



BIRAC Innovations[∞] : **Propelling the** *Bio-economy*

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Way Forward

Foreword



Building and nurturing an innovation nation is a demanding and arduous task that needs singular focus, immense dedication and an ability to attract partners with aligned vision. BIRAC's journey and its work, since 2012, is an exemplar of the fact that dedicated action results in tangible and intangible benefits on the ground.

In the last five years we have been able to inject appropriate funding at each stage of innovation funnel thereby stimulating product and technology development, designed and launched new programmes in 'Grand Challenges' that address global and national challenges and have established collaborative engagement with national and international organisations helping bridge gaps and find optimal solutions.

We need to harness the entrepreneurial energies present in our academia, industry and startups. We believe that the solutions to global challenges would be developed by entrepreneurs (especially startups and SMEs) and nimble R&D organisations with deep translational culture. When we began our journey we sensed that the entrepreneurial ecosystem in the country was poised to grow and we built a panoply of programs that have positively impacted the entrepreneurial ecosystem. Indeed we have laid new pathways for entrepreneurs to push the envelope of cutting edge bioinnovations in the country.

Through our partnering organisations we provide an integrated support network to our emerging startups and SMEs.

Our programs have endeavoured to lay the foundation of building a massive pool of entrepreneurs who are pushing the boundaries of possibilities. The 6th edition of the Compendium highlights the innovations being accelerated through support from BIRAC. It is imperative for us to make sure that the innovations reach their ultimate destination and bring positive impact in our communities- improving health, increasing nutritional security and supporting clean environment.

I would like to wish all our innovators good luck for their future endeavours and I hope this edition will inspire new entrepreneurs to begin new journeys to create impact.

Prof. K. VijayRaghavan

Secretary DBT and Chairman BIRAC

Preface



BIRAC, since its inception, has developed into a nodal organisation in the country for propelling biotech innovations. This has fructified through our 360 degree strategy to energise the biotech ecosystem of the country especially by focusing on building and nurturing biotech startups and SMEs.

Through our efforts we have supported 500 biotech startups and entrepreneurs and this pool is continuing to grow at a rapid pace through our flagship startup programs such as BIG, SPARSH and IIPME. These biotech startups are accelerating product development- products that are cutting edge and affordable and hence the potential for impact is immense. The product development is being accelerated by our programs such as SBIRI and BIPP. Our support has resulted in development of 100 products and technologies and 49 products have been launched over the last five years- a testimony to the immense innovation potential in Indian biotech startups and SMEs. We understand that biotech startups and entrepreneurs need specialised spaces to grow and in this regard we have established world class incubators across the country through our BioNEST program as well as pre-incubation programs such as UIC.

Our partnerships especially with The Bill & Melinda Gates Foundation, Wellcome Trust, Nesta UK, ICMR, WISH Foundation have enhanced the ecosystem and have helped bridge several gaps.

As we quicken our efforts, we will operationalise, in the near future, several strategic programs and tools chief amongst them are the “National Biopharma Mission” (which was launched in 2017), BIRAC AcE Fund (a fund of fund equity program) and BIRAC Innovation Grand Challenge (SoCH). This will help propel the bioeconomy towards greater heights.

The latest edition of the BIRAC Compendium brings to view the innovations supported by BIRAC, the innovators and their team's efforts to develop products and technologies. We extend our wishes and congratulate them for their efforts for transforming the Indian biotech ecosystem. We will continue to work with the entrepreneurs, understand their needs, bridge the gaps in the ecosystem and stimulate new ideations.

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 five 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
- Efficiency
- 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 and SME's & hence our focus is on raising their capabilities



Thinking Aloud

BIRAC Innovations™: Propelling the Bioeconomy

Introduction

The fact remains that biotechnology has the power to provide solutions to myriad challenges that humanity deals with- from climate change, disease burden, food & nutritional security, clean fuel to environmental degradation. The seed for a national transformation in bio-innovation was laid by the Department of Biotechnology when an experimental program, BIRAP that was initiated in 2009, was given the shape of a “not for profit” public sector company, in 2012, with a mandate to drive the emerging biotechnology industry and catalyse its transformation into US\$100B bioeconomy by 2025.

The aim to achieve a US\$100B seems an ambitious but an achievable goal and needs collective efforts from all stakeholders. BIRAC’s aim, from its very inception, has been to nurture, foster, catalyse, galvanise connect, scale and propel Indian biotech startups and SMEs such that novel products that match global standards of quality but still remain extremely affordable are conceptualised, tested and manufactured in India.

Our belief is that several factors need to come together for the propulsion of the Indian bioeconomy towards the goal of 2025.

The Propelling Vectors:

A. Lasered focus on generating globally competitive products and technologies: The Vector of Mission Programs

BIRAC has a clear strategy to contribute to the Make in India national program that entails a ‘laser-like’ approach to boost biotech R&D which leads to design and manufacturing of products for the national, regional and global markets.

Our programs 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), Industry Innovation Programme on Medical Electronics (IIPME) all collectively contribute to the mission of generating products and technologies that have global relevance. These programs have been smartly designed to encompass all stages of the product development cycle.

A significant boost to the propulsion to the Indian bioeconomy was the launch of the US\$250 million “National Biopharma Mission” in partnership with the World Bank in 2017. This mission will stimulate the biopharma industry through a focused approach of developing indigenous products and bring together industry and academia for translational collaboration.

Our portfolio of innovations includes 617 projects in a wide range of areas including agriculture, devices and diagnostics, biosimilars & stem cells, drugs, vaccines and industrial biotech. It is worth pointing out that the total funds committed is INR 1711 crores - and aligned with true nature of partnership- the industry’s commitment is significant as well.

This ‘laser-like’ focus has resulted in tangible changes on the ground- through concentrated efforts, BIRAC has been able to propel development of 100 products and technologies and 49 products have been launched. This is significant and provides an indicator that more novel products will come through the support extended by BIRAC which will positively influence the Indian biotech industry.

Analyses of data reveals that of the total funding- the top three areas which have received major proportion of funding are 'vaccines and clinical trials', 'industrial biotechnology' and 'devices and diagnostics'. When we consider the total number of projects and analyses the areas that have received highest number of projects- in this case medtech which includes devices and diagnostics corner 33% of the projects, followed by industrial biotechnology (21%) and drugs (16%).

A major strategy for building a globally competitive biotech industry is to encourage and help secure 'intellectual property' emerging from the novel projects. BIRAC has majorly contributed to generation of at least 147 IPs from the supported projects. It is interesting to note that 47% of the IPs being generated are in the medtech (devices & diagnosis). It is also to be noted that almost 75% of medtech is currently imported to the country. The generation of IP in the medtech arena as in other areas is indicative of the fact that we can now reduce the burden of imports by building products in India.

B. Unleashing the 'power of bio-entrepreneurship": Vector of Startups

The engine of bioeconomy is powered by the fuel of entrepreneurial energy- this can be seen in all major hubs of biotech across the world. BIRAC recognised this fact early on and built a series of programs that unleashed the untapped energies of entrepreneurship across the country. The BIG program is undoubtedly the largest early stage biotech startup program of the country. Other programs such as BIRAC SRISTI GYTI Awards, Social Innovation Immersion Program (SIIP) have also significantly contributed in the transformation of the entrepreneurial domain.

Cumulatively, BIRAC has supported more than 500 startups and entrepreneurs and the number is growing each year. These entrepreneurs are tinkering, prototyping and building the next generation of products.

Another interesting facet that is emerging is the catalysis of new 'startups' through BIRAC support. Through BIG, 75 individual entrepreneurs established new startups adding their energies to the "Startup India" program.

Along with early stage funding, BIRAC has endeavoured to support "bioincubation" through funding 25 bioincubators (through its BioNEST program) across the country that allow nascent startups to grow.

BIRAC has strategically worked with partners across the country to understand the needs of startups and then address the gapsthereby . Our BIG and SIIP partners provide a range of support to startups- technical expertise, business mentoring, networks and connecting startups to relevant stakeholders.

Further impetus to the bioentrepreneurship movement was provided by the BIRAC SEED Fund program in partnership with our BioNEST incubators. In the near future we intend to launch focused entrepreneurial programs such as SoCH (Solutions for Community Health) and programs for women entrepreneurs.

A major boost to bridging the "valley of death" would be provided by BIRAC AcE Fund- an equity fund of INR 150 crores which is a 'fund of fund' and will partner with angel and venture fund to provide equity funding up to US\$1million which can then catapult biotech startups to the next level.

BIRAC has had a comprehensive approach to kick-start, nurture and propel the entrepreneurial movement in India- the rewards of which will seep into communities.

C. Catalysing Networks & Providing Access to “Testing Beds”: Vector of “Interfaces” & “Partnerships”

As one can notice, BIRAC’s approach has been to fashion ‘new’ propellers that have triggered several new paths in creation of an Indian bioeconomy. We are cognisant of the fact that innovation including bioinnovation is a ‘contact sport’. It is with this philosophy in mind that we have fashioned several platforms that allow exchange of knowledge and hasten collaborations. BIRAC brings together the community of stakeholders including startups, SMEs, Government officials, policy makers, industry, academia on to platforms such as Innovator Meet, BIG Conclave and BioNEST-Conclave. We also actively participate in numerous for a such as US BIO, Bangalore INDIA BIO and BioAsia to name a few.

Our flagship programs encourage partnerships between academia and industry. We now notice active collaborations between academia and industry, between clinicians and engineers and new forms of collaborations are emerging between startups and corporates.

BIRAC has built a range of global and national partnerships that have activated new modes of addressing global challenges and allowing our innovators to access global and national connects as well as infrastructure. This aspect can be seen in our partnerships with the Bill & Melinda Gates Foundation, Wellcome Trust, Nesta, CEFIPRA and USAID. We have also established new partnerships with ICMR and WISH Foundation wherein our startups can access clinical testing beds to pilot their products and gather important data which will quicken their adoption.

The 6th Compendium

Like the previous years, we have attempted to capture and showcase the dynamism in in our portfolio of projects and through a detailed analyses we have highlighted the emerging trends from the novel projects that we have supported. This will help us identify areas of strengths and the gaps that still exist which will need our focus to find solutions. The compendium, like the previous editions, is a repository of information which will help organisations across the world get valuable information about our startups and SMEs which may further lead to positive connections.

BIRAC Innovations™: Propelling the Bioeconomy

India has commenced on a mission to achieve \$100 billion bioeconomy by 2025. India's bio-economy is concentrated on the following sectors, Bio-pharma and healthcare, Bio-services, Bio-Agri, Bio-Industrial and Bioinformatics and System Biology. India has all the essential constituents for success which include top-ranked universities driving cutting-edge research for developing new technologies, talented scientific workforce and an expanding start-up ecosystem. Strategic partnerships and connection between these components is essential to ensure the growth of Indian economy and achieve the goal that has been set. BIRAC with its vision to stimulate, foster and enhance the strategic research and innovation capabilities of the Indian biotech industry, particularly start-ups and SME's, has been playing an enabling role in this mission.

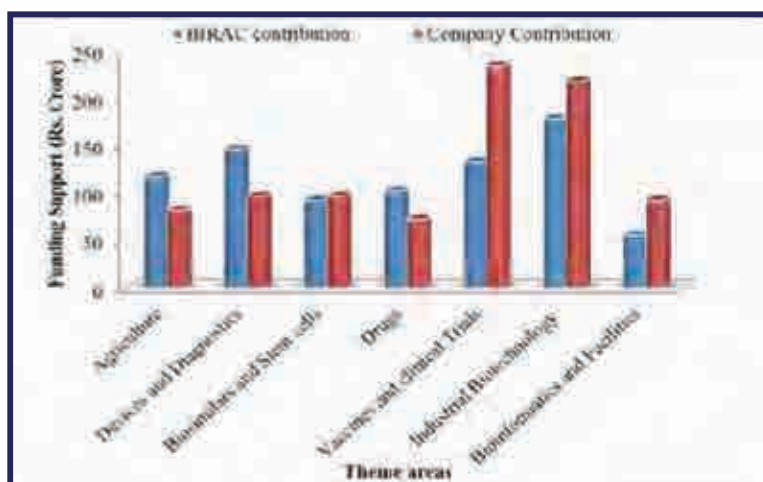
The mandate of BIRAC is to nurture and empower the biotech innovation ecosystem. To serve its mandate, BIRAC operates mainly in 3 verticals, Investment schemes, Entrepreneurship Development and Strategic Partnerships. BIRAC provides support at all levels of the product development chain through its various funding schemes.

- Proof-of-concept studies are supported under Biotechnology Ignition Grant (BIG), Social Innovation programme for Products: Affordable & Relevant to Societal Health (SPARSH), Industry Innovation Programme on Medical Electronics (IIPME) and Academic Innovation Research (AIR),
- Validation studies are supported under Small Business Innovation Research Initiative (SBIRI), Biotechnology Industry Partnership Programme (BIPP) and Contract Research Scheme (CRS)
- Scale-up of the technology is supported under BIPP and CRS

In addition, for empowering and supporting start-ups, BIRAC has supported 25 Bio-incubators (2,50,000 sq. ft. incubation space has been created for start-ups), 2 Regional and Entrepreneurship Development Centres. BIRAC has facilitated access to research resources by establishing protein characterization and cGMP compliant bioprocessing facilities and provides services for IP and Technology Management and provides mentoring support through its panel of subject matter experts and workshops.

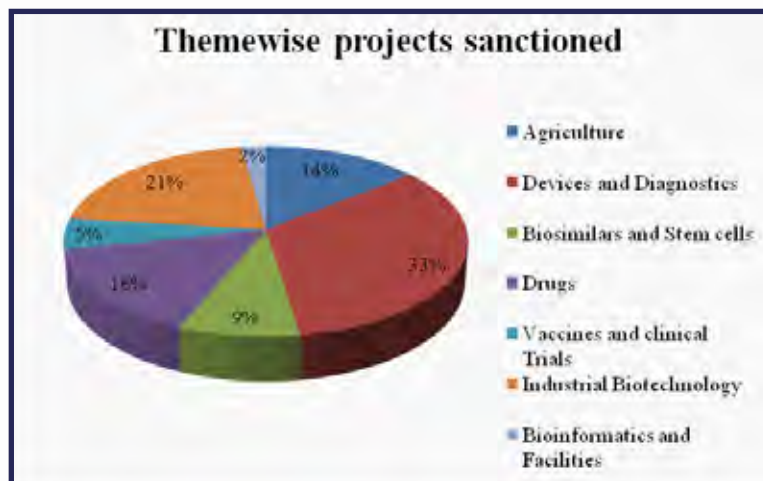
The impact that BIRAC has created in the past 5 years has been remarkable. A total of 500 start-ups and Entrepreneurs have been supported by BIRAC through Rs. 858 crores worth of funding. This has resulted in the development of 100 products and technologies, 147* new IPs (* as on 15th September 2017), 75 new start-ups have been seeded. BIRAC funded projects have generated employment for nearly 3000 people and 114 Women entrepreneurs have been supported. The list of projects is available at www.birac.nic.in/desc_new.php?id=145.

Proposals funded by BIRAC are categorized under 7 broad thematic areas which include Vaccines and Clinical Trials, Drugs (including Drug Delivery), Biosimilars (including Regenerative Medicine), Agriculture (including Aquaculture & Veterinary Sciences), Devices and Diagnostics, Bioinformatics & Facilities and Industrial Biotechnology (including secondary agriculture).



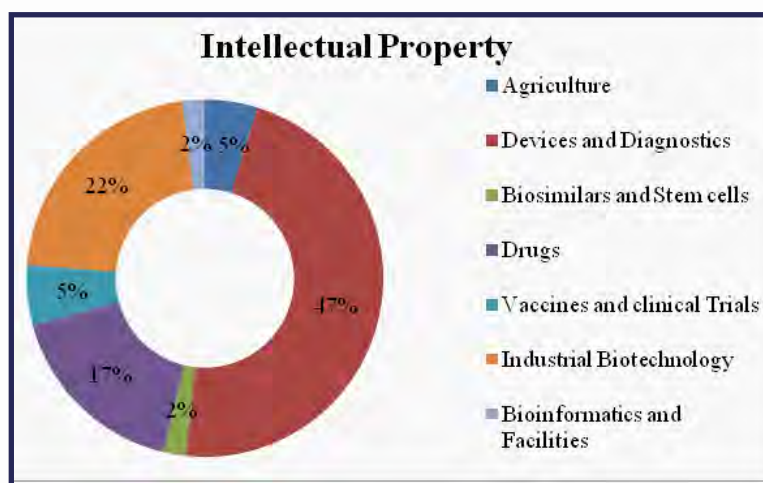


The highest share of BIRAC funding has gone to Industrial Biotechnology & Vaccines and Clinical trials followed by Devices and Diagnostics.



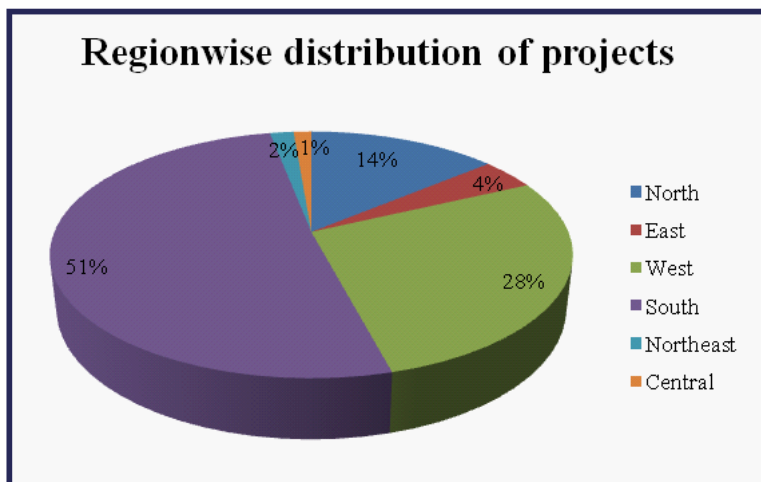
The medical devices and diagnostics industry is growing at a rapid pace. To cater to the Indian population, there is a need to develop “affordable” and “accessible” healthcare products. Thus, there is a constant need to drive innovations in this area. The theme-wise breakup of the projects supported by BIRAC, accordingly, indicates that 33% of the total projects supported fall under Devices and Diagnostics.

The next is Industrial Biotechnology (including secondary agriculture) which accounts for 21% of the total projects supported. The Industrial Biotechnology sector encompasses a suite of technologies and processes catering to enzyme production, speciality chemicals, bio-based products and bioenergy and has huge impact and potential to overcome a number of socio-economic problems like pollution, energy crisis, and high production costs and provide solution to industry in terms of resource conservation.

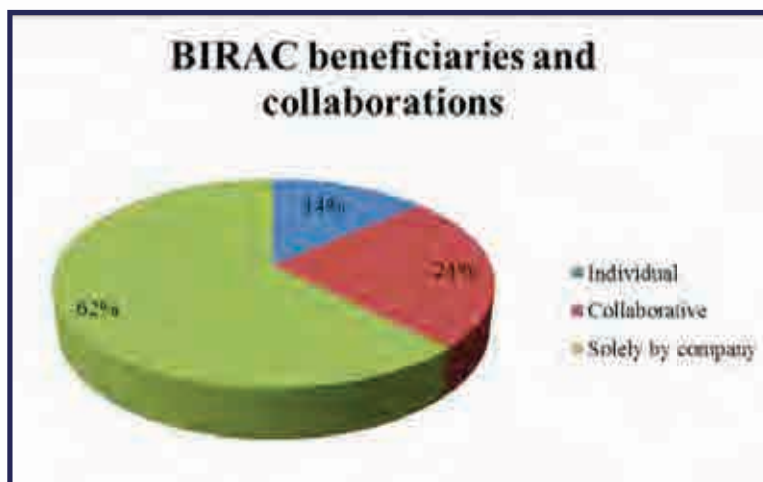


Intellectual property is the lifeline of the biotechnology industry. Strong patents are a vital component to ensure a steady stream of capital in-flow to young as well as established biotechnology companies developing innovative devices, alternative energy sources, disease-resistant crops, and a wide range of other innovative technologies that are helping to feed, fuel, and heal our planet.

Devices and diagnosis continues to top the list of IP generated which mirrors the innovation efforts going in this area. The areas of ‘Industrial Biotechnology’ and ‘Drugs’ follow Devices & Diagnostics in IP generation.



The industry is concentrated around major Bioclusters: Maharashtra, Karnataka, Uttar Pradesh, Andhra Pradesh, NCR and Gujarat. South, being the home to the biggest bio cluster in India, topped the list for BIRAC supported projects, making it 51% of the total projects supported. BIRAC's presence in North-eastern India is continuously showing an increasing trend. This could be attributed to number of outreach activities carried out in the north-eastern part of the country.



BIRAC has been instrumental in bridging the industry-academia gap to some extent. The projects being supported with industry-academia collaboration is steadily increasing. Young entrepreneurs have continued with their innovative ideas and total projects supported to entrepreneurs have increased to 94.



In a nutshell,



* As on 15th September 2017

Some of the BIRAC funded projects which have received awards and recognition,

1. Dr. Sanjiv Sambandan, Openwater.in was ranked amongst GEN Top 10 (of 1000+ startups from 165 countries) and F6S top 10 for his project titled "Hassle Free Waste Water Treatment: From Water-bottles for Individuals to Systems for Communities"
2. Mr. Vinayak Nandalike, Yostra Labs Private Limited received funding from Villgro, Marico and Karnataka Govt. Idea2Poc for his project, Warm Oxygen Therapy for Treatment of Diabetic Foot Ulcer
3. Dr. Rajlakshmi Borthakur, Terra Blue Exploration Technologies Private Ltd. won following awards:
 - a. Innovate for Digital India Challenge, 2016
 - b. Assam Young Innovator's Award
 - c. Acer Award, Taiwan for her project title, "TJay - An Innovative Solution for the Prediction & Management of Epilepsy"
4. Dr. Shanthanu Chakravarthy received funding from Karnataka Govt. (Idea2POC) for his project titled, "A Virtual Reality (VR)-based endoscopy simulator"
5. Dr. Sreekar Kothamchu, Nesa Medtech Pvt. Ltd. received Excellence in Medical Research & Development- IHP Awards and funding from Karnataka Govt. (Idea2POC) for his project on "Affordable and Minimally invasive therapy for woman with Symptomatic Uterine Fibroids"
6. Mr. Mihir Mehta, Green Pyramid Biotech. Pvt. Ltd. won following awards:
 - a. TIE smash-up award of Rs. 25 lacs
 - b. 10 L from SINE IITB-SwissNex (Winner among the top 10 startups in India for the Academia Industry Training - AIT Cycle 3 jointly organized by Department of Science and Technology (DST), Swissnex India and Society for Innovation and Entrepreneurship (SINE, IIT Bombay). For his project titled, "Bio-Synthesis, Production and Formulation of Sophorolipids for the purpose of Sanitizing/Sterilizing Fruits and Vegetables thus enhancing their shelf-life."



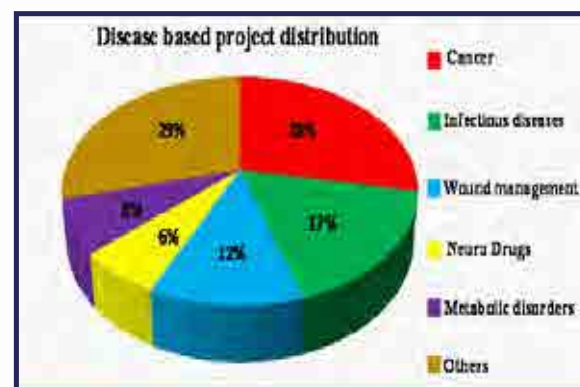
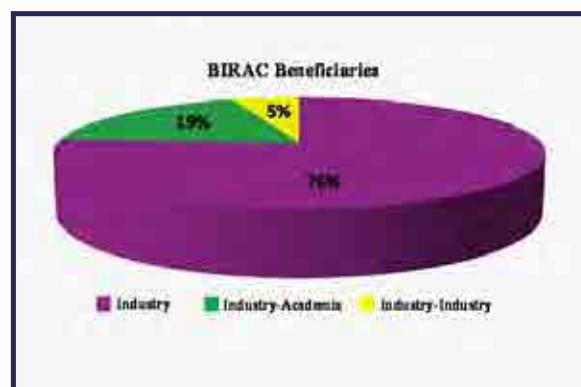
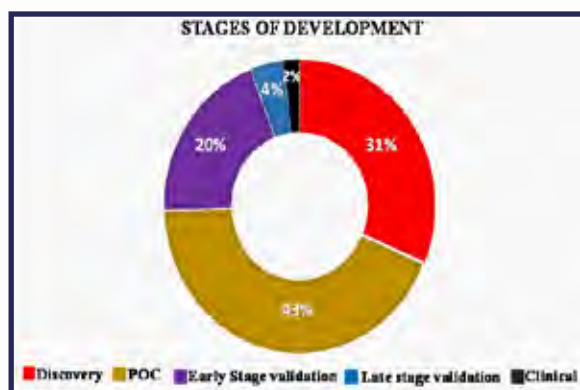
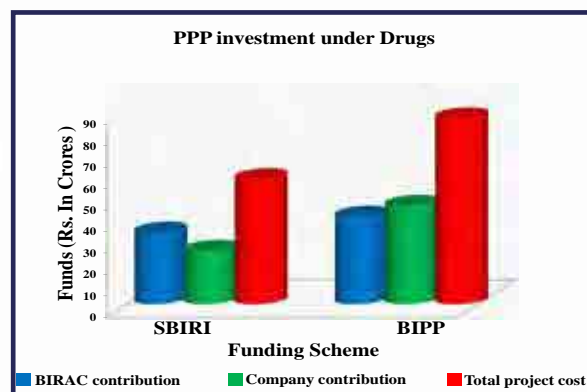
7. Smrita Pradhan was selected as finalist in “Young Innovators Challenge Award, 2017 “ conducted by 3M for her project “Development of Economically Viable Products for Microbial & Mammalian Cell culture, Animal Nutrition etc., by Recovering Silk-Sericin from the Industrial Effluents by Implementing Novel Strategies for Degumming and Recovery”
8. Dr Renuka Diwan, Bioprime AgriSolutions was selected as an Untd fellow, social entrepreneurs, for the 2017 cohort for her project “Process to produce double haploid parental lines with new, unique, rare genetic combinations using DH technology coupled with a strategy to increase or alter meiotic recombination in the technology demonstration system of mustard”
9. Pranav Chopra, Crimson Healthcare Pvt Ltd received funding under IndoUs grant 2017 for his project “SphinX – Ostomy Management Device”
10. Dr. H V Srinivas received Economic Times Power of ideas 2016 and follow on funding under Idea2PoC grant Govt. of Karnataka for his project on “A gonioscope without a slit lamp”
11. Dr. Pankaj Chhatrala, JC OrthoHeal Pvt Ltd received following awards and recognitions for his project titled, “FlexiOH: Breathable, Washable and Lightweight cast immobilization for fractured bone”
 - a. DST Lockheed martin Gold medal for top 30 innovation under Indian Innovation Growth program
 - b. Commercialization support From IC2 institute University of Texas on being shortlisted among top-10 technologies in IIGP-2016.
 - c. Nominated as part of Indian delegate visit to silicon valley- USA by IUSSTF.
12. Ms. Geethanjali Radhakrishnan, Adiuvo Diagnostics Private Limited received follows awards and recognitions for her project titled “Portable Hand Held Dermoscope For Real Time Non-Invasive Detection and Monitoring of Skin Infections Using Multi-Wavelength UV Fluorescence”
 - a. Part of CIIE Accelerator Cohort Program, 3 Month - IIM Ahmedabad
 - b. ASME Ishow - Hardware Innovator Award Conducted By American Society Of Mechanical Engineer In 2016
 - c. Supported by VILLGRO INNOVATION FOUNDATIONS

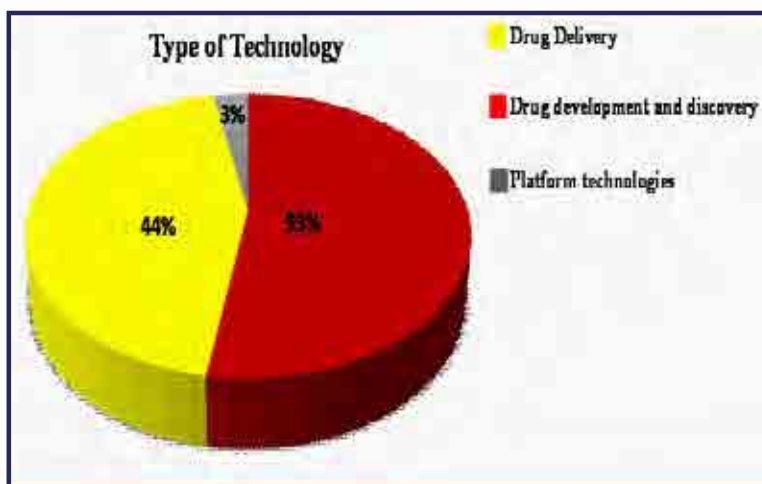
Theme wise assessment

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 deal with the indications such as Cancer, infectious diseases, inflammation and Neuro degenerative diseases etc. Many of the projects accomplished the objectives successfully and are ready to go to the next stage. Few successful outcomes during last few years are 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. Other discoveries include identification of preliminary hits for DNA gyrase which showed potent activity against *E. coli* and *Acinobactorare*. A Facility is developed in which 214 phyto chemical reference substances (PRS) from Indian medicinal plants have been isolated & characterized with 95% purity and commercialized nationally and globally.

Total PPP investment under this area amounts to Rs. 173 crores wherein BIRAC has invested Rs.100 crores for supporting 105 innovative projects. These 105 projects engaged 60 companies, 14 start-ups, 10 entrepreneurs and 18 academic institutes. Till date, a total of 5 products/technologies/PoC and 25 Intellectual property have been generated from this sector.





Analysis:

- BIRAC contribution is slightly more in BIPP compared to SBIRI as well as company contribution is more in BIPP indicating enabling role of BIRAC in catalyzing large scale innovation and company interest in development in this area.
- Many of the projects are for discovery as well as developing proof of concept
- 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, wound management, neurological diseases.
- Drug delivery is taking maximum share after drug discovery & development. Development of platform technologies are also taking some share.

Biosimilars (including Regenerative Medicine):

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 (OOP) spending rate which 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.

Innovation is one of the key driving forces behind the sustainable growth of the biopharmaceutical industry and an important determinant of a nation's potential for economic growth and global competitiveness.

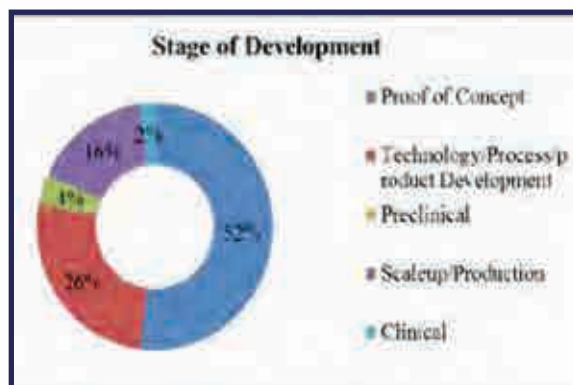
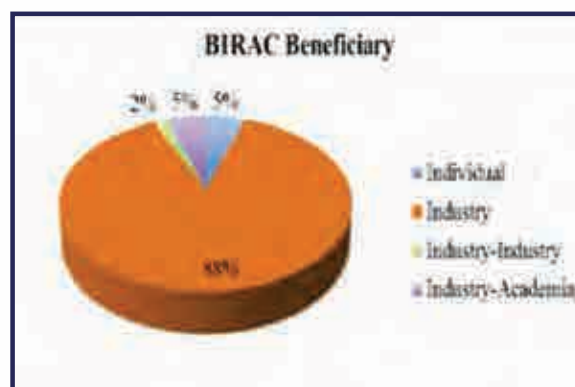
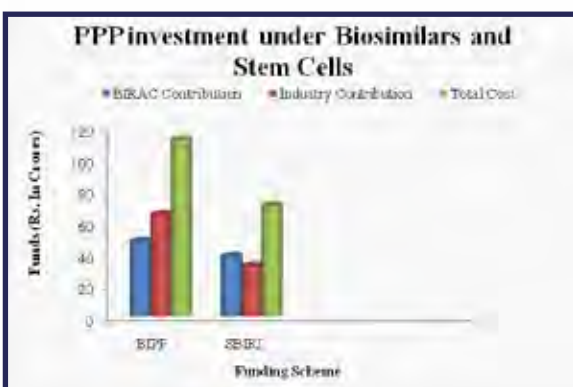
The global Biosimilars market is expected to reach \$6.22 Billion by 2020 from \$2.29 Billion in 2015, at a CAGR of 22.1% from 2015 to 2020. Currently Indian Biosimilar market is 2-3% of Global. There is a huge opportunities to Capture Global market of Biosimilars. Similarly the worldwide stem cells 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 estimated to be about \$540 million in 2010 with an annual growth rate of 15%.

BIRAC has supported a total of 59 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 in the field of regenerative therapy the usage of different types of stem cells. Along with supporting Clinical trial in the field of regenerative therapy, preparation of Stem cell Bank has also been funded.

Total PPP investment under this area amounts to Rs. 188 crores wherein BIRAC has invested Rs. 92 crores for supporting these 59 innovative projects. These supported 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. The company is also being funded for clinical grade plasma purified Alpha-1 Antitrypsin and C1- esterase Inhibitor to conduct clinical trials. In the regenerative medicine field, Regenerative Medical Services Pvt. Ltd. Is funded for conducting clinical trial for safety and efficacy of Uregrow implantation (Stem Cell based product) for the treatment of urethral strictures at 4 different centres.



Analysis:

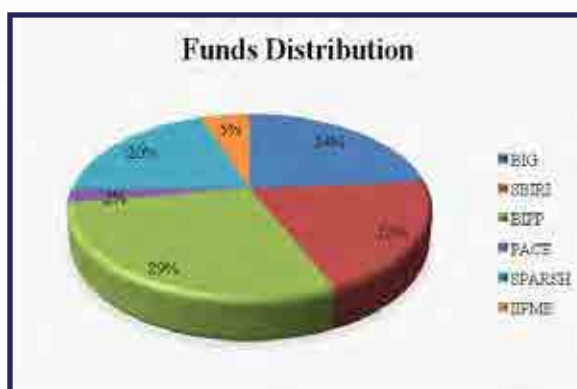
- BIRAC and Industries both are contributing similar funds for the projects under Biosimilars & Regenerative medicine.
- Industry is pursuing maximum number of projects in this area without any collaboration.
- Maximum number of projects funded are at Proof of Concept stage followed by early stage development of technology/process/product development.
- Collaborations (either Industry-Industry or Industry -academia) may be encouraged for successful and timely outputs and to involve more expertise in the respective projects.
- 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

Devices & Diagnostics

The Indian healthcare industry is growing at a tremendous rate and simultaneously going through transformation across the continuum. With the approval of National Health Policy 2017 by the Government of India, healthcare expenditure intends to increase to 2.5% of gross domestic product (GDP) and India embarks on a planned approach to bridge the healthcare divide while maintaining industry competitiveness.

The Indian medical device sector is worth approximately USD 5.5 Billion and is growing at 15% CAGR. Indian medical devices market is the 4th largest in Asia and in the list of top 20 in the world. The medical device sector represents 9% of the overall Indian healthcare industry. The medical device market is dominated by imported products, which comprise of around 75% of total sales.

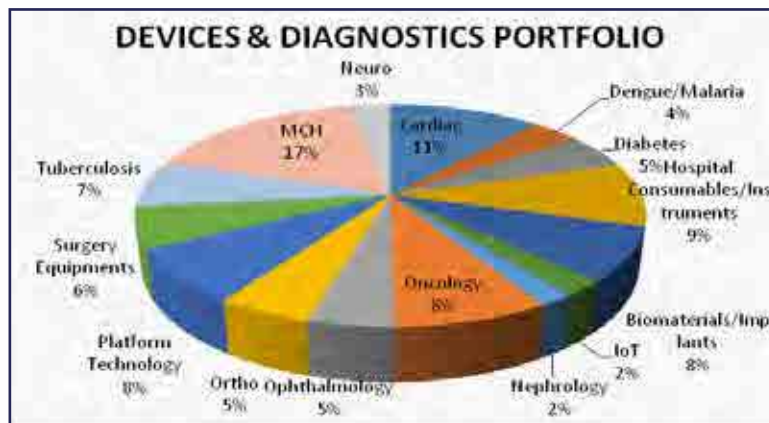
Indian government is making serious efforts to boost domestic manufacturing of medical devices. The Country has witnessed a positive wave of developments in the devices and diagnostics sector over the year. Lot of young individuals have ventured into the sector and started their entrepreneurship journey. BIRAC also promoted the “Make in India” wave and Invested around INR 200 Cr in Devices and Diagnostics through its flagship schemes.



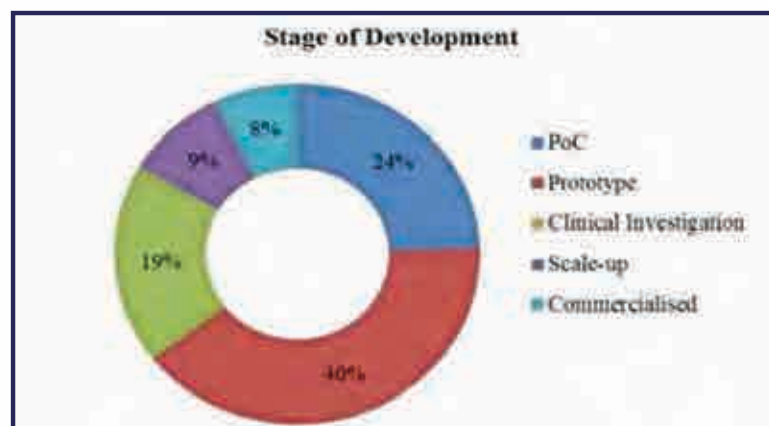
229 Individuals, Entrepreneurs, Startups, SME and Companies are supported for development of Innovative Products/Technologies by BIRAC through its various programs. Out of these 184 projects are submitted solely by Companies or Individuals and 45 as collaborative projects. The collaborative projects account for 20 % of the total projects supported.

As per the analysis of BIRAC funded projects, maximum interest is observed in Diagnostics instruments and kits including Imaging devices and prognostic biomarker based assays. The PoC devices is also in the radar of start-ups. The latest trend is for personal wearable customized IoT based devices. The interoperability of the devices is the current trend amongst the young entrepreneurs. The devices and diagnostics sector has seen maximum number of patent filing. 69 patents are filed by various companies for innovative technologies.

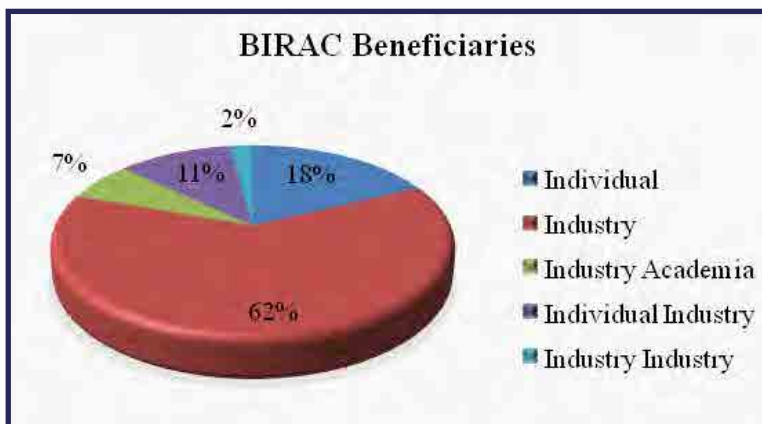
BIRAC supported technologies range from handheld PoC devices to high end Diagnostic Imaging devices and surgical Instruments. Cardiology, Oncology, ophthalmology and Maternal and Child Health has witnessed maximum number of projects. Orthopedics, Biomaterials, Implants and hospital consumables are few latest attractions which are high on market demand.



BIRAC is successful in supporting 17 Companies and helping them to reach pre-commercialization stage i.e. 17 products are commercialized till date with the help of BIRAC support. 33 technologies are currently under large scale clinical validation and have completed early stage validation through BIRAC support, guidance and networking connections.



BIRAC has organized various hands on training events, Ideathon, hackathon to support pipeline generation for the BIRAC flagship programs. Currently, most of the projects are under prototype development phase and going through initial stages of product development cycle. The area witnessed maximum number of successful projects as compared to other areas. This could be because of low gestational period, high market demand and recent initiatives and policies of Government.



Some of the challenges associated with this sector include need of Designing, fabrication, prototyping and validation facilities. Identification of clinical partners and connecting with right hospital network is the bottleneck. 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 collaborations are helping all the stakeholders to cross the "Valley of Death". It is observed through various projects that Collaborations are key to Success.

Analysis:

- Most of the projects in this sector are for developing advanced prototype followed by establishment of Proof of concept
- Industry is pursuing the projects on their own in this sector. Collaborations may be encouraged
- Projects falling across a wide area were supported for innovations right from mobile phone based diagnostics to high end hospital Instrumentations. MCH, oncology and cardiology areas had maximum projects supported
- 8% of the funded projects have been commercialized

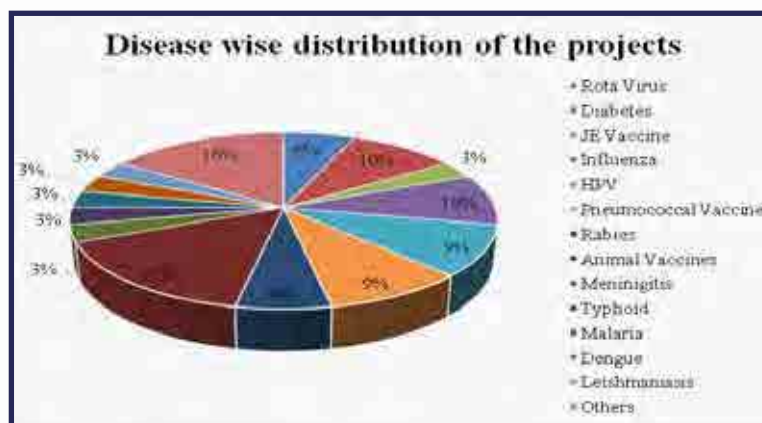
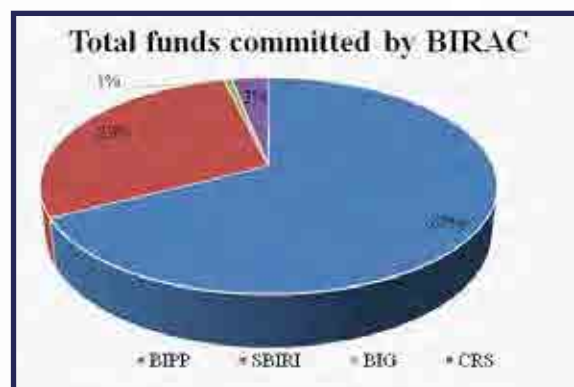
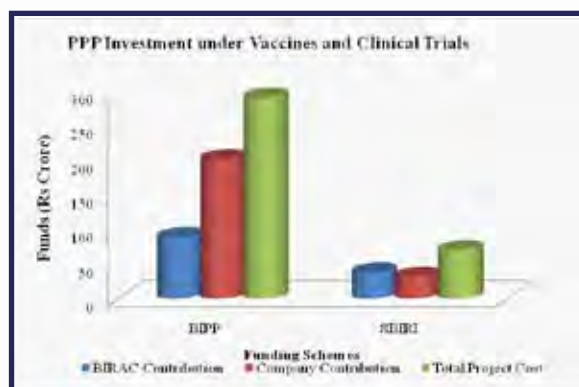
Vaccines & Clinical Trials

Vaccine development has played an important role in combating infectious diseases. By realizing this, BIRAC has supported a total of 36 projects in the area of Vaccine development and clinical trials encompassing Diabetes, Diarrhoea (Rotavirus), Cervical Cancer (HPV), Pneumococcal vaccine, Influenza, Parasitic Vaccines like Malaria and Leishmaniasis, 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. 366 crores wherein BIRAC has invested Rs. 132 crores by supporting 36 innovative projects. These 36 projects engaged 19 companies, two start-up, and 2 academic institutes. A total of 8 IP have been filed.

Two Products i.e. Influenza Vaccine (Cadila) & Vaccine for Marek's Diseases are ready for Commercialization. Four projects completed pre-clinical toxicology studies and now ready for Phase I Clinical Trials



Analysis:

- Industry Contribution is more in the projects supported under Vaccines and Clinical Trials to promote Indian Innovation.
- Industry is preferring to develop vaccines independently. Collaborations may be encouraged.
- Few of the projects are at developing proof of concept while others are at preclinical or scaleup stage.
- 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.

- To nurture indigenous innovation BIRAC has initiated a Mission Program i.e. Innovate in India (I3) program for Accelerating Biopharmaceutical innovation in INDIA.

Agriculture

Agriculture represents one of the most important sectors in the economy of third world countries like India. It plays a vital role in India's economy. Over 58 per cent of the rural households depend on agriculture as their principal means of livelihood. Agriculture, along with fisheries and forestry, is one of the largest contributors to the Gross Domestic Product (GDP) Source (IBEF. <https://www.ibef.org/industry/agriculture-india.aspx>).

In acknowledgement of the sector's vulnerability to climatic impacts, the country has prioritised agriculture as a critical focus and technological interventions have been recognized as a crucial approach for ensuring effective adaptation in agriculture. Encouraging newer technologies in agriculture will not only enhance resilience to climate change but can also offer co-benefits of adaptation, food security and sustainable livelihoods.

In sync with the national needs, in the last few years, close to 100 projects have been supported by BIRAC in the field of agriculture and allied areas. Recombinant DNA technology, marker assisted selection, and tissue culture are some of the key technologies wherein a sizable number of projects have been supported (Fig 1). Besides funding research studies involving high technological merit such as agri-nanotechnology, and agri- diagnostics, several projects related to agri-instrumentation, and development of environmentally benign biopesticides and biofertilizers has also been supported.

To further strengthen the innovation chain, BIRAC has supported few platform technologies as well which are expected to push forward the agriculture ecosystem further. This includes:

1. Integrated Pest Management through mating disruption by using patented SPLAT formulation.
2. Use of nanotechnology to develop efficient pesticides for grain storage pests
3. Use of magnetopriming for seed invigoration

BIRAC has also been supporting research studies in the field of aquaculture and veterinary sciences. Some of the prominent ones include, deregulation trials of BmNPV resistant silkworm strains, and use of bacteriophage for the treatment of *Vibrio harveyi* infection in shrimp.

Under the national mandate of food security, BIRAC has specially and consciously funded projects related to crops like Rice, Tomato, Okra, Brinjal, Maize and Brassica etc.

Crop	Targeted trait/research aspect
Rice	<ul style="list-style-type: none"> Yield enhancement Drought and salinity tolerant lines Resistance against Brown plant hopper, Blast and Bacterial Blight Biosafety trials of GM crops for insect resistance involving Cry genes
Tomato	<ul style="list-style-type: none"> Resistance against sucking pest, and ToLCv-GBNV using GM technology Developing hybrids with longer shelf -life
Brinjal	<ul style="list-style-type: none"> Control of shoot and root borer through GM approach Biosafety trials for Bt Brinjal (transgenics)
Maize	<ul style="list-style-type: none"> Yield enhancement through MAS Stress tolerance Tolerance against drought & heat, and resistance against Downey mildew Biofortification with β carotene
Mustard	<ul style="list-style-type: none"> Heterosis for yield improvement Nutritionally improved mustard with low Erucic acid and Glucosinolate content

Along with the above-mentioned crops, technical interventions have also been supported in other crops such as ginger, onion, potato, etc for various desirable traits.

Fig 1



Fig 3

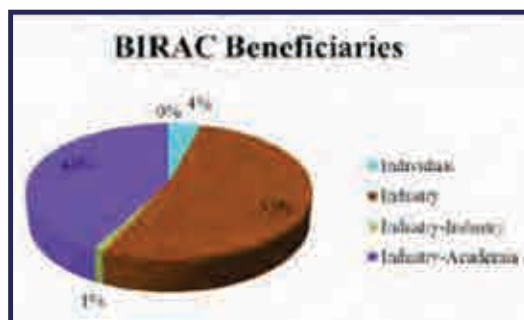


Fig 2

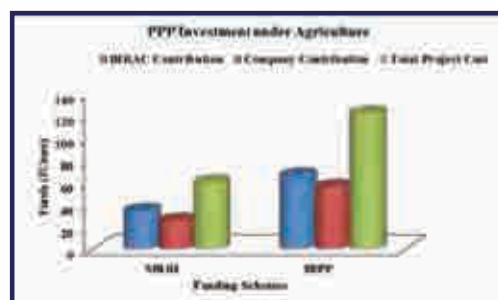
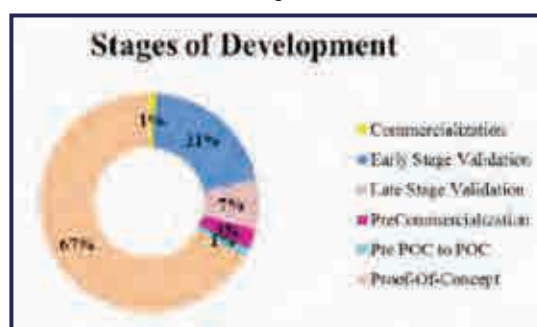


Fig 4



Fig 5



- Of the various BIRAC schemes, BIPP accounts for more than 50% of the funds committed under agriculture
- So far as the stage of technology development is concerned, maximum funds have been allocated for the projects nearly Proof of concept, followed by early stage validation. Relatively fewer projects were funded for late stage validation, pre-commercialization and commercialization
- Conscious effort is being made to draw synergy by promoting academia - industry partnership
- Besides proven technologies like micropropagation, marker assisted breeding, and transgenics, BIRAC has also been supporting newer and advanced technologies such as magnetopriming, agri-nanotechnology, pest control through mating disruption using SPLAT formulation, etc. in the field of agriculture

- Agriculture as supported by BIRAC has a large portfolio of products/ technologies to address food security by minimizing crop losses and enhancing productivity. Besides encouraging innovation and product/technology development, BIRAC has announced special call for proposals to address issues related to plant and soil health and encourage precision agriculture

Industrial Biotechnology (including Secondary Agriculture)

Bio-based manufacturing and product markets are becoming more established, and are poised for rapid growth in the future. BIRAC has been instrumental in supporting projects in several areas of Industrial Biotechnology which can be categorized in sub-areas such as bioenergy, speciality chemicals, industrial enzymes, industrial processes, bioremediation, secondary agriculture, infrastructure support and many other fine chemicals.

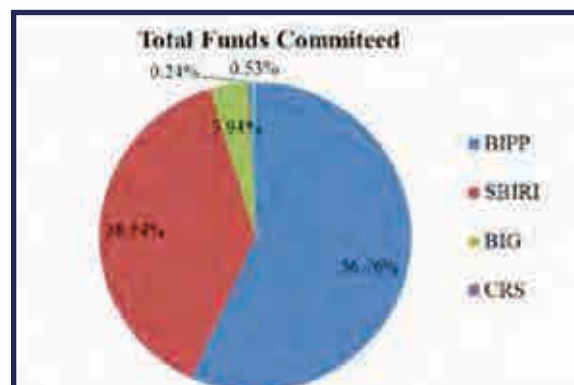
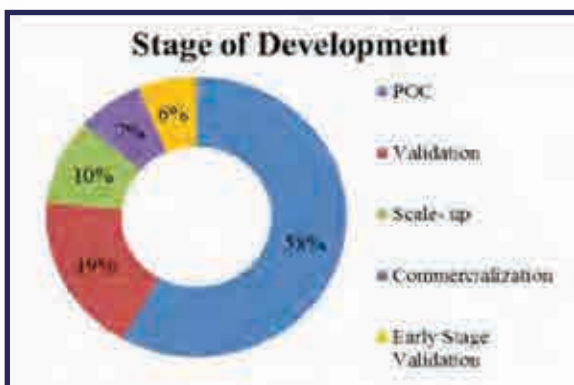
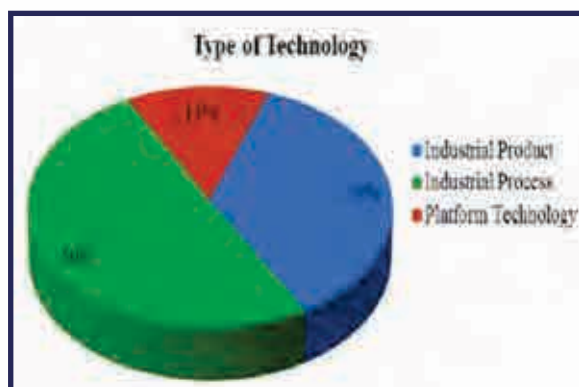
Enzymes have been underemployed and they are going to be a hot area in the future. Fermentation technology using microbes to create new food products also represents potential. Regulatory regime needs to be streamlined to bring more confidence for scale up operations.

Total PPP investment under this area amounts to 371.66 crores wherein BIRAC has contributed ₹ 178 crores for supporting 141 innovative projects. These 141 projects engaged 94 companies, 23 start-ups, 19 entrepreneurs and 28 academic institutes. The major achievements of BIRAC in this area are 21 technologies/product/PoC and 32 intellectual properties.

BIRAC in the last one year has had some remarkable achievements in the area of Industrial biotechnology and Secondary agriculture. Some salient achievements are:

- A technology for the production of beta galactosidase from Agri residues at a 100 kg scale has been developed and the product has been commercialised under the brand name “Lactobran”.
- Two projects on banana pseudo stem have come out with a machine for banana silk fibre and banana rope. The projects not only resulted in technology but were successful for generating employment for women in the rural areas.
- Technology and pilot plant for the production of Lycopene has been established in the southern states of India.
- A lab scale technology from an academic institute on the production of microbial Laccase to check for the effectiveness of laccase for various applications has been validated in a textile industry. The technology is now ready and will be taken up by the industry partner in this project.
- A Technology for the conversion of Bioethanol derived glycerol into 1, 3 propanediol utilizing low cost nitrogen source has been demonstrated at 100 L scale. The company has been awarded as the BEST Biotech Company of the year in the small scale category by the ZEE Business Group and Worldwide Achievers Group in the 7th Business Leaders summit at Mumbai.
- Docosahexaenoic acid (DHA) production from marine microalgae by redirecting the fatty acid metabolisms more specifically to DHA synthesis, which increased the titre of total fatty acids from 40% to 78% on dry cell weight with the DHA yield. This product developed has been certified by a NABL accredited testing lab.





Analysis:

- BIPP scheme still continues to capture maximum share of funds committed due to large scale production units being developed.
- Bioremediation or waste management is slowly catching the fancy of the entrepreneurs as the number of projects is steadily increasing in this area every year. There was a decrease in the biofuel subsector, where the gap still persists between mandate of blending the fuel with 10% ethanol.
- Maximum number of projects has been supported for development of Proof of Principle followed by validation. A number of proposal were sanctioned with a restricted scope of work in order to gain more confidence of the novel idea being proposed.
- Majority of the projects have been funded to industry alone. The gap can be addressed by organising outreach programmes at different organisation. However, interest of young entrepreneurs for development indigenous process and product development is increasing which shows inclination towards Make in India.

Bioinformatics & Facilities

Bioinformatics is considered to be at the forefront of the biotechnology revolution. The rising demand for bioinformatics in genomics, proteomics, transcriptomics, cheminformatics and molecular phylogenetics has created a large commercial market. The spectacular rise of the commercial Indian genomics industry and the broadening application of genomic techniques in biology and medicine has created a commercial market for Translational bioinformatics. BIRAC is also encouraging Translational bioinformatics driven projects.

Bioinformatics technologies developed by BIRAC support:

A. Developed platform, tools & pipelines:

- In-Silico hepatotoxicity prediction platform to conduct toxicity studies of any lead compounds.

- SanGenix named comprehensive NGS data analysis suite that offers a scalable and user friendly solution with predefined or custom workflows for seamless analysis of NGS data. Product is available on (<http://www.sangenix.com/Products.html>)
- High computing infrastructure set up for NGS data Analysis with more than 16 NGS pipelines & providing 25% discount price to the Indian academics and institutions. Services are available on (<http://www.scigenom.com/bipp>)
- A Machine learning based tool on cloud for the early detection of diabetes retinopathy.
- A kit for the detection of Onco mutation for more than 10 type of cancers & computational pipelines for the analysis of NGS data.

B. Products in Pipeline:

- A NGS based gene panel for the diagnosis of cancer.

There are a large and growing number of start-ups and they are developing various innovative products. BIRAC supports in developing Manufacturing facilities to scale up various innovative products. BIRAC vision is in line with the '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 also supports self-use facilities to promote in-house R&D capabilities of the company which is useful for researchers & start-ups.

BIRAC supported Infrastructures:

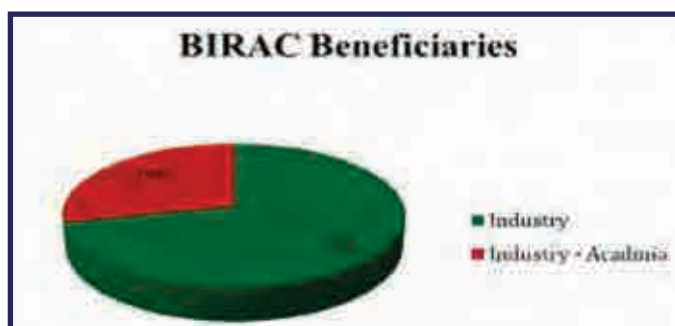
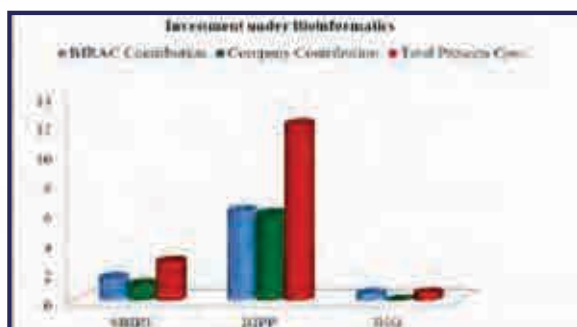
A. Developed Manufacturing Infrastructures:

- For the production of blood products Globucel (IVIG), AlbuGel (Albumin) & Factor VIII (is in process) at Celestial Biologicals Ltd, Ahmedabad. Globucel® contains human immunoglobulins, also known as intravenous immunoglobulins (IVIg). Globucel® is used to provide passive immunity by increasing an individual's antibody titer and antigen-antibody reaction potential. Because of this property, Globucel® remains efficacious and safer treatment option for various diseases of auto-immune origin or immunodeficiency states. AlbuGel contains Human Albumin. AlbuGel Infusion is used in short term fluid replacement after trauma.
- For the production of antigen & antibodies for infectious diseases, at SPAN Diagnostics Ltd also providing differential rental model for usage available for academicians, researchers, SMEs and Start-up companies for developing process and pilot scale production based on their proof of concept and initial laboratory work
- For the production of Phytochemical reference standards at Natural Remedies Private limited, Bangalore
- A Specialized Facility to foster Innovation, Development of Technologies Culminating into Commercial Manufacturing of Therapeutics Made by Fermentation Processes at Anthem Biosciences Private Limited, Bangalore. (Under Development).

B. Developed Self-use Infrastructures:

- Physicochemical characterization of biologics, at Intas Pharmaceutical Ltd.
- Manufacturing of Balloon catheters, at Sahajanand Medical Technologies Pvt. Ltd, Surat

Total PPP investment under this area amounts to Rs. 98.93 crores wherein BIRAC commitment is Rs. 44.61 crores for supporting 12 innovative projects. These projects engaged 11 companies, 1 star-ups and 3 academic institutes. Till date, a total of 3 products developed & 2 are at stage of late stage validation and 1 at the stage of early stage development. 3 Intellectual properties and 5 facilities have been developed.




Analysis:

- 79% funds are disbursed through the BIPP for bioinformatics sector.
- 43% projects has been successfully commercialized. Rest of them are at late stage validation and pre-commercialization stage.
- Few of the projects from Bioinformatics area involved Industry-academia collaborations though many are pursued by industry alone
- Industry contribution is higher in the Infrastructure projects



Innovation Profiles

BIRAC Innovators



**HEALTHCARE-
THERAPEUTICS**



HEALTHCARE- THERAPEUTICS SBIRI

AbGenics Life Sciences Pvt. Ltd.

The Innovation

Development of AbTids as a new class of anti-infective biologicals

Brief description

The project aims to develop a new class of biologic antimicrobials called AbTids and their cocktail based on bacteria specific camelid heavy chain antibodies to specifically target Anti-microbial resistance (AMR)

Stage of development

Proof of concept

Unique features of the product/technology

A new class of antibacterial biologics consisting of a toxic cationic antimicrobial peptide combined to an anionic single chain antibody linked by a cleavable peptide and will be activated only on latching to the target and freeing of the peptide from the complex to lyse the target bacteria

Market potential

The world anti-bacterial market is around USD \$ 30 billion, with very less number of products to tackle drug resistant bacteria. The burn applications has a market size of around USD \$ 60 million

National/Societal relevance

Hospitals in India have a high burden of infections in their intensive care units ICU and general wards (Approx 1.9 Lakhs neonatal deaths/year due to AMR)

Project achievements

- Progress vis-a vis objectives:** Generation of Camelid libraries against ESKAPE pathogens and obtaining hits, purification of AbTids and *in vitro* efficacy
- Technology/ Product developed** - Biologic antimicrobials -AbTids
- IP generated/ Potential for IP generation:** Application of the camelid antibodies and AbTids for controlling pathogenic bacteria. Patent Application No.116/MUM/2015 dated 13-01-2015. An antimicrobial combination of antibodies and antimicrobial peptides to target microbes. Two more patents will be generated
- Resources Generated:** Three new manpower hired and training provider in antibody engineering techniques for 8 employees. Protein purification facility with AKTA chromatography system was established

Plans to take innovation further

Once the POC is developed, collaborations with established pharma players for taking the molecules to the clinic

Risks envisaged

The immunogenic profile need to be studied, to address the toxicity issues (should not be a problem for topical applications at low dose). The stability of the camelid and peptide combination and the cocktail to be generated that is nontoxic upon prolonged storage

Project coordinator

Sanjiban K Banerjee

Team Members

Manisha Sabnis, Anamika Singh, Ajit Kulkarni, Riya Nada, Agasthya Suresh

Contact

AbGenics Life Sciences Pvt. Ltd., Fortune House
Office# 102 S.No.
131/18/11 Baner, Pune,
Maharashtra-411045





The Innovation

Development of trypsin resistant PAN reactive trypsin antibodies

Brief description

Enzyme trypsin is widely used in various biological processes such as Insulin manufacturing to cleave peptide linkers from the pro-drug C peptide removal from Proinsulin and activation of vaccine viruses. Residual trypsin analysis is used during downstream processing

Stage of development

Commercialization. In the past 14 months, they have been successful in immunization of trypsin to elicit immune response in Rabbits and Mice to various epitopes spanning the trypsin enzymes, optimized purification strategies to isolate trypsin resistant anti-trypsin pAb and mAb and developed immunoassay reagents and demonstrated the assay utility for monitoring trypsin clearance during bioprocessing of Biologics Eg: Insulin manufacturing

Unique features of the product/technology

The kits are customized for end users to meet global regulatory requirements. Niche product developed for Insulin manufacturers

Market potential

Potential therapeutic anti-trypsin engineered antibody drug for treating Pancreatitis is an unmet medical need

National/Societal relevance

Anti-trypsin antibodies and immunoassay developed by Affigenix enables drug companies to monitor the clearance of the trypsin used in downstream processing of Biologics and Biosimilar

Project achievements

- Progress vis-a vis objectives:** Identifying trypsin & trypsinogen peptide mimetic completed in Oct 2014, Peptide synthesis and conjugation & anti-peptide/s antibody production completed in May 2015
- Technology/Product developed:** Trypsin resistant PAN reactive trypsin antibodies for industrial application
- IP generated/ Potential for IP generation:** Plan to file the mAb antibody sequences with appropriate utility in the month of Dec 2018
- Resources Generated:** Equipped the cell culture facility, trained two scientists in Immunoassay development, generated employment for two scientists beyond 18 months period

Plans to take innovation further

They plan to install fully automated robotic system for ELISA plate coating, further to carry out the field trials, launch the prenatal diagnostic kit upon regulatory approval.

Risks envisaged

Regulatory hurdles in commercializing the diagnostic products



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HEALTHCARE- THERAPEUTICS **BIG**

Genzir Technologies Pvt. Ltd.

The Innovation

Development of kits for isolation of adipocyte-derived stem cells for prolotherapy and other regenerative medicine

Brief description

A simple device, safe and closed system kind (single-use) to isolate stromal vascular fraction (SVF) rich in stem cells from adipose tissue for autologous stem cell based therapies. The device is a single tube with multiple ports for tissue lipoaspirate intake, washing with buffers, enzyme digestion and collection of cellular population with two filters (40u and 6u). The device will be set in a semi-automated centrifuge with mixer, incubator and a vacuum pump to aspirate out waste.

Stage of development

Proof of concept

Unique features of the product/technology

The device will be an indigenous and affordable to use product with multiple applications like orthopedics/dermatology/skin regeneration/wound-healing/diabetes/kidney-failure etc. The device can be used for autologous and allogeneic stem cell therapies with a minimum essential requirement included an incubator and a centrifuge for usage

Market potential

Presently stem cell related global market is in billions of dollars. Stempeutics in India is working on a fully automated device called Stempeutron. The proposed product will be cheaper and cost effective. The device is at an estimate of 3500-5000 INR as of now

National/Societal relevance

Currently adipose tissue is in use for various cosmetology purposes, the fat is being isolated and treated manually before injecting back into the patient which causes necrosis in several cases. Mixing stem cells from fat along with lipofillers can enhance the efficacy. Clinical trials in US and other countries are under-way for osteoarthritis and similar ailments

Project achievements

- Progress vis-a vis objectives:** First milestone achieved towards isolation and characterization of stem cells from rat fat
- Technology/ Product developed:** A simple, safe and closed device (single-use) to isolate SVF from adipose tissue
- IP generated/ Potential for IP generation:** Indian provisional patent filed.
- Resources Generated:** One project assistant employed & basic research facility has been created

Plans to take innovation further

Looking for partners or investors. Meeting with Companies like Anthem Biosciences, Bangalore

Risks envisaged

Regulatory, but hopeful to cross them

Project coordinator
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The Innovation

Targeting therapy-resistant stem cell-rich cancers

Brief description

The lead molecule MSP004 exhibits unique biological activity profile against cancer and cancer stem cells CSCs. Preliminary studies have undoubtedly shown the superior activity of MSP004 in the anticancer and anti-CSC assays when compared to Cisplatin. In vitro and in vivo studies will evaluate the anticancer and anti-CSC potential of the MSP004 & analogs designed using computer-aided molecular design CAMD and molecular modelling compared to several cytotoxic and molecularly-targeted anticancer agents such as kinase inhibitor drugs. This presents a unique opportunity to develop a specific anti-CSC agent when there is none available in the clinic.

Stage of development

Proof of concept

Unique features of the product/technology

For the first time, the novel anti-cancer drug will target cancer & cancer stem cells in the tumor. The major focus is to target cancer stem cell population in the tumor so that cancer reoccurrence is suppressed

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 53 in males and 6.7 million 47 in females. Many blockbuster drugs are available in the clinic to target various cancers but are not prospective in targeting CSCs

National/Societal relevance

Cancer is the second most dreadful disease in India killing more than 30 lakhs patients each year.

Project achievements

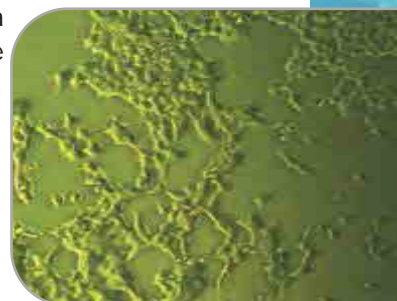
- Progress vis-a vis objectives:** Design and synthesis of novel analogs of lead molecule MSP004 & tested on various breast & prostate cancer cell lines. The work progress is on very preliminary level
- Technology/ Product developed:** The expected outcome is optimized small molecule analog of MSP004 with a potent anticancer and anti-CSC activities tested on Breast, Prostate and Oral cancer related to tobacco
- IP generated/ Potential for IP generation:** Two process patents on MSP004 molecule may be generated
- Resources Generated:** NA

Plans to take innovation further

Keen to commercialize

Risks envisaged

Optimized compound may not work as a monotherapy and a combination therapy required



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HEALTHCARE- THERAPEUTICS **BIPP**

IMGENEX India Pvt. Ltd.

The Innovation

Development of high expression plasmid vectors for Herceptin and other recombinant proteins and antibodies production

Brief description

A proprietary expression vector with the transgene expressed under CMV promoter hence significantly increased expression level of the antibody. Refine Technology's ATF system was used.

Stage of development

Early stage validation

Unique features of the product/technology

A proprietary mammalian expression vector has been developed to express high-level of recombinant antibodies in CHO cells. The CHO cell line has also been modified to prevent apoptosis, thereby increasing the lifespan of cells with higher yield of mAb. ATF system helps to attain volumetric productivity and reduces the cost of operation by reducing 9-step bioprocess to 3-step process

Market potential

Herceptin, is an expensive drug and can cost upto USD 3000 every month. Proposed goal is to develop a high-expresser mammalian cell line that can reduce the production cost

National/Societal relevance

Incidents of breast cancer in India are rising with almost 75,000 new cases every year. Herceptin reduces the risk of a relapse by 50% in fast-growing type of tumor in women. Herceptin is an expensive drug and can cost upto Rs 1.5 lakh every month, which is beyond the reach of most of the patients in India

Project achievements

- Progress vis-a vis objectives:** Project is on-going
- Technology/ Product developed:** High expression plasmid vectors
- IP generated/ Potential for IP generation:** None
- Resources Generated:** Facility to produce trastuzumab at 5 liter scale created and scientific personnel trained

Plans to take innovation further

For commercial manufacturing and marketing, planned to set upto 1000 litre scale GMP facility

Risks envisaged

Cost factor and the existing competitors in India include Biocon and Mylan. Plan is to extend higher discount and incentive to the distributors and subsequently tie up with the government to supply the drug on subsidized rate

Project coordinator
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Innov4Sight Health and Biomedical Systems Pvt. Ltd.

The Innovation

Preparation & profiling of umbilical cord blood derived biologically active peptides/growth factors concentrate (BAPC) for IVF procedure

Brief description

Preparation of BAPC, a combination of growth promoting biomolecules and proteins, to be infused into the uterine cavity exactly to improve endometrial thickness

Stage of development

Early stage validation

Unique features of the product/technology:

A novel approach for increasing thickness of endometrium and improving embryo implantation rate. It is a safe alternative to Hormonal Replacement Therapy which comes with the risk of cancer. Cocktail of cytokines and growth factors are required to trigger the natural way of tissue regeneration and repair. Free from antigenic platelets and plasma membranes renders BAPC immunologically safe with long term stability. The product is aimed to be sold at 10000 INR whereas cost of the similar products ranges from 30000 INR - 100000 INR

Market potential

Fertility market stands at \$ 400 Million - Medical Simulators, Health IT Suite & Biotech with a total of 1.3 Million as fertility seeking couples. In India, currently there are about 3 Crore infertile couple. Based on the trends this number is expected to grow 4-5 times by 2022

National/Societal relevance

PRP finds applications in neurosurgery, orthopedic surgery, cosmetic surgery, general surgery and others. New application areas of PRP like male and female infertility are predicted to create new growth opportunities in the global platelet rich plasma market in the near future

Project achievements

- Progress vis-a vis objectives:** Clinical sample collection-peripheral blood, umbilical cord, preparation & activation of PRP and preparation of BAPC from PRP
- Technology/ Product developed:** Process development for BAPC preparation
- IP generated/ Potential for IP generation:** Potential for new IP
- Resources Generated:** Recruited a Junior Research Fellow

Plans to take innovation further

Targeting healthcare institutions, diagnostic labs, pharma companies, medical colleges, teaching hospitals, health & allied professional aspirants and patients

Risks envisaged

Delay in commercialization as clarity on regulatory aspects for blood derived therapeutics are lacking



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HEALTHCARE- THERAPEUTICS BIG

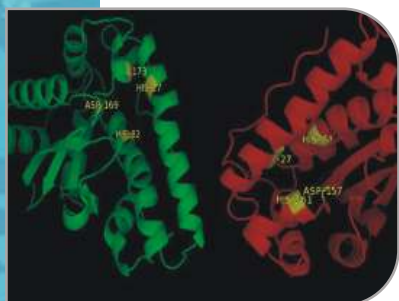
Mahesh Shanker Dhar - FITT

The Innovation

Use of novel superoxide dismutase with anti-ageing properties as oral supplement and cosmetics

Brief description

High expression of a bacterial protein in *E. coli* system will be used as recombinant antioxidant protein in various therapeutic and cosmetic applications. The protein being developed is highly stable at wide ranges of pH and temperature and can survive the transit through the gut proteolysis, a property most other protein based antioxidants lack



Stage of development

Proof of concept

Unique features of the product/technology

Superoxide dismutase (SODs) are the most potent antioxidants in nature. The protein being developed is highly stable at wide ranges of pH and temperature and can survive the transit through the gut proteolysis, a property most other protein based antioxidants lack. As the product will be made from bacteria, large amounts can be produced through fermentation, reducing the costs. Antioxidant based nutraceuticals, protein based ones are rare & also the products are not well tested for their real potential

Market potential

The global nutraceutical market is at 250 Billion dollars and growing. Similarly, the cosmetics market is growing rapidly in India and abroad. Protein based antioxidants are rare

National/Societal relevance

Antioxidant based therapeutics can reverse the damages to the body due to pollution, exposure to toxins, UV etc. Such a product, if affordable can be used by the community

Project achievements

- a) **Progress vis-a vis objectives:** All the objectives stated in the original proposal were met.
- b) **Technology/ Product developed:** Recombinant SODs produced from *E. coli*
- c) **IP generated/ Potential for IP generation:** There is potential for new IP
- d) **Resources Generated:** One PhD and two MSc were employed in the project

Plans to take innovation further

Validation of the product is planned

Risks envisaged

As the product is intended for human consumption there have to be many tests both *in vivo* and *in vitro*

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The Innovation

Development of repositioned drug molecules for inflammatory skin diseases

Brief description

The product is a novel topical formulation of existing oral anti-parasitic drug/s which are repositioned for treatment of inflammatory skin diseases like Psoriasis. This product has evolved from repurposing of existing oral anti-parasitic drugs. Being repurposed product, significant safety information is already available for the drugs, mainly requiring efficacy to be established for the new indication

Stage of development

Proof of concept

Unique features of the product/technology

This product is topical formulation for treatment of inflammatory skin diseases and has evolved from repurposing of existing oral anti-parasitic drugs. Being repurposed product, significant safety information is already available for the drugs, mainly requiring efficacy to be established for the new indication. This product being repositioned drug will have lower development costs and hence will be affordable. Most of the topical treatments become ineffective over time & no new topical drug has been approved by USFDA in last 10 years for psoriasis

Market potential

Drugs to treat psoriasis is expected to grow to a value of USD 3,834.5 million by 2018, at a compound annual growth rate CAGR of 8.2 percent. Existing topical drugs are steroids, Vitamin D analogues, Anthralin, Retinoids, calcineurin inhibitors, Salicylic acid and Coal Tar

National/Societal relevance

According to Indian psoriasis foundation around 5 percent of India's population is affected by psoriasis

Project achievements

- Progress vis-a vis objectives:** The project has started and establishment of mechanism of action of the selected molecules is underway
- Technology/ Product developed:** Expected outcome is topical formulation for treatment of inflammatory skin diseases specially Psoriasis
- IP generated/ Potential for IP generation:** Filed a Provisional patent for use of these drugs for inflammatory skin diseases
- Resources Generated:** None

Plans to take innovation further

The Applicant intends to develop this product till human proof of concept and subsequently partner or out license it

Risks envisaged

Risk of drugs not demonstrating enough efficacy compared with the existing products



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HEALTHCARE- THERAPEUTICS BIG

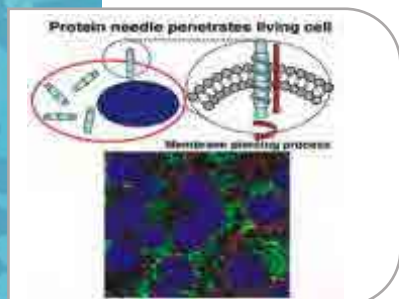
Nusrat J M Sanghamitra - KIIT

The Innovation

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

Brief description

Developed a versatile nontoxic, high speed, high precision molecular machine CyCa delivery device, CyCa-dd that can carry molecular cargoes directly into living cells. CyCa-dd is like FedEx for drugs, it employs a unique and highly efficient technique to deliver cargoes right into the cells without damaging them as smoothly as you cross automatic doors with your luggage. It transforms drugs from toxic to specific. This will reduce the dose and side effects and improve the quality & life of patients



Stage of development

Pre-commercialization, the application of delivery device to deliver simple fluorescent dyes into the living cell. Promo video (<https://vimeo.com/226283705>)

Unique features of the product/technology

Proprietary device CyCa-dd is a non-liposomal material, which has low toxicity, low batch heterogeneity, high stability, high oral availability and specific drug loading. The USP is its novel cell entry mechanism based on a harmless membrane drilling mechanism. This product CyGlo has a 20 less cost in comparison to similar product in the market

Market potential

Worldwide 15 million new cases, 8 million death and 33 million people living with cancer. Mainly two anticancer drugs with liposomal formulations are available. 1. The global liposomal doxorubicin market was valued at USD 814.6 million is expected to reach a value of USD 1.39 billion by 2024. 2. The global liposomal Cisplatin market is \$ 750 million, which is 30 of total 3.2 billion USD of platinum anti cancer drug market

National/Societal relevance

Mortality and morbidity worldwide 8.2 million death, 15 million new cases

Project achievements:

- Progress vis-a vis objectives:** Expression, purification and characterization protein needle conjugated with drug, cell uptake of the drug conjugated protein needle
- Technology/ Product developed:** Validated the technology by developing an early revenue product CyGlo as a live cell tracker
- IP generated/ Potential for IP generation:** Filed an provisional patent
- Resources Generated:** 1 Project Assistant and 1 scientist hired

Plans to take innovation further

Partnership with Tata Memorial Hospital for clinical trials

Risks envisaged

Immunogenicity of the protein needle

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The Innovation

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

Brief description

PNB-001 is the lead molecule that belongs to the 4th chemical series of PNB Vesper Cholecystokinin CCK program. PNB-001 demonstrated, in both *in vitro* and *in vivo* preclinical pharmacology models, excellent CCK inhibitory and anti-nociceptive activities to pain resulting from inflammation. All required safety evaluation and PK studies have been completed in GLP certified facilities. The product has excellent stability. DCGI has accorded permission to carry out Phase- I clinical trial

Stage of development

Proof of concept

Unique features of the product/technology

Successful in synthesizing the molecule with high purity in large scale. The molecule has shown excellent efficacy and safety in studies conducted in variety of animal models. PNB-001 has excellent CCK inhibitory and anti-nociceptive activities to treat variety of pain. Manufacturing process of PNB-001 is not completed but they succeeded in achieving very high purity and could establish stringent QC in the GMP scenario

Market potential

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. Few products are available in market but have huge side effect for example celecoxib

National/Societal relevance

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 achievements

- Progress vis-a vis objectives-** For objective which is to produce CoA for the GMP manufactured material, GMP formulation, development, Placebo manufacturing, conduct of stability studies, conduct of Phase-I SAD studies & MAD studies. As of now the GMP material will be manufactured by December and hope to initiate Phase-I clinical trials in 2018
- Technology/ Product developed:** CCK receptor antagonists for the treatment of inflammatory pain
- IP generated/ Potential for IP generation:** United States Patent awarded Patent No.: US 8,921,577 B2 Dated Dec 30 2014
- Resources Generated:** None

Plans to take innovation further

PNB Vesper welcomes companies who can partner with them

Risks envisaged

All potential risk factors involved in the development of new chemical entities. Risk factors include lack of efficacy, toxicity, and other



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Pentavalent Bio Sciences Pvt. Ltd.

The Innovation

PentaFluVac "An indigenous replication-incompetent viral vaccine for avian, swine and human influenza"

Brief description

The ongoing global public health burden caused by seasonal influenza and the potential global effect of a severe pandemic create an urgent need for a novel highly effective vaccine that can be manufactured rapidly in a cost-effective way

Stage of development

Proof of concept

Unique features of the product/technology

The vaccine is live attenuated. Confers protection against influenza caused any strain of the virus. No genetic re-assortment is possible with wild strains.

Market potential

With the estimated economic growth of vaccine market both at global and national level, development of the proposed vaccine has a positive role to play on market size of influenza vaccine in India as well as worldwide. Unlike other vaccines, the proposed vaccine is a indigenous, rapid in terms of production during outbreaks as the virus back bone for replication-incompetent vaccine strain will be ever ready and adapted to cell lines and cheap as it does not require many downstream processing steps

Project achievements

- Progress vis-a vis objectives:** Novel attenuated vaccine strain of influenza virus and the strategy of generating attenuated strain.
- Technology/ Product developed:** Technology for Novel attenuated vaccine strain of influenza virus and the strategy of generating attenuated strain.
- IP generated/ Potential for IP generation:** None
- Resources Generated: A private limited company:** Pentavalent Bio Sciences has been incorporated.

Plans to take innovation further

Preliminary evaluation of the proposed vaccine for its efficacy as seasonal and/or pandemic vaccine. Obtaining approval from WHO for development of vaccine formulation using the strain combination proposed. Obtaining approval from Genetic Engineering Appraisal Committee GEAC of DBT for large scale use of genetically modified cell lines and influenza virus particles

Risks envisaged

High cost Involved in R&D and clinical trials. Long Gestation Period for development of vaccine

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The Innovation

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

Brief description

MRI contrast agents have extensive applications in diagnostics, MR based angiography, cancer staging, and for monitoring cancer therapy. MR based angiography has tremendous potential in diagnosing cardiac diseases

Stage of development

Proof of concept

Unique features of the product/technology

They are developing biodegradable biocompatible blood pool contrast agent based on a rod-like nanoparticle synthesized from FDA approved materials with superior contrast enhancement. It will be indigenous, low cost and safe blood pool contrast agent with potential in MRI angiography and oncological imaging

Market potential

The global market for imaging contrast agents is projected to exceed \$15 Billion by 2017. There is no blood pool MRI contrasting agent in the market

National/Societal relevance

First Indigenous Blood Pool MRI/MRA Contrasting agent

Project achievements

- Progress vis-a vis objectives: progress is satisfactory
- Technology/ Product developed: Not yet
- IP generated/ Potential for IP generation: IP to be filed on completion of this work
- Resources Generated: 2 research associates, have initiated new enterprising sector specialized in Molecular Imaging and Diagnostic Reagent

Plans to take innovation further

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

Risks envisaged

Risk is the absence of a GMP method for production of the Nanogad materials. Since the Nanogad materials are based on the synthesis of supramolecular nanoparticles, there is a certain amount of variance involved with the production of these materials from batch to batch



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HEALTHCARE- THERAPEUTICS **BIPP**

Serum Institute of India Limited

The Innovation

Clinical Development of Polysialylated Erythropoietin

Brief description

Polysialylation is a process by which the natural polymer polysialic acid is covalently attached to protein and peptide drugs. Polysialylation increases the molecular mass of polypeptides, reduces loss through the kidneys, shields them from proteolytic enzymes, inhibits their uptake by the reticuloendothelial system and renders them less immunogenic and antigenic. The results generated to date amply demonstrate that polysialylation of therapeutics has the potential to address all of the major problems of protein and peptide delivery outlined above. Thus, promising properties of polysialylated therapeutics include improved stability, preserved functionality of therapeutics, reduced clearance rate of therapeutics from the blood circulation, prolonged pharmacological action, reduced immunogenicity and antigenicity



Stage of development

Early stage validation

Unique features of the product/technology

Polysialic acid is biodegradable and has minimum side effects as compared to PEG

Market potential

5-6 billion dollars worldwide

National/Societal relevance

Chronic kidney disease is a worldwide health problem & contribute to global burden with approximately 850,000 deaths every year and 115,010,107 disability adjusted life years. The population of India exceeds one billion and is projected to become the major reservoir of chronic diseases like diabetes and hypertension

Project achievements

- a) **Progress vis-a vis objectives:** PSA-EPO , Phase -II completed in India
- b) **Technology/ Product developed:** Polysialylated Erythropoietin
- c) **IP generated/ Potential for IP generation:** Patent for PSA-EPO is filed in India
- d) **Resources Generated:** Number of employees have been employed and trained in this technology. New facilities have also been created to manufacture the product

Plans to take innovation further

The product is being co-developed with our collaborators in Russia, Australia, New Zealand and South Africa

Risks envisaged

Large phase-III trial needs to be completed only after which the project can be commercialized

Project coordinator
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The Innovation

Affordable HPV Vaccine based on Hansenuella expression system

Brief description

SIPL is developing in Hansenuella expression system an affordable HPV vaccine comparable to Gardasil. SIPL has proven expertise in developing low cost recombinant HBsAg vaccine using Hansenuella polymorpha expression system. The Hansenuella polymorpha expression system for VLPs, is far superior to its peers viz *Pichia* and *Saccharomyces*. SIPL would make available low cost, safe and efficacious vaccine which would be available in volumes of ~ 50M doses per annum. SIPL plans to establish the commercial scale facility of 50M doses for this vaccine in order to take care of continuous supply of low cost high quality vaccine for global mass vaccination

Stage of development

Late stage validation

Unique features of the product/technology

Hansenuella expression system is unique due its ability to form VLPs without the need for disassembly/reassembly. The expression system is highly robust and is proven for HBsAg VLP manufacturing close to two decades

Market potential

As per GAVI forecast an annual requirement of 30 to 80M doses of vaccine is expected from 2019 to 2035

National/Societal relevance

Cervical cancer, the leading cause of female cancer mortality worldwide leads to 275,000 annual cervical cancer related deaths. Approx. 500,000 women are diagnosed with cervical cancer each year, about 80 of which are in the developing countries

Project achievements

- Progress vis-a vis objectives:** Completed the Phase I clinical studies for its quadrivalent HPV vaccine
- Technology/ Product developed:** Phase I clinical studies for its quadrivalent HPV vaccine
- IP generated/ Potential for IP generation:** Under Process
- Resources Generated:** SIPL has invested in training its personnel on site and off site at various knowledge centers like CDC Atlanta, NIBSC UK, WHO Geneva etc. It has created necessary infrastructure that would enable quick development of higher valency HPV vaccine and other VLP based vaccines. In addition, during the course of product development SIPL has added value into various characterization and analytical labs in India

Plans to take innovation further

SIPL plans to work on nonavalent HPV vaccine using novel adjuvant systems which will make available a vaccine with single dose requirement

Risks envisaged

SIPL does not envisage any potential risk in the manufacturing or licensing timelines of this product. It high volume and low cost vaccine will tide over all competition making available a low cost efficacious alternative to the masses



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Sphaera Pharma Research and Development Pvt. Ltd.

Collaborator: Leadinvent Pvt. Ltd. & ICGB

The Innovation

Novel combination therapy for treatment of resistant and non-responsive cancers

Brief description

Project involves use of system biology experimental siRNA and phosphoproteome data validated signaling pathways to target two synergistic proteins for application in oncology and development of novel drug for clinical studies in combinations with an approved drug. The project is based on novel combination therapy for treatment of resistant and non-responsive cancers and shows important role of AKT in cancer

Stage of development

Proof of concept

Unique features of the product/technology

Unique feature of the project is, it has been developed for treatment for non-responsive and /or resistant cancer therapies using a combination of essential system biology, state of the art computational tools and translational expertise. There is a lot of unmet need for developing drug resistance and non-responsiveness in oncology is increasing with no scientific rationale for a solution

Market potential

Synergistic effect with standard of care oncogenics present a huge market opportunity particularly in case of drug resistant cancers. Perifosine, MK2206 and GDC-0068 like AKT inhibitors have not yet demonstrated expected efficacy in humans

National/Societal relevance

Non-responsive and resistant cancer is a rapid growing scourge in India and worldwide, establishment of a scientific approach to help address this emergent societal issue is not only relevant, but needed

Project achievements

- Progress vis-a vis objectives:** Succeeded in developing novel inhibitors for AKT. Identified 4 novel compounds that inhibit AKT at in the range of 5-50 nM. Around 22 compounds that were ATP competitive were synthesized in this period for a total of around 100 compounds for the project since its initiation
- Technology/ Product developed:** Inhibitors for AKT.
- IP generated/ Potential for IP generation:** 237/DEL/2014 Composition of Matter patent
- Resources Generated:** None

Plans to take innovation further

Additional academic and translational research is needed to substantiate the efficacy of AKT inhibitors

Risks envisaged

AKT inhibitors have faced clinical challenges and their acceptance as a validated onco-therapy is currently under evaluation

Project coordinator
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Team Members

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The Innovation

Process Development for Bevacizumab Production

Brief description

Bevacizumab is a full-length IgG1 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 VEGF and neutralizes VEGF's biologic activity

Stage of development

Proof of concept

Unique features of the product/technology

The cell line is developed using the proprietary expression vector of Sun Pharma. The preliminary characteristics of the cell line have been studied. The lab scale and pilot scale process is developed for the production of the product. The tumor regression efficacy of the product is studied in *in vivo* condition. The physicochemical and biological characterization of the product have been studied



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. The US is the single largest market for the drug, accounting for approximately 47 of its global sales, followed by Europe at 27, and rest of the world at 16

National/Societal relevance

Presently the treatment is too expensive to afford by the common mass. Hence the applicant is trying to develop a cost effective and affordable product which could be for the common mass

Project achievements

- Progress vis-a vis objectives:** Cell Line developed, Small scale and pilot scale process developed, Animal safety to be established & PK/PD and immunogenicity to be studied
- Technology/Product developed:** Bevacizumab was found physico-chemically and biologically comparable to the Innovator's product
- IP generated/ Potential for IP generation:** IP will be generated
- Resources Generated:** None

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

Making the product biosimilar to the reference drug in terms of physicochemical, Biological, PK/PD and immunogenicity

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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

Brief description

Aim is the development of a cost effective production technology for CRM-197, the safest carrier protein and a key ingredient in the development of PCV-15. It also finds application in other therapeutic vaccines against cancer and allergy. CRM-197 is a critical game-changer in the development of affordable conjugate vaccines. Cost effective production of carrier protein and Pneumococcal Polysaccharides, highly efficient conjugation protocol and affordable, India specific Vaccine formulation are the critical elements of the innovation. Tergenes PCV-15 would assure a wide protection approximately 80% against *Pneumococcal Pneumonia* in India and other Asian countries



Stage of development

Proof of concept

Market potential

Pneumonia is the most common form of serious pneumococcal disease and accounts for 18% of child deaths in developing countries. Pfizer has launched 13 Valent Pneumococcal vaccine

National/Societal relevance

According to WHO, Pneumonia is the leading cause of death in children worldwide. Pneumonia kills an estimated 1.6 million children every year worldwide, 25 in India alone more than AIDS, malaria and tuberculosis combined

Project achievements

- Progress vis-a vis objectives:** Developed the formulation of 15-valent Pneumococcal Conjugate Vaccine PCV-15. Completed Pre-clinical study
- Technology/Product developed :** Formulation and Production of a 15-valent Pneumococcal Conjugate Vaccine using cost-effective technology
- IP generated/ Potential for IP generation:** Production technology of CRM 197. Formulation and Production of a 15-valent Pneumococcal Conjugate Vaccine
- 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

There are possibilities of protein antigens being developed as alternate vaccine candidates

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The Innovation

Development of fucose knock out technology platform in CHO S cell line for improved biotherapeutics

Brief description

To express glycol-engineered antibody in genetically modified mammalian CHO cell line platform with impaired glycan biosynthetic pathway

Stage of development

Proof of concept.

Unique features of the product/technology:

The glycol-engineered monoclonal antibody products were tested for Antibody Dependent Cellular Cytotoxicity (ADCC) function, with 10 folds improvement in antibody ADCC function without any alteration of antigen recognition property

Market potential

As per market intelligence and reports, the unique proposition is novel with no competitive products in Indian market. With glycol-engineered monoclonal antibody products the cost of treatment is expected to reduce significantly

National/Societal relevance

Much of India, as well as South East Asian populations are deprived of accessibility to many modern therapeutic interventions due to cost limitations. Majority of available biopharmaceuticals are highly priced. Biosimilar antibodies, the generic versions of innovator's or originator antibodies provide only an interim solution. Whereas, such glycol-engineered therapeutic antibody treatment will target the same validated epitope, but are engineered to have improved properties. In these cases, the cost of treatment is expected to reduce significantly. Hence forth, glycol-engineered monoclonal antibody drugs are expected to have a defining role in reducing burden on end users and providing access to affordable and safe therapeutics

Project achievements

- Progress vis-a vis objectives:** Successfully generated desired CHO cell lines. Developed novel constructs to achieve high level of expression of gene of interest. Successfully achieved glycol-engineered monoclonal antibody products with desired improvement of antibody ADCC function
- Technology/ Product developed:** -Glyco-engineered monoclonal antibody
- IP generated/ Potential for IP generation:** Multiple IP applications filed
- Resources Generated:** 2 full time scientists hired and trained for generating unique cell line platform one scientific manager partial funding

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

None



Project coordinator
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HEALTHCARE- THERAPEUTICS BIG

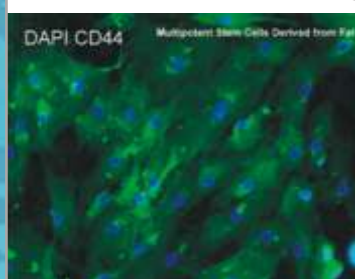
Total Potential Cells

The Innovation

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

Brief description

MSCs derived from adipose tissue of patient's own body for treatment of Osteoarthritis with the help in regeneration of lost cartilage with the eventual reduction in the knee pain, stiffness of joints and difficulties in routine functionality. The proof of concept will be further established from WOMAC Score and MRI results.



Stage of development

Proof of concept

Unique features of the product/technology

The important features are it is autologous treatment. Using your own cells. There is no chances of graft vs. host reaction. No requirement for immune-suppressive drugs. It's a non-invasive process

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. It will be used as an alternative to knee and hip replacement. The demand would be plentiful. There are some other products available but most of them are allogenic.

National/Societal relevance

At present, the only curative treatment option for OA is joint replacement. A less invasive, less expensive therapeutic modality, requiring minimal hospitalization will have significant societal impact. Proposed modality will benefit the country and also make the same affordable to the lower economic strata of the society.

Project achievements

- Progress vis-a vis objectives:** Isolation and culture of human ADMSCs; Successfully treated 25 patients with pre and post-operative evaluation of biochemical factors responsible for induction of inflammatory process in OA
- Technology/ Product developed :** Standardization of isolation of SVF containing ADMSCs
- IP generated/ Potential for IP generation:** 2015/MUM/2015; Process of preparing Mesenchymal stem cells for the treatment of Osteoarthritis as regenerative medicine.
- Resources Generated:** 4 scientists trained and a GMP class V lab updated

Plans to take innovation further

Liasioning with a few orthopaedic surgeons

Risks envisaged

Tumorigenicity - No such report has thus far appeared for human ADMSCs

Project coordinator
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The Innovation

Validation of a novel technology to generate stable transgenic systems with no off-target effects

Brief description

Generation of stable transgenic model systems has always been challenging and traditional methods of making stable transgenic cell lines employed plasmids but their utility fails in animal models. Developed a novel process by which one can achieve targeted insertion of a foreign gene at safe/ neutral genomic locus. They show sustained gene expression from this locus and observe no off-target effects caused by the genetic alteration

Stage of development

Proof of concept

Unique features of the product/technology

Value proposition of this proposal is the targeted insertion of foreign gene at a neutral/ safe harbor genomic locus. The process of stably introducing foreign genes in cells has been further simplified for high reproducibility and minimal requirement of a preferred skill set. Corrective gene therapy can be achieved by inserting the correct gene at the neutral/ safe harbor locus thereby neutralizing the effect of the mutated version. While the competitor cost for the product is to the tune of ~20,000 USD, our product will cost around 14000 USD

Market potential

The global transgenic cell line market is approximately worth 20 million USD. Closest competitor is target gene insertion at the AAVS1 locus with the success rate of 4-6

National/Societal relevance

No commercial units/ companies in India exclusively focusing on developing transgenic model systems

Project achievements

- a) **Progress vis-a vis objectives:** Validated process for cell line development assessed in 6 cell lines, including primary cells
- b) **Technology/ Product developed:** Developed a novel process which allows targeted insertion of a foreign gene at safe/ neutral genomic locus. The current data has been exhibited in Hela cells (immortalized cells of cervical cells origin)
- c) **IP generated/ Potential for IP generation:** None
- d) **Resources Generated:** Employed 3 persons

Plans to take innovation further

Taking the study further into animal mouse models for validation

Risks envisaged

High costs of CRISPR-Ca9 technology license



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Virchow Biotech Pvt. Ltd.

The Innovation

Development of a recombinant uricase for the prevention and treatment of tumor lysis syndrome associated with leukemia, lymphoma & solid tumor malignancies

Brief description:

TULY is a purified and sterile recombinant product of the enzyme urate oxidase, which is generally labelled as rasburicase produced by a genetically modified *E. coli* strain. The cDNA coding for rasburicase (34 kDa; a water soluble protein) was cloned from *Aspergillus flavus* strain.



Stage of development

Commercialization

Name of commercialized product - TULY

Date of launch - 2013-12-01

No. of units sold - 27570

No. of end users - 1020

Unique features of the product/technology

Rasburicase is a recombinant form of urate oxidase, an enzyme that converts uric acid into an inactive and soluble metabolite allantoin

Market potential

Elitek. It is also indicated for the initial management of plasma uric acid levels in pediatric and adult patients with leukemia, lymphoma, and solid tumor malignancies who are receiving anticancer therapy expected to result in tumor lysis and subsequent elevation of plasma uric acid

National/Societal relevance

Prevents high uric acid levels in patients who are at high risk for TLS

Project achievements

- Progress vis-a vis objectives- All objectives achieved and product commercialized
- Technology/ Product developed - TULY is a purified and sterile recombinant product of the enzyme urate oxidase
- IP generated/ Potential for IP generation - None
- Resources Generated - Internal resources

Plans to take innovation further

Product is in the market

Risks envisaged

None

Project coordinator
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The Innovation

Development of plasma purified Alpha-1 Antitrypsin and C1- esterase inhibitor

Brief description

Circulating levels of Alpha-1 Antitrypsin and C1- esterase inhibitor have to be maintained by augmentation therapy by periodically giving the purified protein to concerned patients. Current process is aimed at large scale chromatographic purification of these proteins from human plasma in their native forms

Stage of development

Late stage validation

Unique features of the product/technology

An integrated approach to purify major therapeutic proteins from plasma by employing integrated chromatographic technologies

Market potential

These proteins as drugs may cost USD 40,000 per annum which makes the treatment beyond reach for Indian citizens. The anticipated cost for the dose with the in house purified process, around INR 2000 to 5000, making the treatment viable to most of the Indian citizens. No products are available in Indian market at present. But in International regulated markets plasma purified A1AT is being sold as Zemaira CSL Behring, Prolastin Grifols, Glassia Kamada and Aralst NP Baxter and plasma purified C1-INH is being marketed as Cinryze Shire and Berinert P CSL Behring

National/Societal relevance

Based on the epidemiological data available and the mutation frequency of these two genes, it is clear that these deficiency disorders cannot be neglected in multi-ethnic culture scenario of Indian population. Availability of these two plasma derived products for the treatment of these two deficiencies will be very useful and predicted to save many lives in India

Project achievements:

- Progress vis-a vis objectives:** Optimized the purification process for isolating A1AT from plasma at 100L scale and C1-INH (at 50L). Analytical development for monitoring the quality is going on
- Technology/ Product developed:** Alpha-1 Antitrypsin and C1-esterase inhibitor
- IP generated/ Potential for IP generation:** A Novel Method for Isolation and purification of five important therapeutic drugs from human Plasma
- Resources Generated:** 24 manpower employed and facility created for GMP grade synthesis and purification

Plans to take innovation further

Plan to expand the facility plasma handling capacity to 1000L/batch

Risks envisaged

Lower yields, decreased activity level (during stability, lyophilisation and formulation) of active purified protein in scale up



Project coordinator
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Weinnovate Bio solutions Pvt. Ltd.

The Innovation

Novel combination-gel for rapid healing of Diabetic foot ulcer

Brief description

HEALRAP, is unique formulation which is prepared using silver nanoparticles which take care of infection and their reoccurrence. Unique formulation with cell growth trigger molecules allows blood vessels and adjacent cells to grow rapidly in wound lumen

Stage of development

Proof of concept

Unique features of the product/technology

Formulation is unique blend of small molecules which not only prevents the infection but also helps in accelerating wound healing. The product will be 10 times cheaper than current treatment options such as negative pressure therapy and hyperbaric oxygen chamber therapy costs for 8 week treatment period are \$ 27,270 compared to \$ 36,096 in standard moist wound therapy. No formulations available which will enhance and prevent the wound healing

Market potential

Market for wound care is expected to reach \$20.5 billion by 2020. Among the segments, active wound care Skin substitutes and Growth factors is the fastest growing segment at a CAGR of 11.9 percent 2014-2020 and ulcers being the highest revenue generating segment worth \$7.75 Billion in 2020. Plermin and Regranex are the major competitor

National/Societal relevance

India is a Diabetic capital of the world, with increasing number of diabetics, foot care will be a huge challenge to address

Project achievements

- Progress vis-a vis objectives:** Gel formulation and quality testing, primary cell lines treated with formulation gel accomplished
- Technology/ Product developed:** Developed liposome nano-formulation with silver nanoparticles established by physiochemical characterization, antimicrobial susceptibility, cytotoxicity in-vitro, stability & Wound healing assays
- IP generated/Potential for IP generation:** Indian patent application no. 201621025112 for the formulation
- Resources Generated:** 4 persons were employed

Plans to take innovation further

The preclinical studies will be over by 2018 and pilot clinical study to be performed by 2019

Risks envisaged

Global competition in advance wound care area



Project coordinator
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The Innovation

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

Brief description

Intends to develop a TNF inhibiting first in class, orally bio-available anti-neuro inflammatory small molecule PD2015 prototype drug treatment for neuro-cognitive dysfunction. Developing first in class orally bio available novel TNF inhibitors called thiothalidomides

Stage of development

Proof of concept

Unique features of the product/technology

Nascent discovery of novel thalidomide analogs on which conducted extensive preclinical efficacy studies on AD, and TBI models. The data has been robustly positive and thus have great potential. Next step to create greater value in this technology by conducting IND-enabling studies

Market potential:

Studies indicate, P2Ds thiothalidomide compounds demonstrates excellent TNF modulatory properties thus making it an attractive drug candidate to in AD. No products in competition so far

National/Societal relevance

Alzheimer's disease is a worldwide health crisis afflicts some 35.6 million people in the world. This number is expected to double every 20 years, to an estimated 65.7 million in 2030, and 115.4 million in 2050

Project achievements

- a) **Progress vis-a vis objectives:** Project has successfully completed in April, 2016
- b) **Technology/ Product developed-** TNF inhibitors have been identified and have shown efficacy in STZ model for AD
- c) **IP generated/ Potential for IP generation:** Yasham has no patent but three patents are US7,973,057B2 Pat. Appl.13/153,355 Pat. Appl. 13/648,625 and P2D Inc. has assignment rights to all
- d) **Resources Generated:** 2 Masters candidates & 2 Ph.D. candidates

Plans to take innovation further

To conduct IND-enabling studies and advancing it into human clinical trials for treating a blockbuster disease such as AD

Risks envisaged

Risk associated with thalidomide-based drug technology is the potential teratogenicity associated with these compounds



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Innovation Profiles

BIRAC Innovators



HEALTHCARE-DEVICES AND DIAGNOSTICS



HEALTHCARE-DEVICES AND DIAGNOSTICS **BIPP**

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.)

Brief description

Mobile Lab is a Compact Portable Clinical Laboratory in a suitcase having Power Back- Up which contains all essential instruments like Biochemistry Analyzer, Centrifuge, Incubator, Data Recorder/Mini Laptop with Patient Data Management Software, Micropipettes and other accessories. It is so rugged that it can be easily carried to the far flung and remotest locations. The Mobile lab is being upgraded to include tests like HbA1c, SGOT-Kin, SGPT-Kin, Microalbumin and CR Protein

Stage of development

Validation

Unique features of the product/technology

Mobile Lab is a Compact Portable Clinical Laboratory in a suitcase having power back-up. The Product was designed to make diagnostic available to unprivileged in the society and places where electricity has not yet reached. The Goal of this innovation was to address the healthcare problems in India. About 37 different tests can be carried out and the lab weighs just 600 gms

Market potential

The market potential is high as there are no competitors in market when it comes to Portable Lab.

National/Societal relevance

The main focus of the product is to provide better diagnostics to the society and to reach rural areas where people are not have access to basic medical tests. The aim was to provide Ease of Access and Doorstep Delivery of diagnostics

Project achievements

- Progress vis-à-vis objectives:** Project Deliverables were to add SGOT, SGPT, HbA1c and Microalbumin tests to the present platform. The tests have been developed and the clinical validations are underway
- Technology/Product Developed:** Additional tests are being added to the Mobile Lab
- IP generated/Potential for IP generation:** None
- Resources generated:** Developing the skilled manpower in the health care industries

Plans to take innovation further

The Mobile Lab is already commercialized. Some additional tests are being added to the device

Risks envisaged

Scale up of the innovation to size it deserves in stipulated time and Fund raising



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The Innovation

Portable hand held dermascope for real time non-invasive detection and monitoring of skin infections using multi-wavelength UV fluorescence

Brief description

A portable non-invasive device, named "Skinscope" that can non-invasively detect and monitor any Skin and Soft Tissue Infections ranging from diabetic foot ulcer, burns, Pressure ulcers, surgical sites infections etc. within 2 minutes. It can help the doctors by providing information on colonizing pathogen, pathogenic load and wound closure rate

Stage of development

Early stage validation

Unique features of the product/technology

Real time monitoring of pathogens colonizing the SSTI, Helpful in low resource settings

Market potential

Market potential is High & Competitors are Dermoscope, Dermilite, woods lamp etc

National/Societal relevance:

Early identification of tissue at risk of ulcerating could enable proper preventive care, thereby reducing the incidence of foot ulceration

Project achievements

- Progress vis-a vis objectives:** Fine tuning of proposed device is going on
- Technology/ Product developed:** A working prototype is developed and is under testing
- IP generated/Potential for IP generation:** An Indian Provisional Patent Application is filed & 2 design registrations are also applied
- Resources generated:** 3 Manpower employed

Plans to take innovation further

Already in tie-up with a bio-distributor in India for manufacturing and distribution of the proposed device. Also planning to set-up in-house manufacturing and sales channel to tap into major hospital chains

Risks envisaged

Market adoption



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Agada Medical Technologies Pvt. Ltd.

The Innovation

Percutaneous Aortic Valve (PAV) Technology

Brief description

PAV implantation is a minimally invasive technique for the treatment of diseased aortic valve. The aim is to design a self-expanding PAV comprising of a tissue valve sutured onto a stent frame with a minimum crimp profile to facilitate an easy transfemoral access

Stage of Development

Proof of Concept

Unique features of the product/technology

Open heart surgery is needed for removal of diseased valve and replacing it with a tissue or mechanical valve. For some patients open heart surgery is not possible for various reasons and PAV replacement, in which a trans-catheter aortic valve implantation is carried out, is the alternative technique

Market potential

An estimated, one million patients worldwide suffer from symptomatic aortic heart valve disease, which results in 200,000 surgical aortic valve replacements annually worldwide. At the same time, 30% of patients are denied treatment due to prohibitive risk associated with open heart surgery. Currently 8000 and 25,000 aortic valve replacements are performed per year with 15% growth per annum in India and Asia, respectively. Like coronary stenting, PAV replacement and repair will become an accepted part of the treatment armamentarium. The competitive product in the market is Myval TAVR

National/Societal relevance

The PAV technology has the potential to become an efficient and safe alternative to open heart surgery for patients with diseased aortic valves

Project achievements

- Progress vis-a vis objectives:** Proof of concept design and prototype has been completed and is under validation
- Technology/ Product developed:** Self-expanding PAV comprising of a tissue valve sutured onto a stent frame
- IP generated/Potential for IP generation:** IP filed for unique two ring structure, proprietary design for high radial force and bio material sealant
- Resources Generated:** Three manpower employed

Plans to take innovation further

Seeking regulatory approval for human trial

Risks envisaged

Identifying a good sealant biomaterial and development of a low-profile deployment system



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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.

Brief description

Incidence of the HLA allele in many parts of Asia and many ethnic populations still needs to be explored to understand its strong association with various diseases. Conventional genotyping tests are not the choice for HLA allele screening in this region. Screening the persons with epilepsy for the presence of HLA allele may avoid the severe manifestations caused by the adverse reactions of a particular Anti-Epileptic Drug (AED). Diagnostic test kits like the LAMP reaction provide results quickly and the tests are cheap, simple reliable and point of care. Additionally, heated blood samples can be directly used in this assay. This test design involving LAMP approach may facilitate the detection and validation of different HLA genotypes and their association

Stage of development

Pre-commercialization

Unique features of the product/technology

LAMP kit will be used as a point of care testing kit to test the HLA alleles in persons with epilepsy before the start of AEDs

Market potential

The LAMP kit developed in this study will be used as a point of care testing device for the patients of epilepsy. There are no similar competitive products currently in market. The kit will be easily available at low cost to patients

National/Societal relevance

Patient's life may be saved from life threatening cutaneous reactions once the HLA is tested with the help of this kit

Project achievements

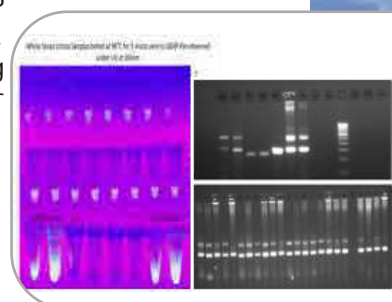
- Progress vis-a vis objectives:** Developed LAMP based HLA allele typing technique using extracted DNA and also using whole blood samples. The technique gives good sensitive read out of the amplicons under UV radiation. Typing of 256 samples for HLA-A, HLA-B and HLA-DRB1 have been done from epilepsy patients for finding HLA allele association with drug reactions against AEDs
- Technology/ Product developed:** LAMP assay based diagnostic kit for HLA allele associated adverse reactions against AEDs in persons with epilepsy
- IP generated/ Potential for IP generation:** None
- Resources Generated:** Developed skill Manpower in molecular diagnostics

Plans to take innovation further

Working with the collaborative partner Khanna Path Lab Pvt. Ltd.

Risks envisaged

None



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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Altreal Bio-Innovations Pvt. Ltd.

The Innovation

Affordable Maxillofacial Prostheses

Brief description

This proposal aims at development of affordable and durable materials and key components which are useful in preparation of maxillofacial prostheses for treatment of loss of facial part ear, eye, nose, skin, etc. due to ailment or accident. Currently available materials are mostly imported and thus are of high cost, not specific for the application and of short shelf-life

Stage of development

Proof of Concept

Unique features of the product/technology

Almost a monopolistic situation on the material supply combined with lack of trained maxillofacial surgeon makes the rehabilitation treatment like maxillofacial surgeries highly un-affordable and in-accessible. The unique features includes unique polysiloxane based resin cross linker for desired quality and increased durability of the components and innovative process for prosthetic preparation based on 3D printed mould for optimizing cost, time and skill

Market potential

Maxillofacial surgeries for patients surviving cancer treatments and trauma cases are the end-beneficiaries of this innovative development. The affordable prostheses market is worth Rs. 120 Cr domestic and almost as much potential for export to both developed and developing countries. International competitors are Comesil HC, Cosmesil St, Factor II, Aquasil, Prestige etc.

National/Societal relevance

Rehabilitation for patients with facial disfiguration is expensive process Affordability & accessibility shall make a big impact on lives of millions of such cases

Project achievements

- Progress vis-a vis objectives:** The ring opening polymerization of cyclosiloxanes for preparation of base resin and cross linker has been demonstrated. 3D scanning experiments are underway
- Technology/Product developed:** Indigenous polysiloxane based resin and Innovative 3D printing technology for affordable maxillofacial prostheses
- IP generated/Potential for IP generation:** IP generation potential for chemical compounds
- Resources Generated:** Supported One Scientist, One project Intern and One Mechanical Engineer. A Chemistry lab has been established

Plans to take innovation further

Team has set up a Pvt. Ltd. company. Scale up of the technology is planned

Risks envisaged

None



Project coordinator
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The Innovation

A smart blood bag monitoring device for safe and reliable blood transfusion in rural India

Brief description

A novel blood bag monitoring solution for blood supply chain for rural India based on cloud platform to analyse each bag's temperature throughout the supply chain. The product is expected to increase the availability of blood in rural India. At present, the temperature of blood products is not recorded during logistics, thus making the current practice unreliable

Stage of development

Proof of Concept

Unique features of the product/technology

Temperature mapping for each blood bag can be done using temperature sensitive tags. Currently temperature sensitive tags are not used in Indian blood banks and very few companies are manufacturing it worldwide. The proposed solution monitors temperature of each unit in a novel way by very less addition of components in the existing system at affordable cost



Market potential

Indian market size is approximately INR 10 crores. Potential market regions includes other developing countries. The nearest alternative is temperature sensitive tags. Price of a temperature sensitive tag with bulk order will be more than INR 65. Proposed solution will cost less than INR 5 per bag

National/Societal relevance

India has the largest number of maternal mortality in the world and nearly 30% of maternal death is due to haemorrhage. Availability of safe blood and prevention of wastage of precious blood can be ensured through monitoring during transportation

Project achievements

- Progress vis-a vis objectives:** Currently prototype design is completed. Prototype assembly and initial lab testing will be followed by late stage validation at hospitals
- Technology/ Product developed:** Novel product and technology based on cloud platform for real time monitoring of temperature of blood bags in the supply chain
- IP generated/ Potential for IP generation:** None
- Resources Generated:** Two Manpower supported

Plans to take innovation further

Plans to hit the market by end of 2018

Risks envisaged

Ability to convince the health workers in rural hospital

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HEALTHCARE-DEVICES AND DIAGNOSTICS SBIRI

Biomoneta Research Pvt. Ltd.

The Innovation

Z-Box: Electrodynamic Ablation of Pathogens from Healthcare Environments

Brief description

To reduce mortality and financial losses caused by healthcare associated infections, non-drug decontamination solutions are in need. The few technologies being evaluated today for infection controls have shortcomings: like UV radiation based technology is not human friendly, filtration methods do not kill microbes and ionization-based purifiers generate harmful free radicals. Biomoneta's nanofiber based technology addresses all these shortcomings and the developed solution is a bedside device, Z-Box that acts at the source of infection to protect vulnerable patients from a range of microbes, from viruses to fungi

Stage of development

Early Stage Validation

Unique features of the product/technology

Biomoneta's Z-Box technology synergistically combines a three-dimensional, microbicidal nanofiber material with a trapping innovation that potentiates the effect of the material. The three dimensional architecture of the nanofiber greatly enhances its trapping ability along with the unique air flow design to maximize the impact of microbes on the material while eliminating issues like clogging, traditionally seen in the filtration based techniques

Market potential

The anti-infective devices has enormous application in multiple markets. Within the healthcare segment, variations of the technology can be used as a standalone bedside device to create local clean zones to a handheld device for the sterilization. The competitive technologies like UV light producing robots from Xenex, CleanroomH13 or Novaerus technology are all priced very high. The targeted price for the Biomenta bedside Z-box device is INR 60-70,000

National/Societal relevance

Over 30% of ICU deaths in the developing world are due healthcare associated infections (HIAs) to immunologically vulnerable groups such as neonates, expecting women, older people, etc. Inadequate numbers of healthcare workers, a low bed to patient ratio, and no stringent cleaning protocols etc are all reasons for HIA. A standalone device like the Z-box that does not require trained staff and sophisticated infrastructure and can be deployed continuously in hospitals.

Project achievements

- Progress vis-a vis objectives:** Creating and verifying alternate designs for a bedside device before taking it to clinical trials
- Technology/ Product developed:** A novel device design based on microbicidal 3D nanofiber technology combined with innovative airflow design to eliminate airborne microbial infections
- IP generated/ Potential for IP generation:** Indian patent filed for "Air Decontamination Assembly". PCT application underway
- Resources Generated:** Three manpower employed

Plans to take innovation further

Testing of the bedside decontamination device in partnership with St. Johns Hospital

Risks envisaged

Inability to translate the lab results in real hospital environment

Project coordinator
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The Innovation

Flow Analyzer

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

Stage of development

Commercialized

Unique features of the product/technology

Microfluidics based Flow Analyzer for biological and non-biological applications & a Point-of-care device for Diagnostics

Market potential

High market potential for biological and non-biological applications

National/Societal relevance

This can be used as a point-of-care device for diagnostics

Project achievements

- Progress vis-a vis objectives:** Project is completed & the Flow analyser is developed
- Technology/ Product developed:** -Miniature flow analyzer in lab-on-chip is developed
- IP generated/Potential for IP generation:** IP has been filed in India, USA, Japan, China and South Africa
- Resources generated:** The project has trained 6 researcher & establishment of microfluidics / fabrication set up

Plans to take innovation further

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

Risks envisaged

None



Project coordinator

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HEALTHCARE-DEVICES AND DIAGNOSTICS SBIRI

Coeo Labs Pvt. Ltd.

The Innovation

VAPCare : An intelligent secretion and oral hygiene management system to reduce risk of acquiring ventilator associated pneumonia

Brief description

VAPCare is an oral hygiene management system to reduce the risk of acquiring Ventilator Associated Pneumonia (VAP). It is a system that provides targeted suctioning of the secretions in order to reduce the risk factors for development of VAP in intubated ICU patients. This system eliminates the need for constant human interaction between caregiver and patient to prevent the chances of cross infection



Stage of development

Late Stage Validation

Unique features of the product/technology

Sensor based secretion management technology. Automated lavage, by sprinkling and removal of disinfectant solution in the oral cavity, to maintain oral hygiene. Suction tube blockage detection and clearance

Market potential

Market potential is high. Current competitor in India is manual secretion management by caregivers

National/Societal relevance

In medical emergencies, these patients are often sedated, intubated with an endotracheal Tube and put on mechanical ventilation in order to save and prolong their life

Nearly 19 lakh patients get on long-term ventilation over 48 hours annually, during which time they are prone to multiple hospital-acquired infections (HAIs). It is estimated that 31%, or close to 0.6 million of these patients annually, develop VAP during their stay in the ICU. VAP is one of the most common HAIs with extremely high mortality rates 42%, leading to 0.25 Million deaths annually in India today

Project achievements

- Progress vis-a vis objectives:** Currently the project is in the clinical and regulatory validation stage
- Technology/ Product developed:** A VAPCare named technology for oral hygiene management system is developed
- IP generated/Potential for IP generation:** None
- Resources generated:** 8 full time employees and 2 interns

Plans to take innovation further

Plan to launch the product commercially before year end 2017 & target to install in 100 hospitals by Q2 2018. The plan is to license the product and/or distribution rights to a third party for mass market access

Risks envisaged

High price in comparison to available products

Project coordinator
Nachiket Deval

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The Innovation

Wearable and Implantable Sensors for Connected Health

Brief description

ConnViva has developed a first prototype for estrous detection in dairy cattle. The device is a neck-worn cattle activity monitor, which can detect large increases in daily activity, which are typical of estrous period. The activity monitor is accompanied by an Android application, to visualize and analyse the data. Activity monitoring data can be visualized over the past day, the past week, or the past month. The data from the activity monitor is wirelessly transmitted to the Android device via Bluetooth

Stage of development

Early Stage Validation

Unique features of the product/technology

Low productivity due to lack of livestock tracking, monitoring, and management using technology is the biggest issue faced by the Indian animal husbandry sector. Connviva technology aims at improving Indian cattle owner's incomes by higher productivity through smart electronic sensors and data analytics for better animal husbandry. A significant drop in daily activity in the animal indicates the possibility of illness. In addition to activity data, the wearable enables unique digital identification of cattle. This technology will give boost to animal-level and farm-level productivity and thus provide secondary income to the Indian farmers. A cattle sensor for estrous detection will be priced at INR 1000- 3000, in addition to annual subscription fee of Rs 5000, depending on the farm size, for software setup, maintenance and analytics

Market potential

The animal husbandry sector supports 2/3rd of the rural population and contributes 27% of Indian agricultural output. The Indian livestock insurance premium market is estimated at INR 1.76 Billion, around INR 10,000 per animal annually. The tracking services market for the livestock banking sector is estimated at INR 200 million. Large multinational companies like GEA and DeLaval have not been able to achieve any significant penetration among India's livestock owners, due to their solutions being very expensive, not tailored to Indian conditions. Other SMEs in the area don't find Indian market attractive, due to its vast geographical expanse, large variety in needs, and price sensitivity. A solution like SMART IoT Farm can enjoy the first-mover advantages in an untapped, but a very important market, enabling poor small Indian livestock farms reach their potential

National/Societal relevance

The proposed solution is tailored to Indian conditions to address the unique problems faced by Indian farms. Also the solution will be made at affordable cost for even the small farm holders to benefit from it

Project achievements

- Progress vis-a vis objectives:** Battery-less biocompatible sensor systems
- Technology/ Product developed:** Wearable and implanted sensors for livestock monitoring and tracking
- IP generated/ Potential for IP generation:** Energy harvesting techniques, Materials for better antennas for low-power long-range RF communications
- Resources Generated:** Three engineers employed & prototyping facility created with state-of-the-art RF electronics equipment

Plans to take innovation further

Partnerships with various govt, non-govt, and commercial bodies for implementing monitoring solutions developed by ConnViva

Risks envisaged

Slow uptake of technology by the animal husbandry sector. Price-sensitive market



Project coordinator
Mandar Gadre

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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Croleon Innovation Labs Pvt. Ltd.

The Innovation

Innovative scar-free organ retractor for reduced port laparoscopic surgery

Brief description

Organ retraction in laparoscopic surgery is typically carried out through several incisions to accommodate the insertion of multiple 5 to 10 mm diameter trocars

Stage of development

Proof of concept



Unique features of the product/technology

The product EndoConnect enables retraction of organs through only a minimally invasive incision of less than 1 mm

Market potential

Worldwide, nearly 8 million laparoscopy procedures are carried out each year. In each of these procedures the organ retraction is carried out by 5-8 mm diameter instruments through trocars, held in place by a trained assistant surgeon

National/Societal relevance

EndoConnect would enable surgeons to provide the retraction themselves, thus reducing their dependence on assistant surgeons. This would thus enable patients in smaller towns to have access to treatment with minimally invasive surgery, that too at a lower cost

Project achievements

- Progress vis-a vis objectives:** Currently, applicant is in the process of setting up the lab, and CAD design of the primary component -i.e the EndoConnect mechanism.
- Technology/ Product developed:** Innovative scar-free organ retractor-Prototype is ready
- IP generated/Potential for IP generation:** IP already generated and filed: PCT/IB2014/064772 and 3059/MUM/2013
- Resources generated:** 2 manpowers employed and 2 other engineers have been employed. They are being trained in design and development of medical devices, with a focus on surgical instruments and facilities are being set up

Plans to take innovation further

Refining the proof of concept, carrying out bench tests, clinical trials and eventually, commercialization through international partners

Risks envisaged

The ability to miniaturize the EndoConnect mechanism at a usable would be the biggest challenge

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The Innovation

To demonstrate POC for a Non-invasive Myoelectric arm with SEMG sensors and Machine Learning algorithms

Brief description

Human hand is highly articulated, possessing approximately twenty major degrees of freedom. Traditional mechanical hand prostheses possess only a single degree of freedom. On the other hand, myoelectric prosthesis can provide multigrasp functionality to amputee person. Surface Electromyography (SEMG) is a non-invasive technique for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles. A myoelectric-controlled prosthesis is an externally powered artificial limb that can be controlled with the electrical signals generated naturally by muscles of an amputee in residual limb

Stage of development

Proof of Concept

Unique features of the product/technology

The current hand prosthetics affordable for masses possess only a single degree of freedom. This doesn't improve the quality of the life of limb amputees and doesn't allow them to perform their daily activities independently. Currently available myoelectric prosthesis solutions are all imported. The proposed technology is based on SEMG, which is non-invasive, along with multiple essential gesture support using machine learning algorithm. The design will be robust and light weight. The targeted price is 30 times lower than the similar imported prosthetics

Market potential

According to census 2011 of India, Indian amputee population is 5 million with upper limb amputee population of 0.5 million. US has 1 lakh arm amputees with 6000 new cases every year. The competitive products available in the market are Ottobock (Micheal Michelangelo), RSL Stepper (Bebionic V3) and Ossur-Touch Bionics (iLimb)

National/Societal relevance

As far as the upper limb prostheses is concerned there is no affordable functional prosthesis solution available in the Indian market. The proposed technology will allow amputee to intuitively access the full capability of a multi-grasp hand which is both reliable and robust. It improves quality of life for upper extremity amputees in terms of both level of independence and quality of self-care

Project achievements

- Progress vis-a vis objectives:** Development of electronic sensor system to detect and process surface EMG signals has been completed. Single gesture detection algorithms using SEMG sensor data and mechanical CAD design of the hand is underway. Multiple gesture detection algorithms, integration of all the electro-mechanical components to build the final prototype of the hand will be the final objective
- Technology/ Product developed:** Myoelectric hand prosthesis with multigrasp functionality
- IP generated/ Potential for IP generation:** Surface EMG detection and processing hardware system can be patented. Algorithms and PCB designs can be copyrighted and mechanical designs can be design protected
- Resources Generated:** Three engineers employed

Plans to take innovation further

Exploring options to have tie-up with central and regional prosthetic government centres, NGOs, semi-government hospitals etc. for validation. Also out-licensing technology to reach outside Indian market is planned

Risks envisaged

Regulatory challenges



Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Df3d Creations Pvt. Ltd.

The Innovation

Conversion of CT/MR data to 3d printed models help the surgeons plan surgery more accurately by means of better implants thereby increasing accuracy & reducing time taken for actual procedure

Brief description

The cloud based 3d printing platform of Osteo3d enables the surgeon to create 3d printable medical models online from any mobile, tablet, laptop or desktop computer. The software automatically generates a high quality medical model and provides the surgeon with options to cut, slice and plan the sections as per his/her surgical requirements

Stage of development

Commercialized with brand name "Osteo3d" on 2016-11-01. 450+ units sold

Unique features of the product/technology

The cloud based 3d printing platform of Osteo3d enables the surgeon to create 3d printable medical models online from any mobile, tablet, laptop or desktop computer

Market potential

5 Million USD in 4 years

National/Societal relevance

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

Project achievements

- Progress vis-a vis objectives:** Made in India, affordable solution to increase adoption of technology by surgeons to decrease the duration of the procedure. To increase the quality of outcome of the procedure with net incremental costs being zero
- Technology/ Product developed:** The cloud based 3d printing platform of Osteo3d
- IP generated/Potential for IP generation:** Provisional patent has been applied
- Resources generated :** Expertise developed in domain, technology and clinical applications

Plans to take innovation further

Exploring collaboration opportunities with local and international organisations, academia

Risks envisaged

Risks involved with funds availability and scaling up sales; and marketing

Project coordinator
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Diagnorite Innovative Healthcare Pvt. Ltd.

**The Innovation**

Development of a Quick, Sensitive and Affordable Diagnostics of Neonatal Septicemia NNS in Any Indian Hospital Setup

Brief description

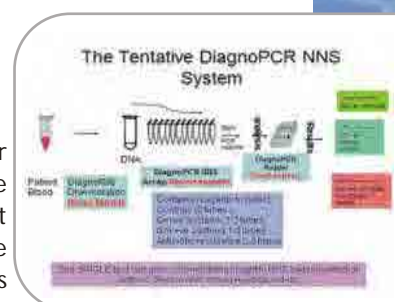
Diagnorite is developing a quick, affordable and highly sensitive molecular diagnostic system for Neonatal Septicemia or NNS, based upon their own DiagnoPCR platform technology. The system can be used in any Indian hospital to provide faster diagnosis for saving lives

Stage of development

Proof of Concept

Unique features of the product/technology

The complete Diagno PCR-NNS system can make molecular diagnostics a routine diagnostic test for everybody. The sample preparation and processing is simple and the analysis is done in a simple affordable unique reader. Same day diagnostics for infectious diseases, especially sepsis, do not exist in India. It takes at least 2-3 days to release the result. The simplicity and affordability of the proposed Diagno PCR system will allow any lab to provide report on the same day for any infectious disease. This in turn will help in reducing treatment cost and reduce antibiotic resistance

**Market potential**

There is no commercial NNS- diagnostic kit, although the disease affects everywhere with a high mortality rate. If the proposed kit fills this gap, it should have a huge market potential worldwide. Real time PCR system can potentially do the same kind of test. However, it is expensive and complicated

National/Societal relevance

Neonatal septicemia (NNS) is a clinical syndrome that affects on an average of 5-6 per 1000 live births worldwide and has a very high mortality rate. A complicating factor in the epidemiology is the emergence of antibiotic resistant bacteria that are resistant to first line of antibiotic therapy. Diagnorite has proposed a molecular test that can be practiced in any hospital in India and give results of neonatal septicemia test within 3-6 hours. This test will thus reduce the cases of neonatal deaths and reduce antibiotic resistant pathogens

Project achievements

- Progress vis-à-vis objectives:** Progressing well as per the objectives
- Technology/Product Developed:** A molecular diagnostic system for Neonatal Septicemia
- IP generated/Potential for IP generation:** One IP for simplified sample handling is filed
- Resources generated:** DSIR recognition obtained for the research and development facility. New collaborations established for instrument development

Plans to take innovation further

Once the PoC is established the next steps are validation, scale up, manufacture, regulatory licences followed by commercialization of the product

Risks envisaged

Constant funding for research and development and regulatory approvals

Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Diagnorite Innovative Healthcare Pvt. Ltd.

The Innovation

Development of Diagnostic Reagents for Acute Myocardial Infarction

Brief description

An instrument-free blood test for earliest detection of heart attack. This test detects early cardiac marker H-FABP in the blood stream. It has animal free active ingredients which can be scaled up and manufactured easily and affordably. Being a blood test, multiple patients can be screened simultaneously



Stage of development

Early Stage Validation

Unique features of the product/technology

A unique instrument-free liquid phase format & unique animal free, antibody-free recombinant reagents. 2D echo instrument costs \$40,000 average and the test costs 1000-3000 for the patient. H-FABP test in foreign market costs \$50-89 and some of them require instruments to interpret. Prize of current test is 350/-INR

Market potential

All South Asian countries & entire India 1.8 billion population and Africa 1.3 billion population is the targeted market. In India the targeted customers will be hospitals, primary health centres. ECG and 2D echo machines are the competitors.

National/Societal relevance

Acute Myocardial Infarction is one of the maladies that has the high mortality rate. Early symptoms of heart attack often overlap with digestive problems and sometimes even a doctor cannot distinguish AMI from non-emergency cases without proper diagnostics

Project achievements

- Progress vis-a vis objectives:** All objectives completed. PoC for the diagnosis of cardiac marker H-FABP has been established
- Technology/ Product developed:** An easy, affordable & sensitive heart attack detection system
- IP generated/Potential for IP generation:** An Indian Patent application is filed
- Resources generated:** DSIR recognised facility has been established

Plans to take innovation further

Further development through other funding

Risks envisaged

Competition from multi-national companies selling similar products

Project coordinator
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The Innovation

Rotary endodontic file in basket form

Brief description

The design relates to a rotary endodontic file used in the treatment of root canal. It is a novel flute less rotary endodontic file for root canal treatment (RCT) which reduces the chances of cyclic and torsional failure seen with available file systems and efficient cleaning of root canals without sacrificing sound dentine.

Stage of development

Proof of Concept

Unique features of the product/technology

Thin flexible wires are developed to reduce the chances of cyclic failure seen in thicker files, absence of any flutes nullifying the chance of canal wall engagement, design insures the easy removal of separated/fractured file and on visible inspection, dentist will know that its time to dispose the file.

Market potential

Infection, trauma or sometimes as an elective procedure, necessitates the root canal treatment RCT of tooth. It has a prevalence of 2 teeth per patient. 15.1 million RCT done in 2005-06 as per American dental association in USA

National/Societal relevance

Indigenous development and manufacturing will bring the technology that is missing in our country at present

Project achievements

- Progress vis-a vis objectives:** Final prototype is ready. Mechanical strength checked using ISO 3630 tests. Statistical report by independent dentist of comparative studies with existing system done on extracted teeth or plastic block mimicking shape of root canal.
- Technology/ Product developed:** Rotary endodontic file in basket form.
- IP generated/Potential for IP generation:** Indian patent filed 201621014443, PCT application: PCT/IN2017/050256 Rotary endodontic file, Design patent also filed 294558
- Resources generated:** Manpower employed: 6, Facility: a separate work place has been created to work on this project

Plans to take innovation further

Applicant is working in house for the development and POC study of this project. Later to scale up, after the successful completion of pilot study

Risks envisaged

Getting the enough strength of nitinol wires joint, that can withstand the clinical stress of file.



Project coordinator

Lavkesh Bansal

Team Members

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HEALTHCARE-DEVICES AND DIAGNOSTICS SPARSH

Excellence in Biological Innovations and Technologies Pvt. Ltd.

The Innovation

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

Brief description

Right Biotic is a novel indigenously developed technology is for determining the antibiotic sensitivity of uropathogens responsible for Urinary Tract Infection UTI in 3hrs. The device, RightBiotic comes with a ready to use kit for rapid culture of pathogens

Stage of development

Early stage validation

Unique features of the product/technology

This is the fastest test available for culture and sensitivity of bacterial pathogens and can be completed in less than four hours anywhere in any setting lab, doctors office, PHC, hospital ward, etc with no additional infrastructure requirement

Market potential

Up to 40 women develop UTI at least once during their lives and a significant number of these women will have recurrent UTIs 0.5 lakh Primary health centers, 1.5 lakh doctors clinics and nearly 0.1 lakh clinical diagnostic labs in the India and 70 of India's 1.2 billion citizens living in rural areas, where, despite governments efforts, hospitals are often under staffed and lack basic equipment and testing facilities. The product can be expanded to serve other neighboring countries as well as in all resource-constrained settings as a test for antibiotic sensitivity

National/Societal relevance

The automated testing systems constitute less than 1% of the market share. Both manual and automated diagnostic tests available to test for antibiotic sensitivity of uropathogens take at least 24 to 72hrs. In addition to trained manpower as well as sophisticated lab setup to run the assay the automated systems cost anywhere between 12-49 lakhs. All available automated systems function as closed systems and the cost of reagents adds to the final cost billed to the patient amounting to Rs 1100 to 1200/test. This technology offers the results at lower cost and in less time

Project achievements

- Progress vis-a vis objectives:** ODM designing and manufacturing of field ready readout prototype and manufacturing of kits
- Technology/Product developed:** Device to determine the antibiotic sensitivity of uropathogens
- IP generated/Potential for IP generation:** New IP has been generated
- Resources generated:** Few researcher trained

Plans to take innovation further

A team for QC and marketing built Documentation submitted for regulatory permissions

Risks envisaged

Healthcare professionals may take some time for accepting the results obtained from this new technology as it defines a new paradigm in conducting tests for clinical antibiograms

Project coordinator

Suman Kapur

Team Members

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Contact

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The Innovation

To demonstrate Proof of Concept for a novel, non-invasive exosome -based screening (for early detection) cum diagnostic kit for multiple cancers (using one test) utilizing patient derived biofluids

Brief description

A diagnostic kit for the early detection of cancer from biofluids blood, urine, saliva. A two-step test to provide complete molecular information

Stage of development

Pre-commercialization

Unique features of the product/technology

A diagnostic kit for the early detection of cancer

Market potential

The total cancer diagnosis market is reaching upto 15 Billion USD by 2020

National/Societal relevance

Early cancer screening is one of the major hurdles in managing cancers globally. Due to rise in number of cancer incidences in India, it is one of the biggest health burden in India

Project achievements

- a) **Progress vis-a vis objectives:** -All objectives completed
- b) **Technology/ Product developed:** PoC on a diagnostic kit for the early detection of cancer has been established
- c) **IP generated/Potential for IP generation:** An Indian patent application has been filed
- d) **Resources generated:** 2 manpower through BIG grant, Established in-house R&D unit

Plans to take innovation further

Plan to establish market in foreign territories

Risks envisaged

Technology Risks at scaling up, Operational risks due to limited funds, Implementation risks for early screening



Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIPP**

Forus Health Pvt. Ltd.

Collaborator: Healthcare Technology Innovation Center,
IIT Madras and Narayana Nethralaya Foundation

The Innovation

Shishunethra - Preventing blindness in Infants

Brief description

The Company is developing a low cost wide field eye-screening device for premature and term infants. It includes the device and the software infrastructure to allow for advanced post-processing, automated diagnostic tools and remote diagnosis capabilities. This product is addressing the need for an affordable, easy to use, handheld, light weight contact fundus camera that allows for remote diagnosis.



Stage of development

Pre-commercialization

Unique features of the product/technology

The device is a contact fundus camera that is light-weight and portable. A novel optical system is designed to achieve both high resolution and wide field of view to enable a quick scan of infant eyes. Secure tele-medicine module that allows a centrally located clinician to remotely view and diagnose images acquired by mobile devices moving in a geographically dispersed area. The device should enable all neonatal ICUs to properly screen at-risk babies for ROP. This will have a tremendous impact in reducing the number of avoidable blindness in this segment of society

Market potential

There is growing awareness about the prevalence of Retinopathy of Prematurity (ROP) and National Rural Health Mission has started to implement screening programs across the country. But the only available digital ROP device is one that is imported from US and is very expensive. A lower cost imaging device will alter this scenario by making it possible for more hospitals to implement digital ROP screening programs.

National/Societal relevance

In developing nations, high rates of premature birth and increasing resuscitation of premature infants is giving way to a third epidemic of ROP. If not treated, ROP can lead to blindness. Traditionally, binocular indirect ophthalmoscopy is performed by the doctor to screen for ROP. However, in India the ophthalmologist-patient ratio is 1:80000. This is where the developed device can make a big difference. It requires only a trained technician to operate and can be connected via telemedicine to an ophthalmologist in the city, thus enabling the screening of premature infants in semi urban and rural areas. Also, the cost of screening and treating an infant is much lower

Project achievements

- Progress vis-à-vis objectives:** Device is built and manufactured and is on track for commercialization
- Technology/Product Developed:** Wide field eye seeing device for ROP
- IP generated/Potential for IP generation:** Two patents applied
- Resources generated:** Collaborations established

Plans to take innovation further

Computer aided diagnosis tools are being considered to help triage images for clinician review

Risks envisaged

Necessary infrastructure and basic healthcare facilities need to be implemented in each Taluka in order to run the infant eye screening program. Also, proper training must be provided to the operators to ensure that at risk babies receive medical attention at the earliest possible

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The Innovation

MindEye :A low-cost, portable, easy-to-use, eye-tracking device integrated with computerized cognitive tests for early diagnosis of Dementia at community level using big-data analytics in cloud under a highly affordable Software-As-A-Service model.

Brief description

The main aim of the proposal is to develop a tool & device named “MindEye” for early dementia diagnosis and follow-up monitoring. MindEye is based on quantitative measures of eye fixation, smooth pursuit, saccade in response to both static and dynamic visual stimuli presented on a computer. Subsequently, the gaze data can be analysed to understand the participant's eye fixation and smooth pursuit with an aim to map the gaze-related indices to detect dementia

Stage of development

Early-Stage-Validation

Unique features of the product/technology

Detection of minute ocular movements and quantify pro-saccade, anti-saccade and memory-guided tasks proven for dementia prediction. Utilization of Artificial Intelligence tools to map the measured gaze-related indices to the possible dementia & further Integration of MindEye with the tele-monitoring platform

Market potential

Global Market \$16.7 Billion in 2016 with a CAGR of 8.5

National/Societal relevance

MindEye will be an early diagnostic tool at the community level for early intervention

Project achievements

- a) **Progress vis-a vis objectives:** Progressing well as per the objectives
- b) **Technology/ Product developed:** Early dementia diagnoses tool and device
- c) **IP generated/Potential for IP generation:** IP is already filed
- d) **Resources generated:** Research Fellows are employed in this project at IIT Gandhinagar

Plans to take innovation further

Arogya Medtech Pvt. Ltd. has plans of taking this further

Risks envisaged

None



Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Jayant Karve - FITT

The Innovation

Intraosseous Device

Brief description

Ozyn-D is an intraosseous IO device which establishes access to circulation through long bones. The device is successfully tested in large scale human cadaveric study at AIIMS, New Delhi and gained access to circulation in less than 10 seconds

Stage of development

Late-stage-validation

Unique features of the product/technology

Insertions in less than 10 secs , Suitable for both adult and paediatric patients, Deployable in resource constrained settings, Reduced clinical complications, No cross-contamination/ need of re-sterilization, Minimal training needs Usable by paramedics Portable and ergonomic design

Market potential

In US, 5 million patients need IO insertion annually & 1.3 million patients annually are deprived for IO access in India also

National/Societal relevance

The Ozyn-D is disposable Interosseous device which is ready to use at the point of care without need of any sterilization. The affordable device is usable in resource constrained environment

Project achievements

- a) **Progress vis-a vis objectives:** Progressing well as per the objectives
- b) **Technology/ Product developed:** an intraosseous IO device is developed and tested on human cadavers.
- c) **IP generated/Potential for IP generation:** IP is filed
- d) **Resources generated:** None

Plans to take innovation further

Through partnerships.

Risks envisaged

Scaling up of the product



Project coordinator

Jayant Karve

Team Members

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Jayant Karve

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The Innovation

FlexiOH: Breathable, Washable and Lightweight cast immobilization for fractured bone

Brief description

A FlexiOH named light weight cast for immobilization on fractured bone/ joint injuries has been developed. FlexiOH is designed for patients having fracture/sprain who are looking for comfortable casts. It is a cast that is breathable, washable and lightweight unlike conventional cast i.e. Plaster of Paris or Glass Fiber cast. FlexiOH gives comfort while being enough rigid to immobilize bone or joint like conventional casts.

Stage of development

Early-stage-validation,

Unique features of the product/technology

Absolute Washability: FlexiOH is made up of washable material. So patient have freedom to wash cast which helps them to maintain better skin hygiene. **Breathability:** FlexiOH is having holes throughout its surface which provides air circulation to skin. This feature of FlexiOH allows evaporation of moisture and perspiration hence skin dryness is maintained. **Light Weight:** FlexiOH is very light i.e. short arm cast weights less than 300 grams. **Easy Removal:** Zipper system allows hassle free application and removal without specialized cutting tools.



Market potential

High market potential. Competitors are Plaster of Paris Cast, Glass Fiber Cast & HM Cast

National/Societal relevance

Helpful for the society

Project achievements

- a) **Progress vis-a vis objectives:** It has been validated on bench-top testing with compared to Plaster of Paris cast or Glass-fiber cast and now moving to be validated on clinical set-up
- b) **Technology/ Product developed:** A light weight cast for immobilization on fractured bone/ joint injuries has been developed
- c) **IP generated/Potential for IP generation:** None
- d) **Resources generated:** Team of 10 people. Established in-house R & D lab for carrying out FlexiOH product development & also raised funding

Plans to take innovation further

Plan to set-up pilot scale manufacturing facility with production capacity of 3500 pieces / month.

Risks envisaged

High price in comparison to available products

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Jeevtronics Pvt. Ltd.

The Innovation

Development of Advanced Prototype of a very affordable Bi-Phasic Defibrillator with a built-in power generator for low resource settings

Brief description

The Company has developed a dual powered electricity+hand cranked defibrillator that would be useful in regions without reliable electricity supply. PHC/ CHCs, Army, Security forces, ambulances, etc could benefit from the innovation. Price of the device would be 1/4th of the currently available devices without compromising on the quality and reliability



Stage of development

Late Stage Validation

Unique features of the product/technology

This is the worlds first defibrillator which works, both, on grid electricity and hand cranked generator. It can be charged up fully to deliver a bi-phasic shock within 7 to 15 seconds. It is batteryless, hence more reliable. It has strong reusable steel paddles and thus need no replacement parts for decades. This is ideal for areas without electricity and ambulances. The currently available CE marked defibrillators are priced at Rs 250,000+. The developed device will be, both, CE marked and ambulance rated and would be priced at about Rs 65,000

Market potential

The market potential is high. Electricity based traditional defibrillators are manufactured by Companies such as Philips, Zoll, Nihon Koden, BPL etc.

National/Societal relevance

Indias death rate due to sudden cardiac arrest is 3 to 4 times that of developed countries. Within India alone, 146,000 PHC+CHC+SC do not have defibrillators. Lakhs of ambulances in India do not have defibrillators. Similarly, all developing countries in Africa, Asia, S. America do not have enough of these devices. Hence, the need for this life saving device is high

Project achievements

- Progress vis-à-vis objectives:** The device is expected to be launched in the market by or before the end of the IIPME project in May 2018.
- Technology/Product Developed:** The Company is developing a defibrillator which works both on grid electricity and hand cranked generator
- IP generated/Potential for IP generation:** US6597949 B1: Granted US patent- assigned to Jeevtronics, PCT/IN2016/000222- PCT filed, PCT/IN2016/000223- PCT filed. Design patent application number: 289404, Trade Mark No. 3351351
- Resources generated:** 5 full time and 1 part time engineers/ technicians employed. Around 20 more will be employed over next 6 months. The applicant has already won the IUSSTF grant

Plans to take innovation further

The Company will be ready for production by early 2018. The Company is looking for distribution partnerships with large OEMs and go-to-market consultants to take the device to the market.

Risks envisaged

Marketing / Pricing and Sales force management

Project coordinator

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The Innovation

Development of a novel medical device for early detection of Liver disease

Brief description

A diagnostic device for the early detection of liver disease (Biomarker based) from blood samples. After development, the device may be use as a platform to test other biomarkers for other diseases. This will be employed in hospitals, diagnostic labs, health centres, accurately diagnosing people with even early stage liver disease

Stage of development

Proof of concept

Unique features of the product/technology

The diagnostic device will detect disease much earlier and more comprehensively and will detect liver disease in blood

Market potential

Market potential is high and competitors are Imaging techniques such as MRI, ultrasound

National/Societal relevance

Liver lifestyle diseases cause harm to society e.g.: alcoholism and cause immense damage financially. Approximately 20 of the world is affected by lifestyle based liver disease

Project achievements

- Progress vis-a vis objectives:** Progressing well as per the objectives
- Technology/ Product developed:** A technology for the early detection of liver disease is under development
- IP generated/Potential for IP generation:** IP will be generated
- Resources generated:** None

Plans to take innovation further

After the development of prototype

Risks envisaged

Market entry and adoption



Project coordinator
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Team Members
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Lattice Innovations Pvt. Ltd.

The Innovation

Networked Critical Care Monitoring in Low Resource Settings

Brief description

Lattice Innovations is 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 design of the product allows it to be used in a plug-and-play manner, without requiring investment in costly IT infrastructure. Furthermore, the device can be used in home settings as well as in ambulances



Stage of development

Validation

Unique features of the product/technology

The product is designed to be portable, plug-and-play device that can be easily installed in various settings, ranging from small hospitals/clinics, ambulances and even at home for post-discharge or post-surgical monitoring. The design utilizes a tablet-based display, which not only serves as a display device but can also be used for digitization of clinical information. This facilitates rapid and seamless transmission of clinical data to the remote specialist allowing him/her to take the right clinical decisions

Market potential

At present, tele ICU solutions are offered only by large multinational device manufacturers, such as GE and Philips. These systems are expensive, as a result of which the market adoption has been fairly limited

National/Societal relevance

Efficient patient management through the use of wireless technology will help to reduce the rising healthcare burden which now affects many developed and developing countries, Wireless remote patient monitoring can also provide continuous and real time data to physicians from remote locations thereby offering the advantage of convenience to both physicians and patients, while hospitalization costs are massively reduced

Project achievements

- Progress vis-à-vis objectives:** Project completed. Final data awaited
- Technology/Product Developed:** Early prototype of the tablet-based multi-parameter patient monitoring system has been developed and validated
- IP generated/Potential for IP generation:** No IP generated
- Resources generated:** 4 team members have been 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 for this project. ISO 13485 certified facility has been established

Plans to take innovation further

The Company plans to identify and partner with distributors who can help them commercialize the technology. Additionally, they are trying to work with critical care specialists and healthcare service companies who can provide the clinical backbone required to deliver remote monitoring services in low resource settings

Risks envisaged

Product certification and marketing the product

Project coordinator
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Team Members

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The Innovation

To Validate U-Sense: Platform based Low cost, Rapid and POC diagnosis of specific Uropathogens causing UTI, helping reduce AMR

Brief description

Module Innovations is developing U-Sense, an affordable and innovative diagnostic platform for rapid microbial detection. U-Sense allows for the visual detection of 4 specific Uropathogens in 30-60 minutes, a significant reduction from the time required for standard culture based testing

Stage of development

Early Stage Validation

Unique features of the product/technology

U-Sense is much faster than culture based testing. While Yes/No strips report on the presence or absence of UTI, U-Sense identifies the specific organism causing UTI. In addition, U-Sense is user friendly and identifies specific bacteria by a simple blue to red color change, at the point of care without instrumentation, laboratory or trained manpower. The current methods to detect UTI and the uropathogens are either time consuming, lab or manpower intensive or do not provide sufficient information

Market potential

U-Sense has high national and societal relevance. It empowers rural PHC and urban hospitals alike to obtain UTI results rapidly. There are two major competitors to U-Sense, one is culture and the others are Yes/No nitrite detecting strips

National/Societal relevance

India has a severe dearth of healthcare facilities. The hospitals and healthcare centres are severely burdened. Thus, rapid and point of care devices that give equivalent results compared to the existing methods attain immense relevance. USense empowers rural PHC and urban hospitals alike to obtain UTI results rapidly. USense thus has huge national relevance and social impact

Project achievements

- Progress vis-à-vis objectives:** The project is progressing as per the timelines. The first technical milestone will be completed soon
- Technology/Product Developed:** Additional tests are being added to the Mobile Lab
- IP generated/Potential for IP generation:** The project has the potential to generate 2 patents
- Resources generated:** 2 manpower employed and one intern engaged. Funds of around 44 lakhs raised

Plans to take innovation further

Once the validation studies are complete, the Company plans to either setup their own manufacturing or outsource it

Risks envisaged

The gestation period for the R&D activities and adoption of new technology for which there is a need of education & creating awareness among people and clinicians



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Optra Systems Pvt. Ltd.

The Innovation

OncoScan- Digital Oncopathology Slide Scanner

Brief description

The OncoScan is an automated, affordable and compact whole slide scanner which is a holistic digital pathology solution empowering pathologists and revolutionizes the process of pathology reporting

Stage of development

Pre-commercialization

Unique features of the product/technology

Automated whole slide scanning to generate high resolution images, scanning of single slide as well as batch of slides, image viewer for viewing high resolution digital images, multiple fields of view, simultaneous viewing at different magnifications, intuitive graphical user interface for scanner operation, easy panning, zooming and annotation of digital slides, integration with image analysis algorithms for automated slide analysis, integrated image management system resulting into efficient archival, search and retrieval of digital slide and affordable, easy to use, desk top based scanner

Market potential

OncoScan has immense potential in India & abroad across health sector specifically Govt. health initiatives, hospitals and private major hospitals. Govt. of India partnership will boost penetration of the device in sales & marketing though OncoScan is qualitatively competitive and affordably priced too. Govt. of India partnership in implementing this innovation at medical health centers/districts nationwide. There is no competitor in the market

National/Societal relevance

With affordable costs, mass application by extensive usage could yield significant improvement in Patient Care and National Health

Project achievements

- Progress vis-a vis objectives:** Cytoscan and OncoScan have been developed and their mass validation is completed
- Technology/ Product developed:** An automated, affordable and compact whole slide scanner
- IP generated/Potential for IP generation:** None
- Resources generated:** NA

Plans to take innovation further

Govt. Of India partnership will provide boost to the innovation to implement it across the Nation. OPTRA on its own is trying to cover the private sector

Risks envisaged

None



Project coordinator
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The Innovation

CytoScan for Scanning and Automated PAP Smear Imaging for Cervical Cancer Screening and Mass Validation of OncoScan, Digital Pathology Scanner

Brief description

The CytoScan is a digital Scanner for pathological Research/Diagnostics for scanning cytology smears to provide automated imaging for cervical cancer screening

Stage of development

Pre-commercialization

Unique features of the product

It uses bright field microscopy for imaging which comprises with white-led illumination and is capable of multi slide scanning with auto-loader facility and volume scanning. It provides flexible to the user in selection of area of interest with the help of auxiliary optics and auto focuses to improve the Image quality



Market potential

CytoScan has immense potential in India & abroad across health sector specifically Govt. health initiatives, hospitals and private major hospitals. Govt. of India partnership in implementing this innovation at medical health centers/districts nationwide. CytoScan is the first whole slide scanner developed indigenously

National/Societal relevance

With affordable Costs, mass application by extensive usage could yield significant improvement in patient care and national health

Project achievements

- Progress vis-a vis objectives:** Technology has helped in taking a pioneering step in digital microscopy/pathology which may revolutionize scanning of glass slides, enormous assistance in analysis and interpretation of images, sharing of images for expert opinions, early detection and treatment for better patient care, especially for Cancer patients
- Technology/ Product developed:** CytoScan provides 3D scanning or z-stack, also called z-axis scanning by having multiple scans of the same slide taken at various focal planes and stacked into a final composite image
- IP generated/Potential for IP generation:** None
- Resources generated:** NA

Plans to take innovation further

Govt. of India partnership will provide boost to the innovation to implement it across the Nation. OPTRA on its own is trying to cover the private sector

Risks envisaged

None

Project coordinator
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Orthocrafts Innovations Pvt. Ltd.

The Innovation

Bioabsorbable implants based on polylactic acid

Brief description

Applicants have identified first three products in portfolio. The first product in the portfolio is "OrthoScrew". This will be used in the anterior cruciate ligament reconstruction surgery. OsteoAnchor - is a suture anchor that will be used to attach torn soft tissues in knee, ankle, shoulder and elbow joint to bone. OsteoTack - will be used to attach hernia mesh to body walls during hernia repair surgery



Stage of development

Early stage validation

Unique features of the product/technology

Product developed will reduce the dependency on multinationals for availability of products. Easy access to biomaterials will encourage rapid development of medical devices

Market potential

Global market for the biodegradable materials based implants is pegged at 100- 200 Million USD growing at a rate of 8%

National/Societal relevance

Many important implants that are solution of choice by surgeons are imported and have poor accessibility in India

Project achievements

- Progress vis-a vis objectives:** Biocompatibility testing ISO 10993 and Sterilization validation ASTM 11135 for OrthoScrew and prototype development for OsteoAnchor. Orthocrafts has identified the required tests and initiated the discussion with Shreechithra Institute for further strategy
- Technology/ Product developed:** Osteoanchor is under evaluation
- IP generated/Potential for IP generation:** IP is under consideration for new designs of device and material composition and mechanisms of delivery of implants
- Resources generated:** NA

Plans to take innovation further

To explore the possibility of engaging medical practitioners to develop new designs of the products and to partner with clean room manufacturing facility provider to make our pilot batch of products

Risks envisaged

Other equipment/ instrumentation set required deploying the implant during surgery. Patient identification for clinical trial and setting up of distribution channel

Project coordinator
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The Innovation

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

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

Stage of development

Early stage validation

Unique features of the product/technology

Portable/wearable CAPD dialysis device, IoT device keeps patients always connected with caretakers/doctors through a cloud based patient management system. Simple, safe and rugged suitable for low resource settings and can be managed by patients

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, even targeting 10 of patients in India

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

Project achievements

- Progress vis-a vis objectives:** Getting Alpha version ready for animal trials, liaise with agencies for conducting trials, design trial protocols and pilot program Free To Operate verification
- Technology/ Product developed:** Proof of concept has been developed safe, affordable, mobile dialysis device
- IP generated/Potential for IP generation:** A Patent for Recyclable technology of CAPD consumable is in process
- Resources generated:** A team of 7 members including CTO, developers, dietool design engineer and mould fabricator

Plans to take innovation further

To conduct pilot, networking through CIIE - IIM Ahmedabad with many partners for research, product design, marketing, contact with ICICI Lombard for marketing support and insurance

Risks envisaged

Adoptation by Nephrologists



Project coordinator
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Panacea Medical Technologies Pvt. Ltd.

The Innovation

Hexapod Computer Controlled Patient Couch for LINAC machine

Brief description

A patient couch with offset load of the patient supported by a Hexapod, such that the hexapod is always away from the radiation beam while supporting the full weight in offset mode and allowing the patient to be positioned with precision with respect the isocentre of the treatment machine

Stage of development

Late stage validation

Unique features of the product/technology

Pioneering Indigenous High tech hexapod based robotic device for patient positioning, real time computation done on embedded FPGA complex coordination of six degrees of motion to achieve end result, designed to handle 225 Kg. pay load of patient with offset load on completely radiolucent carbon fiber couch

Market potential

Currently there are very few companies which have innovative products in radiotherapy and Panacea is one amongst the five companies worldwide manufacturing radiotherapy machines and the only company producing these equipments from India. The end product has competitors from countries in Europe and North America

National/Societal relevance

This will be a major step in treatment facility being available for Indian population at large with a low cost of ownership to the hospitals

Project achievements

- Progress vis-a vis objectives:** The product has been developed is meeting all the objectives and is ready for commercialization
- Technology/ Product developed:** Computer Controlled Patient Couch for LINAC machine
- IP generated/Potential for IP generation:** IPR will be registered IPR appropriately
- Resources generated :** NA

Plans to take innovation further

The project is completed and is being integrated into the main assembly to be commercialized in the current FY. The next stage is to build an articulated robot that can be deployed for medical applications based on the knowledge generated as part of this project

Risks envisaged

The program has to be made to port on generic systems to be able to make the complete system modular

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The Innovation

Development of affordable breast prosthesis and mastectomy bras for breast cancer patients.

Brief description

The kit comprises of one external pre-made light weight silicone medical grade CE certified material breast prosthesis available in different sizes and shapes

Stage of development

Pre-commercialization

Unique features of the product/technology

The kit comprises of one external pre-made light weight silicone medical grade CE certified material breast prosthesis available in different sizes and shapes as per the choice of patient , two pocketed brassieres available in different sizes and colours , two prosthesis covers, one prosthesis holder, information & usage manual and an outer waterproof kit which accommodates all the aforementioned components discreetly



Market potential

Breast cancer is the top most common cancer affecting women all over the world with 16,71,000 new cases being reported per year globally and India harbours approximately 10 of this global disease burden with 1,50,000 being added to the list of existing patients every year Globocan, 2012

National/Societal relevance

Owing to high cost of imported ones, it caters to small percentage of population with no after sales support. Moreover, there is no effective system to address training of paramedics and rehabilitation needs of patients without which no significant impact is possible

Project achievements

- Progress vis-a vis objectives:** Developed a complete solution for catering to the post-mastectomy needs of the breast cancer survivors
- Technology/ Product developed:** Post mastectomy breast prosthesis and brassieres
- IP generated/Potential for IP generation:** Indian Patent Application has been filed
- Resources generated:** Manpower employed/trained, facility created- An ISO certified self manufacturing set-up has been created and enterprise as well

Plans to take innovation further

Creation of self marketing channels for direct sales to end users in prominent cities of India .Institutional sales to hospitals, NGOs and chemists directly or through appointed dealers and creation of a Pan-India breast cancer survivor's network to assist in pre-trial of product for effective sizing

Risks envisaged

Potential risk from the possible creation of an indigenous competitor however the economies of scale would help us in mitigating this potential risk

Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Pradin Technologies Pvt. Ltd.

The Innovation

Fetal Electrocardiogram and Uterine Activity signal extraction from Maternal Electrocardiogram eliminating the need for the use of conventional transducers

Brief description

Acquisition of transabdominal ECG to separate fetal ECG and uterine contractions by a novel method

Stage of development

Proof of concept

Unique features of the product/technology

Computation of fetal heart rate and uterine contractions without ultrasound and pressure transducers

Market potential

The present set of global maternal / fetal monitors dominantly display FHR, Uterine activity UA, fECG& or mECG with a graphical strip chart output of FHR vs UA. The nearest to technical specifications is AN-24 device from Monica Healthcare from the UK

National/Societal relevance

The current range of fetal monitoring devices prevailing in the market is complex, expensive & overloaded with non-essential features. The penetration into different tiers is very poor

Project achievements

- Progress vis-a-vis objectives:** Proof of concept has been developed that leads to an engineered commercially viable product replacing conventional cardiotocographs.
- Technology/Product developed:** A portable model for detecting fetal ECG & heart rate from pregnant woman is ready
- IP generated/Potential for IP generation:** None
- Resources generated:** NA

Plans to take innovation further

To collaborate with a leading US university to develop low noise sensors that is initially developed for EEG monitoring to customize for use in fetal ECG

Risks envisaged

Collection of actual raw abdominal signal data from pregnant mothers before & during labor for algorithm evaluation. External clinical trials at identified hospitals to validate comparisons between sensors based output with the said project output

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The Innovation

Development of antiquorum sensing coated catheters to reduce device associated urinary tract infection

Brief description

The proposed product not only reduces the catheter associated infections but also improve the life quality of the patients. Applicant is working on the modifications as coatings of incorporations to the existing urinary indwelling catheters to make them less prone to the associated infections.

Stage of development

Proof of concept

Unique features of the product/technology

The current technology utilizes anti-virulence agents. These agents will attenuate the pathogens so that the host immune system can eradicate them. This might reduce the possibility of drug resistance

Market potential

The urinary catheters markets in developing economies still have the scope for further growth and investment. The urinary catheter market in Asia and Latin America are expected to expand at 4.7 and 4.6 respectively during the forecast period, thus new innovations in urinary catheters will have a huge impact than any other time period. Silver nanoparticle coated catheters are currently available in the market by Bardex Inc

National/Societal relevance

A middle income country like India, the incidence of device associated infections is estimated to be three to five times more than the high income countries. Approximately 35 of the patients in a hospital is getting catheterized and the probability of getting these device associated infections are 3-5 daily. However, in India, there are no strategies to prevent or reduce these infections

Project achievements

- Progress vis-a vis objectives:** Applicants have identified novel anti-virulence agents using in silico tools and currently synthesizing them
- Technology/ Product developed:** Applicant is the process of making antiquorum sensing coated catheters
- IP generated/Potential for IP generation:** None
- Resources generated:** Two man powers are employed. A basic research facility for the proposed product testing is established.

Plans to take innovation further

Discussions are in progress for valuable collaborations for the further testing of the product

Risks envisaged

Apart from the anti-virulence property of the novel compound, the biocompatibility is needed to be tested. Selection of efficient and effective coating methodology



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HEALTHCARE-DEVICES AND DIAGNOSTICS SBIRI

Robonik India Pvt. Ltd.

The Innovation

Design and Development of Automated In Vitro Diagnostic Instrumentation ELISA processor, Automatic Biochemistry and Urine strip Analysers

Brief description

FABCA, ELISTA and Autourine are common use essential instruments in medium and large laboratories. Products are designed and developed to meet harsh Indian working conditions. Most components are indigenised to increase the competitively and reduce import dependency. Exclusive & innovative sensor developments to optimise the complexity

Stage of development

Late stage validation

Unique features of the product/technology

- FABCA Automated Chemistry Analysers Speed : 400tests/hour, with ISE 600 tests/hour, Input parameters :60 samples 48 reagents, reading chamber with 50 cuvettes, two reagent probes, one sample probe, cooling chamber, washing module, Mixer, ISE module ,Barcode, LIS interface
- ELISTA| ELISA strip processor 4 Different Reagents, 96 wells or 6 plates of 16 strips, automatic tip pick up, separate probe for Reagent and sample. Programmable washer. Inbuilt reading, Automatic strip Pickup, programmable incubation/shaker
- Automatic Urine analyser: 10 parameters, 240 strips/hr. Auto strip pickup, Auto dispensing of urine samples, Barcode, LIS interface

Market potential

FABCA, ELISTA and Autourine are required in all medium to large laboratories. Currently requirements are met by importing. With indigenisation of all components, we have been able to develop and manufacture at competitive price. Hence both domestic and international market can be supplied by us. Having more than 35000 installation of semiautomatic analyses we have already established strong customer base

National/Societal relevance

with awareness of regular medical check up requirement necessitates need for good through put automation at affordable pricing. Products have designed keeping Indian working condition and requirements

Project achievements

- Progress vis-a vis objectives: Product development is completed, and ready for commercialisation
- Technology/ Product developed: Diagnostic Instrumentation ELISA processor, Automatic Biochemistry and Urine strip Analysers
- IP generated/ Potential for IP generation: None
- Resources Generated: NA

Plans to take innovation further

After validation manufacturing will begin by November 2017

Risks envisaged

Inverted duty structure and Chinese dumping

Project coordinator
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The Innovation

Development of Oral Cancer Screening Camera

Brief description

The product is a hand-held imaging device that uses tri-modal imaging technology combining tissue fluorescence, absorption, and diffuse reflectance for screening and detection of oral cancers

Stage of development

Early stage validation

Unique features of the product/technology

The device incorporates a camera to screen and capture fluorescence and diffuse reflectance images of the oral cavity on illumination with LEDs emitting at 405, 545, 575 and 610 nm. The recorded images are processed in real time to identify the optimal site for biopsy and grade cancer. The device is hand-held, affordable, non-invasive and easy to use with minimal training by health workers



Market potential

This is possible through screening camps conducted in the various parts of the country and in rural areas/villages where disease is more prevalent among the BoP population. The device will have market potential in other parts of the world as a similar product for biopsy guidance and cancer detection does not exist

National/Societal relevance

Early detection of oral cancer is a growing concern in the country owing to its large prevalence and high mortality rates. Detection of neoplastic changes in the oral cavity makes treatment simpler and management of the disease much easier and affordable, thereby improving the quality of life of the survivors and families

Project achievements

- Progress vis-a vis objectives:** The prototype of the device for oral cancer detection has been developed and is clinically tested through patient trials carried out during the project tenure
- Technology/ Product developed:** Prototype of the intra-oral cancer screening device
- IP generated/Potential for IP generation:** Indian Patent Application No. 201741017679 /CHE/2017, entitled "Hand-held biophotonic medical device, method and system for multimodal and multispectral imaging of tissue", Filed on May 19, 2017
- Resources generated: Manpower training:** Trained interns from IIT Chennai, Biomedical Design Dept and BMS College of Engineering, Medical Electronics Dept, Software developers, and Hardware engineers. Basic facility setup for UV-VIS spectral measurement, multispectral imaging, and optical design

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

None

Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Sensivision Health Technologies Pvt. Ltd.

The Innovation

Affordable and Safe therapy for Neonates with Hypoxic Ischemic Encephalopathy

Brief description

The Company is addressing one of the most critical conditions impacting Newborns, i.e. Hypoxic Ischemic Encephalopathy or HIE which is a complication of Birth Asphyxia. A comprehensive device platform that can diagnose, treat and prognosticate Birth Asphyxia complications that result in HIE is being developed. This device brings to market an effective and accessible solution to address the high mortality and morbidity associated with HIE. While complying with all the global safety standards, the device is tailored for use in diverse situations as inside an Ambulance and inside a Neonatal Intensive Care Unit



Stage of development

Early stage validation

Unique features of the product/technology

The product is servo-controlled, to ensure effective temperature control, fully automated with Cerebral Function Monitoring enabled for early diagnosis of HIE for monitoring of the treatment. This will be a first of its kind device globally that can diagnose and treat HIE in any setting - including during transport

Market potential

Currently there is only one product available globally to treat HIE in a servo-controlled mode, which is extremely expensive.

National/Societal relevance

Birth Asphyxia complication take a heavy toll not just on the Newborn but also on the immediate family. The babies that survive the impact of HIE, end up with lifelong debilitating complications that makes them dependent on the family for life. The diagnosis and effective treatment of this condition is exorbitantly expensive. Company intends to substantially bring down the Price of the Device to Hospitals and cost of care to patients

Project achievements

- Progress vis-à-vis objectives:** Project has been successfully completed
- Technology/Product Developed:** Prototype device that has been developed is ready for Safety testing followed by Clinical Investigation at select Hospitals
- IP generated/Potential for IP generation:** IP has been filed
- Resources generated:** Four man power supported

Plans to take innovation further

The Company plans to take the device to the market after completing the necessary Regulatory clearances for which they would either partner with distribution channels that cater to Critical Neonatal products or established direct linkages with Hospital chains and Hospitals

Risks envisaged

Slow adoption by Hospitals due to lack of awareness and Prolonged Regulatory cycle for approval resulting in delay in commercialization

Project coordinator
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The Innovation

A Virtual Reality (VR)-based endoscopy simulator

Brief description

Virtual Reality together with haptics offers an immersive and flexible platform for training doctors in medical procedures. The applicant is developing an endoscopy simulator together with haptics and VR-based interactive models

Stage of development

Proof of concept

Unique features of the product/technology

Immersive active haptics technology with three Degrees-of-Freedom, Real-time interactive simulation models, Rich and state-of-the-art training content, Unique user centric design to accelerate training, Cost advantage due to in-house technology and development, Immediate feedback to the user regarding performance on simulation module

Market potential

The product helps in training medical practitioners effectively in endoscopy procedures and addresses the issue of patient safety. There are two major players in the immersive endoscopy simulator space. One is the Canada based CAE Healthcare, second is the Sionix, owned by 3D Systems. Considering the technology barriers for market entry, limited existing competition and large untapped emerging markets, there is a large market opportunity for the product

National/Societal relevance

GI endoscopy, including upper endoscopy and colonoscopy, are complex procedures requiring a high degree of medical knowledge, clinical skills and hand-eye coordination. Currently, outside of clinical encounters, there are limited effective methods to train novice doctors in endoscopy procedures. Available computer-based simulators do not include force-feedback, lack realism, and are prohibitively expensive. In view of this, an affordable and immersive endoscopy simulator made available for trainee doctors will cater to patient safety and have a large societal impact. The goal is to improve patient care by providing a structured, low risk patient training environment

Project achievements

- Progress vis-à-vis objectives:** The project is progressing as per the objectives and milestones
- Technology/Product Developed:** A endoscopy simulator together with haptics and VR-based interactive models is developed
- IP generated/Potential for IP generation:** IP is filed
- Resources generated:** Mimyk Medical Simulations Private Limited has been incorporated for commercializing the proposed technology. Employment opportunities for at least five to ten young engineers have been created

Plans to take innovation further

Connections established with various doctors for product development and commercialization.

Risks envisaged

There are considerable challenges in achieving immersive multi-modal medical simulations



Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Sohum Innovation Labs India Pvt. Ltd.

The Innovation

A novel device to screen newborns for hearing loss in resource poor settings

Brief description

A gold standard ABR technology to conduct Newborn Hearing Screening. Presently hearing screening is done with subjective tests questionnaire, observations or BERA in few tertiary care hospitals imported devices- very expensive, require continuous expensive disposables, need a trained technician. Sohum uses brainstem evoked response audiometry BERA, the gold standard technology with high sensitivity and specificity in an innovative way with an easy-to-use interface to meet the needs of the system



Stage of development

Pre commercialization

Unique features of the product/technology

Unique algorithm: provides high sensitivity and specificity

Optimized design: reduces test duration by reducing time for preparation & analysis which makes it ideal for mass screening

Telemedicine & centralized data: The telemedicine module sends selected data true positive to centralized server for recheck and keeps a track of babies screened

Market potential

The product will serve the market of 20000 pediatricians, 17000 ENT and 40000 maternity and child care institutes private and government. 800,000 hearing impaired babies are born every year all over the world, of which 100,000 are in India

National/Societal relevance

In India, 26 million babies born every year, need to be screened for hearing impairment. We aim to focus on high risk babies first. The strategy is to collaborate with the right partners in India private and public settings. The device is designed to be used by ASHA, Anganwadi worker

Project achievements

- Progress vis-a vis objectives:** Project is completed successfully and further scale up is going on in IIPME project
- Technology/ Product developed:** BERA based hearing screening device
- IP generated/ Potential for IP generation:** IP is filed
- Resources Generated:** 15 people trained and employed

Plans to take innovation further

Their strategy is to collaborate with the right partners in India private and public settings. We will focus on both private pediatricians, maternity homes, NICUs collaborating with neonatal product companies Phoneix, Medtronic, Newborn blood screening services for distribution in India and State government vaccination programs, NRHM, National deafness prevention program and vaccination programs to reach the babies born in a non- institutional setting

Risks envisaged

Rapid scaling and private market reach

Project coordinator
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The Innovation

Develop and Test certain 3d printing technologies to produce Innovative Limbs at affordable costs for the disabled in India

Brief description

Manufacturing of affordable and high comfort below-knee prosthesis innovative reverse engineering and 3D printing technologies enable high level fit leading to great comfort innovative materials give greater strength

Stage of development

Early stage validation

Unique features of the product/technology

Affordable: costs less than Rs. 30,000/-, High comfort and hence encourages the patient to wear and go for work and Excellent strength and durability achieved through innovative materials. The impact created by the product is that it is completely made in India and hence no importing delays, Improve productivity with shorter rehabilitation times, single-trial-fit and hassle-free prostheses and Greater confidence in amputees in the society to accept and wear prostheses

Market potential

The market potential is high as the product addresses the following unmet needs, Affordable below-knee prostheses of high quality and comfort, Minimal or no post-fitting corrections needed due to innovative technologies used and the patient can give his stump digital data on the custom build and patented RE-Workbench at the nearest hospital/prosthetic center and the prosthesis will be shipped to him. The competitor products are BMVSS Jaipur foot, Ottobock, Endolite, Ossur and Alimco

National/Societal relevance

Most below knee amputees in India, particularly trauma cases, do not show interest to get prosthesis due to lack of affordability at good quality. In addition, low cost or donated prostheses are often not comfortable. This results in loss of productivity as the amputee is never able to return back to work. Moreover, the amputee loses quality social life. PSPR-3D-Tech is committed to provide affordable below-knee prosthetic technology solutions for productive rehabilitation and thus fill this gap of enablement

Project achievements

- Progress vis-à-vis objectives:** Project successfully completed
- Technology/Product Developed:** Innovative prostheses with composite material socket, OPTILINER and adjustable pylon developed. Autonomous and efficient patient data collection system, RE-WORKBENCH designed
- IP generated/Potential for IP generation:** Patent: Method and System to Generate Personalized data for Prosthetic Manufacturing. Oct 13, 2015 Application no. 4219/CHE/2015; Trademark: Prosthetic Solutions for Productive Rehabilitation Through 3D Printing Technologies
- Resources generated:** A private limited company named PSPR 3DProsthetic Technologies Pvt. Ltd. is incorporated. One research manager trained. Two technicians have been trained to manufacture prostheses through our innovative technology.

Plans to take innovation further

Partnership with public health institutes such as PHFI and partnership with hospitals having strong orthopedic departments

Risks envisaged

None



Project coordinator
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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIPP**

Tuscano Equipments Pvt. Ltd.

The Innovation

Imaging device for monitoring breast tissue changes

Brief description

Breast Thermography is indicative of the heat patterns on the surface of the breast. The relative change in heat pattern on the surface vary depending on the presence or absence of lesion/ abnormality inside. Rotational thermography acquires more information for better interpretation

Stage of development

Late stage validation

Unique features of the product/technology

No radiation, No breast compression, no pain, non-invasive, no breast exposure to examiner, 360 degree viewing of breast, One breast exam at a time examined, self-contained unit with temperature conditioning happening inside, repeatable, reliable, applicable for all age group, no limitation for dense breast or young woman being examined, Multiple views for better interpretation. This is a product designed, developed, manufactured in India and early detection efficacy is already validated clinically

Market potential

The market potential is high. The estimated population of women due for screening in India is about 80 million. The current cost of breast screening that is about INR 26000 to any woman can be brought down to 1/3rd of its price

National/Societal relevance

Indian women seek treatment very late - around 65 percent are already in stage 3 or 4 when diagnosed. Early detection in order to improve breast cancer outcome and survival remains the cornerstone of breast cancer control. However, there are only 40-50 mammography units available in the country at government centres and are not sufficient to screen and diagnose the millions of people at risk. Also the cost of such procedures are high. With a great potential to be an adjunct to standard imaging modalities at much affordable cost, the thermography screening procedure gains focus in developing countries like India. Its importance is enhanced by the fact that there are no side effects in the long run

Project achievements

- Progress vis-à-vis objectives:** All objectives have been achieved. Multi-site validation involving more than 2500 cases done so far using the device. CE marking done for the device.
- Technology/Product Developed:** Imaging device for monitoring breast tissue changes based on thermography.
- IP generated/Potential for IP generation:** US patent granted in Jun 2017. The issued US Patent number is 9687151
- Resources generated:** 5 Installation engineers, 4 application engineers, one lead engineer employed. Lab unit built to support development, changes and testing based on the feedback from field

Plans to take innovation further

Ready for commercialization

Risks envisaged

Acceptance by the end user.



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The Innovation

System for Accurate Guide-wire Positioning in Orthopedic Surgery

Brief description

A system comprising of various jigs and compatible software on various bones both in 2D and 3D formats. This will ensure accurate positioning of guide wire in the fractured bone with least number of trial and error and in minimal time. The system ensures accurate positioning of guide-wires/implants in fracture surgery, improve results for patients by reduced complication and re operation rates. It will reduce time of anesthesia and surgery and reduce hazardous radiation exposure

Stage of development

Early stage validation

Unique features of the product/technology

Software predicts the position of guide wire in C-arm X-ray image intra operatively. The software detects the jig and extends the directions of multiple parallel holes of jig on to the image of bone in both in 2D and 3D. This enables operator to choose most appropriate option to drill in the guide wire. Software enables intraoperative templating of implants / bones in 2D and 3D. Various jigs are designed for different bones. Jigs help to steady the guide wire on one. In addition these will give predetermined direction to the guide wire and allow change of position of guide wire in second plane while keeping the guide wire onstant in the first plane



Market potential

Hip fractures predicted to rise from 1.7m in 1990 to 6.3m by 2050 globally. All other fracture surgeries will also benefit from the system

National/Societal relevance

Technology developed indigenously

Project achievements

- Progress vis-a vis objectives:** Progressing well as per the objectives
- Technology/ Product developed:** Software in 2D form is tested and validated. All jigs are ready and most have been validated. 3D version is under process
- IP generated/Potential for IP generation:** An Indian patent application is filed
- Resources generated:** One full time design engineer and project manager employed

Plans to take innovation further

Plan to commercialize the innovation through vehicle of LLP, the process for formation is underway. Plan to tie up/partner with others who have expertise in marketing medical or orthopaedic product

Risks envisaged

None

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HEALTHCARE-DEVICES AND DIAGNOSTICS **BIG**

Vikas Karade - FITT

The Innovation

X-ray based Patient Specific Instrumentation for Knee Replacement Surgery

Brief description

X-ray based patient specific instrument (XPSI) is a 3D printable patient specific instrument for accurate, time-saving and cost effective knee replacement surgery, all using only two X-ray images of patient knee

Stage of development:

Late stage validation

Unique features of the product/technology

Usually patient specific instrument (PSI) require costly medical imaging like CT or MRI scans. The XPSI technology uses only two low-cost, easily available X-ray images and automatically designs the PSI which can be 3D printed with biocompatible material. The product also comes with surgery simulation software to choose accurate implant and take accurate clinical decisions. Benefit to end user is that they will get more accurate patient specific surgical outcome without any costly CT or MRI technology and at lower costs. Surgeons will get better surgery performance and save lot of surgery time

Market potential

India has more than 200000 new patients undergoing Knee Replacement every year. Patient specific instrument, PSI, for orthopedic surgery gives better outcome in surgery. However, it needs costly CT and MRI scans which may not be available at many places. In comparison, the XrayTo3D technology converts 2D Xray images of patients knee into 3D model like in CT scan

National/Societal relevance

Since the technology uses Xray images as input, its the best case for great surgical performance with low cost and easily available imaging. Apart from lowering the cost and improving accuracy in surgery, the surgical time saving and ease of use of the instrument can make surgeons available for more number of patients in high population country like India

Project achievements

- Progress vis-à-vis objectives:** As per objectives
- Technology/Product Developed:** 3D surgery planning software and Patient Specific Instrument designed based on 2D X-ray images
- IP generated/Potential for IP generation:** New IP may be generated on PSI design technology
- Resources generated:** 5 researchers trained and A few international collaborations achieved. Company named Algosurg Pvt. Ltd. is incorporated

Plans to take innovation further

Seeking collaborations with global implant manufacturers to take the product to global market

Risks envisaged

Regulatory clearances



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The Innovation

Novel Integrated resuscitation solution to empower front-line health workers to resuscitate newborns effectively

Brief description

NeoBreathe is the world's first foot operated newborn resuscitator which brings together everything needed to save the life of an asphyxiated newborn - on one robust, easy to use product

Stage of development

The product is commercialized under the name NeoBreathe. It was launched on 3rd December, 2016 and about 50 units have been sold with ~100 end users of the product

Unique features of the product/technology

The product has 2 handed mask holding, Real time pressure monitoring, Enhanced pressure safety, PEEP, Built-in suction, oxygen regulation and is reusable and autoclave safe. Every year 8 lakh babies die globally due to birth asphyxia. Almost all of them can be saved through resuscitation. Resuscitation with current devices is difficult to perform. NeoBreathe makes it easy to perform effective resuscitation - thus helping in saving lives

Market potential

The market potential is high. The key competitor products are Self inflating Bag-Mask (Low cost, low efficacy, hard to use, no value added features) and T-Peice resuscitator (High cost, high efficacy, difficult to use). In comparison to these, NeoBreathe is medium cost, proven high efficacy and easy to use

National/Societal relevance

India experiences one of the highest incidences of newborn death due to improper and unavailable resuscitation. NeoBreathe reduces the gap between the skill required and the skill available for saving newborn lives through resuscitation. It can thus help save the lives of babies

Project achievements

- Progress vis-à-vis objectives:** All objectives achieved. NeoBreathe has been commercialised
- Technology/Product Developed:** Foot operated newborn resuscitator developed.
- IP generated/Potential for IP generation:** 2 patents filed, one design registration.
- Resources generated:** Manpower employed/trained, Facility Created, Enterprise Created

Plans to take innovation further

The product is commercialized in partnership with Phoenix Medical Systems

Risks envisaged

Market adoption



Project coordinator
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Innovation Profiles

BIRAC Innovators



AGRICULTURE



AGRICULTURE **BIG**

Adit Bioscience Pvt. Ltd.

The Innovation

Affordable sexed semen technology for successful dairy farming

Brief description

To develop an affordable next generation technology that can accurately separate X and Y spermatozoa non-invasively. This is based on tagging differentiating markers using appropriate nanotechnology procedure

Stage of development

Proof of Concept

Unique features of the product/technology

Non-invasive approach Simple and faster separation which doesn't include any sophisticated equipment, High-quality semen for downstream application and low cost per dose

Market potential

At present ~12 million cattle population, i.e., only ~10 percent of the total breeding pool are bred with artificial insemination (AI). Due to the uncertainty of having a calf of desirable sex, AI has not penetrated to the larger population. So, at a conservative level, considering the dose of sexed semen @ 200/-, the market size is estimated to be ~Rs. 240 crores in India. Additionally, this technology is capable of fetching lucrative export orders across the globe. In addition to cattle, this technology can be suitably modified for other species such as equines, canines, sheep, goat, and pig as well as wildlife species as a boost towards conservation effort

National/Societal relevance

As this technology is an endorsement to AI practice and promises better quality sexed semen at an affordable cost, more and more cattle populations are likely to be covered under AI once desired sex is predetermined. This will significantly enhance the breeding management programme and improve dairy sector efficiency and profitability

Project achievements

- a. **Progress vis-a vis objectives:**
 - i. Few suitable markers have been identified
 - ii. Currently, validation of marker, optimization of separation technology & semen analysis are under process
- b. **Technology/Product developed:** Non Invasive technology development for better quality sexed semen
- c. **IP generated/Potential for IP generation:**
 1. Nanotechnology based separation of sperm cells
 2. Computer-assisted semen analysis platform development
- d. **Resources Generated:**
Manpower - 1, Summer Intern - 1

Plans to take innovation further

The technology in its current form will not be market-ready and need further investment for refinement and prototyping. Partners are needed to help bring venture to next level

Risks envisaged

Emergence of any disruptive technology will put us at risk though this is highly unlikely. The incubation time is bit longer



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The Innovation

Bacteriophage based control of *Vibrio harveyi* infection in shrimp

Brief description

The indiscriminate use of antibiotics in aquaculture has led 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 the 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

Stage of development

Product developed & commercialized

Unique features of the product/technology

Effectively reduces the *Vibrio* counts in Ponds, decreases mortality. Reduces disease incidence and increases survival. Non-chemical anti-microbial formulation No damage to the normal beneficial bacteria. Active against antibiotic resistant bacteria

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 $200000 \times 1000 \times 0.5 = \text{Rs. } 10 \text{ crore per annum}$

National/Societal relevance

Bacteriophage therapy will be a major breakthrough in the treatment of *Vibrio harveyi*

Project achievements

- Progress vis-a vis objectives:** All of the objectives have been accomplished
- Technology/Product developed:** Probiotics cost Rs.5000 to 32000 per kg. Vibrioshield is currently priced at Rs.5500 per kg
- IP generated/ Potential for IP generation:** Under process
- 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



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AGRICULTURE **BIPP** ATGC Biotech Pvt. Ltd.

The Innovation

Development of Novel Technologies for Integrated Pest Management through Mating Disruption using Patented SPLAT Formulation

Brief Description of the Product/Technology

An innovative tool to achieve insect family planning in Agriculture through mating disruption. The technology confuses adult males by luring them to our product which has 10x concentration of female sex pheromone. This false plume of female is emitted by at least 400 source points per acre and adult males always confuse and do not mate with their female counterpart. This prevents further generations of the insect population and protects from crop damage

Stage of development

Pre-commercialization

Unique features of the product/technology

The technology is certified by US EPA that all the ingredients used in the product are edible grade. With minimum labor & time and without physical stress farmer can apply 1 acre in 10-20 minutes. No toxic effect on user/farmer/worker and animals and no off target effects. Bio-degradable and environmentally safe and also safe to honey bees, pollinators and natural enemies like predators and parasitoids. No phyto-toxicity reported. Globally, the pricing for similar products are around Rs 15,000 to Rs 25,000 per acre for other pests as such there are no similar products. The cost is Rs 1500 to for 4 weeks control which is several folds cost effective

Market potential

Estimated market potential worldwide for pheromone based mating disruption pest management solutions would be US \$ 8 billion by 2022. Indian market estimate stands US \$ 3 Billion. Till date there is only one company in the world which has similar technology covering \$ 2 billion market size. ATGC Biotech has products which has a market size of \$ 14 billion globally and \$ 3 billion in India alone. Pheromone based pest control solutions for target crops are developed for the first time

National/Societal relevance

The problem which is proposed to be solved is of high significance as there are no alternatives, including pesticides for the crop pests targeted. The study also shows increase in farm income significantly. This technology confers long term solution and does not confer any kind of resurgence in the pest, unlike robust technologies like BT- GM crops too fail over a period of time

Project achievements

- Progress vis-a vis objectives:** Project is progressing well in advance as per the objectives and is similar to our global results with our technology
- Technology/product developed:** This technology offers 4 weeks pest control per application compared to pesticide applications wherein 10 pesticide sprays are being applied in a 30 day calendar
- IP generated/ Potential for IP generation:** The IP of semiochemical synthesis is protected as a trade secrets and the formulation is covered under various patents worldwide
- Resources Generated:** Under the program more than 20 academic project investigators, 60 doctoral and post doctoral fellows, field assistants were trained and workshops/ field days were organized as part of BIRAC funded program

Plans to take innovation further

Collaborated with multinational agrichem/pesticide companies to bring the products into market. They have been made part of various field days and visits in ongoing and trials are being made to create awareness

Risks envisaged

All possible risks have been evaluated and addressed with appropriate solutions



Project coordinator

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The Innovation

To develop sustained release pheromone dispersion formulation and trap for the In house synthesis, patented and commercially affordable pheromones used by the farmers to control agricultural pests enabling organic cultivation

Brief Description of the Product/Technology

Stable sustained release pheromone dispersion formulation and trap for the effective control of Early shoot borer, Yellow stem borer and Groundnut leaf miner

Stage of development

Early Stage Validation

Unique features of the product/technology

In house synthesised pheromones are high pure, stable, cost effective. The dispenser has been developed with In house design. The company has also developed prototype trap for monitoring and mass trapping of specific pests

Market potential

IPM sector will reach around 14 billion dollars by 2020 & market potential in India is above 10 billion USD. The competitive dispenser technologies such as wood impregnation technology, rubber wick technology, cotton thread technology etc are not efficient for the sustained release of blended dose of pheromones for effective attraction of specific pests

National/Societal relevance

Many techniques of isolation, purification and synthesis of pheromone components have been perfected in many leading countries such as USA, Europe, Japan and Germany. In India, lot of work has been done on the synthesis of pheromones. The important aspect is the monitoring of the quality of pheromone chemicals, quantity of pure pheromone loaded in each dispenser, quality of material used in the construction of dispenser and their packing, quality of material used for traps and uniform standards for their design to achieve desired trapping efficiency, quality of insect collecting bowls, plastic sleeve bags etc., all of which play a significant role in deciding shelf life and field efficacy

Project achievements

- Progress vis-a vis objectives:** The pheromones have been identified and synthesised in 5g scale for the corresponding crops and the scale-up as well as validation batches has to be complete
- Technology/Product Development:** Pheromone dispersion formulation and trap
- IP generated/Potential for IP generation:** A process for synthesis of Z-9-Hexadecenal & Z-9-Hexadecenyl acetate (Patent Application number: 4849/CHE/2015) and a process for synthesis of Z-7-Decenyl acetate (Patent Application number: 4604/CHE/2015)
- Resources Generated:** This project has given opportunity for 8 employees to carry their work in the field of sciences, and enhanced the facility by adding new equipments chemicals and utility

Plans to take innovation further

The aim of the project to control economically important pest in R&D level. Company has enthusiastic to take this project further to commercialization with the partnership with either by government or non-government organisation to support mankind to get rid of pesticides through farmers

Risks envisaged

On time delivery of pheromone molecules to the end users, Prototype trap development pertaining to insect behaviour



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The Innovation

Identification of QTL(s) for drought tolerance and their introgression in elite cultivars of rice

Brief Description of the Product/Technology

Through several years of screening of rice germplasm lines under drought, Bioseed has selected few lines which show very high level of drought tolerance at reproductive stage

Stage of development

Proof of Concept

Unique features of the product/technology

The identified high value QTL(s) will be transferred/stacked in other high yielding cultivars to make them drought tolerant. This approach is expected to deliver drought tolerance technology in high-yielding cultivars of rice in India

Market potential

Development of improved rice cultivars tolerant to biotic and abiotic stresses can result in production of an additional 100 million tonnes of rice, enough staple food for about 400 million people every year, and US\$50 billion in additional annual income to its rice farmers

National/Societal relevance

Drought is one of the major constraints to increased and stable agricultural production in India. As a result of the severe drought of 2002, agricultural GDP growth decelerated by 5.2 vis-a-vis 2001. This decline in agricultural GDP translated into a reduction in GDP growth by 1.8 percentage points. Development of rice cultivars that tolerate drought will be helpful in maintaining the productivity of irrigated as well as rainfed rice production

Project achievements

- Progress vis-a-vis objectives:** Two drought tolerant and a drought susceptible line has been selected and preparation of two sets of recombinant inbred lines for mapping of drought tolerance QTLs under preparation. The protocol for screening RILs under drought is also optimised for large scale field experiment. One of the important component of genetic mapping experiment is availability of high-throughput genotyping platform. A set of 2500 SNP assays developed from in-house rice germplasm is available for genotyping of the mapping populations
- Technology/ Product developed:** QTL discovery in drought tolerance in rice
- IP generated/ Potential for IP generation:** The drought tolerant lines developed in the project will be protected under plant variety protection act. The SNP markers and DNA sequences will be protected through appropriate IPR protection strategy
- Resources Generated:** 4-5 technical manpower having expertise in molecular breeding, genomics and bioinformatics were employed. A high-throughput genotyping facility is set up to take care of the genotyping requirements of the project

Plans to take innovation further

In the first study few linked markers are identified in the region of interest. This is followed by designing of interval markers covering the region of interest, targeting coding regions of the genes present. Further study is possible on identification of genes responsible for trait in a smaller genomic region consisting of 10-15 genes

Risks envisaged

It may not be possible to identify 2-3 major effect QTLs responsible for 70-80 % impact on drought tolerance trait. Also, despite using higher number of SNP markers for foreground and background selection it may not be possible to break the linkage drag and fully recover desirable grain type in the final product



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The Innovation

Discovery of genome-wide SNPs and its use in developing a reference linkage map and association analysis in castor

Brief Description

A 6K SNP genotyping array was developed and validated. A reference linkage map with 1126 marker loci was constructed. A set of SNPs linked to *Fusarium* wilt resistance was identified

Stage of development

Early Stage Validation

Unique features of the product/technology

The SNP genotyping array, the SNP marker based linkage map and the information on SNPs linked to wilt resistance were generated for the first time in castor. Genomic information and tools required to speed up the breeding process in castor. The tools and information developed in this project would help the castor researchers to improve the efficiency and effectiveness of developing new cultivars, which in turn help farmers to realize higher productivity and income

Market potential

Castor is an economically important oilseed crop in India earning about 4,000 crore rupees through the export of castor oil and its products. This crop is the only source of an unusual fatty acid, ricinoleic acid. Current productivity levels in castor are inadequate to meet the requirement, which underscores the need for breeding high yielding cultivars with better adaptability. Availability of genomic knowledge and tools would facilitate the castor breeders in effective cultivar development

National/Societal relevance

Castor is mostly grown in marginal lands contributing significantly to the livelihoods of the resource poor farmers in India. India occupies the first position in the world in terms of area and production. To sustain the castor cultivation in India, it is imperative to increase the yield potential and close the yield gap by developing high yielding and resilient cultivars

Project achievements

- Progress vis-a vis objectives:** Genome-wide SNPs were discovered by resequencing of 12 diverse castor genotypes. A 6K SNP genotyping array was developed and validated by genotyping over 300 castor germplasm accessions. A mapping population of 230 recombinant inbred lines was developed
- Technology/ Product developed:** A reference linkage map with 1126 marker loci was constructed. A set of SNPs linked to *Fusarium* wilt resistance was identified
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** Two research fellows were employed in the project. A high-throughput genotyping facility with liquid handling system for DNA extraction & PCR setup and Fluorescence plate reader for SNP genotyping was established at Indian Institute of Oilseeds Research

Plans to take innovation further

The linkage map will be used for locating useful agronomic genes/genomic regions in castor. The marker linked to *Fusarium* wilt resistance will be further validated and ultimately integrated in to regular breeding programmes

Risks envisaged

NA



Project coordinator
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AGRICULTURE SBIRI

FIB-SOL Life Technologies Pvt. Ltd.

The Innovation

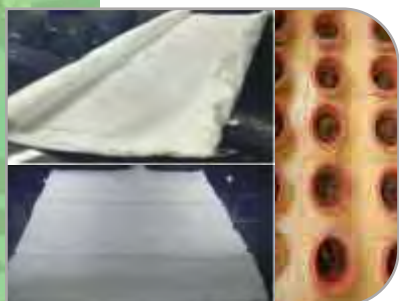
Development of a stable nanofiber carrier for biofertilizers

Brief Description

Developed a nanofiber based fertilizer carrying membrane hosting high pay load (10^{11} cfu/g) of agriculturally important micro-organisms like nitrogen fixers

Stage of development

Proof of Concept



Unique features of the product/technology

Developing nano-fiber based fertilizer carrying membrane which is made of biocompatible polymers to stabilize a high pay load of agriculturally important microbes. The membrane is water soluble and biodegradable and hence leaves no undesirable residues in the soil. The stability and the bulkiness of the biofertilizers are the major issues addressed by the current technology. The reduction in the logistics cost will reduce the cost of the product, which will be a benefit to the farmers. The proposed technology also promote organic farming

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. Solid and liquid biofertilizers are available in the market. A condensate technology is also available from Tropical Agro and Cadilla where-in 10 gram of the material is sufficient for an acre. However the proposed technology is superior to the condensate technology since it eliminates the need for lyophilization and microcapsule formation, thus cuts down the cost

National/Societal relevance

A light weight carrier for bio-fertilizer is a boon to the farmers located in remote areas with less transport facility. Storage of bio-fertilizers is also a problem. The present product resolves the stability issue by protecting the bacteria from adverse climatic conditions

Project achievements

- 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
- Technology/ Product developed:** Nano-fiber membrane hosting a high pay load of nitrogen fixing bacteria which is less bulky than the conventional biofertilizers have been developed
- IP generated/ Potential for IP generation:** An ultra light weight nanofiber polymer carrier for use in agricultural and industrial applications (IDF 1298-F02-CS 3490/CHE/2015). PCT filed for the patent
- Resources Generated:** 4 people were employed and trained in the project. A large scale pilot set up for making nanofibers 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
- Scaling the production of nanofibers

Risks envisaged

Competition from existing bio-fertilizer manufacturers and investments for scaling up operations

Project coordinator

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The Innovation

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

Brief Description

Introgression of genes Pi1, Pi2, and Pi54 conferring resistance to rice blast to rice inbred GK Kaveri and hybrid GK5017. Improved versions of GKSPL variety/hybrid with resistance to blast would reduce the loss due to cause of blast disease and would ensure all agronomic traits including grain quality

Stage of development

Early Stage Validation

Unique features of the product/technology

Key feature of the technology lies in the 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. Since the hybrid/variety has the genes introgressed for blast resistance, the additional cost incurred for spraying of fungicides, damages due to disease incidence and loss to the farmers can be reduced and minimized



Market potential

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

National/Societal relevance

Developing Blast resistant varieties is important for sustainable management of the disease. Output of the project will be helpful to farmers by reducing the loss due to disease, cost of blast control measures and enhancing productivity

Project achievements

- 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:** 3 Research Associate employed. Uniform Blast nursery facility created

Plans to take innovation further

Product is under multi-location field trials for kharif-2017 and after final validation and all other agronomic characters the variety/hybrid will be commercialized in near future

Risks envisaged

NA

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AGRICULTURE SBIRI

Ganga Kaveri Seeds Pvt. Ltd.

The Innovation

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

Brief Description

Introgression of three dominant resistant genes Bph 18, Bph 20 and Bph 21 in to BLB improved GK-rice hybrid parental lines

Stage of development

Early Stage Validation



Unique features of the product/technology

Stacking of Bacterial Blight and Brown Plant Hopper resistance genes in the Paddy Hybrids would offset the damage due to the pest and disease incidence across endemic areas. Since the genes are being stacked, it would give better returns to the farmer due to insulation provided during the pest outbreaks

Market potential

Three hybrids (GK5028, 5003 & 5017) with high yield potential of 6 to 8.5 tons/ha would cover different rice growing areas based on the rainfall and irrigation pattern in Eastern U.P., Bihar, M.P., Jharkhand and Chattisgarh. However, hybrids of similar duration exist in the market with individual resistances

National/Societal relevance

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

Project achievements

- Progress vis-a vis objectives:** The parental crosses were made and the F1s are being tested for hybridity with polymorphic markers and the parental lines are being tested for their response to tissue culture media
- Technology/ Product developed:** Individual F1s were crossed to generate double cross F1s
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:**
 - Manpower employed: Research Associates-3 and Technical Assistants-3
 - Facility created: BPH and Bacterial blight Screening facility

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

NA

Project coordinator
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The Innovation

Generation, evaluation and regulatory appraisal of selected transgenic events for enhanced tolerance against *Lepidopteran* insect pests in cotton, rice and brinjal

Brief Description

Developed 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. *In vitro* as well as *in-vivo* bioassays were carried out to select transgenic events with single copy integration for enhanced resistance against the caterpillars of bollworm complex such as American bollworm (*Helicoverpa armigera*), Spotted bollworm (*Earias vittella*), Pink bollworm (*Pectinophora gossypiella*) and Army worm (*Spodoptera litura*) for cotton

Stage of development

Proof of Concept

Unique features of the product/technology

The new Bt-gene events in Cotton, Rice or Brinjal are expected to be superior or at least equal to the best transgenic events that are currently deployed for commercial cultivation. The proposed technology is not only an alternative to the imported technology but also expected to be superior to existing technologies. The proposed project will improve cotton farming and reduces the dependence on foreign technology

Market potential

Monsanto Bollgard II is the main competitor for Bt-cotton technology. Pre-commercial stage of Bt-cotton, jointly with the Department of Agriculture, Government of the Philippines has been achieved and the Fusion-Bt cotton technology licensed from China and now wholly owned by Global Transgenes Limited. The developed technology services may be extended to the neighbouring countries such as Burma, Vietnam, Philippines etc

National/Societal relevance

Development of indigenous GM-Crop technologies superior to the existing Bt-Cotton would greatly benefit Indian farmers. This will ease cotton farming community problems and also reduce the dependence on foreign companies

Project achievements

- Progress vis-a vis objectives:** The objective was generation and evaluation of the transgenic events having Cry genes against *Lepidopteran* insect pest in Rice, Cotton and Brinjal. They have generated single copy events having Cry genes in Rice, Brinjal and Cotton and their validation was in progress at the time of validation of the project
- Technology/ Product developed:** Development is under process for Bt cotton with Cry genes
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** Trainees and scientific staff were employed. Established and upgraded Cotton and Rice Transformation & Molecular Biology Laboratories. 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

Global Transgenes Ltd is associated with M/s. Nath Bio-Genes (I) Ltd for regulatory processing and GEAC approvals and may licence these technologies to any other companies in India or abroad, on non-exclusive basis

Risks envisaged

It is difficult to obtain commercialization approval for transgenic events and the use of GM technologies in Indian agriculture



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AGRICULTURE **BIG**

Hameeda Bee - IKP

The Innovation

Production of Biofungicide Iturin from *Bacillus amyloliquefaciens* RHNK22

Brief Description

The proposal aim is on process development for "production of biofungicide iturin A by novel strain *B. amyloliquefaciens* RHNK22" isolated from groundnut rhizosphere using synthetic medium and low cost de-oiled cakes as media components. Iturin A is a novel class of potent lipopeptide biofungicide which act against various phytopathogen by disrupting cell membranes. It can be applied directly by conventional spray, fog, or hydroponics to treat plant foliage, fruits, roots, seeds and soil. The toxicological studies revealed that iturin A has no adverse effects and easily biodegradable. It is target specific and acts at low concentration, hence less quantity of active ingredient can be applied

Stage of development

Proof of Concept

Unique features of the product/technology

Development of cost effective medium for production of iturin upto 8g/litre in 250 ml flask using an efficient Bacillus species. Subsequent studies will be conducted in 5 litre bioreactor for commercialization of iturin A, which is used as broad spectrum fungicide. It will have a great impact on the society and market because of its low toxicity and target specificity. Iturin will be produced using low cost and easily available deoiled cake as substrates. Till date in India there is no company producing metabolite like Iturin or Fengycin or Rhamnolipid used in the agriculture fields as a biofungicides or biopesticides

Market potential

Global biopesticides market is primarily driven by the huge prevalence of crop diseases and growing demand for organic foods. Iturin can be a good alternative for synthetic fungicides which cause environmental pollution. In Indian market, microbial metabolite based biofungicide is not available. Hence, Iturin has good commercial value since it is cost-effective and non-toxic biofungicide

National/Societal relevance

Chemical fungicide residues are entering into the food chain which is causing serious diseases to human and animals. Hence, use of economic and non-toxic microbial metabolite based biofungicide could help in reduce the usage of toxic fungicides

Project achievements

- Progress vis-a vis objectives:** Iturin production is standardized and efficient extraction methods developed in large flasks 1-3 ltr on a rotary shaker.
- Technology/Product developed:** Production of iturin in 5 litre bioreactor is are under process
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** One project scientist, one project fellow and one laboratory assistant employed. R&D Lab has been developed with the facilities to work and start up company "KALAM BIOTECH PVT. LTD." has been registered

Plans to take innovation further

Validation of the product after development and later to take the product for commercialization.

Risks envisaged

Cutting down the cost of production is a factor which has to be addressed.

Project coordinator

Hameeda Bee

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The Innovation

Validation of serological diagnostic reagents and kits for plant viruses affecting horticultural crops

Brief Description

Plant viruses are significant constraints in production of horticultural crops in India. Serological diagnosis is a widely used diagnosis method for plant viruses all over the World, major limitation being the non-availability of high purity and adequate quantity of antigens. To overcome such limitations, the capsid protein (CP) genes of different plant viruses affecting important crops were expressed in bacteria (*E. coli*) and utilized to produce polyclonal antibodies (PAb). The proposal is based on the above prototypes of diagnostic kits for detection plant viruses already developed at IARI

Stage of development

Early Stage Validation

Unique features of the product/technology

The proposal envisages making of a DAS ELISA kit coated with polyclonal antibodies and biotin labeled conjugated monoclonal antibodies as detecting antibodies and streptavidin labeled with alkaline phosphatase for PVX and PVS developed and validated. DAS ELISA kit cost will be considerably less than the commercially available similar products. Virus free quality planting material will be available which will give high produce to farmers

Market potential

Commercial kits for these plant viruses are available in market but they are of very high cost, no indigenous kits are available in the market, so product will be utilized in Indian prospective. Diagnostic reagents & ELISA kits are available from multinational companies and are very expensive

National/Societal relevance

This will help to produce good quality virus free potato seed planting material, particularly in vegetative propagated crop like potato, banana and orchid

Project achievements:

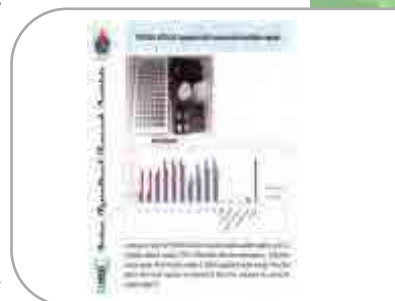
- Progress vis-a vis objectives:** Out of 7 potato viruses, polyclonal antiserum to 6 potato viruses and monoclonal antiserum to 4 potato viruses were produced and successfully validated. Two DAS-ELISA kits PVX and PVS have been developed and validated. Out of 4 banana viruses, polyclonal antiserum to CMV and BBrMV validated. Immuno-Capture PCR was successfully standardized to detect the BBTv and BSMYV using poly and monoclonal antibodies both in banana samples. Monoclonal antiserum of CMV validated. For 2 orchid viruses CyMV, ORSV, Polyclonal and Monoclonal antiserum validated and DAS-ELISA kits have been developed and validated but there are some issues of background reaction with healthy sample
- Technology/Product developed:** DAS-ELISA kit has been developed for detection of potato virus
- IP generated/Potential for IP generation:** ToLCNDV and BBrMV polyclonal antibodies have potential for IP generation. ELISA kits also have potential for IP
- Resources Generated:** Two manpower employed were trained

Plans to take innovation further

The ELISA kit developed in the project will be commercialized

Risks envisaged

Background reactions may be high and low titre antibodies may not be useful for lateral flow device i.e. Dipstick



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Indo American Hybrid Seeds

The Innovation

Marker assisted gene pyramiding of blast and bacterial blight resistance genes into CMS & maintainer lines of rice

Brief Description

Introgression of multiple genes to pyramid BB resistance genes Xa21, xa13 and Blast genes Pi1, Pi2 and Pi54 in to elite hybrid female parents CMS and its cognate lines

Stage of development

Early Stage Validation

Unique features of the product/technology

Marker assisted selection technology address the developing genetically identical lines with new trait near isogenic lines. Using closely linked markers specifically linked to genes and genome, the genetically identical plants can be developed without any linkage drag. It is an indirect selection approach wherein genes can be introgressed very easily at low cost without much altering the native genome of plant. Unique feature is in the introgression of multiple genes to pyramid BB resistance genes Xa21, xa13 and Blast genes Pi1, Pi2 and Pi54 in to elite hybrid female parents CMS and its cognate lines

Market potential

Presently, the market share of the hybrids is 600 tones, if bacterial blight and blast resistant hybrids are developed; certainly the market share goes more than 1000 tones. As of now no hybrids are in the market resistant to bacterial blight and blast diseases, however many varieties released by the public research institutes and hybrids from private companies for single disease resistance are being cultivated by the farmers

National/Societal relevance

Suitable to disease endemic areas, assured yield under disease endemic areas and will minimize the cost of cultivation and great returns

Project achievements

- Progress vis-a vis objectives:**
 - Gene pyramided CMS and Maintainer lines confers resistant for BB and blast diseases
 - Converted B lines can be used as source of donors
- Technology/Product developed:** In progress
- IP generated/Potential for IP generation:** Not generated
- Resources Generated:** NA

Plans to take innovation further

Stacking abiotic stress tolerance genes into CMS & maintainer lines of rice

Risks envisaged

Screening with pathogen specific races

Project coordinator
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The Innovation

Development of biotic stress resistant rice through conjunct use of bio- and hybrid technologies

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

Stage of development

Early Stage Validation

Unique features of the product/technology

The uniqueness of the project is that improved hybrids having multiple disease resistance for BLB, Blast and Bph, and such multiple biotic stress tolerant hybrids will accelerate farmer's adoption and spread of hybrid rice production

Market potential

Rice being a high volume crop, the potential for hybrid rice seed demand is huge. However, so far no public or private bred hybrid with tolerance to multiple biotic stresses is available for commercial cultivation in India. Even though, some private companies have released competitive hybrids with single disease resistance and received good response in the market

National/Societal relevance

The Relevance is due to the fact that the proposal supports one key objective: Seed being the repository of genetic potential, contributes to productivity increase there by creating revenue pathways to farmers

Project achievements

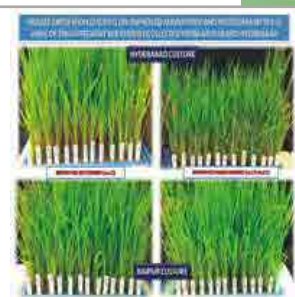
- Progress vis-a vis objectives:** Improved hybrids are being synthesized which need to be evaluated for their performance
- Technology/ Product developed:** Improved hybrids are being synthesized
- IP generated/ Potential for IP generation:** The hybrid developed will be registered with PPV & FR for proprietariness of the product
- Resources Generated:** Phenotyping facility for the screening of Brown Plant Hopper and blast resistance, pollination chamber for crossing program and grain quality lab was developed for grain and cooking quality analysis

Plans to take innovation further

After conducting multi-location trials of improved hybrids, these improved hybrids will be commercialized.

Risks envisaged

NA



Project coordinator
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The Innovation

Marker-assisted dissection of genetic basis of yield and improving yield potential under drought stress in Maize.

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.

Stage of development

Early stage validation

Unique features of the product/technology

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. Improving maize productivity under drought conditions is imperative to meet the growing demand and to ensure food security of millions of poor people in the country. Alternatively, molecular marker technology complementing traditional breeding offers a promising solution to improving maize productivity under drought conditions. Thereby, could generate better revenues to the farmers in the country

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

Project achievements

- Progress vis-a vis objectives:** Marker-assisted dissection of genetic basis of yield and drought tolerance is completed successfully and the improving parental lines using marker-assisted recurrent selection (MARS) method is under progress
- Technology/ Product developed:** High yielding drought tolerant hybrids will be developed
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** NA

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

Project coordinator

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The Innovation

Metabolome analysis in ginger and product development using gingerol

Brief Description

Ginger is valued for its spicy and medicinal properties. Ginger finds wide range of applications in traditional medicine and also in nutraceutical and health food industries. One of the limiting factor in product development using gingerol is the unstability of gingerols in product. The focus of the study was to develop a stable product with total gingerols more than 8 per cent which can be used as a pharmaceutical ingredient

Stage of development

Pre-commercialization

Unique features of the product/technology

The project aims at developing a stable product with total gingerol more than 8 per cent using a high gingerol yielding variety of ginger 'Karthika' developed by Kerala Agricultural University. 6-gingerol is the most potent of different gingerols present in ginger and pharmacologically more active bioactive compound and is now a target for drug development. 6-gingerol can induce stress in cancer cells and cause apoptotic cell death and is effective for the treatment of ovarian gastric postrate and colorectal cancer. Low recovery of gingerol from raw materials and non-stability of gingerol in the final product are the problems faced by the industry. High gingerol yielding somaclones and the technology for stability of gingerol developed by Kerala Agricultural University could be useful in the product development. The end product produced from high quality raw material and quality production process followed could supply quality finished product to the society



Market potential

The export prospects of Indian ginger are high. Ginger fetches a premium price in the world market because of its superior quality. India also now emerged as a potentially good producer and exporter of value added products of ginger like ginger oil and oleoresin. Indian ginger is valued in the international market for high quality components

National/Societal relevance

The cultivation of high gingerol yielding clones developed by Kerala Agricultural University for product development is the next step of the project. The company can enter into Contract Farming through society or a cluster of Farmers. This will get assured market for high quality ginger and there by sustainable income for ginger farmers

Project achievements

- Progress vis-a vis objectives:** Standardised dry ginger extract with high level of gingerol and standardized the temperature, pH and storage conditions for stability of gingerols. Purification of 6-gingerol is achieved and found stable in nitrogen atmosphere at low temperature
- Technology/ Product developed:** Ginger variety 'Karthika' with 12.27% total gingerol
- IP generated/Potential for IP generation:** Patent application has been filed and patent processing is ongoing
- Resources Generated:** Eight manpower employed were trained for various aspects of product development

Plans to take innovation further

The product 'Karthika' with 12.27% total gingerol will be taken forward through contract farming

Risks envisaged

Proper procurement of dry ginger samples from farmers

Project coordinator
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Kwaklei and Khonggunmelei Orchids Pvt. Ltd.

The Innovation

Commercial orchid breeding and production of clones of elite hybrids

Brief Description

Elite clones of the primary hybrids are being micropropagated for commercialization and these are further used for genetic improvement through hybridization

Stage of development

Proof of Concept



Unique features of the product/technology

Orchid based industry is at infancy in India because there is dependency for new hybrids to other orchid breeding countries. If there is continuous supply of new breeds to the growers the industrial scope will be enormous and Indian growers will be self sustainable. Hybrid orchid price can range from Rs. 100 to Rs. 2-5 lakh or above according to rarity and novelty and for general people, it shall cost approx. Rs 100 - 500. This price shall be good enough to meet competition from abroad and in India. Elite clones of the primary hybrids are being micro-propagated for commercialization and these are further used for genetic improvement through hybridization

Market potential

The flowers and pot plant command highest price in markets due to their incredible range of diversity in size, colour, shape, forms, appearance and long lasting flowers. Indian orchids are less exploited commercially and there is great potential for commercialization both in domestic as well as international market. Orchid breeding work is done in Sikkim, Arunachal Pradesh, Kerala and Manipur; however, they are doing in R&D mode or cottage industry scale

National/Societal relevance

Kwaklei and Khonggunmelei Orchids Pvt. Ltd. can lead into employment generation in many states such as Manipur, Nagaland, Mizoram, Arunachal Pradesh, Kerala, Karnataka, Maharashtra, etc

Project achievements

- Progress vis-a vis objectives:** Project just started, however, breeding as well as micropropagation works are undergoing
- Technology/ Product developed:** Elite clones of the primary hybrids are being micropropagated for commercialization
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** NA

Plans to take innovation further

Partnership with Government and Non-Government Organisation shall be encouraged

Risks envisaged

All the synthesised orchid hybrids may not do well in international trade

Project coordinator
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Kwaklei and
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Vijaygovind Imphal
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The Innovation

Development of nutritionally improved mustard (*Brassica juncea*) varieties/hybrids having low erucic acid and low glucosinolate content using marker assisted selection

Brief Description

Double low mustard varieties with less than 2% erucic acid in the oil and less than 30 μ mole glucosinolate in the defatted meal are developed using molecular marker assisted selection

Stage of development

Pre-Commercialization; Multi-location trials and seed production are in process. Product will be commercialized after conducting trials and seed production.

Unique features of the product/technology

Double low mustard varieties with less than 2% erucic acid in the oil and less than 30 μ mole glucosinolate in the defatted meal are developed using molecular markers linked to low erucic acid and glucosinolate content. Developed product will have high nutritional quality which is nutritionally desired having no adverse effect on health and meet international standards for mustard oil

Market potential

Currently, the cultivation of canola varieties accounts for less than 1% of the total area under rape-seed and mustard in India. Raising the share of canola quality varieties and hybrids under rapeseed mustard cultivation is important for increasing the quality of edible oil available to the consumers in the country. Development of canola quality varieties would therefore, increase its market significantly and enhance the cultivation of the crop

National/Societal relevance

A double low variety is expected to have wider acceptance and increased utility both as edible oil and cattle feed that would ultimately benefit Indian farmers

Project achievements

- a. **Progress vis-a vis objectives:**
 - Donors and recipient parents were selected based on phenotype and linked molecular markers
 - Marker assisted introgression of double low trait into elite mustard varieties
 - Phenotypic validation of interrogated varieties and lines
- b. **Technology/Product developed:** New variety NML 100 with double low trait and superior agronomic character is developed
- c. **IP generated/Potential for IP generation:** Not generated
- d. **Resources Generated:** Employment: 4; Facility: Anther and microspore culture laboratory are developed

Plans to take innovation further

Double low NML 100 *Brassica juncea* will be commercialized as a variety and will be further advanced to hybrid development

Risks envisaged

Selection for low erucic acid and low glucosinolates is difficult due to the complicated genetic factors associated with these traits and the biggest challenge is on combining the double low characteristics with good yielding capability



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AGRICULTURE **BIPP**

Nirmal Seeds Pvt. Ltd.

Collaborator: University of Delhi South Campus

The Innovation

Development of Viral resistant okra using RNAi approach

Brief Description

Transgenic okra line harbouring hairpin RNAi construct will be developed. The virus resistance line will be completely resistant to YVMV

Stage of development

Proof of Concept

Unique features of the product/technology

The Company has incorporated marker removal strategy for transgenic plants. Plantlet regeneration in okra will be carried out using different methodologies like zygotic embryo, in planta, apical shoot and petiole as explants

Market potential

YVMV is the major crop disease in okra resulting heavy yield losses, no strategy is available to control the spread of virus. 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 increasing cultivation and production of crop

National/Societal relevance

Okra is most widely cultivated in India It is good source of vitamin B6, vitamin-C, fibre, calcium and folic acid, also rich in protein, minerals, and iodine which helps to nutrition. It prevents neural tube defects indeveloping foetus. Okra is affected by yellow vein mosaic virus .YVMV infection at 50 to 65 days after germination results in heavy yield losses of 64 to 49 percent. YVMV resistant genotypes developed using RNAi approach will have wide acceptance and increased utility both as nutritional and medicinal crop. This would ultimately benefit Indian farmers and society

Project achievements

a. Progress vis-a vis objectives

- Development of agrionfectious clones
- Development of RNAi constructs
- Development of 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

The product involves RNAi Technology to develop resistance against Geminiviruses in okra

c. IP generated/ Potential for IP generation

No IP generated so far

d. Resources Generated

- Developed infrastructure for transformation of okra
- Developed field poly house for growing transgenic pants
- Employed manpower and developed scientific capabilities

Plans to take innovation further

Virus resistant transgenic okra varieties will be developed. Hybrid resistance to YVMV will be developed. 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

Project coordinator
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The Innovation

Development of okra varieties resistant to YVMV using marker assisted selection

Brief Description

Development of YVMV resistant varieties of okra using marker assisted breeding that will significantly protect yield losses due to YVMV ultimately enhancing yield by 75 -80 percent

Stage of development

Early Stage Validation

Unique features of the product/technology

Okra YVMV disease resistance marker has been developed, Marker validation will be done in summer season at multi location hot spot areas

Market potential

The total area of production under okra is reported to be 1148.0 thousand ha and 7896.3 thousand tons respectively. Largest area and production is in India 73 followed by Nigeria 12. Major competition in okra export is from Nigeria, Ghana, Pakistan and Egypt. Hence India must increase the productivity and enhance the quality, in order to enhance competitiveness so that India can make quality product available at a competitive price

National/Societal relevance

The YVMV causes heavy losses upto 95 by infecting at all the stages of plant growth. Since the disease cannot be controlled properly by chemical means, the only practical solution of this problem is to develop tolerant/resistant varieties. The proposal aims to develop the prerequisites for developing resistant varieties through marker assisted breeding

Project achievements:

a. Progress vis-a vis objectives:

- Development of Mapping populations for YVMV resistance
- Phenotyping and genotyping of Mapping populations

b. Technology/Product developed: Variety development is in progress

c. IP generated/Potential for IP generation: Not generated

d. Resources Generated: Infrastructure like polyhouse, lab and capabilities were developed

Plans to take innovation further

Once the markers linked to YVMV traits are developed, markers will be used to develop hybrids and varieties using MAS breeding strategy and these will be directly commercialized in the market by NSPL

Risks envisaged

NA



Project coordinator
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AGRICULTURE BIPP

Saveer Biotech

The Innovation

Towards Smart and Efficient Nanopesticides for Indian-Agro Industry

Brief Description of the Product/Technology

The technology is aimed at betterment of the pesticide activity of nano silica (n-SiO₂) by functionalization of silica, mesoporous silica and ZnO nano particles using in house induction plasma system IPS for insecticide and fungicide activities respectively

Stage of development

Early Stage Validation

Unique features of the product/technology

The project aims at addressing the insecticidal and fungal effects separately with nSiO₂ and nZnO which will acts as insecticide and fungicide respectively. Lab-scale research has already projected SiO₂ and ZnO nanoparticles as efficient insecticides

Market potential

A lot of investigations are underway to find out the suitable alternatives and nanotechnology occupies the crucial role. The nanosilica materials developed are effective in managing insects in stored grains and the experiments are underway to make them more efficient and applicable for the field insects. The aim of this project is not only to develop efficiently nano pesticides and fungicides, but also to provide cost-effective materials. However, there are no such products in the Indian market and the technology carries immense market potential

National/Societal relevance

Pesticides are the key factors which determine the crop yields and most of the pesticides developed for pest resurgence, depletion of natural enemies, pesticide residues, pesticide poisoning do not yield the desired results. Based on the research output, silica, metal oxide nano particles like ZnO could be a better possible and cost effective alternatives to the existing pesticides and fungicides for the Indian-Agro industry

Project achievements

a. Progress vis-a vis objectives

Synthesis of nanoparticles of zinc oxide, silica and porous silica coated with polymer has been completed and their physical characterization, generating toxicology data according to CIB approvals are ongoing

b. Technology/Product Developed

Development of SiO₂ and ZnO nanoparticles as efficient insecticides

c. IP generated/ Potential for IP generation

No IP has been generated so far based on the results obtained in the previous project. However, there is a possibility of IP generation for the standard operating procedures SOPs for silica and ZnO nanoparticles and polymer coated porous silica nano particles and their enhanced pesticide activity towards insects and fungi.

d. Resources Generated

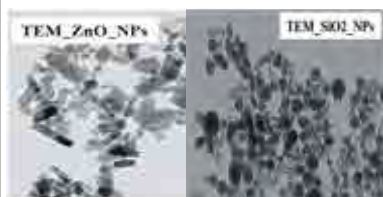
Junior Research Fellow : 04, Senior Research Fellow : 02, Research Associate : 02, Plant Engineer : 01, Field Technician : 01, Operator : 01

Plans to take innovation further

With induction plasma system in R&D lab, which makes it possible to produce the nano powder in kilograms with a consistent rate of production the company is going setup the inflight surface functionalization module where highly stable nanoparticles can be produced as an end product

Risks envisaged

During the pesticide treatment, there is a probability of nanoparticle accumulation into the stored seed grains, and hence biosafety/toxicological tests need to be carried out to check the indirect effect of the products obtained by this technology to the mankind



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The Innovation

Production of plant growth promoting factors by *Bacillus subtilis* SR1 under the influence of feather protein hydrolysate with control of plant pathogens

Brief Description

The proposal aims to assess the influence of feather protein hydrolysate on plant growth promotion activity of keratinolytic bacterial strain *Bacillus subtilis* SR1. The hydrolysed protein provides rich amino acids along with micronutrient in chelated form and plants absorb the hydrolysed protein along with metal ions quickly & easily

Stage of development

Proof of Concept

Unique features of the product/technology

Feather is protein rich waste product of poultry processing industries which are being generated in billion of tons every year. These feathers are generally land filled or burnt which cause environmental problems. Feather are also degraded to feather meal which is used as animal feed, organic fertilizers, feed supplements because it is made up of 90 % protein and rich in hydrophobic amino acids and important amino acids like cystine, arginine, threonine. The cost will be cheaper compare with available products in market. *Bacillus subtilis* SR1 with PGPR activity degrade the feathers completely within 48 hr. This feather protein hydrolysate with rich amino acids used as foliar spray on to the plants and could be used as a fungicide

Market potential

The proposed product is not yet available in agriculture field within India and abroad. Many amino acid based products are available in market made by acid hydrolysis method but not recommended in agriculture field since the pH of the product is below 2.0. The increasing demand for chemical-free food has resulted in an increase in the demand of plant growth-promoting microorganisms; hence this segment is projected to grow at the highest CAGR in the agricultural inoculants market

National/Societal relevance

An attempt can be made to use Keratinases to degrade the proteins of the pathogens, which inhibit them to grow and infect and thus we may control various plant diseases. The hydrolysed protein provides rich amino acids along with micronutrient in chelated form and plants absorb the hydrolysed protein along with metal ions quickly & easily

Project achievements

- Progress vis-a vis objectives:** The potential bacteria *Bacillus subtilis* SR1 with PGPR activity was isolate which can degrade the feathers completely within 48 hr.
- Technology/ Product developed:** Final outcome will be a technology.
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** One research assistant employed

Plans to take innovation further

Scaling up of the product

Risks envisaged

NA



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AGRICULTURE SBIRI

Swasti Agro & Bioproducts Pvt. Ltd.

The Innovation

BioAvert I: Preventing diseases of plants

Brief Description

Technology provide vaccines and healthcare system for the plants which can be delivered to the farmer through an android app "Happy Crop"

Stage of development

Late Stage Validation



Unique features of the product/technology

A digital solution in agriculture is providing 360 degree analysis and advice and this would lead to: reduction in input costs by 15-35, technology driven back-end support and products further increase yield by 20-40 and better produce quality. Technology delivers a complete health care package to the farmer ranging from preventive products to services. Farmers will get economic benefit higher than 10x ROI by using the healthcare system.

Market potential

Technology can prevent 50-70% of the loss through this preventive products and precise analysis

National/Societal relevance

Prevention of Disease can curb the upcoming food security crisis

Project achievements

a. Progress vis-a vis objectives

- Methods for preventive diagnosis of crop diseases have been validated
- Complete data on at least 2 products that prevent specific diseases
- Product has been applied on at least 250 acres with the help of analytical tools for the validation of disease prevention

b. Technology/Product developed: BioAvert-I product has been developed which is under field trial

c. IP generated/Potential for IP generation: Complete Indian Patent and PCT application filed

d. Resources Generated:

- Generated revenue of over INR 3 cr in last 3 years
- Mobilizing INR 2 cr by the way of equity and debt in next 6 months
- Facility of 3000 sq. ft.
- Employment generated for 19 members

Plans to take innovation further

Discussion initiated with "Organic farming" agencies in UK for partnership and a Japanese company for partnership in AI research. Also research agencies has been contacted that are working on wheat rust Ug99 strain for testing the developed products in Kenya

Risks envisaged

Growth at ground level is slow that limits possibilities to raise funds and grow further

Project coordinator

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Collaborator: Varsha Bioscience and technology (India) Pvt. Ltd.



The Innovation

Development and promotion of local fungal strains of tea ecosystem for the management of tea pathogens and insect pests with special reference to Darjeeling "An Innovative Non Chemical Approach"

Brief Description of the Product/Technology

Indigenous strains of three microorganisms i.e. *Trichoderma harzianum* KBN-29, *Beauveria bassiana* BKN-1/14 and *Metarhizium anisoplae* Met-5-1 have been developed and their taxonomic identity has established through DNA finger printing

Stage of development

Late Stage Validation

Unique features of the product/technology

The developed three biological control agents are indigenous isolates, developed from the tea ecosystem of West Bengal itself. The field application of these would certainly solve the problems arising due to large scale use of pesticides and residues in made tea to a great extent and control the diseases and insect pests successfully

Market potential

As of today, the cost of similar products available in the market, ranges from 175-900/- per kg or litre. This formulation may sell at the rate of about 200/- per kg for wettable powder formulation, which is rationale, affordable as well as acceptable amongst majority of the planters

National/Societal relevance

The field application of the developed formulation would control diseases and insect pests, resulting higher production without any residues, which ultimately would increase the profit of grower and would uplift the socio-economic status

Project achievements

a. Progress vis-a vis objectives

Scaling up of lab level to 20 L fermentation has been completed. *In vivo* multi location / ecological zones trials of the formulations developed from 20 L fermenter, up scaling of 20 L fermentation to 800 liter and generation of the data on efficacy of the formulated product over a period of time and the temperature tolerance are ongoing and are near completion

b. Technology/Product developed

Bio pesticide for local fungal strains of tea ecosystem for the management of tea pathogens and insect pests with special reference to Darjeeling

c. IP generated/ Potential for IP generation

The pure cultures of *T. harzianum* KBN-29, *B. bassiana* BKN-1/14 and *M. anisoplae* Met-5-1 would be deposited soon at National Bureau of Agriculturally Important Microorganisms NBAIM, Kushmaur, Mau NathBhanjan â€" 275103, Uttar Pradesh to get accession number thereof

d. Resources Generated

Two research scholars at academia centre and one research scholar at Hyderabad for industry partner have been engaged. Microbiology lab at TRA NBRDC has been fully renovated and well equipped

Plans to take innovation further

There is great scope for the exploitation of other indigenous microbes such as bacteria and actinomycetes which could be used in IPM, INM and IDM approaches as a component for the tea crop sustainability in ecofriendly manner

Risks envisaged

As on date, no risk has been reported with the use of these bio-formulations, therefore, these formulations are safer to ecosystem, user friendly, effective in controlling insect pests & diseases



Project coordinator
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Team Members

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The Innovation

Development of a Genetic Transformation Kit for Plants

Brief Description

Development of a direct, chemical transformation procedure based on peptides which is cost effective and does not require costly antibiotics to suppress Agrobacterium

Stage of development

Proof of Concept



Unique features of the product/technology

Development of a direct, chemical transformation procedure based on peptides which is cost effective and does not require costly antibiotics to suppress Agrobacterium. The cost of the technology per se is much higher than the existing manual methods. However, if the sum of efforts like fine tuning, additional input costs for existing procedures and time saved are taken into account this technology is comparable to existing methodologies

Market potential

The present product will be a unique product as there are no commercial kits for plant transformation. However, there are different entities which provide transformation services at a commercial scale across the world, although this is limited in India. Although, this niche market is small in number they invest substantial costs in R&D. In the basic research fields, the market size is much larger as different research groups across institutes are involved in the research of plant sciences

National/Societal relevance

Direct transformation procedure can ease and scale up this process thereby decreasing the input time as well as cost. This can accelerate the discovery and development of agriculture crops with improved traits and help secure the food security

Project achievements

- Progress vis-a vis objectives:**
 - Putative transgenic tobacco and rice were generated
 - Characterization and selection of transgenic tobacco and rice is in process
- Technology/ Product developed:** Putative transgenic tobacco and rice were generated
- IP generated/ Potential for IP generation:** Not generated
- Resources Generated:** 3 manpower employed

Plans to take innovation further

Pilot studies with potential clients, Strategic Collaborations to highlight the technology and make the technology acceptable working with different groups

Risks envisaged

The uncertain regulatory climate with regards to transgenic technology and copying/variations to the technology

Project coordinator

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The Innovation

Development of a novel fungal biocontrol agent using protoplast fusion technology to target drug resistant gastrointestinal cattle worms responsible for reducing productivity, by an ecofriendly approach

Brief Description

A novel product of fungal origin intended to address drug resistance in gastrointestinal nematodes in dairy animals that has capability of reducing worm burden in the soil

Stage of development

Late Stage Validation

Unique features of the product/technology

Live drug solution represented by fungal spores loaded on special delivery device is low in cost as compared to its synthetic drug counterpart. Unique feature is in use of live fungal spores loaded on molasses-biscuits that take the route of faeces disposal and reach the grazing ground where spores grow and trap nematode larvae before they can migrate and contaminate the grasses. It controls worm burden in soil and not in individual animals causing the entire society to benefit



Market potential

Current Indian market is Rs. 2500 cr. and with over 1000 dairy cooperatives in India, the product has a business potential of 672 billion Rupees per year. Due to its unique features and different approach, product does not have any close competition. However, anti-helminthic synthetic drugs currently in use to control these worms are the nearest competitors

National/Societal relevance

Worm vaccine and biological control of gastrointestinal worms using nematode controlling fungi, the later shows greater promise with potential to be closer to the market and will reduce dependence of chemical drugs for controlling cattle worms

Project achievements

a. Progress vis-a vis objectives:

- A method to generate dried spores and its ability to grow on faecal parts were demonstrated
- A novel delivery device by way of molasses biscuit/tablet was developed
- Multivalent formulation of spores has been prepared in gelatin capsules, suspension buffer and jaggery tablets

b. Technology/Product developed: Multivalent formulation of spores has been prepared in gelatin capsules, suspension buffer and jaggery tablets

c. IP generated/Potential for IP generation: Patent application filed

d. Resources Generated: 4 manpower employed

Plans to take innovation further

Proposes to forge partnership with prominent dairy cooperatives for dissemination of information about the product, distribution of the product through the dairy cooperative channels and manufacturing of the active fungal components

Risks envisaged

Generation of spores in adequate quantity after scaling up the solid state fermentation, availability of molasses powder on a continuous basis and acceptance of the novel concept among the farmers.

Project coordinator

Pratap Narayan Mukhopadhyaya

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BIRAC Innovators



INDUSTRIAL BIOTECHNOLOGY

(INDUSTRIAL PRODUCTS AND
PROCESS AND SECONDARY AGRICULTURE)



The Innovation

Production and upscaling of Polyhydroxyalkanoates (PHA) from the waste of beverage industry

Brief description

PHA are microbial polymers with good tensile strength, nontoxic nature and are completely biodegradable. PHAs are mainly known as a biodegradable substitute of petroleum based plastics but as they are bio-compatible also, recently they have also got great attention as a potential polymers for use as biomedical materials as well as for drug delivery

Stage of development

Proof of concept

Unique features of the product/technology

Production of Polyhydroxyalkanoates PHA, biodegradable and biocompatible polymer. PHA has found applications in the form of packaging materials including films, boxes, coating, fibres and foam materials, and also in the field of medical sciences in the form of medical implants, and drug delivery carriers

Market potential

Even though the price of PHA is very high but due to its unique properties, there is demand of this polymer in the market. Presently, there are some PHAs products available in the international market, such as Biopol, Mirel, and Nodax made in USA, Biomer in Germany, Biocycle in Brazil, DegraPol in Italy, Tianan PHBV and PHB in China. Some companies have made schedules or have started to increase their production capacity of PHAs to several thousand tons or 10 thousand tons per year

National/Societal relevance

Production of value added products from waste is the need of the hour. By utilizing industrial wastes for value production, this technology could play a major role in decreasing the waste generation of beverage industry and could be very useful for our country

Project achievements

- Progress vis-a vis objectives:** To produce PHA using the waste of beverage industry. Second objective is to maximize production of PHA and upscaling the production up to pilot scale. Third objective is to characterize the physical, chemical and blending parameters of the polymer
- Technology/ Product developed:** Technology for the production of PHA from waste
- IP generated/ Potential for IP generation:** None
- Resources Generated:** Two persons have been employed

Plans to take innovation further

The applicant is looking for industrial partner to take it forward

Risks envisaged

High production cost is the only risk associated with PHA production but this problem can surely be addressed by using cheap substrates for the polymer production



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Team Members
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Arjuna Natural Extracts Pvt. Ltd.

The Innovation

Process validation and development of highly stabilized Omega-3 fatty acids in liquid matrix, value addition of its byproduct, preclinical and clinical evaluation of safety and bioavailability for use in paediatric and general population

Brief description

Omega -3 fatty acids are Essential Fatty acids which are to be supplemented through diet. Omega-3 supplements are rapidly becoming an important component in mainstream medicines. Unfortunately the intake of DHA in Indian children is low because of low fish and sea food intake, unpleasant odour and predominantly vegetarian habits. These supplements are commonly available in capsule forms. Omega 3 liquid suspension without unpleasant odour and flavour, but with added fruity flavour will be an attractive option for supplementing children

Stage of development

Pre Proof of Concept

Unique features of the product/technology

The indigenous technology developed will cater to the huge market demand for omega 3 rich liquid formulations for use in paediatric and general population and also an import substitution. The oral bioavailability of Omega 3 fatty acids will be improved from a liquid suspension. This will be used for the development of poultry and animal feed material

Market potential

Infant and child food market is the world's fastest-growing packaged food category. The packaged products is projected to reach \$34.7 billion in 2016, representing a compound annual growth rate CAGR of 6.4 over 2011. Infant formula is projected to continue as the largest EPA/DHA omega-3 product category, claiming a market share of 40.7 in 2016

National/Societal relevance

Kerala is having a large coastal area. Getting fish as a raw material for the project is very easy. Currently Omega 3 supplements are available mostly in capsules which are not convenient for use in children. The liquid suspensions of Omega 3 available are currently imported as it is not manufactured in India

Project achievements

- Progress vis-a vis objectives-** Preparation of odourless, stable omega-3 syrup and development of Pellets as ready to use poultry feed. The toxicity and bioavailability studies of developed formulation are under progress
- Technology/ Product developed** -The indigenous technology developed will cater to the huge market demand for omega 3 rich liquid formulations for use in paediatric and general population and also an import substitution
- IP generated/ Potential for IP generation** - None
- Resources Generated** -Resources Generated in terms of Manpower employed/trained, Facility Created, Enterprise Created, Equipment's and resources such as Fish oil Storage Tank, Carbon Filter, Acid Value Treatment Vessel, Deodorizing Vessel, Viscometer, Tintometer, Pelletizing were installed

Plans to take innovation further

Trials to further increase the loading concentration of Omega-3 in the oral formulations as well as the poultry feed are being carried out

Risks envisaged

None

Project coordinator
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The Innovation

Establishment of pilot-scale Supercritical Fluid Extraction unit for nutraceutical and cosmeceutical products development

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

Stage of development

Proof of Concept

Unique features of the product/technology

The product completely utilizes green technology without any inorganic chemicals

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 us huge business potential and savings in foreign currency

National/Societal relevance

India is the second largest producer of silk with an annual raw silk production of 26,480 MT per annum. This silkworm pupa is cheaply discarded due to its bad odour and becomes an environmental hazard. Considering the enormity of silkworm pupa waste being discarded, 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. The amino acid composition of the silkworm pupa comprises of all the essential amino acids that satisfies the FAO/WHO/UNU recommendation. These proteins can be used as a raw-material for poultry feed, aqua feed etc

Project achievements

- Progress vis-a vis objectives:** Developed products e.g. Growthmin aqua Asprogrow and eggmore. Samples for trials feed formulation have been given to farmers. The final objective is the 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
- Technology/ Product developed:** They are developing a green technology for extracting omega3 fatty acid from discarded silk worm pupae
- IP generated/ Potential for IP generation:** IP is filed
- Resources Generated:** 6 manpower is employed and 15 students have been trained

Plans to take innovation further

To scale-up the product and partner with suitable marketing agency

Risks envisaged

None



Project coordinator
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INDUSTRIAL BIOTECHNOLOGY SPARSH

Cellzyme Biotech Pvt. Ltd.

The Innovation

Development of Iron Rich Rice Bran Protein Hydrolysate from the By-product of Rice Bran oil Industry

Brief description

Rice bran protein hydrolysate 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

Stage of development

Proof of Concept

Unique features of the product/technology

Scalable technology for any geography where rice is primarily cultivated

Market potential

Rice production in India is over 102 million tonnes and the production of rice bran oil is around 1 million tonnes and still untapped market is around 0.6 million tonnes. This easily translates into the defatted rice bran availability in the country of over 0.9 million tonnes. Therefore the solution based on rice bran will have an excellent sustainability index with low environmental footprint

National/Societal relevance

India's greatest human development challenge is malnutrition. In spite of enjoying a strong economic growth, the wide prevalence of undernutrition is an indicator of the poor nutritional status of the masses. Children under five years of age and the expectant mothers were devoid of nutrition. To address this unmet need it is imperative to develop the solutions with the sustainable technology. One key to meet this challenge is to utilise what is considered as a waste material, such as rice bran

Project achievements:

- Progress vis-a vis objectives:** Optimized conditions for producing protein hydrolysate had been achieved in lab scale. Pilot scale studies are in progress. Investigation of functional and nutritional properties are planned
- Technology/ Product developed:** Scalable technology for rice dominated states
- IP generated/ Potential for IP generation:** Potential for new IP generation
- Resources Generated:** 4 scientists were trained

Plans to take innovation further

The strategy for product development is straight forward and required know how is available

Risks envisaged

Constant supply of the high quality raw material and high energy consuming utilities for manufacturing pose a risk

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The Innovation

Green Manufacturing of Cephalosporin Antibiotics Using Recombinant Deacetylase

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

Stage of development

Pre-Commercialization

Unique features of the product/technology

Lower energy requirements and environmental footprint. It has got higher productivity

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 achievements

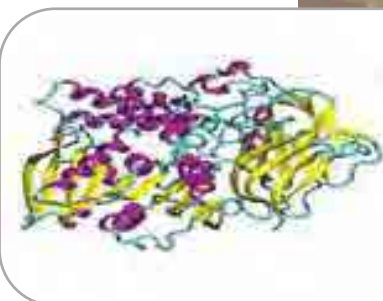
- Progress Vis-a Vis objectives:** Product developed in this project was recombinant deacetylase enzyme. The enzyme can be used for manufacturing of cephalosporin antibiotics. Existing chemical methods can be replaced using the developed product & process
- Technology/ Product developed:** Developing a cost-effective technology for the green manufacturing of antibiotics using a proprietary enzyme
- IP generated/ Potential for IP generation:** Potential for new IP generation
- Resources Generated:** Four scientific staffs were employed

Plans to take innovation further

Industries involved in the manufacturing of API for antibiotics has 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 and Implementation of the process requires regulatory approvals



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Cleanergis Biosciences Pvt. Ltd.

The Innovation

Molasses Spent Wash Treatment "Decolourization, Detoxification leading to algal biofuels"

Brief description

Cleanergis Biosciences has developed a technology for the treatment of distillery wastewater called molasses spent wash MSW. MSW is one of the highest polluting industrial wastewater with very high COD, BOD, colour and toxicity. The technology consist of different principles of bioremediation applied in a sequential manner

Stage of development

Proof of concept has been obtained at lab scale studies. Three pilot scale studies have been completed, one in Bangalore and other two on the site of distillery in Kolhapur district in Maharashtra. The latest study which is still in progress is around 1200 litre scale system. One more study, 120,000 litre scale has been planned and will be started in the near future

Unique features of the product/technology

The capex and opex cost of this technology are lower as compared to other technologies that are used for the same purpose. This is a green technology. Water is cleaned up and is made re-usable for industry/agricultural purpose. The industrial flue gases can be diverted to the algal pond and used by the algae which in turn produce oxygen due to their photosynthetic activity

Market potential

Initial target market is the Indian distilleries. There are approximately 300 distilleries in India and every distillery produces about ten million litres of water every year. Annually there is about 35-40 billion litres of MSW produced in India. Assuming that we can price the treatment at 10 paise to one rupee per litre, the market will be 4-40 billion INR

National/Societal relevance

Zero liquid discharge is the regulatory constraint on distilleries. The cost of setting up effluent treatment plant for distillery nearly equals the cost of equipment for the distillery operation, hence setting up new distilleries is an economically challenging task. The capital and operational cost of our system being low, we offer economic advantage to the distilleries as a low cost option. Potential environment benefits of our system are even greater

Project achievements

- Progress vis-a vis objectives:** Fungal and Microbial cultures have been isolated that can clean MSW. The system for the treatment of MSW has been designed, built and tested for its effectiveness. Several options have been tested for the microbes/ enzymes in suitable form that can be conveniently applied to MSW for the treatment. Lab scale trial for Biofilm/Bio augmentation and Bio filtration technology plant has been successfully completed, 2 field trials are completed and one large scale trial 1,20,000 L is planned demonstrating cleaning action reduction of BOD, COD and colour
- Technology/ Product developed:** Developed a technology for the treatment of distillery wastewater called molasses spent wash MSW
- IP generated/ Potential for IP generation:** Indian Patent has been filed
- Resources Generated:** Two manpower is employed

Plans to take innovation further

One collaboration with Spectrum Renewable Energy Pvt. Ltd has been established for conducting field trials. Larger and larger scale field trials will be conducted. Contact will be established with more distilleries for demonstration of the technology

Risks envisaged

The Central Pollution Control Board should approve the current technology and recommend it for the treatment of MSW



Project coordinator
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The Innovation

Demonstration of conversion of Benzaldehyde to Phenylacetylcarbinol (PAC) with improved efficiency on scale of 4 KL

Brief description

DPRDP Program at IITB resulted in genetic engineering at the allosteric site of enzyme PDC, such that the catalytic site remains open. This resulted in lower K_m value of enzyme for pyruvate

Stage of development

Pre-commercialization

Unique features of the product/technology

1. In-vitro property decrease in K_m value of enzyme could be translated into in vivo effects, resulting in substantial conservation of feedstock molasses
2. Innovations done successfully in downstream and utility to facilitate commercial viability
3. Scaleup done with QbD in place and minimisation of impact of input variations established

Market potential

Embio is second largest producer of R-PAC related APIs and exports to 24 countries. The innovator in BASF Germany, who is on verge of exiting this business. This superior technology could accelerate this exit and give Embio a bigger market share



National/Societal relevance

The production of R-PAC from benzaldehyde was a CDRI technology licensed by MDPL Chennai. The DPRDP program at IITB has brought in a technological breakthrough. This is currently in precommercial stage as part of SBIRI -II. Commercialisation of the process would amount to an evolving success story of public/private partnership

Project achievements

- a. **Progress vis-a vis objectives:** Process optimization till 100 L scale successfully completed with PAC level of 9 g/L up to 70% biotransformation efficiency
- b. **Technology/ Product developed:** A technology for production of PAC
- c. **IP generated/ Potential for IP generation:** IP is filed
- d. **Resources Generated:** NA

Plans to take innovation further

Plan to scale up in plant scale in two phases. GEAC approval under progress

Risks envisaged

Utility inputs for the process should match current norms

Acceptance by the customers for this major change

Project coordinator
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Embio Pvt. Ltd.

The Innovation

Process optimization with improved transaminase for conversion of R-PAC to L-Norephedrine and scale up to 100 L

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 Isopropyl amine, which in turn is converted to acetone. The alpha hydroxy ketone R-PAC is a chiral intermediate coming from yeast whole cell biotransformation. The transaminase is expressed in E.coli and the transamination is also a whole cell biotransformation



Stage of development

Early Stage Validation

Unique features of the product/technology

The technology features a possibility to replace an existing commercial totally synthetic chemistry process, with a Green transaminase based whole cell E.Coli biotransformation

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. Norephedrine derivatives are also intermediates to make amphetamines

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 WHO listing as essential medicine, thereby favouring the patients

Project achievements

- Progress vis-a 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 minimization exercise underway. Currently optimized at benchtop scale to give 98 de and 87 conversion. Although overall recovery of 90 till the salt is achieved, alternative strategies are being worked out. The objective is commercial viability based on target price
- Technology/ Product developed:** Process for conversion of R-PAC to L-Norephedrine
- IP generated/ Potential for IP generation:** IP is filed
- Resources Generated:** NA

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 biotransformation process. Work has been initiated with a CSIR Institute

Risks envisaged

- Existing players based on alternative technologies: Synthetic chemistry based resolution of dl- nor ephedrine: MDPL India, Chifeng China
- New synthetic chemistry technologies: WO/2015/063795 Lauras Labs India
- Stagnant market of Efavirenz

Project coordinator
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The Innovation

Phase 2 of Development of Recombinant Streptokinase in collaboration with CSIR IMTECH for Scaling up and optimization of large-scale production of this life-saving Thrombolytic protein at an affordable cost for the unmet need in Indian patients

Brief description

EPYGEN BIOTECH intends to produce rSK drug substance using kanamycin clone, utilizing its state of the art facility and purify it complying all the compendial requirements of streptokinase drug substance as per biosimilar guidelines by DBT, India Streptokinase Bulk solution IP. EPYGEN BIOTECH has charted out strategies along with CSIR-IMTECH to improve the yield of recombinant streptokinase by High Cell Density Fermentation of E.coli culture/Feed strategies, fed-batch process, and optimization of downstream processing

Stage of development: Phase 2

Establish rSK specific bio-activity and high expression levels at 19 and 100-liter scale at Epygen Biotech by optimizing high cell density fermentation, improved cell lysis, IB solubilization and downstream techniques

Unique features of the product/technology

High cell density fermentation with controlled feeding to compensate drastic drop in dissolved oxygen. Introduction of non-beta lactam marker kanamycin for improved safety profile. Optimization of cell mass for effective cell lysis followed by dilution techniques. Maintaining protein refolding coefficient translating process scales.

Market potential

As per the market figure on number of vials 1.5 million IU sold per year by the major brands, the current usage covers only 2 of the potential candidate. Considering this, the present the Streptokinase market is estimated about \$40 million

National/Societal relevance

According to WHO, cardiovascular diseases are non-communicable diseases, are the major cause of death in both developed and developing countries. With a large portion of Indian society suffering from CVD, there is a serious need for economically viable thrombolytic drugs, especially where cath-lab treatments are rare for the underprivileged. While streptokinase 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 achievements

- a) **Progress vis-a vis objectives:** Multiple HCD fermentation runs performed to optimize fed-strategy. Fermentation scaled up from 10 L to 19 L scale. High OD pilot scale cell lysis conducted using Panda Plus homogenizer. Dilution and elution buffers optimization process in progress.
- b) **Technology/ Product developed:** Scale-up of technology for development of Recombinant Streptokinase
- a. **IP generated/Potential for IP generation:** None
- b. **Resources Generated:** Manpower employed/trained - 1 Bioprocess Manager & 1 QC Manager. Technology Incubation centre for 19 L demo and Therapeutic protein plant for 100 L fermentation and purification

Plans to take innovation further

Ongoing product development with CSIR-IMTECH

Risks envisaged

NA



Project coordinator
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Green Pyramid Biotech. Pvt. Ltd.

The Innovation

Bio-Synthesis, Production and Formulation of Sophorolipids for the purpose of Sanitizing/ Sterilizing Fruits and Vegetables

Brief description

This is a ready-to-use biosurfactant-based formulation that can successfully aid all household consumers, hospitals, hotel industry, educational institutes, farmers, organic growers, exporters and organisations to decontaminate and sanitize their fruits and vegetables before consumption. This formulation can be used by farmers and exporters to increase the shelf-life of their Fruits and Vegetables by multi-fold times

Stage of development

Pre-commercialization

Unique features of the product/technology

Biosurfactant based organic formulation that offers protection against:

- Microorganisms Bacteria, Viruses, Yeasts, Fungus and Moulds
- Dirt, Dust and Soil
- Cross-contamination during handling
- Chemical and Toxic Residue, Pesticides

It extends shelf-life of fruits and vegetables by nearly two - three times while keeping them fresh and safe.

Market potential

In India 76 of the pesticide is insecticide, as against 44 globally. Heavy use of toxic pesticides in agriculture worldwide has raised serious concerns about health issues. The World Health Organization WHO estimates that acute pesticide poisoning APP affects 3 million people and accounts for 20,000 unintentional deaths per year, with 99 percent of these fatalities believed to be in developing countries. In European Union alone 20, 0000 tonnes of pesticides used annually. The number one consumer of pesticides is China, where 3,981,548,455 pounds are applied every year

National/Societal relevance

India is second largest producer of Fruits AND Vegetables in the world, accounting roughly 10 and 15 respectively. The production of F AND V crops was 72.3 and 133.5 million tons in the year 2010 with per capita availability of 172 and 318 gm/day respectively, of total global production

Project achievements

- a. **Progress vis-a vis objectives:** The product has been launched and commercialized
- b. **Technology/Product developed:** They have developed a green formulation based on sophorolipids
- c. **IP generated/ Potential for IP generation:** None
- d. **Resources Generated:** Independent R&D Facility developed and received a Seed Fund and Award Money. 3 Manpower has been employed

Plans to take innovation further

Bioclean will be for industrial use, and Evergreen will be targeted at retailers and Households. Having received NPOP certification from Green Cert which qualifies the product as 100 Organic and FSSAI approvals along with HACCP and ISO22000, we are further working towards getting approvals and certification from few other agencies overseas

Risks envisaged

NA

Project coordinator
MIHIR MEHTA

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The Innovation

Setting up 10 ton Lignocellulosic biomass/day processing plant to produce about 3000 Litre ethanol/day (Phase II: To run the plant in integrated continuous mode)

Brief description

This is India's first multi feed stock continuous flow plant, 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

Stage of development

Proof of Concept

Unique features of the product/technology

- Biomass to alcohol within 24 hrs
- Enzyme reuse in multiple cycles
- Recycling of plant chemicals & water

Biomass plant is commissioned in Feb 2016. The plant has now been in operation for more than a year and several runs have been taken with feedstocks such as wheat straw, Rice straw and cane bagasse. Other feedstocks shall be used as they become available with seasons. Segment wise plant performance is mentioned below:

Delignification: 85

Enzyme net dosage: 3FPU/gm Target 1FPU/gm

Fermentation Yield: 0.40 gm / gm of sugar Biomass to alcohol within 24hrs



Market potential

At present they have achieved 3 blending of ethanol in gasoline, which is far behind the target of 5 blending. But through this technology we can 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 finally yield profit in Indian economy. This blending mandate can be raised up to 20 or higher, for this there is no ethanol available in quantities enough to meet the projected requirement. With a potentially successful lignocellulosic ethanol technology, this gap can be more than bridged and blends up to 20 ethanol can be possible

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.

Project achievements

- Progress vis-a vis objectives:** The plant has processed Bagasse, Rice & 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
- Technology/ Product developed:** The technology for Biomass to Alcohol shall be able to bridge the immediate requirement of blending 5 ethanol in gasoline, which can be raised up to 10 blending
- IP generated/ Potential for IP generation:** NA
- Resources Generated:** Facility has been installed and the plant has been inaugurated

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

Availability of raw material

Project coordinator

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Mallipathra Nutraceutical Pvt. Ltd.

Collaborator: Sir M Visvesvaraya Institute of Technology

The Innovation

Bench scale production of snow flake Cordyceps and Cordyceps militaris through solid-state and sub-merged fermentation respectively for nutraceutical application

Brief description

Bench scale production of snow flake Cordyceps and Cordyceps militaris through solid state and sub-merged fermentation. The major goal of the company is to develop a cost effective method to rear high value Snowflake Cordyceps with adequate active ingredients on par with the naturally growth mushrooms



Stage of development

Early Stage Validation

Unique features of the product/technology

The technology developed involves rearing of Snowflake Cordyceps in an artificial environment in a cost effective and time sensitive manner. The product is expected to be atleast 30 times cheaper than the existing International Products. The technology is addressing the unmet need to match demand and supply and faster cultivation of the mushrooms. The product is found to have several medicinal benefits for various nutraceutical ailments

Market potentia

A product in the form of powder/capsule or tea related to nutraceutical/pharmaceutical, cosmeceutical or insecticidal, focusing B2B type of business development. Hence, there is a huge market potential for the development of business in the related field. Snow flake cordyceps products are not available in India. Few Countries like Korea and Taiwan have developed products like capsules from the same which is sold as high as Rs. 2 lakhs per kg

National/Societal relevance

The mushrooms are rare and expensive. High value and increasing demand has led to over exploitation of the natural resources. Hence there is a need for sustainable cultivation of mushroom on consistent host or substrate for the conservation of the natural species

Project achievements

- Progress vis-a vis objectives:** The project is currently in the first phase, preliminary studies towards bench scale validation is being conducted. Validation in terms of active ingredients parameter establishment will be performed in the subsequent milestones
- Technology/ Product developed:** A low-cost artificial method of cultivation of mushrooms
- IP generated/ Potential for IP generation:** One provisional patent has been filed and they are in the process of filing a complete patent
- Resources Generated:** 5 manpower employed and a dedicated facility for culturing the medicinal mushroom Snowflake Cordyceps is being created

Plans to take innovation further

Plans to enter into partnership with B2B agencies during the next phase of our project

Risks envisaged

NA

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Nagarjuna Fertilizer & Chemicals Limited**The Innovation**

Development of technology Platform for Rare Sugar Production (Phase II)

Brief description

The prevalent chemical based processes utilize catalyst and these catalysts frequently toxic are retained in trace quantities in the end product resulting in health issues. The cost and availability of such catalyst renders the existing processes unsustainable

Stage of development

Pre-commercialization

Unique features of the product/technology

The three rare sugar products are Allulose, Isomaltulose and Trehalulose trademarked as Honeytose Caneose and Nectarose, respectively. The process is compatible with range of feedstocks- corn, cane, beet making the production scalable. The process utilizes protected enzyme, designed to operate efficiently over broad temperature and pH range and maximize conversion rate and has long sustenance. The products are natural, not addictive, low calories and low glycemic index

**Market potential**

Targeting sugar market constituting ~78% of market and not sweeteners. This would enable penetration into wider market base. Apart from providing healthy nutritional options to population with diabetes and obesity ailments, the products are equally adroit to cater to needs of healthy population segments. Competitors' ingredient manufactures or reformulators are geographically and product portfolio limited allowing us to penetrate and build strong relationships across the consumption points

National/Societal relevance

With increasing disposable income and lifestyle changes, there are also increasing health issues related to obesity and diabetes. Our business focuses on product differentiation through making available healthy specialty products at affordable prices

Project achievements

- Progress vis-a vis objectives**-The proof of concept and proof of value have been established. The products have been trademarked and showcased at IFT- 2016 at Chicago and have already received wide acclaim and interest from several entities in the industry. We are now gearing up for commercial production of our products
- Technology/ Product developed** - A technology for rare sugar production
- IP generated/ Potential for IP generation** - The technology / process innovation is patent protected and at present over ten patents are at various stages of being granted globally
- Resources Generated** - Employed and trained 12 people in addition to the existing team of scientists, engineers and technicians

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

Time, Cost & Consumer acceptance

Project coordinator
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Neera Bhalla Sarin - FITT

The Innovation

Innovative approaches for upscaling natural alpha- tocopherol production from engineered Brassica juncea (Indian mustard) for therapeutics

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

Stage of development

Proof of Concept



Up scaling of cell suspension culture in bioreactor under optimized condition

Unique features of the product/technology

Natural alpha tocopherol is being produced using cell cultures. This can lead to continuous production of the product to an industrial scale and has the potential for commercialization for therapeutic purposes. There is a lack of natural alpha tocopherol in the market. Alpha tocopherol being a powerful antioxidant is prescribed in many disease like, hypertension, diabetes, cancer and skin ailments

Market potential

Natural vitamins are preferred over synthetic ones. Therefore, the product has a high market potential. Only synthetic vitamin E is in the market and does not compete with natural product rich in alpha tocopherol

National/Societal relevance

Since earlier on, it has been shown in mouse model system that feeding mustard seeds enriched in alpha-tocopherol led to decrease in tumour incidence and tumour multiplicity, 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 achievements

- Progress Vis-a Vis objectives:** Through metabolic engineering an Indian mustard overexpressing -TMT gene has been developed. HPLC analysis of the engineered plants revealed an enhancement of tocopherol up to 6-folds as compared to controls. HPLC analysis of these tissues showed further enhancement of -tocopherol content in cell cultures
- Technology/ Product developed:** Natural alpha tocopherol is being produced using cell cultures
- IP generated/ Potential for IP generation:** NA
- Resources Generated:** Three post-docs have been employed so far and trained

Plans to take innovation further

Through strategic partnership

Risks envisaged

Green photosynthetic cells are required to be maintained for analytical studies. Whether these results will corroborate with actual amount of product extracted which needs to be standardized

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The Innovation

Hassle Free Waste Water Treatment: From Water-bottles for Individuals to Systems for Communities

Brief description

Electric field based water filtration

Stage of development

Early Stage Validation

Unique features of the product/technology

This technology does not use membranes, specially synthesized chemicals and wastes zero water. The technology will result in hassle free waste water management. Using membranes or chemicals brings in logistics issues related to procurement, storage and maintenance. This technology overcomes this problem

Market potential

Market potential is very high

National/Societal relevance

High

Project achievements

- Progress vis-a vis objectives** - Field Trial of 1000L/day to convert waste water to potable water has been done. A hand held water bottle has been built
- Technology/ Product developed** - Technology for treatment of wastewater developed
- IP generated/Potential for IP generation** - 4 IP filed
- Resources generated** - Team has expended from 2 to 6. Funding to the tune of Rs. 94 Lakhs has been raised. Received GEN Top 10 Worlds Hottest Startups, Google Zurich 1st Place award

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

Manufacturing



Project coordinator
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Oriental Aquamarine Biotech India Pvt. Ltd.

Collaborator: National Centre for Aquatic Animal Health & Cochin University of Science and Technology

The Innovation

Detailed performance evaluation and accelerated commercialization of the nitrifying bioreactor technology in Indian market

Brief description

Integrated organic nitrifying and denitrifying bioreactor for Recirculating Aquaculture Systems (RAS) with a bacterial consortium delivery system that converts inorganic forms of nitrogen to readily available forms

Stage of development

Commercialized in the name of "Bioreactor for RAS" on 21st June 2017. Till date, there are 56 users

Unique features of the product/technology

Aquaculture, in Open Rearing Systems, is a source of pollution with deleterious effect on alkalinity, dissolved Oxygen, and chloride concentrations of groundwater causing grave risk to public health. The current system reduces the use of chemical disinfectants and antibiotics. Nitrification and denitrification is being carried out in the same system as against the conventional systems require two reactors. Optimum levels of nitrogen are being maintained in the reactors. The product can be tailor made for customer requirements. The product is offered at around 60% of the cost of competing European/ U.S. technology

Market potential

The estimated bioreactor market in India is USD 427 Million for an annual output of 4,549,607 metric tonnes. The other major markets are Indonesia, Vietnam, Bangladesh, Egypt, Thailand, Myanmar, Philippines, and South Korea. The total bioreactor market for these 9 territories is estimated at USD 1653 Million. The target markets are proposed to be reached through strategic partnerships

National/Societal relevance

An indigenous technology for nitrification and de-nitrification of water for the establishment of RAS, especially for seed production and maturation, could be brought out, which would help the aquaculture industry to attain stability and sustainability

Project achievements

- Progress vis-a vis objectives:** Fabricated and installed 6 packed bed reactors with a capacity 60000 liters/day in Tamil Nadu. The reactors could be operated without any change in the circulating water up to 300 days. This is a great advantage as compared to conventional process wherein water has to be frequently changed
- Technology/ Product developed:** Nitrifying bioreactor for RAS developed
- IP generated/ Potential for IP generation:** The technology has been patented in India, Thailand, Japan, Philippines, South Korea and Indonesia
- Resources Generated:** A unit has been established in Coimbatore to manufacture Nitrifying Bioreactors. The SBSBR has been deployed in 50 locations. The PBBR is working successfully in Tamilnadu, Kerala and Odisha

Plans to take innovation further

The company proposes to scale up its operations in India and other countries with a well-developed aquaculture industry via strategic partnerships

Risks envisaged

Cost effective; Overcoming switching costs and risk of switching; Overcoming any mental block hatchery technicians may have from years of doing it differently; Space constraint in placing the reactors

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The Innovation

Enzymatic Production of Betaine

Brief description

An enzyme based production technology for Betaine which is first of its kind, globally. This enzymatically produced betaine has properties similar to that of natural betaine

Stage of development

Proof of Concept

Unique features of the product/technology

Currently Betaine is available from Natural or chemical source. Being synthesised enzymatically with properties similar to that of Natural betaine, will help to create an intermediate segment. The product is intended to target poultry as well as health industry

Market potential:

The Global market for Betaine is expected to reach 4 Billion US\$ by year 2020. At present no such technology is available in market. Global players who offer natural betaine extracted from sugar beet are E.I. DuPont, AGRANA and ABVista. The major focus is Indian feed market- cattle & poultry. In this segment major requirement is for broiler feed, approx 58%. This market segment with product produced in India will be safeguarded against varied dollar prices

National/Societal relevance:

Currently, India imports betaine, production within country will not only save dollars but also safeguard users against varying prices due to fluctuation in US\$. Proposed enzymatic betaine will help meet the agriculture land available for food & the manufacturing unit setup will open up employment opportunity

Project achievements:

- Progress vis-a vis objectives:** Cloning & over expression of enzyme to be used for biotransformation has been completed. Production & purification of enzyme choline oxidase is in progress
- Technology/ Product developed:** Enzymatic production of Betaine being carried out
- IP generated/ Potential for IP generation:** Provisional patent filed
- Resources Generated:** A startup - EnziBeta Biotech Pvt Ltd has been created. Two members being hired and trained for carrying out specific lab activities

Plans to take innovation further

Two raw material manufacturers have been identified, whose raw material meets the process specifications. Talks with these manufacturers will be initiated for strategic partnership for ensuring raw material supply

Risks envisaged

The in-vivo performance of EnziB in poultry trial at par with natural betaine; The increase in price of raw material



Project coordinator
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INDUSTRIAL BIOTECHNOLOGY SBIRI

Privi Biotechnologies Pvt. Ltd.

Collaborator: Institute of Chemical Technology

The Innovation

Pilot Scale Translational Facility for Value Added Chemicals from Biomass

Brief description

Technology based on concept of biorefinery wherein different types of secondary agriculture biomass enriched in sugar biopolymers can be fractionated into sugar monomers such as glucose, xylose, arabinose along with phenolic compounds originated from lignin residues. These sugar molecules and phenolic compounds are used in the said technology to convert into commercially valuable products by using biologically accepted routes such as fermentation, biotransformation, and biocatalysis



Stage of development

Early stage validation

Unique features of the product/technology

Technology for fractionation of biomass into sugar monomers and phenolics in pure fermentable forms and Novel fermentation technologies wherein continuous fermentation can be done to achieve higher yield and productivity have been developed. This technology is aimed at constructing a pilot scale facility to address the gap between laboratory scale technologies into commercially viable plants employing the concept of zero waste biorefinery.

Market potential

Three products, Xylitol, Gluconic Acid and Vanillin, are currently being produced synthetically and have significant market size. Proposed Biorefinery will not only provide an eco-friendly route based on renewable raw material source, but will also simplify manufacturing process making these products more economical as well. Production of these chemicals using cheaper bio-based raw materials can make breakthrough in market prices. The current markets are sizeable for these products. Demand for these products can increase manifolds benefitting the manufacturers, consumers and the farmers

National/Societal relevance

Few facilities are there in Europe and the USA for deconstruction of lignocellulosic biowaste. However, in India there are no demonstration facilities for scaling up these novel processes. This unique concept, therefore, offers the possibilities of validating continuously evolving indigenous biochemical technologies

Project achievements

- Progress vis-a vis objectives:** Basic & detailed design of biomass fractionation equipments, fermentors, and downstream equipments is completed. Ordering of biomass fractionation equipments, fermentors, and downstream equipments has been done. Statutory approvals for newly constructed pilot site is completed.
- Technology/ Product developed:** Biorefinery concept for value added chemicals from biomass
- IP generated/Potential for IP generation:** Patent has been filed
- Resources generated:** Facility creation is in process

Plans to take innovation further

The company intends to take innovation further

Risks envisaged

NA

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The Innovation

Development of novel enzyme based processing aid for the reduction of acrylamide in different thermally processed food products

Brief description

Acrylamide, formed during processing of food, is known as carcinogenic, genotoxic and is also responsible for reproductive disabilities in animals and humans resulting in a serious problem for the food industry worldwide. Pre-processing of food products using Acryl-aid will significantly reduce the acrylamide formation and improve the food quality

Stage of development

Proof of Concept

Unique features of the product/technology

A novel acryl-aid enzyme formulation using the novel asparaginase enzyme is being developed which would have potential food technology application. The novel asparaginase based enzyme formulation will have better implications as a pre-processing aid in acrylamide reduction and improved food quality

Market potential

The market of this product ranges from utilization in food manufacturing units, bakeries, major food retail outlets and even at every common household. The product, Acrylaway would serve as a processing aid, which is currently not available either India. In Western countries asparaginases derived from *Aspergillus niger* and *Aspergillus oryzae* Acrylaway, Novozymes, Canada have been used for acrylamide reduction during food processing. There are currently no similar food products available in the Indian market

National/Societal relevance

In the past few decades, the risk of development of various life style associated diseases like cancer, cardiovascular, obesity and diabetes has increased drastically due to increased consumption of processed food products. Food processing is required to improve the taste, color, flavor, texture and aroma. However, it also leads to the formation of health hazardous compounds such as Acrylamide which needs to be removed

Project achievements

- Progress Vis-a Vis objectives:** The novel enzyme is being screened and purified in order to find the best possible efficiency and would be characterized henceforth. Concoctions using the enzyme are being developed and stability assays being undertaken before prototype development
- Technology/Product developed:** Technology for production of novel acryl-aid enzyme formulation
- IP generated/ Potential for IP generation:** NA
- Resources Generated:** NA

Plans to take innovation further

Talks with various food industries including bakery manufacturing and processing companies have been done. They have agreed to use this product for creating products on a consumer assessment study model once the prototype is developed.

Risks envisaged

Regulatory clearances



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The Innovation

Co-treatment of domestic septage and municipal solid waste landfill leachate using dry-thermophilic anaerobic digestion for the production of bioenergy and bio fertilizer

Brief description

The project aims to address problems posed by improper disposal of domestic septage and municipal solid waste landfill leachate by their co-treatment using dry thermophilic anaerobic digestion process for production of bioenergy and aerobic composting of digestate for production of biofertilizer

Stage of development

Proof of Concept

Unique features of the product/technology

This anaerobic technology is specially designed for the treatment of domestic septage and municipal solid waste landfill leachate. However other organic substrates such as sewage sludge, organic fraction of municipal solid waste can be treated using this technology. The Internet of Things based remote monitoring system installed in the digester, helps in close monitoring of the digesters health and restore any issue at the earliest.

Market potential

Domestic septage and landfill leachate are among the list of waste generated from almost all the cities in India, many countries in South-East Asia and Africa. This technology has huge potential to treat septage and leachate in eco-friendly yet economic way

National/Societal relevance

As part of Swachh Bharath Abhiyaan, our nation is progressing towards achieving the target of having a toilet at every house. With this effort, huge quantities of domestic septage are going to be generated. This technology could easily handle the septage in a safe and eco-friendly manner. The biogas and compost can be used to meet the energy and organic fertilizer requirements respectively, of Indian villages

Project achievements

- Progress vis-a vis objectives:** Lab scale dry thermophilic anaerobic digesters were designed, fabricated and commissioned. Optimal mixing ratio for the co-digestion process has been fixed. IoT based remote monitoring system is designed and fabricated. It is under testing phase. The digesters are under in steady state performance. Various design calculations have been made. However, the novel digester design will be finalized during the last phase of the project.
- Technology/ Product developed:** A technology for the treatment of waste is under process
- IP generated/Potential for IP generation:** Through the proposed project intellectual property will be generated particularly for the novel and improved bioreactor design and process, including the remote monitoring system to monitor digester fitness
- Resources Generated:** As part of this project, a private limited company has been registered. One post-doc fellow Research Associate, two junior research fellows and a lab assistant are trained

Plans to take innovation further

The principal investigator is involved in a consultancy project for the Government of Andhra Pradesh and would like to commission the anaerobic digestion technology to treat organic fraction of municipal solid waste generated in major cities such as Kakinada and Vijayawada. The PI is also working closely with National Institute of Rural Development and Panchayati Raj, Hyderabad to implement this technology in various villages and rural areas adopted by the institute

Risks envisaged

None.

Project coordinator

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The Innovation

Manufacture of high performance immobilized lipases for production of a refined oils, zero trans modified fats, emulsifiers and biodiesel

Brief description

The technology involves enhancing the catalytic activity of commercial lipases and immobilizing them in an insoluble matrix with retention of enhanced catalytic activity so the "High Performance Immobilized Lipase" can be re-used for a large number of cycles. This will help to bring down the application cost of lipases for commercial applications

Stage of development

Pre-commercialization

Unique features of the product/technology

The technology brings down the application cost of lipases for various commercial applications so that a large number of commercial processes in oils & fats industry can be converted into enzymatic processes resulting in a better quality, higher yields, less energy consumption and reduced or nil effluent generation. The developed technology will be an import substitution for immobilized lipases and fat based esters.

Market potential

The theoretical global market potential for High Performance Immobilized Lipase is about 23000 ton for biodiesel, 5500 ton for refined vegetable oils and 1200 ton for modified fats. Currently, Trans-Biodiesel, Israel Novozymes, Advanced Enzyme Technologies Ltd and Fermenta Biotech Ltd have immobilized lipases

National/Societal relevance

The technology will result in healthier products and improve economy of industry. It will help to reduce pressure on energy and effluent generation

Project achievements

- Progress vis-a vis objectives:** Enzyme has been produced successfully at 1 kg scale and tested for selected applications. Cost benefit has been established for some applications.
- Technology / Product developed:** Technology for production of high performance immobilized lipases
- IP generated/ Potential for IP generation:** IP has been generated
- Resources Generated:** Employed a Ph.D and one M.Sc; accounting and company secretary teams and established a DSIR recognized laboratory

Plans to take innovation further

Company has signed an NDA with an enterprise to develop lipase with desired properties and is in discussions with a consultant to develop and produce immobilization supports in-house

Risks envisaged

Unexpected increase in prices of lipases and immobilization support; Development of efficient immobilized lipases by competition



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Smrita Pradhan - KIIT

The Innovation

Development of Economically Viable Products for Microbial & Mammalian Cell culture, Animal Nutrition etc., by Recovering Silk-Sericin from the Industrial Effluents by Implementing Novel Strategies for Degumming and Recovery

Brief description

Silk waste is rich in protein Sericin that has various potential applications. The technology relates to the innovative approach of recovering Silk protein Sericin from the waste of Silk industries and processing it towards development of low cost Sericin for various novel applications.

Stage of development

Proof of Concept

Unique features of the product/technology

A novel method of enhanced recovery of Silk protein from Silk waste to develop low cost Sericin is being worked on. Novel applications related to nutraceutical, microbial culture & animal cell culture is also being looked into. This provides an great opportunity of utilizing the Silk waste as low cost raw material for developing product and reduction of the environmental pollution

Market potential

Sericin protein has several applications related to cosmeceuticals like soaps, shampoo, creams, pharmaceutical such as anticoagulant, antithrombic, nutraceutical and as media for microbial and animal cell culture. Hence, it has a huge market potential in the related field. Currently, sericin products like Sericin powder costs around 80-90 euro per gram. However, the sericin used is directly extracted from the silk cocoon thus making it expensive

National/Societal relevance

Sidlaghatta taluk a small locality in Karnataka itself has around 3000 Silk industries that generates more than 1000 liters/day of sericin containing effluent that is discarded. It is intended to recover the Sericin from the waste thus preventing waste generation and environmental pollution. In addition, it will result in revenue generating model for Silk industry women workers who can earn extra income by selling the effluent on daily basis

Project achievements:

- Progress vis-a vis objectives:** Survey has been carried out and tie up with Silk industries is done. Procurement of Silk waste from Silk industries, its effluent testing, qualitative and quantitative analysis and characterization studies has been completed. Novel approach of recovery of silk protein and standardization is ongoing
- Technology/ Product developed:** A novel method of enhanced recovery of Silk protein from Silk waste
- IP generated/Potential for IP generation:** IP is filed
- Resources Generated:** Two manpower employed and few students has been trained

Plans to take innovation further

Looking for collaboration for scale up and partnership

Risks envisaged

NA

Project coordinator
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The Innovation

Resource recovery from septage

Brief description

The effluent from septic tanks still contains most of the sewage nutrients. Hence, the present proposal aims at recovering sanitised soil and fertilisers from septic tanks while adequately abating pathogens and organics. The main purpose of this proposal is to develop financially affordable and simple-to-operate decentralised technologies that will produce effluent for safe disposal and products for agricultural re-use

Stage of development

Pre-commercialization

Unique features of the product/technology

TerraPreta undergoes two types of composting-first lactofermentation followed by vermicomposting. The presence of charcoal in Terra Preta is highly advantageous as it is very stable and remains in the soil for thousands of years, binding and retaining minerals and nutrients. The product is quite affordable similar to other composts. This product not only meets the requirement for high organic matter fertilizer but also helps in treating septage



Market potential

Given the high organic content in Indian urban municipal waste, less upfront capital expenditure, as well as ease of adoption in decentralized setting, composting is also expected to grow from about 26,000 TPD in 2017 to 66,500 TPD in 2052. Competition could be compost from other sources

National/Societal relevance

The fate of the key nutrients chiefly nitrogen and phosphorus that are present in sewage are wasted, either by discharging them untreated into the environment. The total wastewater generation from Class I cities 498 and Class II 410 towns in India is around 35,000 and 2,700 MLD respectively, while the installed centralised sewage treatment capacity is just 11,500 and 230 MLD. The rest of the population is dependent on septic tanks for decentralised sewage treatment. Thus, there is a need to develop financially affordable and simple-to-operate decentralised technologies that will produce effluent for safe disposal and products for agricultural re-use

Project achievements

- Progress vis-a vis objectives:** Samples of Terra Preta have been collected and analyzed by a fertilizer company. Terra preta experiments will be carried out using samples from septic tankers once the belt press is installed.
- Technology/ Product developed:** Technology for safe disposal of effluent
- IP generated/ Potential for IP generation:** None
- Resources Generated:** One Manpower appointed and trained

Plans to take innovation further

In discussions with Zuari Fertilizers Pvt Ltd

Risks envisaged

NA

Project coordinator
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INDUSTRIAL BIOTECHNOLOGY SBIRI

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

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

Stage of development

Pre-commercialization

Unique features of the product/technology

Fast dissolving effervescent formulation for Pediatric, geriatric and adults for prescription medicines, OTC and nutraceuticals. Avoids problem of swallowing, patient compliance, sweetened, flavored product for consumption. The cost factor is being worked on so that this is available to all class of people. Iron ascorbic acid effervescent formulation eliminates the issue of metallic taste of Iron, palatability increases especially for the children age 6 - 14 years

Market potential

The effervescent technology platform could be used for several supplements and amino acids apart from NAC, which is currently required in several diseased conditions. Other products are available in the market, but the right combination of Iron salt and ascorbic acid combination, Cefixime solubility and quick dissolving is not available

National/Societal relevance

The amino acid NAC precursor for cysteine 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, these could become very affordable to common man. The effervescent granules can also be used for supplement of electrolyte. The effervescent formulation results into a liquid preparation wherein high dose drugs can be incorporated and hence the medicines can be administered for the pediatric or geriatric patients

Project achievements

- Progress vis-a vis objectives:** The Company has achieved all the assigned milestones in time. They have developed the technology and has done the first stage validations
- Technology/ Product developed:** A twin screw hot-melt extrusion process to prepare effervescent granules
- IP generated/ Potential for IP generation:** Patent has been filed
- Resources Generated:** Two Scientists have been employed. Tablet compression machine, tablet hardness tester, Microscope and thickness tester have been purchased. Low humidity processing area facility created

Plans to take innovation further

The technology would be licensed to the suitable partners

Risks envisaged

Stability of the components

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The Innovation

Development of a novel synthetic route for manufacturing Levoglucosan for making affordable value added downstream products

Brief description

Levoglucosenone can be used in growing chiral markets and as a scaffold, particularly in new oncology and anti retroviral treatments. Derivative work has been underway in many leading universities in North and South America, Russia, Japan and Sweden

Stage of development

Proof of Concept

Unique features of the product/technology

Novel Patentable route which will be affordable as the temperature being used is less than 100 deg C while competitor uses very high temperature. This product is basic intermediate for various new drug candidates and will have high impact

Market potential

The potential market size has been estimated to be in excess of USD 250 billion considering its application areas in different segments of use

National/Societal relevance

Levoglucosan or its derivatives are being increasingly used for its bioeconomic potential globally. Today India imports Levoglucosan whereas Symchem has done advanced research to develop an Industrial process to commercially manufacture it. This is will be a right step in import substitution and possibly as a global supplier of Levoglucosan at an affordable price and stimulate downstream research activities for new drug candidates in antibiotics segment which is the need of the hour due to drying up R&D pipelines and emerging resistant strains of pathogens

Project achievements

- Progress vis-a vis objectives:** Pure crystals of L-levoglucosan have been obtained
- Technology/ Product developed:** Technology for the production of Levoglucosan
- IP generated/Potential for IP generation:** None
- Resources generated:** NA

Plans to take innovation further

Partnership will be explored after completion of project

Risks envisaged

The risk factor is in scaling up to commercial scale due to the fractional availability of Levoglucosan. The yields have to be increased depending on use of different catalytic agents. The role of optimising the catalytic agents is a key risk factor as it is very expensive



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Vanita Prasad - Venture Centre

The Innovation

A cost effective process of making Anaerobic Granulated Sludge optimized for quick start-up and easy operation of UASB in WWTP while making the process energy efficient, achieving higher COD removal rate, high yield of CH₄ at higher loading rates

Brief description

Our product Anaerobic granulated sludge is a Microbial consortia in form of granules 1.5 -3.0mm size containing all microbes required for biogas production from organic wastes with VS content of above 50 " 60 gm/l , It consists about 680 tpes of various bacteria's of which ~25 are Archaea bacteria. Of these Archaea bacteria 35 are hydrogenotrophic and 17 acetogenic and 48 are mixed function methanogens. Some of Imp ones are Methanobacterium, Methanolinea, Methanosaeta, Methanosarcina. These granules can effectively reduce COD waste water by 90-95 along with higher yield of methane gas

Stage of development

Proof of Concept

Unique features of the product/technology

80 % Economical, 94 % Faster start up, 96 % reduced Biomass wash out, 10 X higher loading rate, 1.5 X higher COD/BOD, 2 X higher biogas yield, highly stable operation of UASB

Market potential

The two prime market segments for waste water treatment is Industries and Municipal corporation. The potential is huge - Only 21% of the wastewater generated from domestic or sewage sources is treated in the country. It has also been estimated that around 60% of the effluent generated by the industries goes untreated into the ecosystem. It is estimated that the waste water treatment equipment market is worth approximately â,~220-367 million, and expected to have double-digit growth rates every year

National/Societal relevance

About 80 of used water worldwide and up to 90 in developing countries is neither collected nor treated, threatening human & environmental health. Problem can be mitigated by adoption of eco-friendly technologies for waste water treatment.

Project achievements

- Progress vis-a vis objectives:** This indigenously developed product is not only an import substitution but also has many improved functionality thereby providing many economic benefits to end customers Municipalities and Industries
- Technology/ Product developed:** A technology for the production of Anaerobic Granulated Sludge
- IP generated/ Potential for IP generation:** Under process

Resources Generated:

5 manpower is employed and 9 manpower were trained. A facility for Waste water testing & Analysis has been created and a company named "REVV Environmental Solutions Pvt. Ltd". is also formed

Plans to take innovation further

Scale up and establish own manufacturing unit for commercialization

Risks envisaged

NA

Project coordinator
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The Innovation

Innovative Method To Extract Silk Grade Banana Fiber.

Brief description

Extraction of silk grade fibres from the waste portion of the banana plant after the banana bunch is harvested

Stage of Development

Commercialization. Product commercialized with the name "velnatural fibers" on 11th April 2017. Till date, 5 units have been sold to 5 end users

Unique features of the product/technology

The technology extracts silk grade uniform single filament yarn. The extracted fiber has the shelf life of more than 20 years. The technology extracts pure silk grade single filament yarn from banana tree and there is no competition for this product. It is agriculture based products. So that it gives social impact with rural society

Market potential

This innovation has very good market potential in India as well as international. They have received many queries all over the world. Till now, there is no competing technology available

National/Societal relevance

This product and innovation is agriculture based. and it is extracting wealth from the waste. So that it will give lot of rural employment opportunities. So it has social importance

Project achievements

- Progress vis-a vis objectives:** A partially automated machine for banana fibre extraction has been developed
- Technology/ Product developed:** A technology for the production of silk grade fibres from the waste portion of the banana tree
- IP generated/ Potential for IP generation:** Patent is granted on the machine
- Resources Generated:** Employment has been given to more than 40 peoples by direct and indirect ways

Plans to take innovation further

Plan to take this innovation to the market

Risks envisaged

Once this machine comes out for market that time the technology may be copied very easily



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Grand Challenges India



DEPARTMENT OF BIOTECHNOLOGY
Ministry of Science & Technology

BILL & MELINDA
GATES foundation



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Grand Challenges India

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 fosters Indian innovation and research to develop affordable and sustainable solutions to improve health and ensure well-being of people in India and globally. GCI tries to galvanize the potential of young and established investigators by piloting their projects through a series of thematic call announcements or definite initiatives. Grand Challenges India is collaboratively funded by Department of Biotechnology (DBT), Bill & Melinda Gates Foundation (BMGF), and United States Agency for International Development (USAID) to improve public health and beyond.

The Program Management Unit at BIRAC (PMU-BIRAC) was set up under a Memorandum of Understanding (MoU) signed by the Department of Biotechnology, Government of India and the Bill and Melinda Gates Foundation to execute, manage, and provide technical and financial oversight of these collaboratively funded projects and initiative.

In 2016, Wellcome Trust joined this partnership and PMU-BIRAC provides technical and management support to the Affordable Healthcare in India portfolio and the Innovators Awards of the Trust.

Over the last year, PMU-BIRAC has been instrumental in managing the jointly funded programs and projects of the partnership.

The Grand Challenges India program, the flagship initiative managed by the PMU at BIRAC for the partnership, currently has three programs.

The oldest of these 'Achieving Better growth through agricultural and nutrition' began in 2013 with five projects. In 2016, three projects were completed successfully and two were nearing completion. One of these projects, from Annamalai University in Tamil Nadu, used an integrated farming system (IFS) to improve agricultural productivity while creating avenues for women empowerment. The pilot project results showed gains in both the agricultural productivity of participating women farmers as well as in economic gains from the integrated farming system. Additionally, the study found an improvement in the nutritional status of the participating women farmers from a small sample. Another project based in Orissa, piloted an initiative where the aim was to increase access to vegetables for consumers while increasing the economic benefits of farmers by putting in place an innovative procurement and supply chain. An impact assessment of the project showed that farmers participating in the study had access to and consumed more vegetables, and also sold more vegetables leading to greater income.

'Reinvent the Toilet Challenge', the second program begun in 2013 with six projects was also managed by the PMU and are approaching completion. Of the interesting projects in this program, from BITS Pilani University in Goa, has piloted a novel waste treatment system that relies on electricity to manipulate the pH of wastewater to kill pathogens. In conjunction with a wetland, the team has developed a complete system that is currently being piloted to manage wastewater from a 100 person community. Initial data suggests that the water coming from the system is free of pathogens including helminthes.

Eram Scientific Solutions and University of South Florida have collaborated on piloting a complete waste collection and management system which is being tested in a school in Kerala, where an anaerobic membrane reactor has been coupled with an eToilet, providing a complete solution to waste management. This eToilet and the bioreactor system is immensely popular with the students using it and opportunities are being explored to scale up the use of the system.

The last call under GCI was for 'All Children Thriving', launched in 2014. Over the last year, six of the seven chosen projects have received their first grant installment against their milestones. A full grant has been selected under this program to study the barriers in the linear growth and development of children by providing pregnant mothers with an integrated package of interventions on nutritional, environmental, water, sanitation and hygiene, and healthcare. The study is designed such that groups get different combinations of the interventions to isolate the effect of these interventions individually. The study is currently enrolling subjects for the various intervention arms.

GCE- India is a fast track program to furnish researchers and people with ideas, small grants to work on developing the idea or providing a basic proof-of-concept. The main idea behind the GCE-India call is to accelerate idea generation and initial validation and to allow successful projects to come through and been taken up for further funding. In the last, GCE-India, in partnership with IKP Knowledge Park, launched its first round of calls and two projects were selected for funding. The PMU and IKP team worked together to launch the second round of calls in early 2017.

The last year also saw the launch of the Gates Foundation's Healthy Birth, Growth and Development knowledge integration- India or HBGDKi India platform in the country through PMU-BIRAC.

The overall goal of creating this platform is to facilitate accelerated progress in our understanding of the multiple interrelated issues that result in poor growth outcomes for the world's children and to use this evidence to design interventions and policies to address these often fatal complications.

The platform now has 10 collaborators with 23 datasets from Indian studies and cohorts who have uploaded their data on the platform.

KnIT, or the Knowledge Integration and Translational Platform, is a unique initiative that was launched in 2016, supported by the foundation and managed by PMU-BIRAC. The platform has been created with the aim of collating and analyzing currently available data in the country from a variety of sources to identify gaps in knowledge to direct research as well as provide validated evidence for policymakers to design policies. Currently, the platform is working on Maternal and Child Health and nutrition through two domain centers.

Affordable healthcare in India is the latest addition to the PMU's portfolio of programs and is funded directly by the Wellcome Trust, UK. PMU-BIRAC provides technical and management support for the 21 projects under this program. The PMU at BIRAC also provides support for the Innovators Awards, announced by the Trust in 2016.



The Innovation



Innovation Profiles



BIRAC Innovators



- AGRICULTURE & NUTRITION
- REINVENT THE TOILET CHALLENGE
- ALL CHILDREN THRIVING

Annamalai University

The Innovation

Designing on-farm participatory models of Integrated Farming Systems for enhancement of household diet diversity and livelihoods of women small holder farmers

Brief Description

Integrated Farming System

Stage of Development

Proof of concept



Unique features of product/technology

- In the Rice + Fish + Poultry system demonstrated and proposed by Annamalai University these salient features differ as listed below:
- The poultry cages are installed in the rice field itself with the help of four concrete posts that lifts the cage above the crop canopy. The cage bottom is of wire mesh, that leaves the poultry waste to reach the rice fields directly, wherein they get dissolved in standing water and serve both as a crop manure as well as fish feed.
- The fish trenches that accommodate the fishes, as a permanent shelter are that run along the side of the rice field, occupying 10 per cent of the rice fields.
- In the improved Goat + Olericulture/Floriculture + Apiary System proposed in this project the salient features are
- The goats reared are allowed to graze on the weed vegetation in the fields during off-season wherein the crops are to follow during cropping season. These goats would be stall fed during the cropping season

Market Potential

Poultry, Fish and Goat meat have well established market potential even in rural surroundings.

National/Societal Relevance

Integrated Farming Systems could be the most effective tool to address different complex situation, offering multi-fold results viz., enhanced household diet diversity, revenue generation, resource conservation, employment generation and prevention of migration among rural population

Project Achievements

- Progress vis-a-vis objectives:**
 - Development of 150 women farmers as Master Trainers of integrated farming system
 - Developed Six Model Villages showcasing the integrated farming systems
 - The manurial addition from the animal components and complimentary pest and weed control
- Technology/ Product developed:** Technology for Integrated Farming Developed
- IP generated/Potential for IP generation :** Integrated Rice + Fish + Poultry Farming system Design
- Resources generated:** Team has expended from 2 to 11, Established two retail outlets for facilitating easy marketing of the produces, Commodity Interest Groups (CIGs) organized, 6 numbers, one each in villages

Plans to take innovation further

Project plan for installation of infrastructure for integrated farming system in women farmers' holdings spread over thirty villages

Risks Envisaged

Location Specificity

Project coordinator

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The Innovation

Participatory Video and Mediated Instruction for Agricultural and Nutrition Behaviour Change

Brief Description

Participatory localized videos to improve awareness on health and nutrition

Stage of Development

Commercialization

Unique features of product/technology

Innovative platforms to enable rural communities to create and share videos for wider adoption of locally relevant practices. Our model combines technology and social organization to maximize the potential of building the capacity of community members on improved, sustainable agriculture, livelihood and health interventions

Market Potential

We are currently implementing projects in collaboration with over 20 partner organizations across 9 states in India and parts of Ethiopia, Afghanistan, Ghana, Niger and Tanzania. Digital Green has recently been awarded a USAID project to strengthen agricultural extension systems across 19 countries (Feed the Future priority countries of USAID)

National/Societal Relevance

The Digital Green approach was found to be 10 times more cost-effective and uptake of new practices seven times higher compared to traditional extension services

Project Achievements

- Progress vis-a vis objectives:** -This program strengthened and engaged 109 women's groups to address MIYCN, produce and disseminate a series of nutrition-specific participatory videos involving 541 mothers of children to address nutrition-specific behaviors, locally feasible solutions as well as expenditure patterns to improve maternal and child diet quality
- Technology/ Product developed:** 3000 videos on improved agriculture, health and nutrition practices. An open source platform - COCO (Connect online connect offline) where frontline workers enter program data from across the world
- IP generated/Potential for IP generation :** Not Applicable
- Resources generated:** Team has expended from 2 to 7, data management software called Connect Online | Connect Offline (COCO) and Analytics dashboard suite customized to low resource settings are used to collect and analyze near real-time data on dissemination, adoption, and community interest

Plans to take innovation further

We are planning to work in new countries and geographies with different donor partners as well as partner with other ICT organizations (radio, IVR, mobile etc) to reinforce and supplement the behaviour change efforts of Digital Green.

Risks Envisaged

Nil



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AGRICULTURE & NUTRITION

EKutir Rural Management Services Pvt. Ltd.

The Innovation

Veggie Lite - Conjunction of agriculture, nutrition, and health for inclusive development of women

Brief Description

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.

Stage of Development

Early stage validation

Unique features of product/technology

The innovation is in setting up an integrated approach of demand-driven vegetable production, distribution, waste reduction, and price optimization, and increased consumption, in line with convergent innovation methods

Market Potential

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. Value chain is done by eKutir through organizing individuals and small businesses as vegetable entrepreneurs - in the neighborhood and thoroughfares of the city.

National/Societal Relevance

Through our model, we are practicing a theory of change model anchored into convergence of efforts among different collaborators with proven efficacy in managing nutrition interventions and impact-based evaluation for agriculture, health, and nutrition

Project Achievements

- Progress vis-a vis objectives:** This program has reached 1,350 Smallholder farmers with Increased average monthly vegetable sales to ~45%
- Technology/ Product developed :** VeggieKart channel points - 106
- IP generated/Potential for IP generation:** All intellectual property (IP) has been made available, and is fully utilizable for the project and scaling. eKutir owns the IP and copyright on the knowledge behind design of software applications, micro-entrepreneurship process and has trademarked its products designed for smallholder farmers, and is recognized as the brand holder of VeggieKart & VeggieLite
- Resources generated:** Farmers enabled to sell directly to VeggieKart - 126; Agri Entrepreneurs- 5; Female entrepreneurs- 32%; Women Participants in Pratidhi mini experiment - 23

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

The project is working in both Odisha hinterlands and low-income urban areas, creating logistical difficulties, and language barriers of Oriya and tribal languages, issues for field implementation and researchers

Project coordinator

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Team Members

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The Innovation

Ensure year-wise nutritional food security to Indian Women through Community level implementation of Domestic Solar Conduction Dryer

Brief Description

Free solar powered food dehydrator

Stage of Development

Commercialization

Unique features of product/technology

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 Achievements

- a. **Progress vis-a vis objectives:** This program has equipped 200 women famers in installation and working of SCD
- 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



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REINVENT THE TOILET CHALLENGE

Amrita School of Biotechnology

The Innovation

Use of viral agents, microbial fuel cell and effective recycling strategy to improve the economic human waste disposal

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 (from vegetable compost) for the effective treatment of sewage via a decentralized sanitation system to reduce infection & smell in wastewater and thereby making it suitable for fertigation (irrigation with fertilizer)

Stage of development

Early stage validation

Unique features of the product/technology

1. Use of bacteriophages for specifically targeting harmful bacteria to reduce infection & smell in sewage
2. Use of kitchen compost for disinfection
3. Safe use of wastewater for value addition in agriculture (fertilizer, irrigation, aquaculture)

Market Potential

Besides the emerging market in developing nations, there is tremendous scope of integrating the technologies in different sewage treatment facilities all over the globe, to reduce the cost of operation and avoid hazardous chemical disinfection methods. The odour control strategies can also potentially be included in all wastewater treatment facilities. Bacteriophage mediated reduction of sulfur reducing bacteria can be applied in the petroleum industry, as well as in anaerobic digesters for biogas (methane) production. Hence together, it could be >300 billion USD market per year.

National/Societal relevance

1. Making an aspirational model of toilet by biological control of smell & infection on one hand and use of wastewater for value addition in agriculture (fertilizer, irrigation, aquaculture). Thus, adoption of toilets will contribute significantly to reducing the open defecation issue as well.
2. Solid waste (kitchen waste) problem can be potentially tackled with simultaneous handling of fecal sludge & kitchen waste

Project achievements

- a. **Progress vis-a vis objectives** -Phase-I of the project has been completed and all the objectives have been fulfilled. Started deploying different versions of the toilet models in rural areas.
- b. **Technology/ Product developed** - Nitrifying bioreactor for RAS developed
- c. **IP generated/ Potential for IP generation**
 1. Provision patent filed for detecting antibiotic resistant microbes
 2. The design of Lytics broadcasting system,
 3. Novel process for increased methane generation in anaerobic digestion,
 4. 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 m² created. Each year about 40 undergraduates, 10 post graduates 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

Deployment of toilet models is in progress. Refinement and wider deployment needs will require further investment

Risk 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 broad-spectrum, targeting wide array of infections might be challenging. Wider level acceptance in the community is a concern

Project coordinator

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REINVENT THE TOILET CHALLENGE

BITS Pilani, Goa



The Innovation

Empowered septic tank as decentralized wastewater treatment system

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 our 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.

Stage of development

Proof of concept

Unique features of the product/technology

We have shown that we can effectively sanitize septic tank effluent by destroying both bacteria and helminth eggs with our approach, 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 in our technology

Market potential

Market potential is very high. The product would be suitable for remote sites with sensitive water supplies or high water scarcity (e.g. mining operations, tourist parks, refugee camps).

National/Societal relevance

High

Project achievements

- Progress vis-a vis objectives:** Experiments at laboratory scale (months 0-6) and construction of a 1 m³ and 20 m³ proof of concept Empowered Septic tank for a single household as well as for a gated community (months 3-8). Pilot plant construction (1 m³ and 20 m³) follow up protocol implementation.
- Technology/ Product developed :** Technology for treatment of wastewater
- IP generated/Potential for IP generation:** No IP filing was done
- Resources generated:** Manpower - 2 One single household treatment system and a 100 people equivalent demonstration units installed and it is working

Plans to take innovation further

will be starting an 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

Single house hold unit



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REINVENT THE TOILET CHALLENGE

Eram Scientific Solutions Pvt. Ltd.

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

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 called NEWgenerator developed by University of South Florida allow for the sustainable recovery of Nutrients, Energy, and Water at the point of disposal. This will provide a cost effective, modular sanitation technology that is relevant to broader segments of the Indian population to be implemented even in locations with unreliable electricity and water connection.

Stage of development

Early stage validation

Unique features of the product/technology

- 1 Technology enabled self-sustainable sanitation models
- 2 Cost-effective sanitation infrastructure for the target groups
- 3 Self-sustained sanitation model with resource generation
- 4 Nutrient, Energy and Water can be generated from Human waste
- 5 Decrease in epidemic diseases caused by lack of adequate sanitation facilities
- 6 Develop new sanitation culture using technology to unaddressed strata
- 7 Off-grid system which does not require any external utility connections
- 8 Unmanned, low maintenance and low Opex system.
- 9 Remote monitoring capabilities will ensure minimum down time.

Market potential

Market potential is very high

National/Societal relevance

High

Project achievements

- a. **Progress vis-a vis objectives:** Design of community model eToilet Construction and installation of slum-based eToilet Detailed design of TRL7 NEWgenerator 100 and procurement of parts Construction of NEWgenerator Ocean freight of NEWgenerator to India Installation and interfacing Integrated system testing using real wastewater
- b. **Technology/ Product developed:** This project merged two technologies which were at very different stages in their development. ESS was developing upon their existing product line and years of field experience, while USF was implementing their first field prototype. As a unique sanitation model the team can further reduced the cost when going for production mode incorporating all the lessons learned from the field testing. The final integrated model will have huge market potential with an affordable product price range and commercialization possibilities especially in India and other developing countries
- c. **IP generated/Potential for IP generation:** eToilet - IP Applied for "Solar powered automated toilets with built in metal base and rapid cleaning mechanism"- 4918/CHE/2014, dated 30/09/2014 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

Will be starting an Indian based company

Risks envisaged

Vandalism and tampering of units, Ownership and legal rights, Coastal environment weather



Project coordinator
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The Innovation

Eco- Toilet

Brief Description

developed proof of concept by redesigning the conventional toilet to use reduced amounts of flush water, improve hygiene and provide auto cleaning. This is achieved using industrial ultrasound transducers to minimize the adherence of waste on the toilet surface

Stage of development

Proof of concept

Unique features of the product/technology

1. Industrial Ultrasound technology applied to Sanitation
2. Reduction in flush water quantity
3. Programmable cleaning sequence
4. Waste compacting in settling leading to smaller tank size

Market Potential

The Eco-Toilet is a complete self-contained stand-alone system that is designed for reducing the amount of flush water. The system is designed to work in the absence of a central sewer line. There is no dependency of mains power requirement as the complete system works on solar power. No pit emptying is needed. It is self-sustaining and independent. The plan is to use a bio digester for on-site waste processing eliminating complex waste management. All these add up to long term benefits including saving on cost of medicines due to minimizing infections in low resource settings

National/Societal relevance

We are sensitized to the fact that elimination of open defecation and minimizing infections due to contamination is high on our governments agenda. The swachh bharat abhiyan is a national drive in this direction. We offer a long-term perspective on saving water resources with a sustainable solution

Project achievements

- Progress vis-a vis objectives:** Presently, steps are underway to engineer the Eco-Toilet system for external field trials in pilot mode to assess the performance metrics before scale
- Technology/ Product developed:** Savings on water consumption, power, infrastructure, infection elimination, maintenance and potential liquid waste re-cycling offsets the cost of Ultrasonics and the other associated electronics incorporated in the product offering.
- IP generated/ Potential for IP generation:** We have filed an IP under the title "Self-contained toilet system"
- Resource generated:** Manpower -1

Plans to take innovation further

We are seeking further investments to pilot the system and small volume manufacturing

Risk Envisaged

The challenge for scale is establishing supply chain for Ultrasound transducers. There is a limited vendor base for the unimorph 40KHz flat disc type elements. Lead time for supply and volume sourcing will play a critical part. There is a large dependency on this critical item in the bill of material. Forecasting, vendor and inventory management will be the fundamental administrative control to mitigate the same. Shipping and installation poses a challenge that will require managing the transportation and partnering with logistic providers for seamless delivery to the installation site. The installation is made easy as it requires no special skills or tools. The workflow is process oriented and automated to minimize any intervention from the user



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ALL CHILDREN THRIVING

Mahatma Gandhi Institute of Medical Sciences

Collaborator: Kings College London, London and Mamta Health Institute
for Mother and Child, New Delhi

The Innovation

Low-cost salivary progesterone testing for detecting the risk of preterm births in rural community settings of India

Brief description

The project aims to validate and test the feasibility, and acceptability, of an innovative low-cost salivary progesterone PTB prediction test in two rural settings in India with high rates of prematurity. Saliva samples collected from pregnant females are being transferred to the laboratories and progesterone levels is being measured through enzyme-linked immunosorbent assay (ELISA) and provide results.

Stage of development

Validation

Unique features of the product/technology

The salivary progesterone test is based on the estimation of progesterone in saliva. As saliva is less complex than blood, the measurement of free steroid concentrations is accurate and samples can be transported and stored without requiring freezing

Market potential

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

National/Societal relevance

The ease of sample collection, the safety and simplicity of the procedure, the non-invasive nature of the procedure, the preservation of the patient's privacy, and the avoidance of any discomfort and psychological stress associated with a trans-vaginal ultra-sonographic (TVS) procedure, makes the measurement of salivary progesterone as an excellent tool for the prediction of early PTB. In addition, the low-cost non-invasive test is expected to have social and financial sustainability for scaling up in resource poor settings

Project achievements

- Progress vis-a vis objectives:** The study has currently recruited 1145 females and of these saliva has been collected from 305 participants.
- Technology/ Product developed:** Low-cost salivary progesterone testing is being developed
- IP generated/ Potential for IP generation:** The ELISA data including cut off points for a positive and negative test for risk of PTB will be protected as intellectual property
- Resources Generated:** Study coordinators and outreach workers (ORWs) have been recruited for pregnant females' enrolment and collection of salivary samples

Plans to take innovation further

After the successful validation, collaborations will be explored with government in India and other neighbouring countries of South Asia.

Risks envisaged - While collecting the sample, there is small risk of contamination of blood in saliva among women who have oral diseases or injuries or gum bleeding. Saliva samples visibly contaminated with blood will be discarded and recollected. As India is a culturally sensitive society, there is possibility of social taboo i.e. women might be reluctant to give saliva during pregnancy. This is why the project includes a feasibility/acceptability component and advocacy visits carried out by the frontline functionaries

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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

Brief Description

The goal of the study is to develop biological markers of stress during pregnancy that correlate with enhanced risk of adverse outcomes in mothers and their babies

Stage of Development

Proof of concept

Unique features of the product/technology

The proposed approach of initially measuring stress by psychological instrument during the selection and recruitment of study participants 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 this study by preventing unnecessary performance of biological assays on large number of participants who may not be considered for the study after the initial screening. Further, the linear discriminate function that they propose to develop to identify mothers exposed to stress during pregnancy will be a major innovation



Market Potential

The economic burden due to IUGR and PTB is substantial, due to the enhanced requirements of neonatal care, complex health needs and poor economic productivity. Their prediction can result in considerable reduction in the public health burden

National/Societal Relevance

Once biological markers of stress identified, such at-risk mothers can be subjected to specific antenatal stress control programs aimed to eliminate or reduce stress during pregnancy, ultimately resulting in outcomes favourable to the production of healthy children

Project achievements

- Progress vis-a vis objectives:** collection and transportation of hair sample in a standardized manner, equipments set-up, participant recruitment progressing as per schedule
- Technology/ Product developed:** Project initiated, A-Z score for clinical assessment of stress validated for study
- IP generated/ Potential for IP generation :**None
- Resources Generated:**Manpower recruited and trained, Biochemical assays procured, workflow for differential proteomics established

Plans to take innovation further

None

Risks Envisaged

None

Project coordinator
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ALL CHILDREN THRIVING

Society for Applied Studies (SAS)

The Innovation

Improving linear growth of children in low resource settings through integrated nutrition, WASH, care and support interventions during the Pre- and Peri-conceptual period, pregnancy and early childhood- A randomized controlled trial

Brief Description

The project aims to achieve optimal growth and development in infants and children living in low resource settings in India, through integrated delivery of a package of evidence-based interventions endorsed in our national programs and by the WHO. The study is a individually randomised, factorial design trial

Stage of Development

Proof of concept

Unique features of the product/technology

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. Employed new ways of delivery of interventions and engagement of participants at the household level

Market Potential

The integrated package of interventions if proven efficacious will have application in India, and the several other developing countries

National/Societal Relevance

High

Project achievements

- Progress vis-a vis objectives:** Formative research completed. About 1000 women have been enrolled for the study. Mechanistic sub-study (IMPRINT trial) draft proposal underway.
- Technology/ Product developed :** A set of interventions for accelerated linear growth have been finalized
- IP generated/ Potential for IP generation :** None
- Resources Generated:** Manpower has been employed and trained for the project. Established teams such as Screening & Enrollment team, Medical team and Counsellors, Nutrition & Development team and Outcome ascertainment team

Plans to take innovation further

A policy support team may be established to will examine a range of policy options including cost implications of potential approaches. 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



Project coordinator

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Team Members

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The Innovation

An intergenerational prebiotic approach to establishment of a healthy colonic microbiome in infants

Brief Description

Study proposes to feed a safe and readily available resistant starch (namely high amylose maize starch, HAMS) to participants (weaning infants and women of reproductive age group) in a series of studies, with appropriate consent, and to longitudinally collect fecal samples for microbiota analysis using next generation sequencing

Stage of Development

Proof of concept

Unique features of the product/technology

The innovation lies in the concept of an inter-generational intervention. Further innovations in technology may be incorporated at a later stage in the process when discovery leads to development and validation

Market Potential

If the primary hypothesis of an inter-generational beneficial effect turns out to be indeed correct, they would have identified a simple intervention that will potentially alleviate environmental enteropathy (EE) and its long term consequences (recurrent acute illnesses, slowed growth velocity, cognitive defects) in infants at risk

National/Societal Relevance

Development of a product that can reduce environmental enteropathy and hence stunting to a great extent

Project achievements

- Progress vis-a vis objectives:** Clinical Trials Insurance Cover obtained, Ethical approvals for protocol, recruited all women and infant subjects for the study and stools samples collected
- Technology/ Product developed:** HAMS obtained from Australia
- IP generated/ Potential for IP generation:** There is potential for IP generation from the microbiome studies
- Resources Generated:** Manpower recruited (scientist for lab studies, dietician, field worker, co-ordinator), Real time PCR instrument received

Plans to take innovation further

They already have a partnership between the coordinator and the scientists in Australia. This will be taken further once the results are available. They also plan to take the bigger trial to prove the primary hypothesis, once this is completed

Risks Envisaged

None



Project coordinator
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ALL CHILDREN THRIVING

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

Brief description

Research work carried out by the investigators and awardees using 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

Proof of concept

Unique features of the product/technology

The study will advance a comprehensive and cohesive research solution pathway to address multiple strategic priorities in preterm birth (PTB) discovery and development, needed in India and other low-middle income countries

Market potential

The research project will lead to development of electronic clinical record repository; imaging bank of ultrasound images; biospecimen repository and omics data bank to aid future researchers. The diagnostics/biomarker developed 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

Multi-omics research directed at discovering prospective diagnostic predictive biomarkers is profoundly dependent on the accessibility of large number of consistently and accurately collected serial clinical samples from humans in whom the phenotype has been well characterized. The ultimate aim is to use this knowledge to develop an effective algorithm for accurate diagnosis and timing of intervention to prevent PTB

Project achievements

- Progress vis-a vis objectives:** Currently 400,000 bio specimens (maternal serum, saliva, feces, high vaginal swabs, urine, cord blood, paternal saliva) have been stored in the biorepository. The collection of placenta (672 till now) has also been added. Approximately, 50% of the total enrolled participants have provided bio specimens. Additionally, 90,000 images have been collected for e-repository
- Technology/ Product developed:** None
- IP generated/Potential for IP generation :** None
- Resources generated:** A long term stable infrastructure of deep freezers with monitors, data management hard ware and software has been established. A dedicated repository manpower has been hired

Plans to take innovation further

The repository will serve as a platform to conduct collaborative research in the maternal and child health area and develop hypothesis driven sub-studies

Risks envisaged

There is a risk of sample deterioration, therefore, alternate strategies have been proposed to minimize sample deterioration while storage



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Healthy Birth, Growth and Development Knowledge integration (HBGDki)

One of the initiatives which are facilitated by PMU-BIRAC and funded by Gates Foundation is *Healthy Birth, Growth and Development Knowledge integration (HBGDki)*, India. The HBGDKi - India Consortium have been launched with the aim to facilitate collaboration between researchers, quantitative experts, and policy makers in fields related to HBGD, with a focus on reducing the global burden associated with three complex and interrelated outcomes: Preterm birth, physical growth faltering and impaired neurocognitive development.

The initiative supports the rapid aggregation and comparison of data from these fragmented sources by providing a single platform for this data to be stored. This initiative intends to essentially create a knowledge compendium that will allow researchers and others to access a variety of data from different parts of the world, to allow them to obtain a much clearer picture of global trends and analyses on factors that affect child birth and subsequent development based on the insights obtained by integrating knowledge from past and ongoing studies.

This will be done by incorporating individual study data into larger pooled analyses. To transform data into insights, the foundation has built a Global Health Analytics Platform (GHAP), which is a modelling, analysis, and interactive visualization model. This platform will lead to accelerated learning by means of faster analysis and data modelling, and will help in drawing inferences and comparisons with similar populations of the world and within our country. Combining available data presents a unique opportunity to generate actionable conclusions, predictions, and new hypotheses that will enable us to define effective strategies to promote healthy neurocognitive development and growth in children.

Dataset Information to be included on HBGDKi-India platform:

The clinical variables to be taken into account from gathered datasets are:

- i. Variables that are known or postulated to be associated with gut function capacity (gut integrity and inflammation markers),
- ii. Child's history of enteric infection (cumulative reported diarrhoea morbidity, microbiologic assays of enteric pathogens) and other infections,
- iii. Growth and development (anthropometry, macro- and micronutrient intake, biochemical indicators of nutritional status),
- iv. Cognitive function (global development, language, motor function, temperament),
- v. Household assessments (demographics, maternal IQ, parental height, socioeconomic status),
- vi. Mucosal/oral vaccine response and immunogenicity, and
- vii. Any other illness surveillance data accompanying longitudinal and cross sectional anthropometric data.

The platform will allow contributing academics, statisticians and ultimately policymakers to access this data which would enable them to obtain a much clearer picture on trends and patterns which will in turn help design packages of interventions to address these issues as well as identify gaps in research to direct future efforts.

Knowledge Integration and Translational Platform (KnIT)

KnIT is a unique platform that has been launched with the aim of collating and analyzing available evidence within India, to inform policymakers and health authorities and aid in the development of evidence-based policy to address the inequalities in the health outcomes in our country. The platform works by identifying gaps in our knowledge and policy, and synthesizing currently available evidence to improve our understanding of current or new interventions or packages of interventions to address the major health issues in our country.

This platform was launched in 2016 and specifically targets Indian policymakers as the end users of the knowledge synthesized, specifically at the State level. This is to ensure that the data and evidence collection is done with the overarching goal of developing and implementing cost-effective, sustainable interventions or packages of multi-sectoral health interventions that are appropriate to the context of different states.

The platform will work by conducting extensive systematic reviews and will conduct workshops and other meetings to widely share the findings of these studies. Currently, KnIT focuses on two tracks, maternal and child health issues and nutrition.

The Nutrition track examines public health and medical interventions to mitigate stunting, wasting, severe malnutrition, low birth weight, optimal body composition and metabolic unfitness or obesity. In addition KnIT also aims to address multi-sectoral interventions for health; nutrition; family planning; water and sanitation hygiene; air pollution; child development; food fortification; and agri-nutrition linkages.

MCH focuses on identifying the health system challenges that are barriers to effective, equitable, impactful delivery of health services and identifies strategies how to overcome them. It also focuses on designing delivery strategies based on evidence, and piloting and evaluating programs aimed at improving program delivery, directing implementation research to optimize primary and secondary level healthcare, and generating evidence-based, human resource linked strategies relevant to MCH.

Currently, the Society for Applied Studies (SAS) and the International AIDS Vaccine Initiative (IAVI) are the two domain centers that are working on the nutrition track and the Maternal and child health track respectively.

Way Forward

Over the last 5 years we have seen a tremendous growth in the Indian biotech ecosystem. BIRAC, to its efforts, has significantly contributed to this growth story.

We are confident that if we continue to focus on identifying existing gaps and through consultative mechanisms find solutions, this will lead to significant growth of the Indian Bio-economy propelling it to becoming a major hub in the global biotech industry.

As we look into the future, we are strategizing to operationalize a few flagship programs such as the National Biopharma Mission, Ace Fund and SoCH. We will also continue to build new capacities in Bio incubation and other infrastructure. We hope that the impact of these new programs as well as the continued effort of existing programs will catalyze development of new products and technologies which will bring positive impact in the country and the world. Collectively, we strive to building a biotech power house for a bio-economy driven society.





**Biotechnology Industry Research
Assistance Council (BIRAC)**

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