devices for other procedures such as hip and shoulder replacement, spine surgery and trauma surgery and also diagnostic devices such as joint motion trackers and gait analysis systems to study the biomechanics of joints.

National/Societal Relevance

Provide a more affordable, cost-effective alternative to currently available navigation systems for the Indian market. Increase acceptance and penetration of this very important technology among majority of Indian surgeons performing TKR surgery. It will improve the overall results and outcomes in patients undergoing TKR. It will prevent complications, failures and need for repeat or revision surgeries in patients undergoing TKR. Provide technology platform for navigation based diagnostice and surgical planning tools.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing as per the objectives & milestones.

b. **Technology/Product developed –** Proof of concept of an accurate, affordable, easy to use, portable surgical navigation tool for total knee replacement surgery

c. **IP generated/ Potential for IP generation -** Product Design , Software Algorithms, Sensor design, Motion tracking system, Calibration and Integration procedure

d. **Resources Generated -** Hardware engineer, Software developer, CAD Designer, Electronics engineer.

Plans to take innovation further

Developing and testing of beta prototype on saw bones and cadavers, clinical trials, regulatory approval and commercialization, within 3-5 years after POC. The product can be made commercially available by contract manufacturing and marketing or licensing to existing orthopaedic implant companies

Risks Envisaged

Achieving desired accuracy and Regulatory issues

Innovator Team

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Axxonet System Technologies

Collaborator: NIMHANS, Bangalore

The Innovation

Automated Portable Epilepsy-EEG system

Development Stage

Validation

Brief Description

Axxonet Automated Portable Epilepsy-EEG System is a cost-effective device. It is portable, thereby making it feasible to be used at epilepsy screening camps, and various other epilepsy care-related services conducted especially in rural areas, and home care. The portable EEG will measure brain electrical activity from a series of sensors, amplify the signal to measurable and interpretative levels, filter out specific frequencies and present the occurrence of distinctive brain waves specific to epileptic seizure activity.

Innovative element

As compared to traditional EEG, this system can be carried from one location to another, thereby facilitating its use in epilepsy screening camps, epilepsy care workshops as well as hospitals.

Market Potential

Approximately 50 million people worldwide have epilepsy, making it one of the most common neurological diseases globally. Nearly 80 of the people with epilepsy live in low- and middle-income countries. Globally, an estimated 2.4 million people are diagnosed with epilepsy each year. In high-income countries, annual new cases are between 30 and 50 per 100 000 people in the general population.

National/Societal Relevance

In India there is a time gap between the onset of illness and the initiation of treatment in epilepsy. Lack of appropriate facilities to diagnose epilepsy is considered to be one of the major reasons for this treatment gap. Neurologists have been depending heavily on EEG to diagnose and monitor epilepsy for more than 5 decades. The effectively portable Epilepsy-EEG system will be a crucial aid to neurologists in urban and rural sectors.

Project Deliverables

a. **Progress vis-à-vis objectives -** Epidome Headcap & Signal processing unit, Analysis Software are undergoing Clinical Trials

b. **Technology/Product developed –** Technology includes Miniature Signal Acquisition and Processing Unit, and Analysis Algorithms.

c. **IP generated/ Potential for IP generation -** Unique Portable EEG recording system, with specialised algorithms to detect Seizure activity

d. **Resources Generated -** 10+ engineers, neurophysiologists, neurologists and psychologists

Plans to take innovation further

They have plans to collaboration in Europe and Africa through various partners including UK Trade and Investment.

Risks Envisaged

Cost escalations due to increased R&D costs, Delay in Clinical Trials, Increased production costs.

Innovator Team

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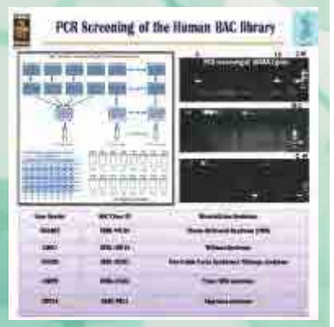
Bhat Biotech India Pvt. Ltd.

Collaborator: Manipal Life Sciences Centre



The Innovation

Development of probes based on a human BAC library for the diagnosis of disease for use in situ hybridization and in microarray.

Development Stage

Validation

Brief Description

Fluorescence in situ Hybridization (FISH) is the method of choice for detecting genetic abnormalities like inversions and translocation. We have Indigenously developed fluorescent organic dyes based BAC probes for primary use in FISH. Taking advantage of inherent fluorescence property of nanoparticles, we had developed DNA probes coupled to metal nanoparticles and probes for the detection of the following genetic disorders: the Prader-Willi Syndrome 15qll-ql3, SNRPN , Angelman syndrome, Velo-Cardio Facial Syndrome DiGeorge syndrome 22qll, UBE3A Phelan-McDermid 22q13, SHANK3 and Williams syndrome 7qll.23, LIMK1 .

Innovative element

Fluorescent organic dyes based BAC probes for primary use in FISH.

Market Potential

The technology has very high market potential as no Indian company is involved in the development of the same and the imported kits are highly expensive. We have indigenously developed probes based detection techniques for a number of genetic diseases which will ultimately lead to affordable diagnostics, earlier detection and better treatment outcomes

National/Societal Relevance

Affordable diagnostics early detection and better treatment outcomes

Project Deliverables

a. **Progress vis-à-vis objectives** - Successfully completed.

b. **Technology/Product developed –** We have developed probes for the detection of the following genetic disorders: the Prader-Willi Syndrome 15qll-ql3, SNRPN , Angelman syndrome, Velo-Cardio Facial Syndrome DiGeorge syndrome 22qll, UBE3A Phelan-McDermid 22q13, SHANK3 and Williams syndrome 7qll.23, LIMK1 .

c. **IP generated/ Potential for IP generation** - None

d. **Resources Generated** - 3 employed and 8 Trained

Plans to take innovation further

Yes through partnerships with Healthcare sector and education institutes

Risks Envisaged

Commercialization and on field validation effects

Innovator Team

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K Satyamoorthy

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Contact

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Bigtec Pvt. Ltd.

The Innovation

Assay validation enabling infectious disease detection at point-of-care using Bigtec handheld microPCR

Development Stage

Validation

Brief Description

The microPCR platform is the first commercially available micro-PCR worldwide and a prime example of Indian innovation in medical devices. Bigtec has developed a stand-alone sample preparation device, Trueprep-MAG and hand-held battery operated micro-PCR that can identify specific pathogenic DNA/RNA on a rapid time scale. The Truelab Real Time micro-PCR system comprises of all the equipments, reagents and essential accessories that are required by the user for conducting rapid, microchip based real time, quantitative PCR tests, starting from sample preparation to the final reporting of result, all in under an hour time. The system is a sample-to-result platform, no additional equipment is required, permitting point of care applicability.

Innovative element

This product can provide the ideal solution to overcome barriers associated with poor adoption of molecular diagnostics in the developing world. Bigtec micro-PCR device is a portable, light weight, real-time PCR based nucleic acid detection device, operated using a re-chargeable battery. The device uses a disposable microchip with pre-loaded, room temperature stabilized PCR reagents enabling the user to just add the purified nucleic acid sample and start the test.

Market Potential

The developed microPCR device and tests will allow healthcare authorities to use PCR at a fraction of the cost of commercially available PCR tests.

National/Societal Relevance

Project involved validation of tests for *Plasmodium falciparum*, *Plasmodium vivax*, *Salmonella typhii* and Dengue on Bigtec handheld micro-PCR. Conclusive PCR tests usable in resource-limited settings for detection of malaria, dengue and chikunguna could reduce healthcare management costs, reduce patient suffering and reduce non-rational antibiotic use.

Project Deliverables

a. **Progress vis-à-vis objectives:** Successfully completed

b. **Technology/Product developed –** Bigtec microPCR tests could contribute to reduction in Malaria and Dengue disease burden due to rapid identification and treatment of cases. It could also curb the spread of disease and prevent epidemics.

c. **IP generated/ Potential for IP generation –** bigtec disease-specific microPCR tests are the subject of patent applications that are pending grant by the Indian Patent Office

d. **Resources Generated** - NA

Plans to take innovation further

Tulip Group has partnered with bigtec Labs to commercialize the Truelab micro PCR system under their JV company, Molbio Diagnostics Pvt. Ltd.

Risks Envisaged

None

Innovator Team

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Contact

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BiolMed Innovations Pvt. Ltd.

The Innovation

Osteoconductive bone graft substitutes

Development Stage

Discovery

Brief Description

Development of 3D osteoconductive bone graft substitute based on silk fibroin protein. The novel scaffold is biocompatible, has excellent mechanical properties and degradation resistance with appropriate porosity.

Innovative element

Two different types of polymers - naturally occurring polymers and synthetic polymers have been used in the production of composite materials for use as bone graft substitutes and Silk fibroin either has comparable or sometimes even better properties than most of these materials. Our technology involves fusing the silk fibroin micro-particles using dilute regenerated silk fibroin solutions.

Market Potential

Market potential is very high

National/Societal Relevance

This technology will reduce the price of implants by one third and make them easily available and affordable to the Indian population.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives, Currently they have developed a processing protocol that enables them to prepare three dimensional scaffolds of silk fibroin with controlled pore size and pore size distribution is also establish.

b. **Technology/Product developed –** Preliminary work has demonstrated the feasibility of preparation of 3D porous silk fibroin scaffolds. The scaffolds have been characterized for their unique pore architecture, their excellent mechanical properties and also their degradation behavior.

c. **IP generated/ Potential for IP generation –** 3 patent have been filed by NCl, CSIR and applicant has exclusive licenses to the background Intellectual Property.

d. **Resources Generated -** Two Project Assistants and one technology Lead hired.

Plans to take innovation further

By identifying a suitable marketing partners to promote and sell this product in the local and global market

Risks Envisaged

None

Innovator Team

Anuya Nisal
Premnath Venugopalan
Ashish Lele

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BiolMed Innovations Pvt. Ltd.
National Chemical laboratory,
Homi Bhabha Road Pashan,
Pune - 411008

Cardea Biomedical Technologies Pvt. Ltd

Collaborator: AIIMS, Delhi

The Innovation

An Innovative, HighEnd, Palm Sized, Single Lead ECG Display Device for Ambulatory and Long term rhythm monitoring and OnTheGo Applications

Development Stage

Commercialization

Brief Description

Applicants have developed a device called MiRHYTHM which is an advanced arrhythmia monitor and it captures and displays arrhythmia, it happens in real time on any mobile phone working on Android platform. The hardware is a precisely designed single lead, locket sized ECG system

Innovative element

miRHYTHM is the only technology available at a Global scale which plots and processes ECG data in real-time to detect all kinds of arrhythmia as it happens on a run-of-a-mill smart phone without any dependability on internet

Market Potential

Globally the market was $14.6 billion in 2010 and is expected to rise upto $ 27.8 billion by 2021.

National/Societal Relevance

In India approximately 45 million individuals are at a risk of stroke. In fact, India has created an epidemic rate of CVD, accounting for 60 of the world's cardiac diseases. India has a population of 20 million obese, projected to rise to 70 million by 2025. 20 of Indians are suffering from hypertension, one of the major causes of Hypertensive Heart Disease.

Project Deliverables

a. **Progress vis-à-vis objectives -** Successfully completed

b. **Technology/Product developed –** A medical grade single lead ECG system for arrhythmia monitoring at home and development of a mobile app for real time arrhythmia monitoring.

c. **IP generated/ Potential for IP generation -** US Copyright secured. Indian Patent applied.

d. **Resources Generated –** 03 Manpower

Plans to take innovation further

Commercialization plans by tie-ups

Risks Envisaged

None

Innovator Team

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C-CAMP

Collaborator: IIT-Madras

The Innovation

Flow Analyzer

Development Stage

Commercialization

Brief Description

A miniature flow analyzer in lab-on-chip form combining principles of optics, flow cytometry, microfluidics device fabrication, optoelectronics, data acquisition and analysis to allow rapid cell analysis.

Innovative element

A miniaturized instrument with increased functionality and accurate information using following techniques: Microfluidic device using 2D focusing, Flow monitoring and flow control, Coupled opto-electronic system, Embedded lens fiber, Gated avalanche photodiode for high-sensitivity detection & Gated data analysis

Market Potential

There is a need for portable and affordable immune health monitoring device. This device will have market in places like India, China, Africa and many other countries.

National/Societal Relevance

There is a need for less expensive, user friendly and portable flow cytometers that can measure immune health.

Project Deliverables

a. **Progress vis-à-vis objectives** - All objectives have been achieved.

b. **Technology/Product developed –** A technology for affordable miniature flow analyser for various healthcare and non-healthcare applications is developed.

c. **IP generated/ Potential for IP generation** - Patent is filed in India via reference number 4067/CHE/2011 followed by PCT application number PCT/IB2013/050871 which is globally filled in US, EP, South Africa, JP, Vietnam, Nigeria, ARIPO, EURASIA, South Korea, China; patent is granted in USA and South Africa

d. **Resources Generated** - The project has trained around 6 researchers and enabled establishment of a microfluidics/fabrication set up.

Plans to take innovation further

Planning to take the innovation further for one-laser multiple detection capability.

Risks Envisaged

None

Innovator Team

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Ambili Mohan
Anish Bhardwaj

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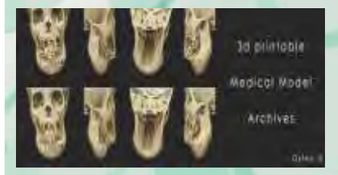
Df3d Creations Pvt. Ltd.



The Innovation

Conversion of CT/MR data to 3d printed models

Development Stage

Proof-of-Concept

Brief Description

Conversion of CT/MR data to 3d printed models helps the surgeons to plan surgery more accurately by means of better implants thereby increasing accuracy & reducing the time taken for actual procedure. This brings down costs and increases throughput & accuracy.

Innovative element

Increase Access and Reduce costs to enhance the adoption of 3d printing

Market Potential

Good market potential

National/Societal Relevance

Reduce the costs for 3d printing and increase the accuracy of surgical procedures.

Project Deliverables

a. **Progress vis-à-vis objectives** - Cloud based software platform, Currently in Design Stage.

b. **Technology/Product developed –** Cloud based platform for 3d printing.

c. **IP generated/ Potential for IP generation –** To be initiated.

d. **Resources Generated –** Medical models, software development expertise.

Plans to take innovation further

Exploring collaboration opportunities with local and international organisations, academia.

Risks Envisaged

Attrition of critical human resources, Performance Issues of 3d model.

Innovator Team

Deepak Raj K
Nachiketha Someshwara
Abhijeet Dutta
Himaja Kanampalli
Aaanchal Gowardhan
Vishakha Vaibhav

Contact

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DSS Imagetech Pvt. Ltd.

Collaborator: Dr. B.R. Ambedkar Center for Biomedical Research (ACBR), Delhi University

The Innovation

Validation, Field Trial, Scale-up and Commercialization of Sensitive and Specific PCR based Diagnostic kit and Instruments for diagnosis of Chlamydia and Nisseria infection

Development Stage

Commercialization

Brief Description

The CT/NG test kit is beacon based PCR assay for the detection of Chlamydia trachomatis and Neisseria gonorrhoeae infection using vaginal swab samples. It has four major processes: Sample Preparation, PCR Amplification of Target DNA using specific primers, hybridization of molecular beacon to amplicon and detection of hybridized product by direct visualization of fluorescence. DSS has developed a hand held fluorescence detector for direct visualization of the amplicon without any additional step.

Innovative element

The beacon based PCR test for *Chlamydia and Neisseria* is simple, sensitive and user-friendly. The technology for the kit has been patented. DSS has developed a hand held fluorescence detector for direct visualization of the amplicon without any additional step.

Market Potential

There is a huge demand for the diagnosis *Chlamydia and Neisseria*. Such programs can be implemented with the support of govt. using indigenous product. This would further lead to expansion of the market potential.

National/Societal Relevance

Like in developed countries, there is need to introduce Chlamydia and Nisseria screening programs for women in India. Often, a lot of symptomatic treatment happens without proper diagnosis which has led to widespread antibiotic resistance. The combination of indigenous instrument and reagent kit would help in conducting screening programs as well as routine diagnostics at an affordable cost.

Project Deliverables

a. **Progress vis-à-vis objectives –** Commercialization of the product / Launch plan- In progress

b. **Technology/Product developed –** A Beacon based PCR duplex test for Chlamydia trachomatis and Neisseria gonorrhea infection has been developed along with a hand held fluorescence detector for direct visualization of the amplicon without any additional processing.

c. **IP generated/ Potential for IP generation –** US (US 9139883) and Indian patent (Patent No. 239908) have been granted for Multiplex PCR based process for detecting infections.

   Also, patent applications have been filed for PCR based diagnostic kits.

d. **Resources Generated -** Plans to take innovation further - DSS would like to tie-up with the govt. for conducting the screening program for women using indigenously developed product.

Risks Envisaged

Government intervention would be needed to initiate Chlamydia or Neisseria diagnosis and treatment at various hospitals and district centers. At present there is limited market in India for these kits and market needs to be developed.

Innovator Team

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Parul Desai

Contact

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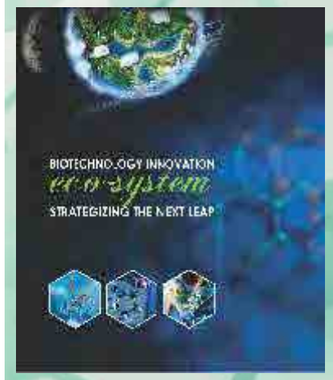
ExCel Matrix Biological Devices Pvt. Ltd.

Collaborator- Indian Institute of Science, Bangalore



The Innovation

Pre-clinical (GLP) evaluation and validation of rapid manufacturing of cartilage prototype

Development Stage

Proof-of-Concept

Brief Description

Acute cartilage focal damages have limited surgical options as cartilage does not regenerate and repair itself in vivo. The applicant proposes to develop a cartilage product amiable to rapid manufacturing by avoiding cell culture using either autologous or heterologous cells along with a novel extracellular matrix composition.

Innovative element

Normally, cartilage repair is a two-step surgical procedure causing significant risk and patient morbidity. A manufacturing process to prepare artificial cartilage will lead to off-the-shelf product requiring single surgical intervention.

Market Potential

Total market potential for cartilage damage repair is estimated to be 25 billion Euro worldwide. It is estimated that autologous cartilage transplant (ACT) performed in UK would cost UKP 5000 or 8000 for cell culture and surgery. Actual revenues of ACT is 60 million Euro, restricted mostly to USA and Europe and it is expected to increase steadily at the rate higher than 28 per year.

National/Societal Relevance

An artificial cartilage is often an answer to many debilitating damages limiting persons mobility. Such damage occur in high frequency at proactive age of 25 to 60 years. Due to lack of financial support, such surgeries are often beyond reach of most of the people in India. A low cost alternative will be therefore highly desirable.

Project Deliverables

a. **Progress vis-à-vis objectives -** Recently initiated

b. **Technology/Product developed –** We expect to generate rapid tissue prototype.

c. **IP generated/ Potential for IP generation -** IP applied and further possibility of additional ones.

d. **Resources Generated -** Project is ongoing and expect to fulfill manpower training and other mandate.

Plans to take innovation further -

GLP and GMP compliant data generation and clinical trials

Risks Envisaged

There are major technology risks owing to the novel idea

Innovator Team

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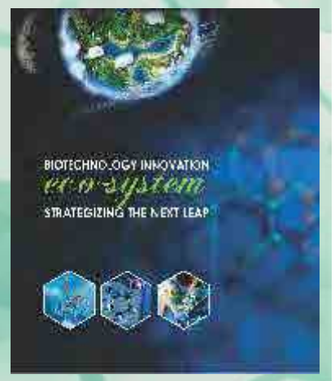
InDNA Research Labs Pvt. Ltd.



The Innovation

Proof-of-concept for an automated clinical analysis and annotation pipeline for NGS based somatic cancer genomic test for diagnosis, prognosis and personalized therapy

Development Stage

Proof-of-Concept

Brief Description

The product is a clinical NGS data analysis and interpretation pipeline called OncoNGx Genomic Workbench. Initial focus is on somatic cancer panels. The pipeline will be hosted on Amazon cloud AWS and can be accessed through any browser.

Innovative element

This tool has Innovative Workflow integration and Annotation data integration that helps in the development of a clinical report.

Market Potential

InDNA Research planned to offer the pipeline as a Software-as-a-service Saas model to Hospitals, Diagnostic Labs and prognostic market testing.

National/Societal Relevance

The relevance of OncoNGx is to routine clinical testing as it enables comprehensive multi-gene panel sequencing in a single test.

Project Deliverables

a. **Progress vis-à-vis objectives** - Project is progressing well as per the objectives,

b. **Technology/Product developed –** A Product named "OncoNGx" Genomic Workbench is under devlopment

c. **IP generated/ Potential for IP generation** - None

d. **Resources Generated** - 4 team members, 1 PhD in Molecular Biology for annotation, 2 bioinformatics programmers, 1 software developer.

Plans to take innovation further

InDNA Research Labs is partnering with Prashanti Cancer Mission, Pune for the diagnosis & treatment of Breast cancer patients.

Risks Envisaged

Genomics and NGS data analysis is currently revolving at very rapid pace. Additional resources may be required after POC to integrate with new algorithms and annotation data source as new data is added.

Innovator Team

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Alok Rai

Contact

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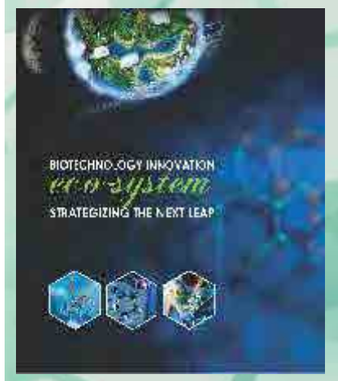
Jigsaw Bio Solutions Pvt. Ltd.

Collaborator: Institute of Life Sciences, Bhubaneswar



The Innovation

An Innovative Algorithm-Based Detection of Identical Multi-Repeat Sequences (IMRS) in the Genome of Plasmodium and its Validation in Malaria Diagnostics.

Development Stage

Validation

Brief Description

This project is aimed to improve the sensitivity and specificity of malaria diagnostics through novel biomarker discovery. Mining pathogen genomes has facilitated the discovery of oligonucleotide biomarkers called IMRS. The applicant report them to be 100 times more sensitive than conventional 18S rRNA primers in detecting *P.falciparum and P.vivax* on a qPCR platform using isolated genomic DNA.

Innovative element

The IMRS concept is a platform technology and can be applied for the diagnostics of any pathogenic disease.

Market Potential

There is an unmet market for sensitive and specific but low-resource amenable malaria diagnostics. Major market for falciparum malaria exists in S. African countries along with SE Asian countries including India. P.vivax disease burden is present only in India and SE Asia.

National/Societal Relevance

There is major unmet need for a highly sensitivity malaria diagnostic test.

Project Deliverables

a. **Progress vis-à-vis objectives** - Project is progressing well as per the objectives, Validation of Diagnostic primers are in final phase.

b. **Technology/Product developed –** POC with clinical validation of new diagnostic biomarker for Pf and Pv malaria.

c. **IP generated/ Potential for IP generation** - IP applied

d. **Resources Generated** - Strengthening of in-house research wing for new biomarker discovery

Plans to take innovation further

Development of IMRS biomarkers into a point of care malaria diagnostic test using affordable paper-fluidics technology. Probable collaborators from a reputed US university identified.

Risks Envisaged

Deploying the biomarkers on paper-fluidics platform using isothermal technologies may lead to a marginal decrease in the limit of detection of the biomarkers.

Innovator Team

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V Arun Nagaraj

Contact

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Lattice Innovations Pvt Ltd

The Innovation

Networked Critical Care Monitoring in Low Resource Settings

Development Stage

Proof-of-Concept

Brief Description

Applicant is aiming at developing a networked patient monitoring system that can be used in low resource settings. The objective is to be able to relay vital patient information to offsite, remote specialists who can provide the necessary treatment advice. The device can be used in the home settings as well as in ambulances.

Innovative element

Use of the android platform provides scope for future applications, like for Electronic Health Records, Critical Care Protocols. The networked system, comprising of Centralized monitoring stations, remote monitoring stations and mobile applications, ensures that relevant data is always accessible to healthcare providers.

Market Potential

Based on a research report from GBI Research, the global patient monitoring devices market will hit $8 billion in 2017, up from $6.1 billion in 2010. The firm pegs the device markets CAGR at about 4 percent for the next five years. GBI notes that advancements in wireless and sensor technologies are driving the patient monitoring devices market

National/Societal Relevance

The addition of new medical facilities provides significant opportunities for growth in the patient monitoring devices market in India, which GBI says is expected to grow from a value of $85 million in 2012 to $134 million in 2019, at a compound annual growth rate of 7 percent.

Project Deliverables

a. **Progress vis-à-vis objectives –** The applicant completed electronics hardware design and has developed android user interface for bedside display of vital health information. Proof of concept has been developed for desktop based software for central monitoring
   Technology/Product developed – Electronics design - Multiparameter patient monitoring system with built in wireless wifi and bluetooth modules. Data is streamed in real time in to a cloud server. Android UI development - Bedside display consisting of patient vital statistics and real time graphs. Web-based application for remote monitoring of patient details, including alarms.
b. **IP generated/ Potential for IP generation** - None
c. **Resources Generated** - 4 team members are added. Product sales - A SMS-based variant of the product being developed has been deployed in various Primary Health Centers in Andhra Pradesh, Madhya Pradesh and Odisha. A total of 39 units have been sold to NHSRC.

Plans to take innovation further

Applicants are planning to identify and partner with distributors to commercialize the technology and work with healthcare service companies to deliver remote monitoring services in low resource settings.

Risks Envisaged

Unexpected outcomes in the testing process could increase the number of iterations and subsequently product development time and budget. Price pressure from market incumbents. Risk is associated with the product testing and certification processes

Innovator Team

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Lumisoft Technologies Pvt. Ltd.

The Innovation

A gonio camera without a slit lamp

Development Stage

Proof-of-Concept

Brief Description

For proper management of glaucoma, Gonioscopy technology is helpful. An ophthalmologist is needed to perform this test on a bulky slit lamp. Due to shortage of ophthalmologists the test is not performed in the initial consultation on all patients with glaucoma leading to higher risk of blindness. Applicant proposes to develop a portable and affordable equipment which captures images of the angle structures of the eye without rotation. As the equipment uses a smart phone, images can be shared with an ophthalmologist directly for interpretation and management.

Innovative element

Proposed equipment can capture 360 degree image of angle of anterior chamber without rotation of the mirror and does not require a slit lamp for examination.

Market Potential

Potential of 2000 unit sales per year in India leading to revenue of Rs 100 million/ year and 2000 units sales per year abroad generating Rs 200 million/ year.

National/Societal Relevance

The device can help National Programme of Control of Blindness to reduce the level of blindness to 0.3 by 2020. From 2010 to 2020, Indian blindness due to angle closure glaucoma spiral from 3.7 million to 5.0 million. Gonioscopy help in proper diagnosis and appropriate treatment of glaucoma.

Project Deliverables

a. **Progress vis-à-vis objectives –** They have developed initial design and fabricated it to record the images of angle structures to improve depth perception and clarity. App has been created for patient registration and their images can be viewed on the server
b. **Technology/Product developed –** POC underway.
c. **IP generated/ Potential for IP generation –** Potential of IP generation for Gonio mirror and App for gonioscopy and two more copy rights for image processing techniques.
d. **Resources Generated –** Employment of an intern is underway. Enterprise is created,Called Lumisoft Technologies Pvt Ltd.

Plans to take innovation further

They will negotiate with universities in the UK for fabrication of mirror and also with Aurolab of Arvind Eye Care group for trials and marketing. They are negotiating with Altimetrik to explore possibilities of using the software solution in other medical specialities and sectors.

Risks Envisaged

Not being able to fabricate good quality conical mirror, delay in developing software.

Innovator Team

H V Srinivas,
Usha Manjunath
Vijaysimha
Manoj Mathew
Ajay Saxena
Innovation Cluster Lab, BMSCE in association with Altimetric: Software and app development

Contact

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Nayan Eye Centre Pvt. Ltd.

The Innovation

Pupil Expansion Devices and Delivery System

Development Stage

Commercialization

Brief Description

Easy, safe and economical Pupil Expansion device. The simple single plane design of the B-HEX Pupil Expander redefines the way pupil is expanded during cataract surgery in eyes which do not dilate with medication.

Innovative element

The B-HEX Pupil Expander uses a radically different concept to engage the pupil margin. The different way in which the pupil margin engaging part of the device engages the pupil margin, is the inventive step. The pupil margin straddles across the plane of the device whereas in all prior devices a part of the device straddles across the plane of the pupil margin.

Market Potential Heading Global market is $ 120 Million per year.

National/Societal Relevance

The present standard of care is the Malyugin Ring which costs about 125 USD. This is an additional cost to the patient, Government & health care system. The B-HEX Pupil Expander having a simpler design is machine produced. This reduces production time and cost translating to lesser cost to the patient and the health care system.

Project Deliverables

a. **Progress vis-à-vis objectives –** Commercial version of truly continuous Pupil Expansion Ring and Delivery device Ready. Applied for extension for development of prototype of Expandable Pupil.

b. **Technology/Product developed –** Truly continuous Pupil Expansion Ring and Preloaded Delivery device B-HEX Pupil Expander which is held sterile at the incision.

c. **IP generated/ Potential for IP generation –**

   1. Device Providing Enlargement and Preventing Collapse of the Pupil of the Eye - 225/KOL/2013, PCT/IN2013/000457, US National phase 14/379684. Pending national Phase patent applications in India, USA, Europe, Japan, Canada, Australia, Korea, Singapore, China & Hong Kong.
   2. Pupil Expansion Device: CIP Application USPTO 14/ 628,636 - This application discloses the Expandable & Self Expanding Pupil Expansion Device.
   3. Microsurgical forceps with broad jaws: 245/ KOL/ 2015, USPTO 14/ 686991

d. **Resources Generated –** Two Private Limited Company formed - Nayan Eye Centre Private Limited, Med Invent Devices Private Limited & Employment generated for 6 persons

Plans to take innovation further

Med Invent Devices Pvt. Ltd. will produce the device in compliance with global regulatory standards. Negotiatons initiated with distributors in USA, India and other countries for sale of the device.

Risks Envisaged

Grant of Patent.

Innovator Team

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OmiX Research and Diagnostics Laboratories Pvt. Ltd.

The Innovation

DNA Testing on Disposable Plastic Biochips: A High Sensitivity Platform for Malaria Detection

Development Stage

Proof-of-Concept

Brief Description

Development of a system for pathogen DNA detection on a disposable plastic biochip. It involves enriching the sample for pathogen DNA, followed by isothermal amplification and signal detection on the biochip.

Innovative element

The biochip uses a novel material that allows creation of a low-cost microfluidic device, a proprietary sample preparation method that enriches the pathogen DNA in the sample and enables a lower limit of detection and higher sensitivity & a proprietary DNA signal amplification not requiring thermal cycling.

Market Potential

Market potential is very high.

National/Societal Relevance

Low cost point-of-care nucleic acid testing has the potential to make a difference to the way diagnostics is practiced in small clinics, diagnostic labs and primary health centers.

Project Deliverables

a. **Progress vis-à-vis objectives -** Project is progressing well as per the objectives & milestones.

b. **Technology/Product developed –** Biochip prototype 1 has been manufactured in which DNA probes are immobilized.

c. **IP generated/ Potential for IP generation -** IP filing is underway on amplification method.

d. **Resources Generated –** 5 Manpower employed .

Plans to take innovation further

Partnerships being explored to expand the offering to other diseases like HIV, HPV screening.

Risks Envisaged

Loss of DNA in enrichment results drops in sensitivity and access to clinical samples .

Innovator Team

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Padmaseetha Technologies Pvt. Ltd.

The Innovation

Validation, Pilot and Pre Market Survey of mCAPD - mobile Continuous Ambulatory Peritoneal Dialysis; an anytime, anywhere dialysis solution

Development Stage

Validation

Brief Description

mCAPD is a simple, safe, affordable, mobile dialysis device, which empowers renal patients with a near normal life style through an anytime, anywhere CAPD dialysis, without requiring a break from their work/routine. Its mobility, recyclability and connectivity shall bring in cheers to millions of renal patients, their families world over. Our patented sterile connector, reduces the risk of infection prevailing in current methods of dialysis.

Innovative element

Mobility - anytime, anywhere CAPD dialysis

Safety - Innovative Sterile and automated processes reduce the risk of infection.

Affordablility - 4 times less costlier than existing alternatives

Accesibility - Simple device managed by patients themselves even in remote and rural areas

Connectivity - Always connected to doctors through a cloud based system

Recyclability - Recycling consumable will reduce the cost from Rs. 30,000 plus per month to Rs. 6000 per month per patient.

Market Potential

There are 2 lakh patients added every year who need to survive on dialysis after kidney failures. This translates into a revenue of more than INR 100 crores.

The number of patients in developing countries like Srilanka, Malaysia, Indonesia, Middle East, and sub-Saharan and African nations itself will runs to millions, who will be offered mCAPD in coming years.

National/Societal Relevance

More than 80 of renal patients, numbering to approximately more than a lakh of people, succumb due to non-availability and high affordability of dialysis treatment. mCAPD addresses these keys issues, and will surely bring in cheers to thousands of renal patients, their caretakers and families, especially to those located in remote and rural areas.

Project Deliverables

a. **Progress vis-à-vis objectives –** In progress

b. **Technology/Product developed –** mCAPD device

Consumables - Sterile Connector, Cassette Mechanism for Auto Peritoneal Cyclers Recyclable Membranes - In progress

c. **IP generated/ Potential for IP generation -** An Indian patent application (687/CHE/2014) has been filed. Provisional Patent for Recyclable technology of CAPD consumable in progress.

d. **Resources Generated -** 7 team members

Plans to take innovation further

Networking through CIIE-IIM Ahmedabad for research, product design and marketing contact with ICICI Lombard for marketing support and insurance. Contact with WISH Foundation, TANKER Foundation to introduce mCAPD in low resource settings.

Risks Envisaged

Adoptation by Nephrologists

Innovator Team

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Panacea Medical Technologies Pvt Ltd

The Innovation

Development of Flat Panel Computed Tomography (FPCT) machine

Development Stage

Proof-of-Concept

Brief Description

CT image acquisition is aimed at using commercially available flat panels. This will lead to future development of flat panels specifically for CT application. The first step is to construct a CT machine with flat panel and commercialize the technology to serve the patients. This helps in capturing large areas in one single X ray exposure in one revolution and can cover area bigger than 256 slice fan beam CT machine. This will reduce the time required to acquire the images and also reduce artifacts due to high speed rotation.

Innovative element

Equipment aims to be one of the first few such machines addressing global market. The advantage of the system is that it can acquire a large area per exposure with high resolution of the image. The details of the reconstructed image will greatly increase considering the high resolution of the input images.

Market Potential

Flat panel CT for radiological and radiotherapy simulation will evolve into the main stay imaging product due to inherent lower patient dose. Machine will have market opportunity across the globe. Dose delivered especially for pediatric patients is of concern from a conventional CT

National/Societal Relevance

The product will be one of the first few commercial applications of Flat panel for CT. CT detector technology is closely guarded by the CT Scan machine manufacturers, and hence in this system commercial flat panel is being used to achieve the CT functionality. This implies, advanced CT scan machines, based on flat panel can be manufactured in India. Radiotherapy application for treatment planning and simulation is another application of the machine

Project Deliverables

a. **Progress vis-à-vis objectives -** Currently, Panacea is working on designing of the machine, controller & imaging systems. The project is delivering as per schedules.

b. **Technology/Product developed –** Product is under development.

c. **IP generated/ Potential for IP generation –** Good scope for the IPR which will be registering appropriately.

d. **Resources Generated -** Existing resources are being used.

Plans to take innovation further

It is unique product and has potential for developing into a product line and has scope for backward integration. Panacea is planning to work on this aspect post completion of the current development

Risks Envisaged

Their product is going to compete with well-established Fan beam CT and has to face stiff competition and commercial challenges.

Innovator Team

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Periwinkle Technologies Pvt. Ltd.

The Innovation

Registry and community system for Haemophilic children

Development Stage

Proof-of-Concept

Brief Description

The proposed product connects the patients directly to the registry system via smartphone media. It allows them to maintain a log of bleed records and receive online consultation with just a smartphone enabled with mobile data connection, putting them in reach of relevant resources and mentors from the community. A community model has been employed especially seeing the benefits of such a model in the western world and with current human-interaction trends in the Indian society.

Innovative element

Patients are connected directly to the registry system via smartphone media . It allows maintaining a log of bleed records and receiving online consultation.

Market Potential

There are ~ / lakh Hemophilia patients in India 65,000-67,000 Beta Thalassemia patients and with around 9,000-10,000 cases added every year, Alzheimers patients and Diabetes patients in India are 63 Million. The product can be used in public health and commercial setting. Once proven for hemophilia it can be made available for other diseases .

National/Societal Relevance

Many developed countries have registries for Hemophilia patients for facilitating effective provision of treatment and enabling further research into the ailment and available treatments. Due to lack of awareness, social taboos, and unavailability of computers with Internet connection, Indian hemophiliacs have been deprived of availing similar benefits of a registry.

Project Deliverables

a. **Progress vis-à-vis objectives –** Progressing as per objectives.

b. **Technology/Product developed –** Registry, Remote Support and Community Platform for Congenital and Chronic Diseases

c. **IP generated/ Potential for IP generation –** IP for data will be generated

d. **Resources Generated –** 6 employees. They plan to train 1 HSI chapter volunteers and assign 3 personnel for ongoing support for the system when operational.

Plans to take innovation further

Collaboration with Hemophilia Society of India and medtech/ pharma companies to distribute product licenses to a larger medical community

Risks Envisaged

Limited acceptance of system from District Hospitals due to high patient loads

Innovator Team

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Veena Moktali
Koustubh Naik

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Perwinkle Technologies Pvt. Ltd.

Collaborator: Tata Memorial Centre, Mumbai

The Innovation

Development and Non Inferiority Evaluation of a portable transvaginal digital colposcope with smartphone interface for single visit cervix cancer screening in low resource settings.

Development Stage

Proof-of-Concept

Brief Description

The transvaginal digital smart colposcope is a solution to increase the success rate of the screening, diagnosis and treatment programs for cervical cancer.

Innovative element

The product uses portable, interventional cameras with a smartphone cloud-based system as a replacement for traditional, expensive, heavy and electricity-dependent colposcopy setups.

Market Potential

Developed product can be used in public health as well as commercial settings. Once proven for cervical cancer, similar kits can be made available for other types of therapies - replacing the current painful mechanisms. The product can be marketed not only in India, but in other countries as well.

National/Societal Relevance

The cervical cancer screening programs at PHCs run into difficulties in India mainly due to 2 reasons: 1 Patients going out of touch due to delays in diagnosis and treatment following a screening, 2 High cost of screening and diagnosis equipment, its usage, and maintenance. Our solution proposes to provide single-visit screening, diagnosis and treatment using an affordable and easy-to-use colposcope system that can cut down the time and cost of the entire process.

Project Deliverables

a. **Progress vis-à-vis objectives -** Smartphone-based interface for image handling and cloud-based software to handle patient data have been developed.

b. **Technology/Product developed –** Smart TVDC.

c. **IP generated/ Potential for IP generation -** IP will be generated.

d. **Resources Generated -** Employment for 14 peoples.

Plans to take innovation further

Partnerships with Tata Memorial Hospital and other cancer specialist hospitals .

Risks Envisaged

Cost of device and cost of data maintenance not being within limits due to vendor dependencies.

Innovator Team

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Raghabendra Samantaray - KIIT

The Innovation

Optically tuneable nanobio-sensor for detecting the efficacy of mosquitocidal repellants

Development Stage

Discovery

Brief Description

It is vital to find out technological expertise to detect the efficacy of mosquitocidal repellents, and hence qualify the available commercial products. Hybrid nano biocomposite is a viable option in this regard.

Innovative element

Hybrid nano biocomposite is a viable option to detect the efficacy of mosquitocidal repellents, and hence qualify the available commercial products. The advantages of such hybrid biomaterials are diverse. It allows optimal control over the sequence and length of polymers that changes the scattering behavior, and thereby the optical properties. Doping these materials with optically sensitive quantum dots would make these composites more stimuli responsive, the ligand-receptor interactions.

Market Potential

National and international

National/Societal Relevance

National and international

Project Deliverables

a. **Progress vis-à-vis objectives** - In progress

b. **Technology/Product developed** – Technology under development

c. **IP generated/ Potential for IP generation** - In progress

d. **Resources Generated** - In progress

Plans to take innovation further

In progress

Risks Envisaged -

Synthesis of protein of interest. Synthesis procedure is optimised for better results.

Innovator Team

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Contact

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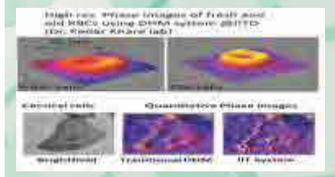
Sarita Ahlawat - FITT



The Innovation

Development of an early Breast and Cervical cancer detection method using novel, high resolution digital holographic microscope

Development Stage

Proof-of-Concept

Brief Description

An imaging based quantitative method to detect and classify Cervical cancer using Digital Holographic Microscopy (DHM). Using Pap smear samples directly, the applicant has imaged cell nuclei for the quantitative analysis of characteristic cancer associated nuclear changes. From the digital holographic images a plurality of associated parameters were extracted and used in characterization of cervical cell nuclei.

Innovative element

The most innovative element of the technology is the combination of cervical cancer screening and diagnosis with high resolution phase or DHM imaging with no extra sample preparation.

Market Potential

In 2015, the global cervical cancer screening market was approximately $16 billion. Quantitative method when made fully automated will have greater appeal in India and world wide.

National/Societal Relevance

The high resolution Digital Holographic Microscope and its application in cervical cancer diagnosis is indigenously developed, thereby making the technology highly cost effective. Social impact can be large if the developed product is made portable which will take cervical cancer screening to women in remote area and save millions of life.

Project Deliverables

a. **Progress vis-à-vis objectives** - Identified two unique nuclear parameters that makes cervical cancer screening and diagnosis accurate and quantitative in nature.

b. **Technology/Product developed** – Developed a POC for cervical cancer screening and cancer cell grading using high resolution Digital Holographic microscope.

c. **IP generated/ Potential for IP generation** - IP filed with India patent office, application number is 201611027124.

d. **Resources Generated** - Trained four students on this technology and established an interdisciplinary team of eight including scientists and doctors.

Plans to take innovation further

Establishing a partnership with Holmarc, Kochi for taking the developed method to next phase, and, additionally seeking collaboration with doctors at ICPO, Noida for more samples. Efforts are simultaneously going on in making the commercial avaible DHM microscope based on IIT-Delhi technology and incorporate our findings in imaged based diagnostic software.

Risks Envisaged

There is a learning curve in accepting new technology, and small delay can harm the successful adoption of a quantitative cervical cancer diagnostic method. Additionally, it may require development of new protocols for different samples.

Innovator Team

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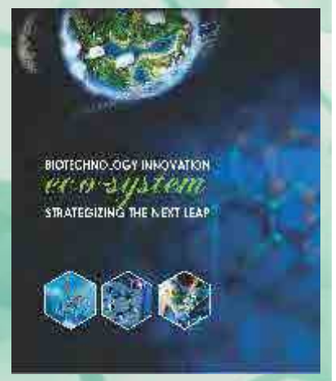
SciGenom Labs Pvt. Ltd.



The Innovation

Development of Single Tube Multi Gene OncoDiagnostic Tests for use with Next Generation Sequencing Platforms

Development Stage

Validation

Brief Description

Current tests for cancer mutations have several limitations-mainly cost and time. These tests are done one gene at a time, mostly using Sanger sequencing technology, and at times only a small portion of the gene. These single gene assays take 6-8 weeks to complete.

Innovative element

The project aims is to develop a multi-gene kit that will utilize Next Generation Sequencing technologies to test for cancer mutations in tumour samples.

Market Potential

Cancer mortality rate in India is expected to cross 1.2 million per year mark by 2020. Identifying gene mutations is important for prevention, improved disease management and effective treatment of cancer. The mutation status information will help clinicians to take the most appropriate decision on therapy with good prognostic and predictive value.

National/Societal Relevance

This kit will be designed to test 100+ cancer genes in parallel in a single-tube reaction in less than a week at an affordable cost..

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well, beta testing in progress

b. **Technology/Product developed –** For clinical report generation annotation pipeline is developed, development of GUI is going on & Kit assembly initiated,

c. **IP generated/ Potential for IP generation –** None

d. **Resources Generated –** Man Power- 2 Research Associates, 1 Bioinformatic Scientist and 1 Bioinformatic analyst

Plans to take innovation further

A user friendly Software development that can be operated with out expertise

Risks Envisaged

As of now Nil

Innovator Team

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SciGenom Labs Pvt. Ltd

The Innovation

High Performance Computing Infrastructure

Development Stage

Commercialization

Brief Description

The High Performance Computing Infrastructure setup at SciGenom will provide state-of-art facility to analyze high-throughput genomics data that needs huge computing and storage resources. The facility will help SciGenom scientists and programmers to run next-generation sequence analysis pipelines and programs efficiently and reduce the turn-around time of the projects. The high-performance computing HPC and storage infrastructure will also encourage SciGenom researchers and research institutions to collaborate on projects of national importance. This will help India in the area of genomics and biomedical research.

Innovative element

We have improved upon the computing and performance of various open-source data analysis pipelines.

Market Potential

The bioinformatics potential in India is largely untapped. There are many R&D labs that have the data but do not know how to analyze or where to get it analyzed.

National/Societal Relevance

We have set up rice variation databases which is of national importance. Further, the setup will help to analyze data of national importance. The center can help in genome sequencing and analysis of new species and organisms.

Project Deliverables

a. **Progress vis-à-vis objectives –** Successfully completed

b. **Technology/Product developed –** We have developed data analysis pipeline for the next-generation sequencing dataset.

c. **IP generated/ Potential for IP generation** - Nil

d. **Resources Generated** - We have trained 4-5 members in the first year when the facility was being setup.

Plans to take innovation further

We are planning to collaborate with sister companies to provide services and have discussions with R&D institutes to provide services to them.

Risks Envisaged

The bioinformatics component of commercial project is generally not costed. In general, the customers want to avail free service for the bioinformatics. So it will be challenging to sell only bioinformatics to the customer.

Innovator Team

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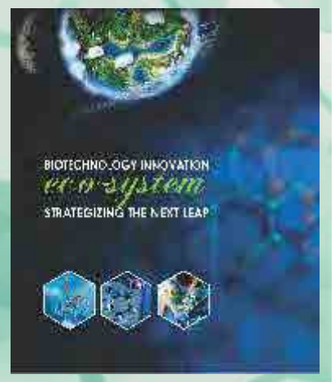

The Innovation

Social Innovation Immersion Programme (SIIP) by Translational Health Science and Technology Institute, Faridabad, India

Development Stage

Proof of concept

Brief Description

Neutrophils are drawn to sites of microbial colonization or are consumed during the clearing of microbes from circulation. When colonization is within reasonable levels, myelopoiesis from the bone marrow is able to keep up with neutrophil losses and maintain neutrophil counts. In infants where colonization has been excessive and or circulating microbes require large numbers of neutrophils, the marrow maybe unable to compensate leading to low circulating ANC. If low ANC is shown to be associated with poor linear growth, it could be used as an early clinical and population screening marker of subsequent poor linear growth and stunting.

Innovative element

Novel biomarkers for intestinal pathology in blood.

Market Potential

A total and differential leukocyte count costs less than a dollar a test and even lesser when performed as a high throughput screening exercise on a large number of infants. The test is easy to perform and is currently available even at the smallest of laboratory facilities all over India and the world. It therefore lends itself to use at various levels of healthcare and public health needs.

National/Societal Relevance

A biomarker that can predict short stature as early as 6 weeks of age, can provide health care and public health practitioners sufficient time to intervene and prevent stunting and salvage the growth potential of each child.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is in nascent phase & progressing
b. **Technology/Product developed –** None so far
c. **IP generated/ Potential for IP generation -** None so far
d. **Resources Generated -** Research Associate 01 , Data Entry Operators 02 , Staff Nurses 04 , Field Workers 05

Plans to take innovation further

Planning for large scale validation.

Risks Envisaged

Competitors technology.

Innovator Team
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Vikas Karade

The Innovation

Tabplan3D - (XrayTo3D)- Cloud based 3D Surgery Planning Software

Development Stage

Validation

Brief Description

Tabplan3D is a cloud based 3D surgery planning software for orthopedic surgeons. This allows surgeon to simulate/plan a complicated orthopedic surgery in 3-dimentional view with high accuracy by using a web-based platform. The unique technology behind this product is XrayTo3D which gives the 3D model of bones by using conventional 2D X-ray images.

Innovative element

1. XrayTo3D : Generation of 3D bone models using 2D X-ray images.
2. Automatic surgery simulation - Surgery simulation algorithm gives the optimal surgical solution Surgeon can just upload Xray image to the software, and get the solution in 3D which then can be applied directly to patient case.

Market Potential

This software is mainly developed for knee deformity and knee replacement cases. These surgery cases occur in high numbers in many countries like USA, Europe and India.

National/Societal Relevance

This product is socially relevant because India has almost 2.5 lakh cases of knee replacement or arthritis every year. Tabplan3D will save cost and time of surgery and improve accuracy.

Project Deliverables

a. **Progress vis-à-vis objectives –** Project is progressing well as per the objectives, a 3D surgery simulation software for knee deformity has been developed.
b. **Technology/Product developed –** A 3D surgery simulation software for knee deformity on cloud computing platform has been developed.
c. **IP generated/ Potential for IP generation –** None so far.
d. **Resources Generated -** A start-up company named AlgoSurg Products Pvt Ltd has been created through this support.

Plans to take innovation further

AlgoSurg Products Pvt ltd will commercialize this product and also looking for partnership with Implant manufacturing companies.

Risks Envisaged

Competitor product and FDA approval.

Innovator Team
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Virtis Bio Labs

The Innovation

Rapid, Point-of-Care Diagnosis of Neoatal Sepsis

Development Stage

Proof-of-Concept

Brief Description

Rapid diagnosis in Neonatal sepsis is problematic because the first signs of this disease may be minimal and are similar to various non-infectious processes. Adhesion to host proteins is mediated by bacterial cell-wall associated protein called MSCRAMMs. Among several MSCRAMMs in *Staphylococcus aureus*, protein A spa is an important virulence factor which enables *S. aureus* to evade host immune responses. Our diagnostic system utilizes lateral flow immuno-chromatographic technique which can detect *S. aureus* in blood using monoclonal antibody developed specifically against protein A within 10-15 min.

Innovative element

Point of care diagnosis of neonatal sepsis by lateral flow immuno-chromatography using Protein A specific monoclonal antibody for detecting S. aureus in blood.

Market Potential

The global lateral flow assay market is expected to grow at a strong CAGR of 8.3 during the forecast period of 2015 to 2020 and is estimated to reach USD 6.78 billion by 2020.

National/Societal Relevance

Death rate due to Neonatal sepsis is as high as 18-36 and the overall sepsis rates are upto 38 per 1000 in India. The gold standard blood culture and identification of markers like procalcitonin, C reactive protein, cytokines using ELISA lacks early and accurate detection. The RT-PCR and nucleic acid sequence based amplification methods are prohibitively expensive and time consuming. Hence, It would be practical to develop immuno-chromatographic method coupled with gold conjugated monoclonal antibody for detection of *S.aureus* in single step with high specificity and with low sample volume which can support neonatal sepsis also.

Project Deliverables

a. **Progress vis-à-vis objectives** - Objective I :Development of monoclonal antibody specific for Protein A of *S.aureus*-8 Sucessful clones obtained

b. **Technology/Product developed –** Lateral flow immuno-chromatography using Protein A specific monoclonal antibody of *S.aureus*

c. **IP generated/ Potential for IP generation** - IP will be generated for lateral flow immuno-chromatographic kit coupled with Protein A monoclonal antibodies of *S.aureus.* There is no infringement of intellectual property , as diagnostic system utilizes protein A for diagnosis.

d. **Resources Generated** - Manpower employed 3 and Cell culture facility

Plans to take innovation further

The innovation will take further with the patnership or licensing to large companies like J.Mitra & Co., Tulip diagnostic etc

Risks Envisaged

Nil

Innovator Team

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Xcellence in Biological Innovations and Technologies

The Innovation

A point-of-Care (POC) device for detection of antibiotic sensitivity of uropathogens found in human urine

Development Stage

Validation

Brief Description

Applicant intends to develop an indigenous novel technology called RightBiotic for analyzing the antibiotic sensitivity of uropathogens which are responsible for Urinary Tract Infection (UTI) within 3hrs.

Innovative element

It is a small portable, battery operated instrument which provides on the spot rapid analyses of results. Its reliability is at par to conventional assay for antibiotic sensitivity, 3 affordable low cost per test at par with the present manual test and four fold less than the cost for test done on automated systems 4 Ensure access to healthcare for all and 5 Ease of operation and 6 is the fastest antibiotic finder available.

Market Potential

UTI account for over 10 million doctor office visits/year, at a cost of over $1 billion. Up to 40 women develop UTI at least once during their lives and a significant number of these women will have recurrent UTIs. 5 lakh Primary health centers, 1.5 lakh doctors clinics and nearly 1 lakh clinical diagnostic labs in the India and 70 of India 1.2 billion citizens living in rural areas, where, despite government efforts, hospitals are often under staffed and lack basic equipment and testing facilities.

National/Societal Relevance

The current testing modalities use manual test in 99 of settings as it is more affordable. The automated systems constitute less than 1 of the market share. Both manual and automated diagnostic tests currently available take atleast 24 to 72hrs. This technology offers the results at lower cost and in less time.

Project Deliverables

a. **Progress vis-à-vis objectives –** Applicant has finished ODM designing and manufacturing of field ready readout prototype and manufacturing of kits. Training of manpower for conducting the assays is underway.

b. **Technology/Product developed –** Two new technologies are being developed

c. **IP generated/ Potential for IP generation** - New IP will be generated

d. **Resources Generated** - NA

Plans to take innovation further

In process

Risks Envisaged

Healthcare industry might take some time for accepting the results obtained from their new technology as it defines a new paradigm in conducting tests for clinical anti-biograms.

Innovator Team

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Sunil Tadepalli
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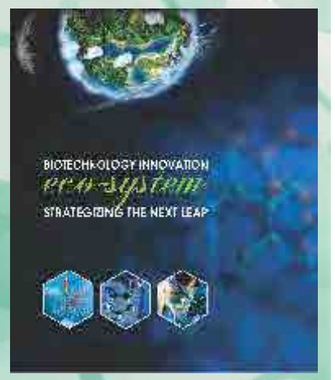
Yostra Labs Pvt. Ltd.



The Innovation

Warm Oxygen Therapy for Treatment of Diabetic Foot Ulcer

Development Stage

Proof-of-Concept

Brief Description

Kadam is a medical device developed for the treatment of Diabetic Foot Ulcers. The proposed therapy involves exposing the patients foot to a constant stream of oxygen inside a therapy chamber at elevated temperatures.

Innovative element

Some of the novelty features of Kadam are:

(1) The therapy equipment is compact - hence the therapy is focused only on the affected area,

(2) As the therapy equipment is compact, the treatment can be given in an outpatient setting

(3) The therapy equipment can be operated in resource poor settings

Market Potential

The target market for Kadam is approximately INR 300 Crores over the next 3 years. Our customers include tertiary hospitals, district hospitals, hospitals and clinics specializing in diabetic foot care and the fledgling home care segment.

National/Societal Relevance

Diabetes can lead to several complications, one among which is Diabetic Peripheral Neuropathy (DPN). There were approx. 37 million patients with DPN in 2015 which will swell to 69 million patients by 2040. DPN can make the patient prone to Diabetic Foot Ulcers, which left untreated can lead to amputation. Unfortunately every 30 seconds a leg is lost somewhere in the world due to diabetes. The treatment procedures and medical equipment available in the market currently for diabetic foot ulcer treatment are very expensive and out of reach of most of the diabetic foot ulcer patients from rural and semi urban India. In light of the above discussion there is a need for a low cost and effective device such as Kadam for the treatment of diabetic foot ulcer

Project Deliverables

a. **Progress vis-à-vis objectives –** Ongoing

b. **Technology/Product developed –** Develop a market viable diabetic foot ulcer treatment equipment that consists of a gas warmer and a therapy chamber which is used along with an off the shelf oxygen concentrator.

c. **IP generated/ Potential for IP generation -** Patent application has been applied for "Device for dermatological and sub-cutaneous tissue treatment"

d. **Resources Generated -** 4 full-time employees are working on the project helped by two clinicians working part-time on the project.

Plans to take innovation further

We are evaluating strategic partnership with established players in order to take the innovation further.

Risks Envisaged

Successful completion of clinical trials which has been mitigated by the involvement of premier medical institutions - St. Johns Research Institute and Manipal University in the clinical trials

Innovator Team

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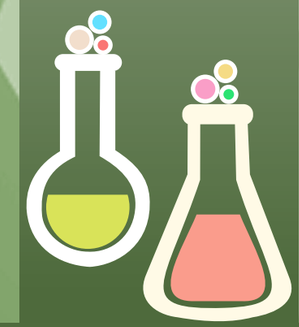
BIRAC Innovators

Agriculture



September 2016

Aristogene BioSciences Pvt. Ltd.

The Innovation

Bacteriophage based control of Vibrio harveyi infection in shrimp

Development Stage

Pre-commercialization

Brief Description

The indiscriminate use of antibiotics in aquaculture has lead to the emergence and spread of antibiotic-resistant bacteria. In a study of a luminous vibriosis outbreak in a shrimp hatchery, isolates of V. harveyi were resistant to antibiotics used. Thus they were ineffective in controlling the disease among shrimp larvae. In the non-availability of appropriate strategy to eradicate vibriosis in aquaculture, bacteriophages appear to be the most plausible and appropriate candidate to overcome the above problem.

Innovative element

Creation of library of Vibrio harveyi isolates from vibriosis affected farms. This includes collecting isolates causing vibriosis and characterization of isolates by biochemical and molecular methods. Proof of concept study will be carried out in a shrimp farm with suitable control group.

Market Potential

Aquaculture in India contributes to large portion of marine exports.Approximately 200000 tons of shrimp is produced in the country spread over 50000 hectares.

The production cost per kg of tiger shrimp is around Rs.200-250/kg.

Out of this the cost of phage is considered as Rs.0.5 per kg of shrimp produced.

Hence the potential market is 200000 x1000 x 0.5 = Rs. 10 crore per annum.

National/Societal Relevance

Bacteriophage therapy will be a major breakthrough in the treatment of Vibrio harveyi in Shrimp culture and hence increase in export revenue.

Project Deliverables

a. **Progress vis-à-vis objectives** – A library of phages against the pathogenic Vibrio harveyi. A phage cocktail which can tackle and eliminate vibriosis from shrimp culture.

b. **Technology/Product developed** – Ongoing

c. **IP generated/ Potential for IP generation** – None

d. **Resources Generated** - Manpower -8, Facility- Phage facility with the capacity to make 1000 l per annum

Plans to take innovation further

Commercialize the product through partnership with feed companies

Risks Envisaged

Phage resistance

Innovator Team

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Central Rice Research Institute Cuttack

Collaborator: Xcelris Labs Ltd

The Innovation

Association mapping of genes/QTLs for yield under reproductive stage drought stress in rice (Oryza sativa L.)

Development Stage

Validation

Brief Description

Two drought tolerant varieties, Sahbhagi Dhan and Vandana have been released by CRRI for the drought prone areas of the country. Three genotypes, Mahulata, Brahamnnaki and Salkain have been registered for drought tolerance

Innovative Element

Genome-wide association mapping is a novel approach and powerful strategy for identifying genes underlying quantitative traits in plants by capturing natural variation. It overcomes the limitations of the biparental QTL mapping .

Market Potential

Rice genotypes identified as promising in terms of yield under drought stress in the project can be directly used as variety for drought affected areas of India

National/Societal Relevance

Some of the promising rice genotypes identified in the project would be useful for pre-breeding, marker-assisted-breeding and gene/ allele mining programs for developing high yielding varieties, suitable for drought affected areas of the country.

Project Deliverables

a. **Progress vis-a vis objectives** - Development of association mapping panel and its phenotyping for grain yield under reproductive stage drought stress. Preliminary screening of genotypes was carried out for grain yield under reproductive-stage drought stress About 400 rice genotypes having different levels of tolerance/ susceptibility to drought at vegetative stage were sown in rain-out shelter. ROS and normal conditions during kharif, 2015 for initial screening for grain yield at reproductive-stage drought stress.

b. **Technology/ Product developed** - Some rice genotypes would be identified as promising in terms yield under drought stress suitable for using directly as variety or for pre-breeding, marker-assisted-breeding and gene/ allele mining programs.

c. **IP generated/Potential for IP generation** - Genotype suitable for cultivation in drought affected areas.

d. **Resources Generated** - The SRF and RA will be trained to handle drought screening experiments and also data analysis related structure and NGS.

Plans to take innovation further

Fine mapping, cloning and transgenic plant development. Variety development tolerant to drought through molecular breeding approach

Risks Envisaged

Cyclone usually occurs in the month of October in Odisha which may affect the drought screening experiments.

Innovator Team

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FIB-SOL Life Technologies Pvt. Ltd.

The Innovation

Development of a stable nanofiber carrier for biofertilizers

Development Stage

Proof-of-Concept

Brief Description

Developed a nanofiber based fertilizer carrying membrane hosting high pay load (1011cfu/g) of agriculturally important micro-organisms like nitrogen fixers.

Innovative Element

Developing nano-fiber based fertilizer carrying membrane which is made of biocompatible polymers to stabilize a high pay load of agriculturally important microbes.

Market Potential: The global bio-fertilizer market is expected to reach 1.88 million US dollar by 2020. The market potential for nano-fiber based carrier materials for bio-fertilizers is expected to be huge.

National/Societal Relevance

In a country like India where most of the farms are situated in remote areas with less transport facility, a light weight carrier for bio-fertilizer is a boon. Storage of bio-fertilizers is also a problem. The present product resolves the stability issue by protecting the bacteria from adverse climatic conditions.

Project Deliverables

a. **Progress vis-a vis objectives- 1 sq. Meter nano** - fiber membrane have been developed and the process of procuring a uniform nanofiber with bacteria entrapped was standardized

b. **Technology/ Product developed** - A nano-fiber membrane hosting a high pay load of nitrogen fixing bacteria which is 1000 times less bulky than the conventional biofertilizers have been developed.

c. **IP generated/Potential for IP generation** - An Indian Patent application (3490/CHE/2015) has been filed.

d. **Resources Generated** -

- 4 people were employed and trained in the project
- A large scale pilot set up for making nano-fiber was developed

Plans to take innovation further

- To partner with anchor clients and selling of products to them
- To partner with Biofertilizer manufacturers and supply the developed products through their distribution channels

Risks Envisaged

- Competition from existing bio-fertilizer manufacturers
- Investments for scaling up operations

Innovator Team

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Ganga Kaveri Seeds Pvt. Ltd.

The Innovation

Development of blast resistant rice hybrid GK 5017 and rice variety GK46 through Molecular Marker Assisted Breeding

Development Stage

Pre-commercialization

Brief Description

Introgression of Pi1, Pi2, and Pi54 genes conferring resistance to rice blast to rice inbred GK Kaveri and hybrid GK5017. Breeding strategy involves introgression of resistant genes to inbred GK Kaveri, Hybrid restorer and maintainer lines through marker assisted foreground selection for above said genes.

Innovative Element

Introgression of blast resistance genes Pi1, Pi2 and Pi54 through marker aided selection in the genetic background of highly promising rice variety GK Kaveri and rice hybrid GK 5017

Market Potential

GK 5017 Hybrid is medium maturity duration of 135-140 days and higher yield 7.8-8.2 tons/ha. GK Kaveri is also of medium duration variety with high yield ranging from 6.5 - 7.0 tons/ha. Both of them gained acceptance by the farmers in Bihar, Chhattisgarh, Jharkhand, Eastern UP and are spreading fast.

National/Societal Relevance

Developing Blast resistant rice varieties is important for sustainable management of the disease.

Project Deliverables

a. **Progress vis-a vis objectives**- Value added GK Kaveri having all the three blast resistance genes Pi1, Pi2 and Pi54 is being tested at five locations for its resistance spectrum.

b. **Technology/ Product developed**

- Improved version of inbred variety GK Kaveri possessing Pi1, Pi2 and Pi54
- Improved maintainer line GK 5017 carrying Pi1 and Pi2 genes
- Improved restorer line GK 5017 carrying Pi54 gene

c. **IP generated/ Potential for IP generation** - Not generated

d. **Resources Generated** - Three (3) Research Associates have been employed and a uniform Blast nursery has been created.

Plans to take innovation further

The product is under multi-location field trails and variety/hybrid will be commercialized after the final validation and studying all the agronomic characters.

Risks Envisaged

None

Innovator Team

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Ganga Kaveri Seeds Pvt. Ltd.

The Innovation

Development of brown plant hopper (BPH) resistant rice hybrids by marker-assisted breeding.

Development Stage

Pre-commercialization

Brief Description

To introgress three dominant resistant genes from two diverse sources of resistance viz. Bph 18 from IR 65482-7-216-1-2-B derived from Oryza australiensis and Bph 20 and Bph 21 from IR 71033-121-15 derived from O. Minuta into BLB improved GK-rice hybrid parental lines.

Innovative Element

Improvement of restorer lines of GK rice hybrids introgressed with bacterial blight resistance genes viz., Xa21 & Xa21+xa13 through introgression of three dominant Bph resistance genes viz., Bph18, Bph20 and Bph21 for achieving durable resistance to Brown plant hopper. At the end we can achieve pyramided rice hybrids for BB and BPH.

Market Potential

Three hybrids which are under different testing with high yield potential of 6 to 8.5 t ha would cover different rice growing areas such as Eastern U.P., Bihar, M.P., Jharkhand and Chattisgarh.

National/Societal Relevance

Development of BPH resistant rice Hybrids for cultivation in the target states, viz., Eastern U.P., Chattisgarh, Jharkhand, West Bengal, and Bihar which constitutes major Rice Bowl of India is truly a matter of national importance and social relevance.

Project Deliverables

a. **Progress vis-a vis objectives** - The parental crosses were made and the F1s are being tested for hybridity with polymorphic markers. Also, the parental lines are being tested for their response to tissue culture media.

b. **Technology/ Product developed** - NA

c. **IP generated/ Potential for IP generation** - NA

d. **Resources Generated** - Three Research Associates and three Technical Assistants have been employed and a BPH and Bacterial blight facility have been created.

Plans to take innovation further

NA

Risks Envisaged

NA

Innovator Team

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GEO Biotechnologies India Pvt. Ltd.

Collaborator : University of Agricultural Sciences

The Innovation

Development of F1 Hybrid Tomato with high shelf life

Development Stage

Pre-commercialization

Brief Description

The present technology is aimed at increasing the shelf life and to improve the quality of tomato.

Innovative Element

Use of SSR markers to confirm the tomato RIL's with high shelf life.

Market Potential

There is a great demand for long shelf life varieties in India, since sometime there is tomato glut in the market.

National/Societal Relevance

The present technology will solve the problem of perishability and also the farmer can send the tomato to far of places since these tomato lines have long transportation capability.

Project Deliverables

a. **Progress vis-a vis objectives** - F1 hybrids were developed and evaluated in replicated trial at GEO Biotechnologies trial farm, multi-location trials were also conducted at three locations Bangalore, Kolar and Haveri.

b. **Technology/ Product developed** - Two (2) hybrids (Hybrid-2 and Hybrid-5) having good shelf life, yield and stability have been identified for commercialization.

c. **IP generated/ Potential for IP generation** - Not applicable

d. **Resources Generated** - SRF were appointed in the project and also students have been trained.

Plans to take innovation further

Planned to take up seed production and to test in other tomato growing areas in the country.

Risks Envisaged

No Risk, since it is developed through marker assisted breeding.

Innovator Team

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Global Transgenes Ltd.

The Innovation

Generation, Evaluation and Regulatory Appraisal of Selected Transgenic Events for Enhanced Tolerance Against Lepidopteran Insect Pests in Cotton, Rice and Brinjal.

Development Stage

Proof of Concept

Brief Description

Development of transgenic technologies and transgenic events for enhanced tolerance against Lepidopteran insect pests in Cotton, Rice and Brinjal by mobilizing different Bt-genes such as cry1F, cry2Aa and cry1Ac through Agrobacterium-mediated and/or biolistic transformation techniques.

Innovative Element

- Generation of numerous cotton and rice transgenic events with two dissimilar Bt genes under the control of two independent and different promoters on single T-DNA.
- Generation of rice transgenic events devoid of any reporter gene gus, gfp etc and antibiotic hptII, nptII etc selection markers.
- Generation of brinjal two-Bt gene stacks by inter-crossing selected Cry1Fa1 and Cry2Ab transgenic events for enhanced and sustainable tolerance against the most damaging insects of brinjal Shoot and Fruit Borers .

Market Potential

The technology proposes to offer the seed industry and Indian farmers in particular, transgenic GM technologies developed within the country and available at a reasonable royalty fee.

National/Societal Relevance

The national importance lies in the fact that the proposal offers indigenously developed GM-Crop technologies, especially Bt-Cotton which is benefiting the Indian farmers immensely.

Project Deliverables

a. **Progress vis-a vis objectives** - Under process

b. **Technology/ Product developed** - Two-Bt Cotton transgenic events.
Antibiotic marker free Bt-rice events. Two-Bt Brinjal transgenic events.

c. **IP generated/ Potential for IP generation** - NA

d. **Resources Generated**
- Recruited and trained large number of trainees and scientific staff.
- Established and upgraded Cotton and Rice Transformation & Molecular Biology Laboratories.
- Commissioned / Renovated Transgenic Poly-houses and Green Houses compliant in accordance to GM regulatory requirements .
- Developed exclusive field and net house facilities equipped with Netafim dripper technology for transgenic field trials etc.

Plans to take innovation further

For product development, regulatory processing and GEAC approvals these programs are jointly conducted with our sister organization, M/s. Nath Bio-Genes I Ltd.

Risks Envisaged

Regulatory implications of transgenic cotton and brinjal.

Innovator Team

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Healthline Pvt. Ltd.

The Innovation

Development of silk protein based cryopreservation medium for bovine sperm to sustain viability and motility to enhance success rate of artificial insemination.

Development Stage

Proof-of-Concept

Brief Description

Cryopreservation extends the availability of sperm for fertilization for longer period. However, the fertilizing potential of the frozen-thawed bovine sperm is compromised because of alterations in the structure and physiology of the sperm cell especially.

Innovative Element

- Extraction of specific silk proteins, purification, validation of anti-freezing capability and standardization of the fractions formulating semen extender.

Market Potential

The need for quality frozen semen being the key requirement of dairy industry is huge and market potential exists in dairy centric countries.

National/Societal Relevance

The national /societal Relevance is due to the fact that the proposal supports two key objectives:-

- For meeting the demand for increase in milk yield.
- To ensure better fertility in animals by incorporating anti-freeze proteins like silk protein/peptides in the semen diluents protecting sperm from thermal shock during freeze-thaw cycles.

Project Deliverables

a. **Progress vis-a vis objectives** - New range of anti-freezing proteins derived from silk-proteins as additive to semen extender- five different silk protein fractions obtained starting from cocoons from three different silkworm breeds. They are under characterization and testing.

b. **Technology/ Product developed** - Under process

c. **IP generated/ Potential for IP generation** - There is a possibility of generating IP for formulation and specific application for semen cryopreservation in terms of assuring better productivity by using anti-freezing proteins which acts non-colligatively.

d. **Resources Generated** - One manpower recruited and second one to be recruited. Special cryo-microscope under development.

Plans to take innovation further

Collaboration with NDDB for large scale trial for post completion of the project.

Risks Envisaged

Silk protein/peptide not performing to the expectations with no significant support to maintain viability and motility of the sperm during freeze-thaw cycle.

Innovator Team

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Indian Agricultural Research Institute

Collaborator: IMGENEX Pvt. Ltd.


PVX-ELISA KIT

The Innovation

Validation of serological diagnostic reagents and kits for plant viruses affecting horticultural crops

Development Stage

Commercialization

Brief Description

The conserved CP gene of potato viruses was cloned and expressed in *E. coli* and purified. PAbs were generated against rCP for broad spectrum detection of viruses. Enzyme-linked immunosorbent assay ELISA kit will be developed to detect PVX virus

Innovative Element

Indigenous diagnostic antibodies to plant viruses are not commercially available in India. By this technique, the antibodies can be raised in two months time and it will benefit entrepreneurs to produce indigenous commercial kit..

Market Potential

Commercial kits for plant viruses available in market are of very high cost, no indigenous kits are available in the market, so product will be utilized in Indian perspective.

National/Societal Relevance

This will help to produce good quality virus free tissue culture/planting material, particularly in vegetative propagated crop like potato.

Project Deliverables

a. **Progress vis-a vis objectives** - The polyclonal and monoclonal antisera for some of the potato, banana and orchid viruses have been developed and kits are in various stages of development and validation.

b. **Technology/ Product developed** - DAS ELISA kit developed for diagnostic of one potato virus PVX , one for Banana virus BSV, two for Orchid viruses CyMV and ORSV.

c. **IP generated/Potential for IP generation** - None

d. **Resources Generated** - Manpower: 2 manpower trained as SRF. Facility Created: ELISA Reader and Ultra Sonicator Machine

Plans to take innovation further.

The ELISA kit developed in the project will be commercialized.

Risks Envisaged

1. Polyclonal Antibody and Monoclonal Antibody may not be of high titre.
2. Their sensitivities may be below the optimal concentration for DNA viruses found in low concentration in crop like banana.
3. Background reactions may be high.
4. Low titre antibodies may not be useful for lateral flow device i.e. Dipstick.

Innovator Team

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Indo American Hybrid Seeds

The Innovation

Utilization of Marker Assisted Selection for development of salt tolerant hybrids in rice Oryza sativa

Development Stage

Validation

Brief Description

Utilization of Marker assisted backcross approach to introgress Salt QTL into cytoplasmic genetic male sterile cognate lines maintainer.

Innovative Element

Development of salinity-tolerant F1 hybrids through marker assisted backcross MAB.

Market Potential

Promotion of salt tolerant rice hybrids will ensure further intensification of cropped areas and sustainable production

National/Societal Relevance

In India, about 8.6 m ha of land area is affected by soil salinity and area is still increasing as a result of secondary salinization and land clearing. In this regard, efforts on breeding saline tolerant rice hybrids having great yield advantage is required to reach the farmers field.

Project Deliverables

a. **Technology/ Product developed**
   - Developed salinity tolerant Cytoplasmic Genetic Male Sterile lines
   - Saline tolerant F1 hybrids were developed which are under primary testing in saline hotspots

b. **IP generated/ Potential for IP generation** - IP not generated but potential for IP generation

c. **Resources Generated**
   - Manpower has been trained for Phenotyping and genotyping
   - Saline micro tanks have been created for Phenotyping

d. **If Commercialized, Nos. of units sold** - Not yet commercialized, Developed F1 hybrids being evaluated at multi stages

Plans to take innovation further

After successful development and production of hybrids, it can be given to farmers.

Risks Envisaged

Differential productivity could be expected under different degree of soil salinity

Innovator Team

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Kaveri Seed Company Ltd.

The Innovation

Marker-assisted dissection of genetic basis of yield and improving yield potential under drought stress in Maize.

Development Stage

Late Stage Validation / Pre-commercialization

Brief Description

Maize Zea mays L. is the third most important food crop in India and drought is an important abiotic stress limiting productivity potential of the crop.

Innovative Element

Molecular markers can be effectively deployed to dissect the genetic basis of yield under drought stress and marker-assisted selection strategy facilitates fast track breeding to improve per se performance of parental lines and subsequently for developing high yielding maize hybrids.

Market Potential

Maize being primarily grown under rain fed situations, improved hybrids outperforming the existing, under limitations of moisture stress will carry a very high market potential.

National/Societal Relevance-

Improving maize productivity in drought prone regions is of national relevance in terms of providing adequate grain to the poor farmers and land less labour who depend on maize farming for their livelihood

Project Deliverables

a. **Progress vis-a vis objectives**
   - The first objective or Marker-assisted dissection of genetic basis of yield and drought tolerance is completed successfully.
   - The second objective of improving parental lines using marker-assisted recurrent selection MARS method is going on in the project.

b. **Technology/ Product developed** - Maize hybrids having high yield potential under drought stress will be developed in the project

c. **IP generated/ Potential for IP generation** - The hybrid developed will be registered with PPV & FR.

d. **Resources Generated** - Manpower employed as per the project provision.

Plans to take innovation further

The project will be run as per its design.

Risks Envisaged

Failure to develop competitive hybrids could adversely affect seed business and depends on the product value and performance.

Innovator Team

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Kaveri Seed Company Ltd.

The Innovation

Development of Biotic stress resistant rice through conjunct use of Bio- and Hybrid Technologies.

Development Stage

Late Stage Validation / Pre-commercialization

Brief Description

Genetically insulate the popular Kaveri rice hybrid by introgression of blb Xa21 and xa13 blast Pi54 resistance genes in female parent and brown plant hopper resistance Bph18 and xa13 genes in restorer parent and to pyramid the resistances in the hybrid using molecular markers.

Innovative Element

The hybrids per se outperform varieties due to inherent phenomenon of heterosis or hybrid vigour. Hybrid quality, however, also imparts greater genetic buffering capacity to withstand abiotic stress. Built in genetic resistance to major pests in the hybrids adds a third dimension advantage.

Market Potential

Rice being a high volume crop, the potential for hybrid rice seed demand is huge.

National/Societal Relevance

The Relevance is due to the fact that the proposal supports one key objectives:-

- Seed being the repository of genetic potential, contributes to productivity increase there by creating revenue pathways to farmers.

Project Deliverables

a. **Progress vis-a vis objectives**
   - The project progress is as per the objectives envisaged.

b. **Technology/ Product developed** - Biotic stress resistance fortified rice hybrids will be developed.

c. **IP generated/ Potential for IP generation** - The hybrid developed will be registered with PPV & FR.

d. **Resources Generated** - Manpower employed as per the project provision. The phenotyping facility for the screening of Brown Plant Hopper and Blast resistance at Kaveri Seeds, Hyderabad. Also pollination chamber for crossing program, grain quality lab was developed for grain and cooking quality analysis.

Plans to take innovation further

The improved maintainer lines possessing bacterial blight and blast resistance will be twice backcrossed with the CMS line in order to convert the improved maintainer lines into improved CMS lines.

Risks Envisaged

Conversion of the improved maintainer line into improved CMS line may take 12 to 18 months period for the completion of the project.

Innovator Team

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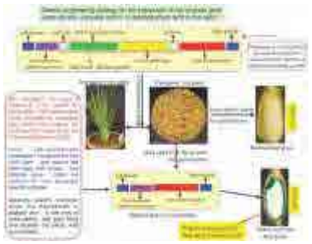

The Innovation

Production of Phytate free food grains: Effective strategy to deal with Micronutrient deficiency.

Development Stage

Proof-of-Concept

Brief Description

Production of phytic-acid free food grains to improve human health and reduces country's diseases burden.

Innovative Element

The presence of phytic acid is a nutritional problem and removal of phytic acid is a crop fitness problem. Genetic Engineering strategy will be utilized by reputed expression of Phytase to degrade the Phytic acid selectively in grains that are grown for food. The production of phytic acid free food grains will eliminate the micronutrient deficiency forever.

Market Potential

Licensing the technology to seed companies for production of phytic acid free food grains to improve bioavailability of micronutrients.

National/Societal Relevance

Successful Implementation of production of phytic acid free food grains in the farmers field without any intervened food processing technologies for effective assimilation of micronutrients to improve human health and cognitive growth.

Project Deliverables

a. **Progress vis-a vis objectives**
   - Developed genetic strategy for the regulated expression of phytase to remove phytic acid in developing rice grains.
   - Transformation of selected rice cultivar through Agrobacterium -mediated transformation. Molecular analysis of transgenic rice plants for stable integration of transformed construct and expression of its constituents.
   - Evaluation of different transgenic events for inducible expression of phytase, to degrade the phytic acid and production of phytic acid free rice grains.

b. **Technology/ Product developed** - Developed transgenic rice plants with regulated phytase expressing construct

c. **IP generated/ Potential for IP generation** - Filing patent for "Alcohol inducible genetic switch to regulate the trans-gene expression and its application thereof".

d. **Resources Generated** - Training of scientific manpower in plant molecular biology and plant transformation. Developed transgenic rice plants.

Plans to take innovation further

Continued research to generate the scientific data for improved bioavailability of micronutrients before exploring the possibility of commercial utilization.

Risks Envisaged

No risks envisaged.

Innovator Team

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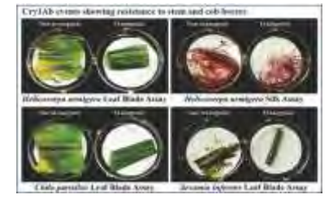
Metahelix Life Sciences Pvt. Ltd.



The Innovation

Deregulation Trials Phase I of Transgenic Maize Events Expressing Metahelix Synthetic Cry1C, Cry1Ac and Cry1Ab Genes for Tolerance to Stem and Cob Borers

Development Stage

Validation

Brief Description

Metahelix has developed transgenic maize events expressing either Cry1Ac or Cry1Ab.The efficacious events are being introgressed into elite genetic backgrounds to study the performance of the event.

Innovative Element

The Cry genes used in the project have been codon optimised for better expression in maize plants. The genes have been tested for its expression under the control of different promoters such as D35S , Ubiquitin and Metahelix proprietary Chimeric promoter.

Market Potential

The products emanating from this project are expected to have a significant market relevance under the circumstances of severe economic damage being caused by SCBs.

National/Societal Relevance

Conventional genetic improvements have only resulted in limited control of SCBs. The transgenic crop resistant to SCBs will result in reducing the pesticide use and a consequent increase in yield due to prevention of loss caused by the insect pests.

Project Deliverables

a. **Progress vis-a vis objectives** - Metahelix has developed transgenic maize events expressing either Cry1Ac or Cry1Ab that provide stable resistance against stem and cob borers viz., Helicoverpaarmigera, Chilopartellus and Sesamiainferens. The efficacious events are being introgressed into elite genetic backgrounds to study the performance of the event.

b. **Technology/ Product developed** - Agrobacterium mediated gene transfer method was used to generate transgenic maize events expressing either Cry1Ac or Cry1Ab to impart resistance against the SCBs.

c. **IP generated/Potential for IP generation** - The genes Cry1Ac and Cry1Ab that were used to generate transgenic maize events were codon optimised and synthetically designed by Metahelix for optimum expression. Metahelix has complete proprietary rights to file patents on these genes.

d. **Resources Generated** - A total of 20 members were employed in the project. PCR machine, Refrigerator and Autoclave machines one each, chemicals, plastic wares, stationery materials, IT related equipments and software support were purchased besides maintenance of equipment

Plans to take innovation further

The efficacious events that have been generated are being introgressed into diverse elite genetic background to determine their performance. Bio safety data for BRLI is being prepared

Risks Envisaged

None

Innovator Team

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Nirmal Seeds Pvt. Ltd.

Collaborator: The Energy and Resources Institute

The Innovation

Development of Okra varieties resistant to YVMV using Marker Assisted Selection

Development Stage

Proof-of-Concept

Brief Description

Development of genotypes resistant to YVMV will significantly protect yield losses due to YVMV ultimately enhancing yield by 75 -80 percent. Farmers will get benefitted in terms of revenue from the crop.

Innovative Element

The use of available YVMV resistant lines to develop PCR based markers for application in marker assisted breeding. Method of agroinnoculation for screening of resistance in Okra crop will be standardized.Viruliferous white files will be alternatively used for screening resistant lines

Market Potential

Product developed through present proposal will significantly increase okra production in India via saving damages due to YVMV

National/Societal Relevance

The proposal aims to develop the prerequisites for developing resistant varieties through marker assisted breeding. The YVMV resistant genotypes will be developed using MAS approach

Project Deliverables

a. **Progress vis-a vis objectives** - Development of mapping population for YVMV resistance and identification of markers linked to YVMV resistance and their validation

b. **Technology/ Product developed** - Molecular markers linked to YVMV traits will be developed for MAS breeding of YVMV resistant Okra .

c. **IP generated/Potential for IP generation** - None so far

d. **Resources Generated** - Infrastructure like polyhouse , lab and capabilities.

Plans to take innovation further

Once the marker linked to YVMV traits are developed , the markers will be used to develop hybrids and varieties using MAS breeding strategy. Developed varieties and hybrids will be directly commercialized in the market by NSPL

Risks Envisaged

However, the okra genome is very large with large number of chromosomes with polyploidy so careful application of MAS is needed.

Innovator Team

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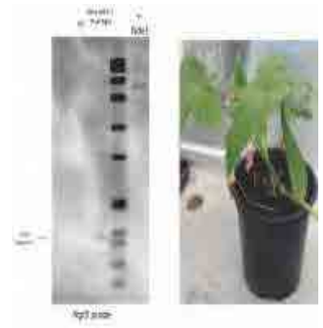
Nirmal Seeds Pvt. Ltd.

Collaborator : University of Delhi, South Campus



The Innovation

Development of Viral resistant Okra using RNAi approach

Development Stage

Proof-of-Concept

Brief Description

Transgenic okra line harboring hairpin RNAi construct will be developed. The virus resistance line will be completely resistant to YVMV.

Innovative Element

Each RNAi constructs developed with one or more viral gene in a hairpin orientation will be evaluated for resistance. The best combination or individual gene will be used for okra transformation. Infectious clones of geminviruses will be constructed for agroinoculation of okra and Nicotiana benthamiana. Transformation protocols will be standardized for elite okra cultivars.

Market Potential

Development of YVMV resistant okra using RNAi approach is a strategy which will increase the Value of this crop. Genotypes developed in this way will be preferred by the farmers and ultimately increase cultivation and production of crop

National/Societal Relevance

YVMV resistant genotypes of Okra developed using RNAi approach will have wide acceptance and increased utility both as nutritional and medicinal crop.

Project Deliverables

a. **Progress vis-a vis objectives** - Development of agrionfectious clones, RNAi constructs and regeneration and transformation protocols for elite/selected okra.Screening for resistance using agro clones or by agroinoculation and inoculation using mechanical inoculation or Viruliferous whiteflies

b. **Technology/ Product developed** - Hairpin RNAi construct of AC4 and AV1 gene developed for transformation of okra

c. **IP generated/Potential for IP generation** - No IP generated so far

d. **Resources Generated** - Developed infrastructure for transformation of okra, field polyhoused for growing transgenic plants and trained manpower

Plans to take innovation further

Virus resistant transgenic okra varieties, Hybrid resistance to YVMV and seed multiplication and bio safety studies will be conducted as per DBT guidelines for approval of the event

Risks Envisaged

The level of resistance may be low or the inoculation procedure may not be robust for large-scale testing for resistance. There could also be inefficient removal of the marker gene in the transgenic lines, resulting in difficulties in the grant of biosafety clearance.

Innovator Team

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Mayursaindane
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Nirmal Seeds Pvt. Ltd.

Collaborator: The Energy and Resources Institute

The Innovation

Development of nutritionally improved mustard (Brassica juncea) varieties/hybrids having low Erucic acid and low Glucosinolate content using marker assisted selection

Development Stage

Validation

Brief Description

Double low mustard varieties with less than 2 % Erucic acid in the oil and less than 30 µm Glucosinolate in the defatted meal are developed using molecular markers.

Innovative Element

Utilization of gene based molecular markers in a backcross breeding strategy thus reducing the total duration of the breeding program by removing the selfing steps .

Market Potential:

This crop accounts for nearly 1/3rd of the oil produced in India making it the country's key edible oilseed crop. The double low trait would add more quality to the produce

National/Societal Relevance

Mustard oil has high amounts of Erucic acid which is anti-nutritional. The oil cake has also high levels of Glucosinolate which makes it unfit as cattle feed. There are no double low variety and hybrids of B. juncea released so far. Therefore, a double low variety is expected to have wider acceptance and increased utility both as edible oil and cattle feed.

Project Deliverables

a. **Progress vis-a vis objectives** - Double low trait has been fixed and traits showing the required characteristics have been shown in glass house trails

b. **Technology/ Product developed**- Markers developed in Brassica juncea for low Euricic acid trait. Development of NML 100 Brassica juncea line with double low characteristics. Developed anther and microspore culture protocol for Brassica juncea line NML100.

c. **IP generated/Potential for IP generation** - None

d. **Resources Generated** -
   1 Markers developed in Brassica juncea for low euricic acid trait
   2 Developed NML 100 Brassica juncea lines with double low characteristics
   3 Developed anther and microspore culture protocol for Brassica juncea line NML100

Plans to take innovation further

Double low NML 100 Brassica juncea will be commercialized as a variety and further

advanced to hybrid development.

Risks Envisaged

The biggest challenge is to combine the double low characteristics with good yielding capability, as some of the loci associated with low glucosinolate content are negatively associated with yield loci.

Innovator Team

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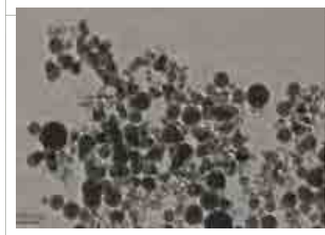
Saveer Biotech



The Innovation

Commercial Scale Production of Nanopesticides and Nanofungicides for Indian Agro-industry

Development Stage:

Commercialization

Brief Description

The engineered nano silca which is amorphous in nature has been formulated and evaluated with and without surface functionalization against key pests of seeds in storage. The functionalized nano material is more efficient in supressing the insect pest population in store seeds of grains etc.

Innovative Element

The innovative element of the project is that the synthesized and surface engineered hydrophilic form of n-SiO_2 causes mortality of the test insects significantly and quite comparable with the traditional synthetic organophosphates usually used in grains during storage.

Market Potential

The crop protection chemicals accounts for ~2% of the total chemicals market in India. India is currently the second largest manufacturer of pesticides in Asia, second only to Japan.

National/Societal Relevance

Based on the research output, engineered and functionalized silica nano particles could be a better possible and cost effective alternative to the existing pesticides for seed storage in India. The product will be user friendly and not having any problem of insect resurgence, resistance, residues and environmental hazards as compared to the chemical pesticides.

Project Deliverables

a. **Progress vis-a vis objectives** - Through induction plasma system nanopowder can be synthesized in kilograms with a consistent rate of production. The inflight surface functionalization module, highly stable nanoparticles can be produced as an end product. If the field trials are successful, a supply of nano product to Indian agro industry will be ready to fight against pests and fungi.

b. **Technology/ Product developed** - Induction plasma technology allows the synthesis of pure metal, alloy, oxide and ceramic nanopowders for many different types of applications. Induction plasma is particularly suitable for high purity processes due to lack of contamination caused by the erosion of electrodes associated with other plasma technologies

c. **IP generated/Potential for IP generation** - S.O.Ps developed for synthesis of different grades of nano silica. The process for patenting is on

d. **Resources Generated** - Trained manpower

Plans to take innovation further

Product of silica nanopesticide which after formulation can be applied for the Indian agro industry.

Risks Envisaged

Looking into risk factors of nanomaterials it essential for exploring their potential applications, for social acceptance and safe use of the nanotechnology. During the pesticide treatment, there is a probability of nanoparticle accumulation into the stored seed grains

Innovator Team

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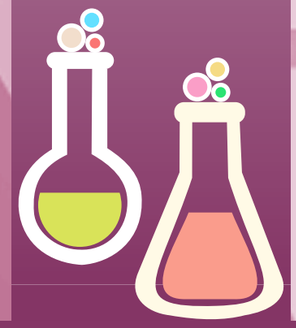
Innovation Profiles

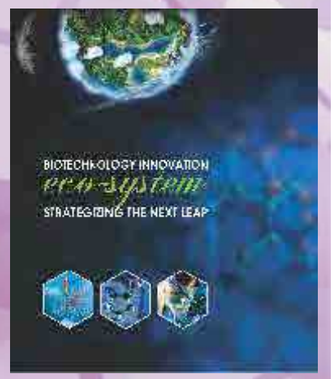
BIRAC Innovators

Industrial Biotechnology



September 2016

Affigenix Biosolutions Pvt. Ltd.



The Innovation

Development of trypsin resistant PAN reactive trypsin antibodies for industrial application

Development Stage
Commercialization

Brief Description
Enzyme Trypsin is used in various biological processes such as Insulin manufacturing to cleave peptide linkers from pro-drug C peptide removal from Proinsulin and activation of vaccine viruses. Residual Trypsin analysis is used during downstream processing.

Innovative element
Selected anti trypsin antibodies address critical unmet market need such as rapid, sensitive, specific and reliable trypsin clearance assay, anti-trypsin antibody immunogenicity assessment kit and matrix for purifying Trypsin from various sources. It is a low cost & high value product. It can be used as potential therapeutic trypsin inhibitor and can be exploited by food or meat processing industry for monitoring shelf life stability.

Market Potential
Biologics and biosimilar companies, trypsin manufacturing companies, diagnostic companies will be the customers.

National/Societal Relevance
Anti-trypsin antibodies and immunoassay enables drug companies to monitor the clearance of the Trypsin used in downstream processing of Biologics and Biosimilars. It enables purifying Trypsin from native and recombinant source Removal of contaminating Trypsin in the drug substance or drug product. Critical reagents for academic research and by various food industries. Trypsin inhibitor could be used as therapeutic agent for treating pancreatitis, shock and disseminated intravascular coagulation.

Project Deliverables
a. **Progress vis-à-vis objectives –** 1. Identifying Trypsin &Trypsinogen peptide mimetic Completed 2. Peptide synthesis and conjugation : Completed 3. Anti peptide/s antibody production: Completed 4. Critical reagent preparation, Method development and Qualification: Completed 5. Validation/qualification of the method: In progress

b. **Technology/Product developed** - Trypsin resistant polyclonal antibody generating process, Antibody purification strategy and custom sensitive immunoassay for monitoring trypsin clearance in the biologics.
Generation of anti-Trypsin Monoclonal antibodies or its fragments there off that can recognize specifically the active trypsin without cross reacting to Trypsinogen which can be used as immunomatrix for purifying native and recombinant trypsin.
Method of diagnosis using polyclonal and monoclonal antibodies for detecting the presence of immunoreactive trypsin in prenatal subjects.

c. **IP generated/ Potential for IP generation –**Mab antibody sequences with appropriate utility to be filed.

d. **Resources Generated –** With BIG grant fund, the lab is equipped with cell culture facility, trained two scientists in Immunoassay development, generated employment for two scientists beyond 18 months period.

Plans to take innovation further
The company plans to carry out the field trials, launch the prenatal diagnostic kit upon regulatory approval. Collaboration with an industry partner for integrating antibody as an immunomatrix for purifying trypsin from native and recombinant sources would be done.
After establishing the Proof-Of-Mechanism of the potential therapeutic antibody in vitro, the company will look fori partners for preclinical development and for further clinical development towards treating pancreatitis patients.

Risks Envisaged
Regulatory hurdles in commercializing the diagnostic products.
Unknown risk associated with therapeutic antibody drug development.

Innovator Team
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Amnivor Medicare Pvt. Ltd.

The Innovation

- Production of collagen and by-products from fresh water fish origin for biomedical applications

Development Stage
Discovery

Brief Description
A proprietary process of extraction of collagen from fresh water fish origin and a method of preparation of collagen-biopolymers combinations has been developed for efficient and accelerated chronic wound healing. This dressing material can also be used as a new wound-dressing system for damaged tissue recovery of various wounds types.

Innovative element
A low cost alternative to mammalian or avian derived collagen based wound dressing materials has been developed from fresh water fish waste. The efficacy of the developed dressing materials for wound healing has been validated in vitro and in animal model. In vivo studies showed that the wound healing outcome was comparable with the existing similar products available in the market.

Market Potential
Considering the price to volume ratio, each of these are expensive products considering the Indian and international scenario. Hence, the developed materials have the potential to be financially viable products. With 50.8 million diabetics, India has 18% of Global diabetic Population and Diabetes accounts for 11 billion of the total healthcare expenditure of India.
In the Indian market scenario, the ultimate selling point of the developed products would be higher efficiency to heal wounds, preparation of collagen based advanced wound healing material into different forms according to the nature and size of the injury and affordability of the product.

National/Societal Relevance
In India, a proper and advanced wound care management is yet to be developed indigenously to make it affordable to all section of our society. A holistic approach is essential for the efficient management of all types of the wound including diabetic, burn and surgical wounds which is currently lacking in our country. Therefore, to combat this serious issue of efficient management of all types of wounds which can even cause harm to a patient as amputation of limbs, a simple, effective but economical method of treatment is necessary which can be affordable to all section of the society.

Project Deliverables
a. **Progress vis-à-vis objectives** - Semi- Pilot scale studies of extraction of collagen and collagen based dressings for dermal would healings towards commercialization have been successfully completed, Pre-clinical development, safety studies and assessment of the collagen based wound dressings have been done in vitro as well as in rat model. The report has been submitted with all the objectives fully verified. The results have also been validated.

b. **Technology/Product developed –** Extraction process of collagen from fresh water fish waste and formulations of collagen and biopolymer based dressings for dermal would healings

c. **IP generated/ Potential for IP generation** - A Process for Extraction of Collagen from Fish Scale and Polyelectrolyte Based Bioactive Super-Absorbent Materials, application number: 201631001353 Date of filing: 14th January, 2016

d. **Resources Generated** - 3 persons have been employed and they are now properly trained. Moreover, equipment like Lyophilizer, BOD incubator Shaker, Freezer - 20°C , Weighing balance, Deionized water plant, customized Dialyzer have been purchased

Plans to take innovation further
As the proof-of-concept is already established and results are validated in vitro and in vivo, now the focus is on the clinical study of the same material to obtain certification for commercialization.

Risks Envisaged
The preservation of the collagen based wound healing material is crucial as it is sensitive to temperature, and it is also important to retain in its native form for a long time. Another major issue is proper sterilization of the wound dressing products. Otherwise it will be a source of infection to the wounds.

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Aspartika Biotech Pvt. Ltd.

Collaborator: Sir M Visvesvaraya Institute of Technology

The Innovation

Establishment of pilot-scale Supercritical Fluid Extraction unit for nutraceutical and cosmeceutical products development

Development Stage

Validation

Brief Description

Establishing a state-of-the art facility for the purpose of supercritical fluid extraction at laboratory scale and pilot scale production of herbal extracts, essential oils, flavours, therapeutic components etc using Supercritical Carbon dioxide. Also, a complete reclamation of silk industry wastes in and around Bangalore by converting them into high value omega-3 fatty acids and low value high volume poultry feed.

Innovative element

The innovative elements include the development of an odor free process of extracting pupa oil from silkworm pupa waste enriched with 75 of omega-3 fatty acid. Silkworm pupa waste being the cheapest and the richest source of omega-3 fatty acid. Moreover, the extraction process includes the utilization of a carbon dioxide as the solvent, which is completely recoverable.

Market Potential

At present, GLP Grade Silkworm pupa cake costs USD 150/kg , Silkworm pupa dried as per GMP norms costs USD 15/kg and Silkworm pupa oil costs USD 250/kg. This gives a huge business potential.

National/Societal Relevance

India is the second largest producer of silk with an annual raw silk production of 26,480 MT per annum. Sericulture is practiced in 52,360 villages in India and provides employment opportunity to about 7.6 million people in India.

Silkworm pupae accounts for 80% of the total raw silk produced. This silkworm pupa is cheaply discarded due to its bad odour and becomes an environmental hazard. If this waste is effectively utilized, it can completely meet the Omega-3-fatty acid requirement RDA of 78 lakhs children or 26 lakhs pregnant women/lactating mothers. Additionally, the cake discharged after the extraction of Omega-3-fatty acid is rich in protein and can be used as a raw-material for poultry feed, aqua feed etc

Project Deliverables

a. **Progress vis-à-vis objectives –** A one point solution for industries, individual researchers to standardize and scale-up and produce extracts for nutraceutical and cosmeceutical applications. Complete reclamation of silk industry wastes in and around Bangalore by converting them into high value omega-3 fatty acids and low value high volume poultry feed

b. **Technology/Product developed** - Silkworm pupa waste was successfully converted and developed into: Omega-3 fatty acids and poultry feed additive

c. **IP generated/ Potential for IP generation –** One complete patent has been filed covering the product developed as mentioned above. Patent Number: 3965/CHE/2015

d. **Resources Generated –** After the completion of BIG Project, Aspartika Biotech Pvt Ltd., was incorporated and have a total manpower of 6. About 15 students have been trained through the facility.

Plans to take innovation further

Intention is to scale-up the product and partner with suitable marketing agency

Risks Envisaged

No major risks envision as pilot scale trials have been performed and at least 100kgs of omega 3 fatty acids and 300 kgs of silkworm pupa powder in a single day of two shifts have been produced.

Innovator Team

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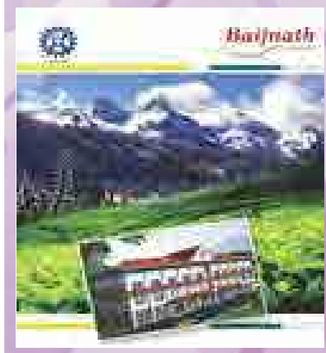
Collaborator: Institute of Himalayan Bioresource Technology-CSIR



The Innovation

Development, adoption of green technology for commercial production of tea catechins and its formulations

Development Stage

Pilot scale production and standardization of Tea Catechins.

Brief Description

Catechins and theaflavins, the polyphenolic antioxidants of green and black tea, respectively are extracted from coarse shoots and other underutilized parts of the tea plant. Catechin obtained is an off-white amorphous powder containing 60-70% Catechins. The technology is green and employs no harmful chemicals.

Innovative element

Tea catechins are extracted by water, purified using green solvents.

Market Potential

As per CAGR tea polyphenols are leading polyphenols consumed worldwide accounting for 72.5% of total market volume in 2012, with fastest growing polyphenol product, growing at an estimated compound annual growth rate CAGR of 8.8% from 2013 to 2020. Global market for black tea polyphenols is expected to exceed USD 25 million by 2020 at an estimated CAGR of 6.3% from 2013 to 2020.

National/Societal Relevance

India is the world's second largest producer of tea. For processing tea of commerce, the apical bud and subtending two leaves are used. But due to labour shortage, there is difficulty in maintaining the flush and the shoots overgrow.

During the rainy months the tea factories are not able to handle the flush which results in poor manufacture. Therefore, this technology aims at utilizing these overgrown shoots and abundant flush for extracting catechins which otherwise results in lower returns of the produce.

Project Deliverables

a. **Progress vis-à-vis objectives –** Design, fabrication, installation and commissioning of equipment reached at company site and will be installed and made functional soon. Optimization of storage conditions (temperature, humidity) and tea leaf quality done.

b. **Technology/Product developed** - Products standardization is under process at extraction stage.

c. **IP generated/ Potential for IP generation –** New IP will be generated on development and preparation of oral, topical formulations based on tea catechins.

d. **Resources Generated** - Two Scientist, One Technician and one assistant employed in the project. The related equipment i.e. one SS extractor, one SS column, one filter press and one spray dryer procured.

Plans to take innovation further

Implementing the plan as per the approved project.

Risks Envisaged

India does not have an established market for catechins as yet but the awareness to consume tea catechins is increasing. The other competitor in the market is China which gives catechins at a lower rate but the method used for purification in not green and is using solvent extraction. Cost-benefit ratio at industrial scale needs to be done.

Innovator Team

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Bionary Bioproducts Pvt. Ltd.

The Innovation

Development of L-arginine production process with novel genetically engineered E.coli strains

Development Stage

Validation.

Brief Description

L-arginine through fermentation of genetically modified E.coli.

Innovative element

A novel method has been used to genetically modify the E.coli to increase the L-arginine production.

Market Potential

L-arginine has established use in increasing muscle mass for body building, repairing damaged tissue for wound healing and lowering blood pressure. Evolving applications include treating heart diseases, erectile dysfunction, cancer, etc. Most of India's requirements are imported from countries like China, Korea, etc.

National/Societal Relevance

L-arginine is one of the important amino acids, which is gaining market now because of evolving applications. India imports most of its requirements from countries like Korea, China and Japan. This being an indigenously developed technology would help us in reducing our dependency on imports.

Project Deliverables

a. **Progress vis-à-vis objectives /commercialization status–** Not commercialized yet.

b. **Technology/Product developed -** The technology demonstrated has proved to produce around 10-13 g of L-arginine from one litre of fermentation broth. Also after purification, it is established to be pure and compared to pharmaceutical grade.

c. **IP generated/ Potential for IP generation –** No IP has been filed now. But the clone details may be used to file an IP.

d. **Resources Generated –** Two manpower were employed full time in the project. The PI is trying to create a facility for scale-up and manufacturing. Presently they are looking for funds for the above activity.

Plans to take innovation further

The PI is trying to create facility for scale-up and manufacturing. Presently, they are looking for funds for the above activity.

Risks Envisaged

No risk has been envisaged as such now.

Innovator Team

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Cellzyme Biotech

The Innovation

Development of Iron Rich Rice Bran Protein Hydrolysate from the Byproduct of Rice Bran oil Industry

Development Stage

Proof-of-Concept

Brief Description

Rice bran protein hydrolysate will be developed which can either be used as a functional food or a fortification agent. The product is rich in essential vitamins, micronutrients and minerals which can be used by pregnant women and young children.

Innovative element

The inventive step is to optimize the parameters for enhanced recovery of proteins and micronutrients from rice bran. Product will be used to formulate the novel functional foods.

Market Potential

Rice production in India is over 102 million tons and the production of rice bran oil is around 1 million tons and still untapped market is around 0.6 million tons. This easily translates into the defatted rice bran availability in the country of over 0.9 million tons. Therefore the solution based on rice bran will have an excellent sustainability index with low environmental footprint. This rice bran based product would be an economically feasible option to address the nutritional requirements of infants and young mothers.

National/Societal Relevance

India`s greatest human development challenge is malnutrition. In spite of enjoying a strong economic growth, the wide prevalence of under nutrition is an indicator of the poor nutritional status of the masses. Children under five years of age and the expectant mothers are devoid of nutrition. To address this unmet need it is imperative to develop the solutions with a sustainable technology. One key to meet this challenge is to utilize what is considered as a waste material, such as rice bran.

Project Deliverables

a. **Progress vis-à-vis objectives –** Optimized conditions for producing protein hydrolysate have been achieved in lab scale. Pilot scale studies are in progress. Investigation of functional and nutritional properties are planned.

b. **Technology/Product developed -**Protein hydrolysate from rice bran

c. **IP generated/ Potential for IP generation –**IP generation potential is high

d. **Resources Generated –** Required equipment were procured and 4 scientists were trained

Plans to take innovation further

On realization of Proof-of-Concept and third party validation trials, a small scale production facility will be built to manufacture the product.

Risks Envisaged

The strategy for product development is straight forward and required know how is available. However, constant supply of the high quality raw material and high energy consuming utilities for manufacturing pose a risk.

Innovator Team

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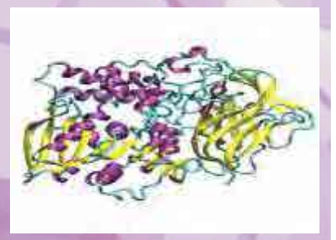
Tamil Nadu-641301

Cellzyme Biotech



The Innovation

Green Manufacturing of Cephalosporin Antibiotics Using Recombinant Deacetylase

Development Stage

Proof-of-Concept

Brief Description

Developing a cost-effective technology for the green manufacturing of antibiotics using a proprietary enzyme. A novel enzyme will be developed using recombinant DNA technology.

Innovative element

Large scale manufacturing of API for antibiotics is performed under extreme pH conditions, involving large volume of organic solvents and cooling the reaction mixture to -45°C. Using the proposed product, the manufacturing can be performed at milder operating conditions with improved yield

Market Potential

The green chemistry represents a market opportunity that will grow from $2.8 billion in 2011 to $98.5 billion by 2020. The global sales of drugs that could potentially use the proposed product for manufacturing is valued around $1.3 billion in 2012.

National/Societal Relevance

The sustainable technology addresses the India`s commitment to the development of pharmaceutical processes with higher efficiency and minimal waste. The proposed technology will open up a new market with import substitution potential.

Project Deliverables

a. **Progress vis-à-vis objectives –** NA

b. **Technology/Product developed -** Recombinant enzyme for green manufacturing of API

c. **IP generated/ Potential for IP generation –** Potential for IP generation is high

d. **Resources Generated –** Fermenter will be procured from the BIG project. Four scientific staffs were employed.

Plans to take innovation further

Industries involved in the manufacturing of API for antibiotics have been contacted. The product will be made available for trials. Based on the feedback of large scale trials, technology transfer or setting up a manufacturing plant for the finished product is envisaged.

Risks Envisaged

- Changing technology landscape
- Implementation of the process requires regulatory approvals

Innovator Team

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Embio Limited

The Innovation

Process optimization with improved transaminase for conversion of R-PAC to L-Norephedrine and scale up to 100 L

Development Stage

Validation.

Brief Description

The technology is aimed at converting a chiral alpha-hydroxy ketone to chiral amino alcohol by using a transaminase, using an amine donor Isopropylamine, which in turn is converted to acetone. The alpha hydroxy ketone R-PAC is a chiral intermediate coming from yeast whole cell bio-transformation. The transaminase is expressed in *E.coli* and the transamination is also a whole cell bio-transformation.

Innovative element

This is a Green process. Two whole cell bio-transformation process for a high volume low value product. Absence of metal catalysis and better stereo-selectivity are other highlights.

Market Potential

Current production of the product through synthetic route is about 70 TPA. Although increase in HIV cases is not seen, there is a stable market for Efavirenz and therefore Norephedrine.

National/Societal Relevance

India is the biggest producer of Efavirenz, which is anti- HIV. Norephedrine is the chiral auxiliary used in the production of Efavirenz. Reduction in Norephedrine price could be passed on to the Efavirenz pricing, thereby favouring the patients.

Project Deliverables

a. **Progress vis-à-vis objectives –** Achieved at 10 L scale to give 75 units of activity per gm biomass, and a biomass yield of 160 gm/L wet weight. Cost minimisation exercise underway. Currently L-norephidrineoptimised at bench top scale to give 98% de and 87% conversion. Although overall recovery of 90% till the salt is achieved, alternative strategies are being worked out.

b. **Technology/Product developed –** A process for production of RS-norephedrine through bio-transformation of R-PAC has been developed. Embio already is a market leader in this product and has a patent portfolio based on synthetic routes. This is an attempt at replacing the process with a biological route if techno-commercial feasibility is achieved.

c. **IP generated/ Potential for IP generation –** Embio has filed patent application on the process Application No. PCT/IB20 12/054 176. Patent 7414153, Application 20090112025

d. **Resources Generated –** This project would be bringing in capital worth 40.47 lakhs. Small volume glass fermentors is a key resource. Manpower would be intensively trained in bacterial process optimization for techno-commercial viability.

Plans to take innovation further

Taking the idea further, possibility of expressing transaminase in a yeast producing the substrate would be explored. This would make it a single host 2 step bio-transformation process.

Risks Envisaged

Existing players based on alternative technologies; Synthetic chemistry based resolution of dl-norephedrine; MDPL India, Chifeng China. Challenges from new synthetic chemistry technologies (WO/2015/063795 Lauras Labs India) might be there. Stagnant market of Efavirenz could pose a problem

Innovator Team

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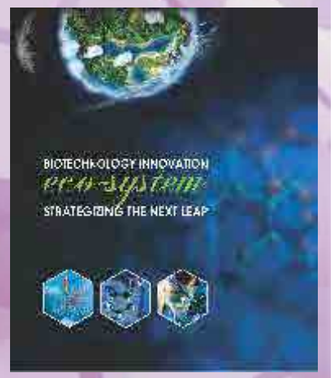
Epygen Biotech Pvt. Ltd.

Collaborator : Institute of Microbial Technology-CSIR



The Innovation

Demonstration of Recombinant Streptokinase in collaboration with CSIR IMTECH for Scaling up to 100L high density fermentation of E.coli harboring rSK and small scale purification

Development Stage

Validation

Brief Description

Biosimilar Recombinant Streptokinase (rSK) was developed from in-vitro to animal and to clinical studies in patients with acute myocardial infarction (AMI). Expressed by a non-streptococcal bacteria, it can overcome the disadvantages of earlier version of SK, namely the induction of an antigenic response and of acute nonspecific febrile and hypotensive side effects.

Innovative element

Production of rSK using Kana clone in E. coli BL21-DE3 using high cell density fermentation at 100 L fermenter level. Purified to near-homogeneity using a 2-step HIC and IEX chromatographic processes, confirmed by SDS-PAGE/Coomassie.

Market Potential

SK is currently the most economic Thrombolytic agent available, costing approximately Rs. 2000-3500 for a full dose of 1.5 million units. Mainly because of its cost, it remains the most commonly used agent in clinical practice in the country. In addition, rSK being a recombinant protein, it is free from streptolysin/streptodornase associated with natural SK. AlteplasetPA is the most expensive agent available, costing approximately Rs. 40,000 per full dose. In 2003 the market for SK in India was valued at over $14.5 million growing at a rate of 25 to 30%.

National/Societal Relevance

With a large portion of Indian society suffering from cardiovascular diseases (CVD), there is a serious need for economically viable thrombolytic drugs. While SK has been found to be a workable solution, a major portion of Indian patients still do not have access to this treatment due to unavailability and cost factor.

Project Deliverables

a. **Progress vis-à-vis objectives –** Over expression of rSK using HCD fermentation and purification resulted in high yields of 700 mg to 830 mg per liter. Purified rSK had a specific activity around 1Â±0.1x105 IU /mg, matching standard with WHO Streptokinase obtained from NIBSC

b. **Technology/Product developed –** a. HCD fermentation has been successfully done along with CSIR-IMTECH, achieving targeted increase in expression. b. Protein purification to homogeneity with high yield has been achieved. c. The purified protein has been shown to be biologically active.

c. **IP generated/ Potential for IP generation –** Project is based on IP owned by CSIR-IMTECH

d. **Resources Generated –** Set up Technology incubation center with a full-fledged microbiology, bioprocess, protein purification and analytical lab at CBD Belapur, Maharashtra. Have employed 4 full time Scientists and 4 support staff. Nearly Rs. 10 crores invested by promoters of Indian Origin and further funds infusion is in process.

Plans to take innovation further

EBPL has purchased and developed its MIDC-Patalganga site in Maharashtra, where it will set up the Therapeutic Protein plant, to manufacture recombinant streptokinase at high expression and high purity to make it affordable for the masses. The Technology Licensing process from CSIR-IMTECH has started in 2014 and batch preparations for Pre-Clinical trials are currently underway.

Risks Envisaged

Technical challenges in obtaining desired yields and consistency of biologically active protein. Cost effectiveness of the process.

Innovator Team

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India Glycols Ltd.

Collaborator: DBT-ICT Centre for Energy Biosciences

The Innovation

Setting up a 10 ton Lignocellulosic biomass/day processing plant to produce about 3000 Litre ethanol/day.

Development Stage

Validation

Brief Description

This is India's first multi feed stock continuous flow plant which can convert agricultural Lignocellulosic residues Bagasse, Rice Straw, Wheat Straw, Bamboo, Cotton Stalk, Corn Stover, Wood chips etc. into alcohol with optimum product yields through novel indigenous technology. The technology can convert biomass to alcohol within 24 hrs, - Enzyme reuse can take place in multiple cycles and recycling of plant chemicals & water takes place.

Innovative element

The technology can process agricultural waste wheat/rice straw/bagasse as well as high lignin woody biomass cotton/castor stalk. All process steps operate in rapid continuous flow mode. Reuse of Enzyme up to multiple cycles is possible. Recycling of acid, base & Water takes place. Conversion of both sugars C5 & C6 into Alcohol takes place. Biomass can be converted to ethanol within 24 hrs.

Market Potential

At present, the country has achieved 3% blending of ethanol in gasoline, which is far behind the target of 5% blending. But through this technology, it is possible to achieve the mandate of 5% blending of ethanol in gasoline, which leads a direct benefit to oil manufacturing companies for blending & same can be used for manufacturing green chemicals for selling in open market which will finally yield profit in Indian economy.

National/Societal Relevance

Lignocellulosic ethanol has a huge potential to supplement gasoline used in India up to more than 20% or more. The recent compulsory mandate of blending 5% ethanol in gasoline, followed by 20% blending target by 2020, will be difficult to meet through sugar cane and grain derived ethanol. By means of this technology, a mandate of even 10% blending of ethanol in gasoline can be achieved.

Project Deliverables

a. **Progress vis-à-vis objectives/commercialization status –** NA

b. **Technology/Product developed** - This cellulosic ethanol plant developed and designed by the DBT-ICT Centre is the low cost cellulosic ethanol production, achievable at a significantly high speed total process within 24h . The technology is also feedstock agnostic and can be used with various agricultural feedstock such as rice straw, cotton stalk, corn, bagasse etc. Further, the technology has been successfully optimized for production of other valuable byproducts such as high purity sugars, bio-chemicals etc.

c. **IP generated/ Potential for IP generation –** NA

d. **Resources Generated –** Yes

Plans to take innovation further

So far we have processed Bagasse & wheat straw as a main raw material but other feedstocks shall also be used as they become available with seasons. Finally data generation for each raw material will be accomplished for further scale up to commercial plant. At the same time this technology also opens the opportunities for many value added products such as green chemicals & sugar based chemicals, likewise typical bio refinery approach.

Risks Envisaged

None

Innovator Team

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Institute of Microbial Technology

Collaborator: Rossari Biotech Ltd.

The Innovation

Development of a novel bioreactor system for production of IMTECH-laccase and verification of commercial viability of IMTECH process.

Development Stage

Validation

Brief Description

Laccase E.C.1.10.3.2, p-benzenediol:oxygen oxidoreductase, belongs to a group of enzymes known as blue multi-copper oxidases containing 4 copper atoms per enzyme molecule. Laccase exhibit broad substrate specificity which can further be enhanced by the use of small organic molecule called "mediators". Laccase catalyze four single electron oxidations with concomitant reduction of oxygen to water.

Innovative element

The project involves design of a novel surface culture reactor for fed-batch operation for scale up of laccase production.

The constraints posed by the physiology of the fungus can be addressed by the design and operation of the reactor in fed-batch mode. The reactor will enable linear scale-up of the process.

Market Potential

Laccase is one of the expensive enzymes. Laccase is currently being imported in India. Indigenous Laccase production is expected to reduce the cost of laccase in India as well as it is expected to be cost competitive in the International market with export potential.

National/Societal Relevance

Indigenous production of laccase will result in self-reliance thereby saving foreign exchange. Due to cost competitiveness, Laccase produced in India will also have export potential.

Project Deliverables

a. **Progress vis-à-vis objectives** –Progressing as per milestones/objectives

b. **Technology/Product developed** –
   1. A novel surface culture reactor for production of enzymes and microbial metabolites
   2. A process for production of laccase using surface culture reactor.

c. **IP generated/ Potential for IP generation** - NIL

d. **Resources Generated** – A project assistant is being trained.

Plans to take innovation further

Setting up the pilot plant or industrial plant for laccase production

Risks Envisaged

There is no risk involved as the fermenter parameters have been standardized, and the yield is stable.

Innovator Team

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Kuantum Papers Ltd.

The Innovation

Cellulosic Ethanol Pilot Plant For Rice Straw Management

Development Stage

Validation

Brief Description

The high silica content in rice straw limits its utilization for value added applications Rice straw management through cellulosic ethanol production, apart from prevention of environmental pollution, will help to meet the targets of ethanol blending program of Govt. of India.

Innovative element

This technology/involves an alkaline pulping stage after hemicelluloses hydrolysis and before cellulose hydrolysis to remove lignin. This step removes the Silica Content inherent in Rice Straw, The next step is incorporation of a pre-soaking step in the pre-hydrolysis to initiate incipient and thorough hydrolysis of hemi-cellulose under milder conditions.

Market Potential

India needs about 105 Crores litres of ethanol for 5% mandatory blending The higher price and availability of ethanol are still limiting factors in implementing the ethanol blended petrol plan of Government of India. The proposed technology is expected to produce ethanol at competitive cost calculated based on current cost of inputs which makes this process very attractive for industrial application.

National/Societal Relevance

Among agricultural residues, rice straw is an attractive source of ethanol feedstock in Punjab, which is presently burnt after harvesting the crop leading to serious environmental concerns locally and globally. The cellulosic ethanol industry based on this patented technology may be able to use a significant amount of rice straw as feedstock.

Project Deliverables

a. **Progress vis-à-vis objectives** – The proposed demonstration plant is currently under implementation.

b. **Technology/Product developed** – The proposed demo plant will result in development of Anhydrous ethanol as main product. Apart from this, other by-products to be developed/ generated are Lignin, Caustic, Silica, Gypsum, CO_2, Steam/Power through an integrated process.

c. **IP generated/ Potential for IP generation** – Two Indian patents (IN 270534 and IN 235803) have been granted for ethanol preparation by hydrolysis of cellulase of lignocellulosic biomass and for recovery of caustic soda from weak black liquors.

d. **Resources Generated** – The implementation of the proposed demonstration plant will result in around 20 manpower trained for cellulosic ethanol production from paddy straw. The demo product will also result in creating a pilot plant facility for exploring the potential of various non-food/feed waste residues for generation of cellulosic ethanol. This facility may also be used for training of manpower for future commercial projects.

Plans to take innovation further

Kuantum Papers Ltd has signed Memorandum of Understanding MoU with Punjab State Council for Science and Technology (PSCST), Government of Punjab. PSCST, on behalf of the State Govt., is also preparing White Paper on ˜Paddy Straw Management in Punjab. Thus, PSCST is associated with this project as a Facilitator organization. Apart from BIRAC, PSCST will also guide Kuantum Papers Ltd for demonstration and promotion of the technology for transferring the benefits of the outcome of the proposed work to various Stakeholders within Punjab.

Risks Envisaged

The availability of long-term supply of feedstock i.e. rice straw is critical for success of cellulosic ethanol plants. The availability of a significant market for the product is important for the sustainability of any project.

Innovator Team

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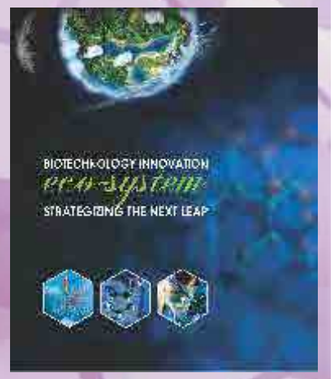

The Innovation

Development of De-metalizer Kit from Biopolymers for Efficient Removal of Heavy Metal Ions from Contaminated Water Especially of the Mining Areas

Development Stage

Discovery/ Proof-of-Concept

Brief Description

The product is a polyanion developed from polysaccharide. A monomer was grafted onto the polysaccharide. The technology is referred as tea-kit technology.

Innovative element

The concept is unique since a kit made from ecofriendly material for removal of soluble heavy metal ions particularly Pb II from the contaminated water is not available. The "tea-kit" technology that is being intended to develop whereby just by dipping the kit in the water for a while could remove significant percentage of Pb II from the water.

Market Potential

The market potential of the product is immense since this is going to be the first one to be used exclusively for removal of Pb II from water. Coupled with a strong marketing strategy, it is expected to grab a large market share both at the domestic as well as at the international level due to the unique concept, low price and user friendly technology.

National/Societal Relevance

The surface water gets heavily polluted with various heavy metals due to direct discharge of various industry effluents. Pb II has been the major contaminant found due to its various uses. Innovative technology that is being proposed to develop could be used both in the domestic as well as larger scale of water treatment.

Project Deliverables

a. **Progress vis-à-vis objectives –** The primary objective of this project is to develop a de-metalizer kit from biopolymers for removing soluble lead ions from contaminated waters in the state of Orissa. After achieving high adsorption efficiency with lead, the subsequent objective will be experimentation with other heavy metal ions like mercury, cadmium, arsenic, chromium etc. and their mixtures and finally field water testing and scale up.

b. **Technology/Product developed** - Till date trials on both the development of the product and the technology for its use has been conducted in the laboratory and scale up has been done. Without using synthetic chemical, modification of naturally occurring polysaccharide was done and the product was characterized. The product was immersed in the model waste water containing known concentrations of Pb II and Hg II. The extent of adsorption of the metal ions were measured after a stipulated time.

c. **IP generated/ Potential for IP generation –** Yes

d. **Resources Generated** - Manpower hired and getting trained, Instrument purchased

Plans to take innovation further

Under process

Risks Envisaged

At this moment, no risk has been envisaged

Innovator Team

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Mohans Healthcare Products Pvt. Ltd.

The Innovation

Promotion of Dr Mohans High fibre rice and its value added products for management of type 2 diabetes.

Development Stage

Validation

Brief Description

Cereal staple diets in India have high glycemic index and load contributing to half of the daily calories. These staple foods are associated with the risk of type 2 diabetes. Hence, substituting high GI staples such as white rice with lower glycemic index options and subsequently lowering the glycemic load could potentially mitigate the risk. The recently discovered Dr. Mohans High Fibre Rice DMHF rice has a lower GI and higher dietary fibre as resistant starch which could be one of the potential solution to the national problem of type 2 diabetes.

Innovative element

High Fibre white rice with greater proportion of non digestible carbohydrates compared to regular white rice.

Market Potential

So far DMHCP has produced and marketed 4 metric tonnes of DMHF rice in its own outlets within a short period from its release on July 17th 2013. Further it is envisaged to produce and market 100 tonnes of the product during the year 2014. The company has already intiated marketing tie ups with well established departmental stores and hotel networks at Chennai and PAN India.

National/Societal Relevance

DMHF low GI rice being an Unique Selling Proposal, if further validated for its efficacy through large scale intervention studies will acquire the distinction as an unique evidence based healthy cereal. DMHCP has produced and sold 4 tonnes of the product through its own in house sale outlets within a short time after its launch by legendary Agriculture Scientist Dr. M.S. Swaminathan on July 17th 2013. Based on the preliminary market surveys made by DMHCP in Chennai departmental stores such as Nilgris , Spencers, Big Basket 80 outlets are marketing this product throughout Tamil Nadu.

Project Deliverables

a. **Progress vis-à-vis objectives –** Proof of concept for the health benefits of DMHF rice through a randomized intervention trial among adults with type 2 diabetes. Awareness to enhance the consumer demand for an evidence based cereal staple, the DMHF rice by publishing the results of the intervention trials as scientific and popular articles. Development of DMHF rice based, novel, value added products and hence creating more health food choices in market

b. **Technology/Product developed** - Using this novel High Fibre Rice, three more value added products will be developed

c. **IP generated/ Potential for IP generation –** The product DMHF rice was developed using classical plant breeding approaches with the mutations at DNA level. This has been discovered and filed as a patent jointly by Texcity Biosciences Pvt Ltd and DMHCP. Texcity Biosciences Pvt Ltd has production and DMHCP has marketing rights of the DMHF rice. Even though there is no possibility of generating a new IP through this proposal,the data generated will be useful for strengthening the IP claim of the DMHF rice for its proposed health benefits.

d. **Resources Generated –** Manpower recruited : Product development assistants and Production supervisor. Facility was upgraded with company contribution.

Plans to take innovation further

Already jointly owned IP status with Texcity BioSciences Pvt Ltd, Coimbatore

Risks Envisaged

DMHF rice is a unique selling product and first of its kind in the country. Lack of awareness among the general public on its health benefits and increased cost of production owing to special processing and stringent quality checks as compared to the regularly consumed rice are the risk factors.

Innovator Team

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Nagarjuna Fertilizer & Chemicals Ltd.

The Innovation

Development of Technology Platform for Rare Sugar Production

Development Stage

Pre-Commercialization.

Brief Description

A technology platform for production of three rare sugars D-Psicose, Trehalulose and Isomaltulose has been developed. The uniqueness lies in the technological differentiation which focuses on sustainability, safety and eco-friendliness. An enzymatic route has been developed for rare sugar production which is driven by biological catalyst and makes the process economical.

Innovative element

The process uses recombinant protein platform which makes the process efficient, stable and adaptable to wider pH ranges etc. The matrix for immobilization makes for efficient conversion and also simplifies the downstream process making it robust and easily scalable. The products are safe to consume and have low calories / low glycemic index. They have no aftertaste and are economical and sustainable to compete in the sugar market.

Market Potential

The global market for artificial sweeteners has been growing at CAGR of 4 over last five years. Over 2015-2020, the global market is expected to grow at CAGR of 5.1 from 2,10,140 tons to 2,69,799 tons. It is forecasted that from 2015- 2020, the highest growth rate for sweeteners is projected for the Asian Pacific region followed by North-American region. This demand in Asia is due to rising population, improved standards of living & changing consumption patterns. Product wise, highest growth is expected in Allulose CAGR 14.17 followed by Isomaltulose CAGR: 5.16 during the period 2015-2020.

National/Societal Relevance

The existing products / artificial sweeteners provide sweetness without any nutritional value and also might become addictive. There are increasing number of reports suggesting that most of sweeteners cause a number of harmful side effects in myriad patients, including those with cancer, severe depression, multiple sclerosis and systemic lupus. The existing products and processes are not cost effective making it difficult to penetrate the sugar / natural substitute markets. The products Allulose, Isomaltulose and Trehalulose meet all the above criteria and have a large social impact as they will give the consumers an option to choose a safer and healthier alternative.

Project Deliverables

a. **Progress vis-à-vis objectives/commercialization status –** Presently in pre commercialization phase.

b. **Technology/Product developed** - The products Allulose, Isomaltulose and Trehalulose were showcased at the recently concluded July 17th - 19th, 2016 International Food Technologists IFT exhibition at Chicago. The trademark registration for the product names is complete. Allulose is registered as "Honeytose", Isomaltulose is registered as "Caneose" and Trehalulose is registered as "Nectarose".

c. **IP generated/ Potential for IP generation –**7 core patents and 5 peripheral patents have been generated.

d. **Resources Generated –** At present, there are over 50 plus dedicated team for this project and over the next five years the company plans to recruit around 300 people. They plan to have multi location production plants at various locations both national and international.

Plans to take innovation further

The company has its own production plants at multiple locations and at various locations globally.

Risks Envisaged

Regulatory risk; Technology robustness, scalability and production cost and Market competition

Innovator Team

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Neera Bhalla Sarin-FITT

The Innovation

Innovative approaches for upscaling natural tocopherol production from engineered Brassica juncea (Indian mustard) for therapeutics

Development Stage

Proof-of-Concept

Brief Description

The objective of the project is to enhance the synthesis of alpha-tocopherol using in vitro cell cultures as well as hairy root cultures.

Innovative element

Innovative elements involve the use of cell and hairy root cultures for increasing the level of alpha-tocopherol. Proof of concept for latter still needs to be established.

Market Potential

Natural vitamins are preferred over synthetic ones. Therefore a lot of market potential for the product that will be produced in India is foreseen. Regarding market potential abroad, the technology is at a very basic stage to comment on that although talking with some stakeholders in meetings has been promising.

National/Societal Relevance

Since earlier on we have shown in mouse model system that feeding mustard seeds enriched in alpha-tocopherol led to decrease in tumour incidence and tumour multiplicity [unpublished], this product could be of national as well as societal relevance in the long run. A lot of testing remains to be done in that direction.

Project Deliverables

a. **Progress vis-à-vis objectives –**Progress is as per schedule.

b. **Technology/Product developed** - Technology is by and large standardized. Product development is awaited.

c. **IP generated/ Potential for IP generation –** There seems to be a good potential for generation of IP.

d. **Resources Generated –** Three post-docs have been employed so far and trained. More are being trained. Installation of fermenter is under process.

Plans to take innovation further

Talks with people who would like to benefit from this endeavour are in process.

Risks Envisaged

The temperature fluctuations can affect the growth of the cultures. Sometimes contamination can take place.

Innovator Team

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Oriental Aquamarine Biotech India Pvt. Ltd.

Collaborator: National Centre for Aquatic Animal Health

The Innovation

Design modification and commercialization of nitrifying bioreactor technology for the establishment of organic recirculation prawn seed production system.

Development Stage

Validation

Brief Description

The company offers Nitrifying Bioreactor, Packed Bed Bioreactor (PBBR) to develop a bio-secure Recirculating Aqua-culture System (RAS). The reactor has a modular design and can be scaled up.

Innovative element

The Nitrifying Bioreactors work using specific nitrifying bacterial consortia generated according to the salinity of water. They automatically adjust the nitrification process to handle varying amounts of Ammonia and Nitrites in the water and adjust to different flow rates. Infection can be controlled using probiotics and even when disinfection is required, downtime is lower as re-starting can be achieved within 3 days.

Market Potential

Aquaculture is the world's fastest-growing agriculture sector and produces more than 50% of the global seafood supply. The global aquaculture industry, currently valued at over $144 billion, is growing at an average of 8% annually in the last 20 years.

National/Societal Relevance

Commercialization of this technology would give ample avenues to manage the required water quality in aquaculture sector with maximum consistency, and least incidents of diseases and with enhanced survival rate.

Project Deliverables

a. **Progress vis-à-vis objectives/commercialization status –** Field trials have been done. The company is looking for buyers.

b. **Technology/Product developed -** The work carried out has resulted in development of Nitrifying Bioreactor in two capacities:

i. Ex-situ PBBR with a capacity of 60 tons per day for establishment of recirculating aquaculture systems for maturation and brood stock maintenance; for larval production; nitrification of incoming water and spent water treatment and reuse.

ii. In-situ Stringed Bed Suspended Bioreactor which can handle 500 liters of water for In-situ nitrification in larval production system and quarantine of brood stock

c. **IP generated/ Potential for IP generation –** Technology in-Licience : Patent has been granted in India (IN 241648) and in other jurisdictions such as Thailand, Japan, Philippines, South Korea and Indonesia.

d. **Resources Generated –** The company has established a manufacturing facility in a rented premise to manufacture 3 units of Packed Bed Bioreactor (PBBR) and 25 units of the Stringed Bed Suspended Bioreactor (SBSBR) per month. A nitrifying bacterial consortia production unit and a microbiology laboratory have been established to culture the bacterial consortium necessary for 6 reactors per month.

Plans to take innovation further

Intend to demonstrate the capability of PBBR in improving the efficiency of operation in Indian Market in collaboration with leading institutions like RGCA, etc. The company is also trying to obtain orders from market leaders in the industry on the basis of demonstration and studies conducted so far. Looking at neighboring countries like Sri Lanka, Thailand, Indonesia, Malaysia, Philippines etc. to validate product performance.

Risks Envisaged

Overcoming any mental block hatchery technicians may have from years of doing it differently; Diligently following the system protocol and proper maintenance of the reactors to ensure that they operate efficiently

Innovator Team

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Rope Production Centre

Collaborator: Tamil Nadu Agricultural University

The Innovation

Value addition and waste utilization in Banana pseudostem

Development Stage

Commercialization

Brief Description

Rope cutting machine : The machine able to cut 14 banana pseudo stem sheath/Hour and 5000 sheath/day which save the labor of 6 numbers. Rope making machine: The machine contain 4 roll and a single roll make the banana rope of 1500m/hr 4500m/hr for 4 roll and in a day 36000m of banana rope can be produced which save the 20 labors. Cake basket: An Eco product, no chemical or colouring agent added, Water proof and can be used for 2-3 years. The unit cost of product is Rs. 90/-

Innovative element

Two new machine and five new products

Market Potential

Huge demand for domestic and export. To expand the business

National/Societal Relevance

Effective utilization of banana pseudo stem waste and value added products indirectly protect the environment in the banana growing belt. Providing skill development to the rural women and permanent employment help to sustain their family

Project Deliverables

a. **Progress vis-à-vis objectives –** Transfer of the technology to women self-help groups. 160 rural women trained during the project period and 38 women were employed. Training hall facility created

b. **Technology/Product developed -** Fabricated new Rope cutting machine and Rope making machine and five new eco-products developed and received order from companies

c. **IP generated/ Potential for IP generation –** 1125/CHE/2011

d. **Resources Generated –** 160 rural women trained during the project period and 38 women were employed. Training hall facility created. Green Tech Private Ltd added as new enterprise and XLr8 Andhra Pradesh as Accelerator

Plans to take innovation further

India Innovation Growth Programme and the Millennium Alliance Initiative. Participation in BRICS TRADE FAIR 2016 -INNOVATION AND START-UP SHOWCASE - First BRICS Trade Fair to be held from October 12- 14, 2016 at Pragati Maidan, New Delhi Andhra Pradesh Accelerator Application in final selection process.

Risks Envisaged

Marketing of new products

Innovator Team

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Sorokhaibam Suresh kumar Singh - KIIT

The Innovation

Development of food colourants and textile dyes from natural pigments of microbial origin

Development Stage

Proof-of-Concept

Brief Description

Use of synthetic colourants in food are well known to cause various side effects to human health and environment. Various natural pigments are produced by filamentous fungi.

Innovative element

The pigment is free from most of the known mycotoxins. The strain of the organism is novel by producing no mycotoxins in the culture conditions of pigment production though the type strains produce mycotoxins. The pigment is water soluble, biodegradable and can be regenerated to produce industrial scale food colourants within short period of time

Market Potential

The pigment being organic in nature will be equivalent to other herbal based products in the market. It has enormous market potential in local and abroad in terms of organic food colourant demands.

National/Societal Relevance

In India, there has been no such similar product being developed so far and are not available in the market. Therefore, at the introductory phase, there may be reluctance of people to consume foods coloured with this dye from fungi. In developed countries, particularly EU , US and other Asian countries, already similar products have been introduced in the market.

Project Deliverables

a. **Progress vis-à-vis objectives –** i. Production of red pigment at laboratory scale is completed, Optimization of fermentation for scale-up process is ongoing. ii Crude pigments isolated from liquid culture with a yield of 5.3g/L Characterization of natural pigments for food quality and textile dying properties is to be done

b. **Technology/Product developed** - A novel strain of fungus was isolated and a standard protocol of production of a red pigment has been developed. The developed standard protocol for production red pigment is reproducible and can be used at laboratory scale.

c. **IP generated/ Potential for IP generation –** At present, a process of filing of a IP patent for production protocol of the mycotoxins free red pigment from the novel strain of fungus is in progress.

d. **Resources Generated –** A research staff, a JRF is employed and trained with specialized skills in production protocol and purification of the red pigment.

Plans to take innovation further

After completion of validation and commercial trials of the proposed product, it is planned to partner with any of the market leaders in nutraceuticals or pharmaceuticals for product formulation and marketing.

Risks Envisaged

Presence of toxic compounds may contaminate a product or a batch of product. However, such problems can be resolved before release of a product in the market through proper and regular verification/examination for every batch of product. As of now, it is confirmed that the strain of fungus used to produce the red dye pigment does not produce any of the mycotoxins of health concern.

Innovator Team

Sorokhaibam Suresh Kumar Singh

Contact

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Steer Engineering Pvt. Ltd.

Collaborator: Manipal College of Pharmaceutical Sciences, Manipal University

The Innovation

Continuous process for economic production of effervescent preparations of aminoacids and other supplements

Development Stage

Early Stage Validation

Brief Description

A twin screw hot-melt extrusion process could be modified such that it could be used without the use of water or organic solvents to prepare effervescent granules. Drying and particle size reduction will be performed in-situ.

Innovative element

The developed process will be a continuous process for manufacturing of effervescent preparation. The current process is an environmental friendly process i.e. no use of organic solvent. The product retains high percentage of Carbon-di-oxide which in turns help fast disintegration of the tablets less than a minute. The granules generated have excellent properties of tabletting.

Market Potential

The effervescent technology platform could be used for several supplements and amino acids apart from NAC, which is currently required in several disease conditions such as Autism, kwashiorkor, seizure, Alzheimers disease, Parkinsons disease, liver disease, cystic fibrosis, sickle cell anaemia, HIV, AIDS, cancer, heart attack.

National/Societal Relevance

The amino acid NAC precursor for cysteine which is in turn used for synthesis of glutathione is used in the treatment of oxidative stress in several disease conditions. This and other supplements that could be prepared through the technology developed are intended for long term use and are currently very expensive. With the current innovation, NAC and other unstable supplements could become very affordable to common man.

Project Deliverables

a. **Progress vis-à-vis objectives –** The objectives have been achieved. NAC and two other drugs have been evaluated for a thorough understanding of physico-chemical properties, thermal properties, stability and compatibility with excipients.

b. **Technology/Product developed** - A novel technology has been explored for preparation of effervescent preparations of NAC and two other drugs.

c. **IP generated/ Potential for IP generation –** Two PCT applications have been filed

d. **Resources Generated –** None

Plans to take innovation further

The technology will be protected with IP, The technology would be licensed to the suitable partner/s.

Risks Envisaged

We would be using an advanced twin screw fragmentation technology that does not use solvents and additionally does particle size reduction in-situ. The identified critical variable in this project is processing temperature. When sodium bicarbonate is used as carbon-dioxide source, the operation temperatures have to be kept low or the temperature and residence time have to be optimized such that there is minimal or no decomposition of sodium bicarbonate which in turn produces water which in-turn triggers further effervescence.

Innovator Team

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Swayambhu Biologics Pvt. Ltd.

The Innovation

Bioremediations for Agro Industrial Solid Wastes By ARBIT for Effective Management through Energy and Biomanure conversions

Development Stage

Commercialization

Brief Description

Solid waste management of Agro process and product industries like coirpith, Sugar and distillery industry etc and converting their waste into humus rich organic manure.

Innovative element

Accelerated Rapid Biological Intervention Technology ARBIT is an Innovative Element. Cultivation of consortium of microbes using natural resources without any chemicals like Urea or DAP. Coirpith is used as such without any acid and alkali treatment. Bioremediation of coirpith within 27 days with reduction of C:N ratio , Neutral pH. Second technology on ash management is enrichment of Sugarcane industry and Distillery Spentash for Potash which can be used as organo potash substitute for Synthetic fertilizer

Market Potential

All the Technologies have high Market Potential both in India and Abroad

National/Societal Relevance

Presently, around 40 coirpith industries and 400 sugarcane industries have their process waste in the form of coirpith and ash in different forms which can be converted into high value nutrient substitute that can benefit both farmers and environment.

Project Deliverables

a. **Progress vis-à-vis objectives** – MOU has been signed for both the technology Coirpith and Spentash. Protocols and procedures for coirpith and Spentash has been standardized. Batch process is done and Industrial validation needs to be completed before commercialization.

b. **Technology/Product developed** - Technology developed on Coirpith can be used for soil free agriculture and Enrichment of Spentash is a substitute of synthetic Potash. Since other technologies like conversion of Sugarcane pressmud into manure and managing Spentwash onto the pressmud are available, together Swayambhu offer them as Technology package to these industries. Coirpith composting to Coirpith process industries.

c. **IP generated/ Potential for IP generation** – Filed 3 patents on converting sugarcane pressmud in 14 days against 90-120 days and other for effective management of Spentwash onto the pressmud4:1 . PCT filed for Spentwash technology in 2015. Patent on Biodegradation of Corpith filed in 2016.

Resources Generated

Around 30 unskilled labourers in industrial operations so far have been trained and are now in the process of establishing Technology Programme Management Systems in the respective industry premises. We have also mobilised funds to the tune of 1.00 crore through private placement to conduct mass scale commercial demo to industries this crushing season viz.Sept 2015 to Jun 2016. Currently demo cum commercial model for RADICO NV industry is being done.

Plans to take innovation further

Signed an MOU with Indus Coco substrates, TN, India for Coirpith project. Once commercial validation is done the technology will be transferred.

Risks Envisaged

Fungus method of composting is being practiced all over the world instead of microbial method. Propagation of technology takes time. Sugar industries operation is seasonal and hence the availability of ash and it might be chargeable in future.

Innovator Team

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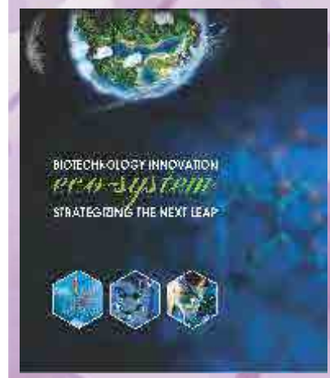
Varuna Biocell Pvt. Ltd.



The Innovation

Indigenous production of Dextranase using SSF Technique

Development Stage

Discovery

Brief Description

Indigenous Production of Dextranase using SSF Technique successfully conceived, developed, standardised and successfully commercialised.

Innovative element

VarunaBiocell has successfully produced cost effective Dextranase branded as Dextrasol using SSF technique using agro-waste.

Market Potential

VarunaBiocell has successfully implemented Dextranase application at 5 sugar mills in India @ 5ppm. The product has penetrated international markets having sold 15 MT Dextranase equivalent to 5000 du/gm. Moreover, VarunaBiocell has successfully completed and perusing commercial trial at various sugar mills in India and abroad to grab more market share.

National/Societal Relevance

Application of Dextrasol will support sugar industry with about Rs 10 crore by import substitution

Project Deliverables

a. **Progress vis-à-vis objectives –Not Available**

b. **Technology/Product developed** -Indigenous Production of Dextranase using SSF Technique successfully conceived, developed, standardised and successfully commercialised.

c. **IP generated/ Potential for IP generation** –None

d. **Resources Generated** –Revenue generated by sales of products/technologies yearly in INR

2013-14 - INR 1,51,96,573/-

2014-15 - INR 1,53,31,750/-

2015-16 - INR 1,43,38,090/-

Plans to take innovation further

Further VarunaBiocell is also pursuing application of Dextrasol on Dental Plaque removal. A clinical trial is conducted at some dental clinic for plaque removal. The company has further expanded its capacity for making 50 tons as the demand of Dextranase is increasing day by day.

Risks Envisaged

The activity and stability of the strain

Innovator Team

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Vel Natural Fibers

The Innovation

Innovative Methed To Extract Silk Grade Banana Fiber

Development Stage

Commercialization

Brief Description

After harvesting the banana punch the remain portion of the tree becomes agricultural waste. From the waste the valuable silk grade fibers are extracted.

Innovative element

We have developed a device to extract silk grade uniform single stand fiber by applying our innovative machine.

Market Potential

This innovation has very good market potential in India as well as international. We have received many queries all over the world.

National/Societal Relevance

This product and innovation is agriculture based and it is extracting wealth from the waste. So that it will get lot of rural employment opportunities. So it has social importance.

Project Deliverables

a. **Progress vis-à-vis objectives –** Our innovative machine extracts silk grade uniform single stand fibers.
b. **Technology/Product developed** - The new device developed
c. **IP generated/ Potential for IP generation –** IP already granted.
d. **Resources Generated –** Given employment to more than 40 peoples by direct and indirect means.

Plans to take innovation further

Planning to take this innovation to the market. It is ready for commercialization very shortly

Risks Envisaged

The technology may be copied very easily once the machine is in the market.

Innovator Team

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Grand Challenges India

Global
Grand Challenges

Department of Biotechnology
Ministry of Science & Technology,
Government of India

birac
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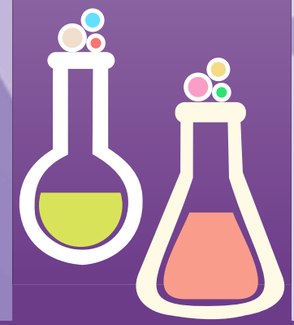


September 2016

GRAND CHALLENGES INDIA (GCI)

The mandate of GCI is to address some of the critical challenges confronting health and development issues in India. This unique program initiative fosters Indian innovation and research to develop affordable and sustainable solutions to improve health and ensure well-being of humankind in India and globally. The GCI tries to galvanize the potential of young and established investigators by piloting their projects within a series of thematic calls announcements or definite initiatives to be collaboratively funded by Department of Biotechnology (DBT), Ministry of Science and Technology, Government of India (GoI), Bill and Melinda Gates Foundation (BMGF) and United States Agency for International Development (USAID) to improve public health and beyond. The GCI framework supports strategic and well-articulated research proposals, capturing the imagination/engaging the world's best researchers. The research efforts mainly caters national and societal needs focussed to accelerate progress and ensures that advanced technologies reaches to developing countries masses. Funders, investigators and other stakeholders actively collaborate and follow global access commitments to ensure the fruits of their research are available to those most in need.

To effectively disseminate GCI core objectives, ***Program Management Unit (PMU)*** was established. The PMU housed at the Biotechnology Industry Research Assistance Council (BIRAC) jointly administers the programmes with DBT, Gates Foundation and USAID.

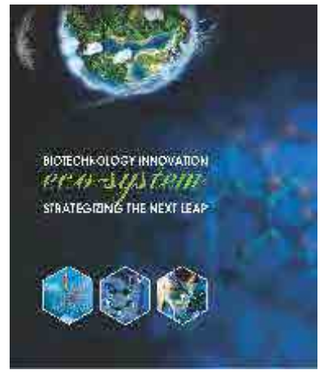
The programs launched under GCI partnership have been shaped by experts who are luminary in their fields. Since its inception three successful calls have been launched under GCI initiative:

The Grand Challenges framework announced ***"Achieving Healthy Growth through Agriculture and Nutrition"*** as the first initiative under 'GCI' program. The goal was to fund a portfolio of Indian-led pilot projects that seek to target the relationship between agriculture, nutrition, and health and to reduce the high incidence of low birth weight and early stunting and wasting among Indian infants through interventions.

Grand Challenges framework announced ***"Reinvent the Toilet Challenge-India"*** as the second initiative under 'GCI' program with support from DBT, and the BMGF to tackle issues related to poor sanitation that results in 1.5 million child deaths and responsible for the stunting of 62 million children less than five years old each year, globally. The initiative encourages grantees to drive research and development of low cost, eco-friendly and efficient 'next generation toilets'.

Keeping in view the World Health Organization (WHO) estimates that globally over 6 million children below 5 years of age die every year and approximately 165 million have stunted growth, the ***"All Children Thriving"*** was launched as a third call under GCI framework. Although, birth defects, adverse pregnancy outcomes and developmental disabilities in children are interrelated functions of several known determinants (such as maternal health, nutritional deficiencies, infectious diseases, genetics, enteric health, water, and sanitation). Incidentally, much remains unknown about the root cause. The program intends to investigate novel cost-effective measurement tools and mechanisms to combat unhealthy birth, growth and development. The program, by putting best strategies in place, aims to ensure that not only all children survive, but also remain on the trajectory of healthy and productive lives and try to adequately alleviate the burden of birth defects, adverse pregnancy, outcomes and developmental disabilities in children.

The other initiatives which are facilitated by PMU-BIRAC and funded by Gates Foundation are ***(i) Healthy Birth, Growth and Development Knowledge integration (HBGDki)*** India. The HBGDKi - India Consortium have been launched with the aims to facilitate the needed collaborations and permit greater data sharing and collaboration across the awarded grants, related grants and projects in India and international collaborations to concurrently address the health, nutrition and environmental factors and create a positive impact. ***(ii) Knowledge Synthesis, Transfer and Integration (KnIT)*** Platform will provide evidence and experience based guidance to accelerate progress, equity, impact in maternal and child health and nutrition. The platform will also provide guidance on health system redesign relevant to the above areas. The program is focused on establishing a science based bridging platform through a team of experts, as a virtual institution between researchers and policy makers which will enable a structured process for knowledge synthesis, transfer and integration in a cost efficient manner.



Amity University

The Innovation

Novel Approach to Reduce Zinc Malnutrition in Rural Women and Children through Agronomic Bio-Fortification of Food Crops

Development Stage

Proof of concept

Brief Description

The technological intervention is expected to result into increased production, sustained productivity, profitability, reduction in zinc malnutrition of children and rural women. The current intervention is a food based approach for raising levels of zinc nutrition in human populations. Agronomic bio-fortification of food crops is cost effective, pro-rural, pro-poor, agriculture based intervention to reduce zinc malnutrition in humans.

Innovative Element

Bio-fortification is yet to be fully scaled up but much evidence and experience has been assembled to support its eventual effectiveness. Scientific evidence shows that agronomic bio-fortification is technically feasible without compromising agronomic productivity of food crops.

Market Potential

High zinc wheat and rice grains have great potential for higher prices in the national and international market.

National/Societal Relevance

High zinc wheat and rice grains consumption will ensure adequate levels of zinc intake through diet to tackle zinc malnutrition problem in Indian population.

Project Deliverables

a. **Progress vis-à-vis objectives –** The project outcome will provide evidence that the fertilizer (and leaf spray) can improve zinc content of grain thereby improving nutrition qualities. The project focuses on entire population especially rural women and children rather than individual and is replicable at national level and in other developing countries.

b. **Technology/Product developed –** NA

c. **IP generated/ Potential for IP generation –**NA

d. **Resources Generated** - Research Associate has submitted Ph.D thesis. Laboratory and field assistants were imparted training to handle various lab instrument/equipments. Established new lab for soil and plant samples testing with facility for micronutrients analysis using Atomic Absorption Spectrophotometer.

Plans to take innovation further

Need collaboration with medical and nutrition researchers on the biofortification of food crops with zinc in a form which is bio- available to consumers

Risks Envisaged

NA

Innovator Team

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Annamalai University

The Innovation

On-Farm Participatory Models of Integrated Farming System

Development Stage

Proof of Concept

Brief Description

Integration of fish polyculture and poultry rearing directly in the transplanted rice fields followed by vegetables in the fallows offer better scope for lowland rice farmers. Similarly integration of Goat + Olericulture/Floriculture and apiary holds good potential for upland farmers. These two IFS models would be disseminated for adoption as on-farm participatory models by selected development partners in villages of continuum and similar agro-ecological identities that together form clusters. Each cluster would comprise three such villages and 75 women farmers (25 in each village).

Innovative Element

Market Potential

Poultry, Fish and Goat meat have well established market potential even at rural surroundings

National/Societal Relevance

Farming System Research and Extension has evolved Integrated Farming System models with the integration of best suited farming elements for both lowland and upland farming situations.

Project Deliverables

a. **Progress vis-à-vis objectives –** Increased poultry/fish/vegetables intake by project beneficiary women farmers of 4 kg/month compared to control women farmers with 2.8 kg /month. Additional revenue of Rs.15,000 from poultry rearing and Rs.1,500 from fish culture Rs.135 from vegetables totalling to Rs.16,635 per household has been generated by the participating wetland development partners.

b. **Technology/Product developed –** Integrated Rice + Fish+ Poultry Farming System & Integrated Goat + Olericulture/Floriculture + Apiary System

c. **IP generated/ Potential for IP generation –** Integrated Rice + Fish + Poultry Farming system Design

d. **Resources Generated** - Established two retail outlets for facilitating easy marketing of the produces, by the participating rural poor women farmers.

Plans to take innovation further

Yes, with larger cluster of farmers

Risks Envisaged

NA

Innovator Team

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Digital Green

The Innovation

Participatory Video and Mediated Instruction for Agricultural and Nutrition Behaviour Change

Development Stage

Commercialization

Brief Description

A participatory process for video production on improved livelihood practices, a human-mediated learning model for video dissemination and training, a hardware and software technology platform for data management customized to limited or intermittent Internet and electrical grid connectivity, and an iterative model to progressively address the needs and interests of the community with analytical tools

Innovative element

To enable rural communities to create and share videos for wider adoption of locally relevant practices

Market Potential

The approach is also effective in health and nutrition behaviour change in addition to agriculture.

National/Societal Relevance

Approach was found to be 10 times more cost-effective and uptake of new practices seven times higher compared to traditional extension services.

Project Deliverables

a. **Progress vis-à-vis objectives –** 6 videos have been prepared disseminated.

b. **Technology/Product developed –** An open source platform – COCO (Connect online connect offline) where frontline workers enter program data from across the world.

c. **IP generated/ Potential for IP generation –**Need to evaluate possibilities of IP

d. **Resources Generated** - 3000 videos on improved agriculture, health and nutrition practices

Plans to take innovation further

Currently implementing similar projects in collaboration with over 20 partner organizations across 9 states in India and parts of Ethiopia, Afghanistan, Ghana, Niger and Tanzania.

Risks Envisaged

Adoption of behaviourchange communication

Innovator Team

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eKutir Rural Management Services Pvt. Ltd.

The Innovation

VeggieLite – Conjunction of agriculture, nutrition, and health for inclusive development of women

Development Stage

Validation stage

Brief Description

The project tested the impact and viability of the VeggieKart/VeggieLite model, which uses micro-enterprise retail outlets and distribution channels to make fresh and healthy produce of women smallholder farmers accessible for low-income rural and urban consumers.

Innovative element

To establish a self-sustaining entrepreneurial model that increases the availability and affordability of fruits and vegetables with the social objective of improving diet quality in rural households and low-income households in the urban areas through increased vegetable consumption.

Market Potential

Theory of Change- Basis our pilot project, in the traditional supply chain, the farmer captures approximately 41% of the end value of their produce, with the balance shared by series of middlemen, brokers, and finally retailers.

National/Societal Relevance

This innovation can be integrated with state- and national-level programs and schemes, primarily under "National/State Rural Livelihoods Mission", "National/State Rural Health Mission", and Ministry of Family & Health Welfare. The set-up of micro-entrepreneurs fills in an important gap in up-skilling the unorganized labor market, an integral component under Ministry of Labor and National Skill Development Corporation.

Project Deliverables

a. **Progress vis-à-vis objectives –** eKutir has been able to setup local networks of micro-entrepreneurs; VeggieLite entrepreneurs and farming households by establishment of demand-based vegetable production systems.

b. **Technology/Product developed –** eKutir through its network of micro-entrepreneurs and vegetable entrepreneurs at the heart of the VeggieKart intervention links producers and consumers in an equitable and efficient value chain that empowers them in a way that other methods fail to address.

c. **IP generated/ Potential for IP generation -** The project is designed around the principles of Convergent Innovation, ideated by MCCHE. MCCHE will be using this IP on innovation processes to guide the innovation forward, and gain input from various sectors to strengthen the initiative.

d. **Resources Generated** - The fund utilization generated multiple outcomes:
   1. Manpower employed – 6
   2. Smallholder farmers reached – 1,350
   3. Farmers enabled to sell directly to VeggieKart – 126
   4. Agri Entrepreneurs – 5
   5. VeggieKart channel points – 106'
   6. Female entrepreneurs – 32%
   7. Increased average monthly vegetable sales - ~45%
   8. Innovation in providing incentives to Lactating & Pregnant Women for purchasing vegetables prescribed to them – Successfully conducted the mini-experiment "Pratidhi" in Kandhamal district of Odisha with 69% adoption rate.
   9. Inventory Assets – 3 mini-vehicles for delivery

Plans to take innovation further

eKutir had submitted a transition-to-scale proposal to grow this innovation within Odisha and is looking for partners in different states to uptake this innovation through a franchisee & partnership model.

Risks Envisaged

Though many of the basic challenges have been faced during the pilot phase, significant risks remain.

Innovator Team

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Science for Society

The Innovation

Ensure year-wise nutritional food security to Indian Women through Community level implementation of Domestic Solar Conduction Dryer

Development Stage

Commercialization

Brief Description

Solar Conduction Dryer (SCD), an electricity-free solar powered food dehydrator that reduces moisture content in agri-animal produce so that women farmers and rural women can preserve seasonal produce up to 1 year without using any chemicals and earn additional income through sale of dehydrated products. SCD costs 2 times less than other solar dryers and has payback of 100 days against cost of electricity saving. SCD, patented technology recognized by the UN, US-AID and University of Texas, maintains 45% better nutrition. Dehydrated products can be preserved at normal conditions and used in normal cooking recipes. One SCD, 3ft x 3ft in size, processes 1 ton material annually.

Innovative element

SCD is the electricity free women centric system. SCD maintains 70-90% nutrition in dehydrated products and through GCI project 200 women are trained for using dehydrated products in daily diet.

Market Potential

The potential of domestic SCD is 66 million units across India just to target the post-harvest losses and convert into value added products.

National/Societal Relevance

Project SCD targets three national and social objectives:

1. Reduce post-harvest losses which currently stand at 66 million ton/year
2. Create economic returns to farmers by sell of dehydrated products
3. Ensure food and nutritional security

Project Deliverables

a. **Progress vis-à-vis objectives –** Equip 200 women farmers with SCD, Integrated dehydrated food products in daily diet and linked women farmers to market

b. **Technology/Product developed –** Solar Conduction Dryer

c. **IP generated/ Potential for IP generation** - Patent, Industrial design, copyright

d. **Resources Generated** - Manpower: trained: 30, Facility of nutrition testing and stability study, additional fund mobilization of Rs. 20 Lakh, 8 women led enterprises are created (not registered under companies act)

Plans to take innovation further

Scale up has happened from 200 (project target) to 1000+ farmers. Right partnerships in terms of scale up are in place.

Risks Envisaged

Project needs local integration of food habits which change from geography to geography. Hence each time when project needs scale up, it needs to understand local food dynamics.

Innovator Team

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Amrita School of Biotechnology

The Innovation

Use of viral agents, microbial fuel cell and effective recycling strategy to improve the economics human waste disposal

Development Stage

Proof of concept

Brief Description

The proposed technology involves the development of a lytic broadcasting system (LBS) for the purpose of enriching and utilizing bacteriophages (bacterial viruses) and non-viral lytic agents for the effective treatment of sewage via a decentralized sanitation system.

Innovative element

Phage mediated treatment of sewage using two broad approaches - Ecological system target (EST) approach (where phages will be enriched by a broad selective media without considering the specific pathogens) and pathogen target (PT) approach where specific target enteric bacteria will be cultured and phages isolated from sewage will be utilized to significantly reduce bacterial load.

Market Potential

Besides the emerging market in developing nations, there is huge scope of integrating the technologies in all different sewage treatment facilities all over the globe to reduce the cost of operation and avoidance of hazardous chemical disinfection strategies. The odour control strategies can also potentially be included in all wastewater treatment facilities.

National/Societal Relevance

Around 620 million people resort to open defecation in India. This has had a negative impact on the social and physical development of the population especially for children below the age of 5 years. Developing a decentralized toilet system with methods to reuse the water and sludge for flushing and agriculture respectively, would help in tackling not only the open defecation problem but also malnutrition and stunting in children afflicted with pathogenic enteric bacteria and parasite infections.

Project Deliverables

a. **Progress vis-à-vis objectives –** Phage library stock expanded to more than 30 phage stocks against different targets of infection & smell, isolated from samples collected from local hospital sand sewage treatment plant/septic tank. Efficiency of Phages (individuals and as cocktail) in reducing the target organism spiked in wastewater was studied. Charcoal and roots of different aquatic plants (duckweed, Pistia) for simultaneous phytoremediation and phage-remediation have been tested. Potential anti-helmintic compounds in the form of chitin synthase inhibitors, chitinase enzyme from different fungal and bacterial sources tested on C. elegans eggs and adult L4 stages have been identified. Field trials have been initiated helping to optimize vital parameters required for successful control of infection and smell, such as stability, flow rate of biosand filter and microbial consortium.

b. **Technology/Product developed** - Lytic Broadcasting system based on Charcoal, Sand, Bacteriophage and Consortium of effective inoculum

c. **IP generated/ Potential for IP generation –** Yes. IP possible in the design of Lytics broadcasting system, novel process for increased methane generation in anaerobic digestion, novel hydrolytic enzyme/bacteriophage cocktail for disinfection and odour control

d. **Resources Generated –** A complete new laboratory (sanitation biotechnology) with floor space of about 110 m^2 created. Each year about 40 undergraduates, 10 post graduate get trained in sanitation biotechnology related research projects. Three enrolled for PhD, three more are in the process, three young faculty members are enrolled for part time PhD program. About ten faculty members are involved in the related projects

Plans to take innovation further

Yes along with international collaborators across the globe.

Risks Envisaged

Phage cocktail may need to be customized across geographical regions even though that may be quick and cost effective compared to other development processes. Production of high strength (titre) bacteriophages which can be broadspectrum targeting wide array of infections might be challenging

Innovator Team

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Collaborator: University of Ghent, Belgium

The Innovation

Empowered septic tank as decentralized wastewater treatment system

Development Stage

Proof of concept

Brief Description

An electrochemical technology sits after discharge point of a septic tank and disinfects. The technology aims at maximal simplicity through minimal mechanical processes. Septic tank effluent passes through the electrochemical cell and sequentially goes through high and neutralizing pH regimes. The system does not rely on hazardous chemicals, does not generate additional unpleasant odors. The electrical element operates at a relatively mild voltage and current, and is housed in a container that the user does not interact with, and thus poses no risk under normal operation. The system can effectively be incorporated into existing community toilet structures.

Innovative element

The system can effectively sanitize septic tank effluent by destroying both bacteria and helminth eggs, fulfilling discharge requirements. These conditions may also prevent mosquitos from laying eggs in the tank. The system requires minimal maintenance, mainly related to manual electrode cleaning. Electrode cleaning and electrical failures can be easily interpreted by a control system that can be used to signal the need to clean. The effluent can be provided to a wetland, or inversely septic tank effluent can go through a roughening wetland filter and be post-treated.

Market Potential

Electrochemical units tend to be very adept at shifting through levels of scale, and products can be tailored towards different private applications, within India and abroad. The product would be suitable for remote sites with sensitive water supplies or high water scarcity (e.g. mining operations, tourist parks, refugee camps). This is a more niche market.

National/Societal Relevance

Approximately 40 million urban households (excluding slums) are not connected to drainage, leaving waste from toilets in open drainage channels and causing sanitation problems as a result of exposure to water contamination, and pathogens including bacteria, helminths, etc. The Indian Government considers that another 120 million toilets need to be built to end open defecation by 2019, at a current program cost of US $30 billion. A system thus dealing with septic tank effluent at community level via disinfection to internationally accepted safety standards at a cost below US$2000 per installed toilet would imply an investment of US $8 billion over time, which is a fraction of the annual cost caused by inadequate sanitation.

Project Deliverables

a. **Progress vis-à-vis objectives** –Experiments at laboratory scale and construction of a $1m^3$ and $20m^3$ Empowered Septic tank for a single household as well as for a gated community have been completed. Pilot plant construction for $20m^3$ is under process.

b. **Technology/Product developed** - An electrochemical cell unit able to disinfect septage has been developed. The unit is highly compact (for community toilet the reactor volume is about 50L) and can be deployed on new sites as well as via retrofitting. The system is controlled by a dynamic power supply, which will be able to deal with flow variations. The system can be mounted directly after a septic tank, or be implemented as a combined roughening wetland – electrochemical cell.

c. **IP generated/ Potential for IP generation** – Proprietary knowledge exists within the team

d. **Resources Generated** –Three personnel were trained as well as a complete working unit is established for a single household and for a 100 people equivalent.

Plans to take innovation further

Intends to start a Indian based company

Risks Envisaged

The key risk is still inadequate operation due to uneven incoming flows. The combination with a wetland minimizes risks, but where no space exists the system has to be stand-alone. The main means of verification is performing field trials, enabling an adaptation of operation parameters and system internal design to accommodate this.

Innovator Team

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Reinvent the Toilet Challenge - India

Eram Scientific Solutions Pvt. Ltd.

Collaborator: University of South Florida

The Innovation

Field testing of off-grid, self-sustained, modular, electronic toilet for slums, with solar energy for Indian weather and integrated with mixed waste processing unit, with water, energy/fertilizer recovery

Development Stage

Validation

Brief Description

The overall goal of the project is to develop and demonstrate an innovative sanitation and resource recovery solution for the community areas in India with complete off grid operations. eToilet, an unmanned and automated electronic toilet developed by Eram Scientific is integrated with a waste treatment technology. NEW generator developed by University of South Florida allow for the sustainable recovery of Nutrients, Energy, and Water at the point of disposal.

Innovative element

eToilet is an innovatively designed sanitation model that involves unmanned and continual operation of the toilets, sensor enabled water minimization, auto flush and floor wash mechanisms and remote monitoring capabilities which will ensure the user a next level of sanitation experience. Integration of NEW generator will allow the recovery of nutrients, energy, and water at the point of disposal. The complete system is working in off grid with the help of solar energy and water recycling.

Market Potential

A global concern has progressively emerged during the last decade, which has translated into numerous actions aimed at reversing the threats to water and expanding the access to related services. There is a huge challenge in terms of non-availability of resources like water, electricity, etc. to ensure reach and sustainable usage of toilets. To achieve this, self- sustained toilets are the answers. The need for off-grid systems are on rise due to the scarcity of resources.

National/Societal Relevance

UNICEF estimated that 54%of India's population, practice open defecation due to inadequate sanitation. The main goal of Government of India is to eradicate the practice of open defecation by 2017 which is possible to a greater extent by developing decentralized sanitation system with minimum water usage. The system being developed is cost-effective and self-sustained model with resource generation.

Project Deliverables

a. **Progress vis-à-vis objectives** –Prototype development and integration with New generator is complete. Field trials are ongoing.

b. **Technology/Product developed** - Full integration of the eToilet and NEW generator will allow the combined system to be implemented in a greater variety of settings, including locations with unreliable or non-existent electricity and water connection.

c. **IP generated/ Potential for IP generation** – e-toilet- IP Applied for "Solar powered automated toilets with built in metal base and rapid cleaning mechanism"- 4918/CHE/2014, dated 30/09/2014. ii. NEWgen- IP applied for "Portable Wastewater Treatment System" – International Patent

d. **Resources Generated** –No external funds have been sourced. Eram as augmented, its existing resource base for the project. Experts and specialised consultants were hired for the project as well.

Plans to take innovation further

The company intends to re-engineer and value engineer eToilet, NEWgen combined model for commercialization with smaller footprint, streamlined design and reduced cost.

Risks Envisaged

Vandalism and tampering of units; Ownership and legal rights; Coastal environment weather

Innovator Team

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The Innovation

An Enterprise-Driven High Quality Community Toilet System Sustaining on Commercial Values Generated by Black Soldier Fly Larvae Grown on Human Faeces and Fertilizer derived from Urine

Development Stage

Proof of concept

Brief Description

We propose to use Black Soldier Fly Larvae (BSFL) to consume the human fecal matter and other bodily wastes. Mature BSFL are good source of fat, protein and chitin. Harvested BSFL after drying and pulverization can be an effective food for farmed fish as well as animals. Further, there is a scope that BSFL can be processed to extract essential oil, biodiesel, protein-rich fish and animal feed, chitin and other valuable commercial products. We are looking into the kinetics and growth of BSFL, artificial mating and mass hatching and life cycle events for different types of substrate varied proportion of Human Faeces, under different environmental conditions. We are also looking into the potential market for the value-added by-products.

Innovative element

Trying to have an innovative toilet where black soldier fly larvae are employed to consume human faeces, and convert them into their body fat, protein and chitin, which can be a source of essential oil, biodiesel, protein-rich fish- and animal-feed, chitin-based biopolymer and other valuable commercial products.

Market Potential

BSFL stored protein can be a potential source of animal feed and the stored fat can be a source of essential oil and biodiesel. These products have a huge market value. BSFL is already produced by companies like Entera and Agriprotein and are in huge demand in USA as animal feed (Poultry and fish feed). Also the chitin of BSF can be extracted and looked in for its use in either pharmaceutical industry or chemical industry for water treatment. Approximate price of Chitin is around Rs. 335/Kg or 5 USD/Kg.

National/Societal Relevance

This solution has the potential of creating opportunity of business growth through the development of an enterprise-driven high-quality community sanitation system benefitting every stakeholder. Ultimately, it can help India in achieving its zero open defection goal under Swacch Bharat Mission by 2019.

Project Deliverables

a. **Progress vis-à-vis objectives** – A growth chamber has been established at IITR and kinetics studies for the fly are ongoing.

b. **Technology/Product developed** - In this proof-of-concept project we are not looking forward to develop a new technology, rather we are working to get data which will be the foundation of a technology development in the future.

c. **IP generated/ Potential for IP generation** – None, however there is potential of IP generation through future application oriented project where the data obtained from this project shall be used.

d. **Resources Generated** –Manpower trained- 03; Internship- 03; Facility generated: Improvement and fortification of the solid waste management laboratory to conduct research related to human feces as well as BSF and its larvae

Plans to take innovation further

Yes

Risks Envisaged

None perceived so far

Innovator Team

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Pradin Technologies

The Innovation

Eco-Toilet

Development Stage

Proof of concept

Brief Description

Eco-Toilet is an Ultrasound assisted system to reduce wash water and accelerate waste settling time

Innovative element

Extending industrial Ultrasound applications used in cleaning systems to add value in Eco-toilet

Market Potential

The proposed solution is a complete sustainable, standalone offering that reduces the dependency on infrastructure like connection to main sewer lines and power supply. Additionally, the project goal is to reduce wash water use, compact and accelerate waste settling time to help in post processing.

National/Societal Relevance

Though Eco-Toilet project was started before the Swachh Bharat Abhiyan initiative from our government, it now aligns with the vision and goal of the program. The value addition is the reduction of wash water use and accelerated waste settling time. The solution is designed to be a sustainable standalone system independent of mains power availability and the central sewer line.

Project Deliverables

a. **Progress vis-à-vis objectives** – For the toilet seat, seven factors have been identified for the settling tank, five factors have been identified. Results of toilet seat experiment show that controllable factors influencing higher displacement are higher transducer power and water flow. Results of settling tank experiment show that factors influencing maximum volume reduction are combination of higher transducer frequency and low transducer power. Currently the prototype integration tests are underway.

b. **Technology/Product developed** - The proposed project is designed as a sustainable, economical and a stand-alone Eco-Toilet for the population in low resource settings. The design aims to provide a simple construction of the system to enable easier scale up for wider reach, specifically in developing countries.

c. **IP generated/ Potential for IP generation** –During the design stage a full patent application was filed in the India patent office to protect some of the novel techniques that will bring about a huge societal change in the long term.

d. **Resources Generated** –We have added a full time experienced test and quality engineer.

Plans to take innovation further

The company intends to explore partnership opportunities for post processing of digested waste to convert it into a usable consumable. In addition, the partnership will complement not only the skill sets but the final solution offering that is part of our vision and goal.

Risks Envisaged

There is an element of scaling up risk at present due to work space and work force. The team will need a larger work area and get skilled resources on board to ramp up from pilot production.

Innovator Team

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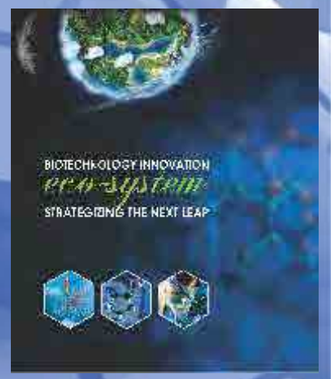
Centre for Health Research and Development, Society for Applied Studies



The Innovation

Improving linear growth of children in low income settings through integrated nutritional, environmental WASH, medical support and care interventions in pregnancy and early childhood- A randomized controlled trial

Development Stage

Proof-of-concept

Brief Description

The set of integrated interventionsaim to establish the maximum growth potential of young children living in low resource households that can be achieved through integrated interventions that address nutritional, health, environmental and caregiving barriers to child growth, delivered from the preconception period, through pregnancy and early childhood.

Innovative element

The innovative element in the trial is simultaneous provision of all evidence-based interventions during 1000 days, from peri-conception to second birthday to achieve maximum acceleration in linear growth.This will be a path breaking practical application research to guide strategy to accelerate war against stunting.

Market Potential

The integrated package of interventions including behaviour modification and several different technologies for water, sanitation and hygiene (WASH), if efficacious in the trial will have application in India, and the entire developing world.

National/Societal Relevance

The study will generate key information for the definition of policies and programmes for child stunting and development in India. It will also indicate the magnitude of intergenerational limitations on growth by examining the extent to which maternal height limits the effects of interventions on fetal and early child growth.

Project Deliverables

a. **Progress vis-à-vis objectives –**
- approach to formative research
- Survey for collection of anthropometric and household information
- Survey to ascertain pregnancy rate in study population

b. **Technology/Product developed –** A set of interventions for accelerated linear growth have been finalized for WASH, medical care, nutrition supplementation; some other components are being evolved.

c. **IP generated/ Potential for IP generation –** None

d. **Resources Generated –**Initial stage

Plans to take innovation further

We will establish a policy support team to interpret the results of the study in the context of the global evidence base. The results of the study, the consolidated evidence base and policy briefs will be presented to key Ministries in India and expert groups involved with strategic planning and monitoring.

Risks Envisaged

None

Innovator Team

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The Innovation

Low-cost salivary progesterone testing for detecting the risk of preterm births in rural community settings of India

The Innovation

The project aims to validate and test the feasibility, and acceptability, of an innovative low-cost salivary progesterone preterm birth (PTB) prediction test in rural settings of India with high rates of prematurity.

Stage of Development

Validation

Innovative Element

The salivary progesterone test is based on the estimation of progesterone in saliva. The use of saliva for biomarker measurements has well known advantages, for example it can be easily collected and is non-invasive.

Market Potential

The low-cost non-invasive test is expected to have social and financial sustainability for scaling up in resource poor settings.

National /Societal Relevance

A relatively low cost salivary-based screening test for early detection of risk of PTB, provides a solution for Indian setting where public health infrastructure is limited in rural areas.

Project Deliverables

a. **Progress vis-a vis objectives** -Enhanced practices/skills of health service providers to identify pregnant women and sample collection, capacity of technicians on analysis and interpretation of results

Acceptability of test by pregnant women and frontline functionaries, documentation of test conducted (ease of sample collection, storage, transportation and analysis)

ROC curve for the estimation of critical cut-off values of salivary progesterone in the prediction of PTB at <34 weeks and <37 weeks of gestation respectively.

b. **Technology/ Product developed** - Not applicable

c. **IP generated/ Potential for IP generation** - To protect these data as intellectual property, the investigatorplans to develop a predictive algorithm and mobile phone app.

d. **Resources Generated** - The different manpower resources would be capacitated in the study are frontline functionaries like ASHAs, ANMs for collection of salivary samples and laboratory technicians for performing the tests.

Plans to take innovation further

After successful validation of salivary progesterone test, a scale-up study in public health setting by frontline functionaries for improved referral and management of pregnant women is intended to define the measurable impact of the test.

Risk Envisaged

Small risk of contamination of blood in saliva among women who have oral diseases or injuries or gum bleeding.

Innovator Team

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The Innovation

Stress outcomes on pregnancy, foetal growth and birth weight: Development of methods to identify mothers at risk of preterm birth and intrauterine growth restriction resulting from maternal stress

The Innovation

The proposed study adopt a multidimensional approach based on genomic, epigenomic and proteomic analyses to develop a tool for identification of mothers at risk of preterm birth (PTB) and intrauterine growth restriction (IUGR) due to exposure to sustained stress during pregnancy.In this study stress among pregnancy cohort will be ascertained by a validated psychological instrument and biologically by assaying for telomere length, DNA methylation alterations, hair shaft cortisol levels and by proteomic analysis.

Stage of Development

Proof-of-concept

Innovative Element

The approach of initially measuring stress by psychological instrument and subsequently using the biological assays only on selected participants in the bottom, middle and top twentieth percentile of stress will enhance the efficiency of the study by preventing unnecessary performance of biological assays on large number of participants. Further, the linear discriminant function proposed to develop to identify mothers exposed to stress during pregnancy will be a major innovation.

Market Potential

The economic burden due to PTB and IUGR is substantial. Their prediction will result in considerable reduction in the public health burden as well as in increased levels of health, both in early and adult life.

National /Societal Relevance

Identifying, mothers at enhanced risk of adverse pregnancy outcomes and subjecting them to specific antenatal stress control programs to eliminate/reduce stress during pregnancy will ultimately result in outcomes favourable to the production of healthy children who will continue to thrive in later life.

Project Deliverables

- Study the impact of maternal stress during pregnancy on risk of preterm birth and IUGR
- Develop a method to identify pregnant women at risk of preterm birth and IUGR due to exposure to sustained stress during pregnancy

a. **Progress vis-a vis objectives** –project initiated

b. **Technology/ Product developed**- project initiated

c. **IP generated/ Potential for IP generation**- None

d. **Resources Generated**- Manpower recruited

Plans to take innovation further

None

Risk Envisaged

None

Innovator Team

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SRM Institutes for Medical Science (SIMS)

The Innovation

An intergenerational prebiotic approach to establishment of a healthy colonic microbiome in infants.

The Innovation

Designing a product that will benefit infant gastrointestinal function and gastrointestinal microbiome when the product is fed to their mothers while they are still in utero. The studies proposed in the titled project aim to close gaps in our knowledge prior to designing such a product.

Stage of Development

Discovery

Innovative Element

The concept of an inter-generational intervention

Market Potential

Great market potential as it will impact management of pregnancy and the neonatal period.

National /Societal Relevance

Stunting, related to environmental enteropathy, affects 40% of children in India, thus the effort related to this study has great national and societal relevance.

Project Deliverables

- Catalogue of alterations in fecal microbiota after the prebiotic feeding intervention in women of reproductive age
- Catalogue of alterations in fecal microbiota after the prebiotic feeding intervention in weaning infants.

a. **Progress vis-a vis objectives** - Awaiting disbursement of project fund, following which the project will commence.

b. **Technology/ Product developed** - Project yet to commence.

c. **IP generated/ Potential for IP generation** - There is potential for IP generation from the microbiome studies.

d. **Resources Generated** - Project yet to commence.

Plans to take innovation further

We already have a partnership between the coordinator and the scientists in Australia. This will be taken further once the results are available.

Risk Envisaged

Recruitment of weaning infants could be delayed based on mothers' perceptions. There may be compliance issues with regard to product consumption. There may be compliance issues with regard to fecal collection.

Innovator Team

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The Innovation

Enhancing nutritional security of pregnant women, infants and young children in rural households of Tamil Nadu, India through agricultural intervention

Development Stage

Proof of Concept

Brief Description

A traditional rice genotype namely "Kavuni" was found topossess therapeutic properties viz., low carbohydrates, highlevel of lutein, GABA, flavonoids, phenolic acids and biochemical properties associated with controlling Type-II diabetes. Kavuni was improved for its yield (3 - 3.5 t/ha) and agronomy through innovative breeding strategies.

Innovative element - Development and dissemination of staple food crops like rice possessing therapeutic and nutritional compounds will have significant impact on the health and nutritional status of rural sections.

Market Potential

Farmers will get additional income of USD 3000 to USD 4000 per hectare whencompared to cultivation of white rice varieties due to high procurement price.

National/Societal Relevance

In the near future,alarming rise in the occurrence of diabetes and ARMD is expected in India and also throughout the world.Hence thisimproved rice grains will have lot of potential globally for preventing these disorders

Project Deliverables

a. **Progress vis-à-vis objectives –** Superior high yielding rice lines possessing nutritive/therapeutic properties will be developed

b. **Technology/Product developed –** yet to decide

c. **IP generated/ Potential for IP generation –** The proposed technology has potential for IP once its effect is studied through clinical trials.

b. **Resources Generated -** Initial activities on germpalsm evaluation, biochemical characterization of traditional genotype Kavuni and mapping population development

Plans to take innovation further

Once the suitability of this therapeutic rice on combating health disorders is assessed through appropriate clinical/house hold studies, then efforts will be taken to join hands with industries to promote this technology through value addition, processing etc.,

Risks Envisaged

Conducting bioavailability studies, Clinical trials

Innovator Team

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Translational Health Science and Technology Institute

The Innovation

Creation of a Biorepository and Imaging Data Bank for Accelerating Evidence Generation to Facilitate Children to Thrive

The Innovation

The bio-specimens from the bio-repository may lead to development of test panels for diagnostic purpose of predicting adverse pregnancy outcomes early in pregnancy.

Stage of Development

Discovery

Innovative Element

The project aims to build a long term stable repository resource of longitudinally collected bio-specimens and images of pregnant women across the pregnancy with well characterized clinical, social, epidemiological and environmental data.

Market Potential

The market potential of the outcome of research leading to diagnostics/biomarker development out of use of the repository will be shared with the funders as and when they are near the proof of concept stage.

National /Societal Relevance

The repository will be one of a kind in India where repositories of similar collection is lacking. This multi-omics research directed at discovering prospective diagnostic or predictive biomarkers, profoundly dependent on the large number of clinical samples from humans with well characterized phenotype will serve as national and societal resource.

Project Deliverables

Building long term stable infrastructure for collection of bio-specimens and imaging data bank; development of young investigator program; hypothesis driven collaborative research proposals in the maternal and child health area

a. **Progress vis-a vis objectives –** Procurement and installing of infrastructure is near completion, Applications for young investigator program has been advertised. Collection of bio-specimens and imaging data are in progress, collaborative research proposals in the maternal child health area using the repository resource have been submitted.

b. **Technology/ Product developed-** None

c. **IP generated/ Potential for IP generation-** None. However, study has potential for IP generation as an outcome of the research studies.

d. **Resources Generated-** Stable infrastructure of deep freezers with monitors, data management hard ware and software is being established. Standard operating procedures for collection, storage and retrieval of samples developed. Dedicated manpower has been hired and trained.

Plans to take innovation further

The repository will serve as a platform to conduct future hypothesis driven sub-studies in the maternal and child health area.

Risk Envisaged

Alternate strategies to minimize sample deterioration when transporting and storing have been proposed.

Innovator Team

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Way Forward

Through efforts of BIRAC and its partners a stage has been reached in India especially in the biotechnology arena where we can now begin planning for the next leap for this sunrise sector with the aim of making theIndian Biotechnology a bioeconomy of US$100 Billion by 2025.

The components required for taking the next leap are falling into the right place in the Bio-innovation landscape of the country- BIRAC has built a large base of innovations driven by entrepreneurial biotech startups and SMEs who now have the capabilities to bring new products into the market- positively impacting lives of citizens in innumerable ways.

Scaling the Indian Biotechnology sector to the next level will require re-doubling the efforts at BIRAC, seeking greater convergence with other Government Departments and expanding our networks of partners.

BIRAC will pro-actively seek advice, continue to sense changes in the ecosystem especially trajectories of new technologies, increase its communication to all in the community, understand existing and emerging gaps in the ecosystem and seek new partnerships with national and international organisations. These cumulatively will inform our strategies to scale the Indian biotech industry.