Compendium of Technologies Developed under Scheme for Young Scientists and Technologists

विज्ञान एवं प्रौद्योगिकी विभाग
DEPARTMENT OF
SCIENCE AND TECHNOLOGY
भारत सरकार
GOVERNMENT OF INDIA

सत्यमेव जयते

CSIR–National Botanical Research Institute, Lucknow

सत्यमेव जयते
प्रो. अभय करंदीकर
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सचिव
भारत सरकार
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विज्ञान एवं प्रौद्योगिकी विभाग
Secretary
Government of India
Ministry of Science and Technology
Department of Science and Technology

07th November, 2023

FOREWORD

Science, Technology, and Innovation (STI) are essential pillars of socio-economic growth of the country. India ranks 40th in the Global Innovation Index (2022) and holds the top ranking in indicators such as finance for start-ups and scaleups, graduates in science and engineering, etc. The country's Gross Expenditure on R&D (GERD) has also tripled in the last decade indicating the strengthening of STI ecosystem.

As per the Hon'ble Prime Minister Shri Narendra Modi, Innovation for the people and by the people is the direction of our 'New India' and young scientists must utilize the power of Science and Technology (S&T) for development through cost effective and superior innovations leading to nation-building and achieving the vision of '*Atmanirbhar Bharat*'. Therefore, nurturing, mentoring and empowering the next generation of researchers is essential for achieving leadership in research and development (R&D) and attaining National Goals. The Scheme for Young Scientists and Technologists (SYST) of the Department of Science and Technology (DST) strengthens the link between science and society by orienting young scientists towards solution-centric R&D.

The program has evolved in last 9 years to catalyze the potential of young researchers in the problem solving process through innovative ideas, scientific know-how and integration of new & emerging technologies for the benefit of the society. A total of 373 projects were supported to young researchers, out of these 24% of the projects were supported to women candidates. These projects were supported across the country in 26 States and 6 UTs.

This Compendium is an ensemble of 45 technologies developed in four sectors in Health, Agriculture, Energy & Engineering and Waste to Wealth, by young enthusiastic researchers supported under SYST. These 45 researchers whose technologies have been compiled were able to publish more than 80 peer review research papers and filed 12 patents. Technologies were also transferred to line ministries and private companies i.e equipment's designed & developed to reduce drudgery of bamboo artisans were transferred to Tool Room and Training Centre, MSME-Amingao, Guwahati; tissue culture technology for growing dwarf cherry trees for efficient management of crop to private tissue culture lab in Himachal Pradesh etc. Also, one of the Investigators who developed prototype of dissolvable micro needles for vaccine delivery could be able to create her own startup company. The technologies developed have been able to address the issue of cost effectiveness, drudgery reduction, environmental hazard, sustainability in already existing process, method or technology.

It gives me immense pleasure to state that the program has been able to create a visible impact in terms nurturing and mentoring young researchers towards adopting people centric, solution driven approach. I must congratulate Dr. Debapriya Dutta and Dr Rashmi Sharma, DST and the members of the Expert Committee on SYST for creating a compilation of technologies for further outreach and generating forward linkages for the benefit of the society at large.

(Abhay Karandikar)

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The statements/opinions expressed, and photographs used by the author(s) in their technologies are based on their research findings. The expression made by the author may not be construed as the views of the Government of India or any of its agencies, and thus, the responsibility of the correctness and completeness lies solely with the technology developer. The technologies were developed by different institution with funding from Science for Equity Empowerment and Development (SEED) Division of Department of Science and Technology (DST), Government of India (GoI).

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Compendium of Technologies Developed under Scheme for Young Scientists and Technologists (SYST)

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Department of Science and Technology
Ministry of Science and Technology
Government of India

Compendium of Technologies Developed under

Scheme for Young Scientists and Technologists

Technologies for Health Sector

HERBAL PRODUCT FOR GOUTY ARTHRITIC CONDITIONS

User Groups

Elderly, patients suffering from gout and its associated conditions

Description and Functionality

A natural supplement made from a combination of medicinal plants to mitigate gouty arthritic conditions in patients. The supplement also addresses the inflammation produced in joints due to gout. The product's USP is water-soluble, safe, effective, and scientifically validated to reduce the clinical manifestations of gout.

Technical Description

The primary aim of the formulation is to reduce the synthesis of uric acid, which is the primary clinical cause of gout, by inhibiting the xanthine oxidase enzyme through competitive inhibition with plant metabolites. Inflammation produced in joints due to gout is also addressed using this formulation. After screening over 30 medicinal plants, 5-7 potential leads were selected to develop different permutation combinations and after post formulation studies, most effective formulation was tested for efficacy and safety through animal modeling following AYUSH guidelines. The technology falls under the UN Good health and well-being goal, SDG-3, and is committed to addressing gout as an adjuvant treatment to the existing line of action.

Technology Readiness Level (TRL) and Cost

The manufacturing/production of the product is economical and can be done using conventional instruments used by herbal drug industries. The approximate cost of tablets will be around ₹ 2 to 3 per tablet, including the cost of raw materials, extraction, labour cost, and tablet preparation. The technology is at a level of TRL-7 and under negotiation with two pharma companies.

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NBRI GOUT-OUT

A scientifically validated synergistic herbal supplement for gouty arthritis

Gout: Increased uric acid (>7mg/dl).
✓Pain, stiffness in joints due to deposition of uric acid trophi.
✓Compromised locomotion.

National Prevalence: 0.5 to 0.9%

KNOWLEDGE GAP

- Lack of scientific data.
- Based on traditional use only.
- High number of ingredients in existing herbal products.

S&T INTERVENTION

- Targeted to reduced uric acid production and underlying inflammation.
- *In-vivo* Anti-Gout and Anti-hyperuricemia efficacy was established in experimental mice model.
- Quantification of proinflammatory cytokines i.e. IL-1β, IL-6, TNF-α.
- Biochemical estimation of serum and urine samples i.e. Uric acid, creatinine in serum, urine samples and blood urea nitrogen (BUN).
- Safety and toxicity data generated.

BENEFITS

- >80% reduction in serum uric acid level and serum creatinine.
- 70% reduction in inflammatory mediators.
- Improved Locomotion (~65 %), compared to control.
- Increased urine uric acid and urine creatinine secretion.
- No abnormal behaviour in animals.

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SCRUB TYPHUS DETECTION TOOL USING ELECTROCHEMICAL DNA SENSING TECHNOLOGY

User Groups:

Medical professionals, hospitals, and clinics dealing with the diagnosis of scrub typhus

Description and Functionality:

A portable, nanocomposite-based electrochemical DNA sensor for detecting *Orientia tsutsugamushi* bacteria instantly with high sensitivity and specificity. The sensor has been validated using patients' DNA samples and showed compatible results with commercial ELISA kits. The prototype device is a pen drive-sized android app-enabled potentiostat/galvanostat that can be run using an Android mobile with minimum effort, making it user-friendly and portable.

Technical Description:

The electrochemical DNA sensor is based on the nucleic acid hybridization principle. The sensor is highly specific to the 56 kDa tsa gene of *Orientia tsutsugamushi*. The sensor has higher sensitivity (7849 μA/cm2/ng DNA) and specificity than currently available serological tests. The sensor is based on AuNPs/carbon nanofiber-based screen-printed electrodes modified with 5'NH2 labelled DNA probe. The sensor detects the G-DNA of *Orientia tsutsugamushi* with a detection limit in the femtogram range (0.02 ng/μl of ssDNA) and a short response time (60 sec).

Technology Readiness Level (TRL):

The technology is at a level of TRL-7, demonstrated in a realistic environment and is ready for commercialization.

Technology Developer:
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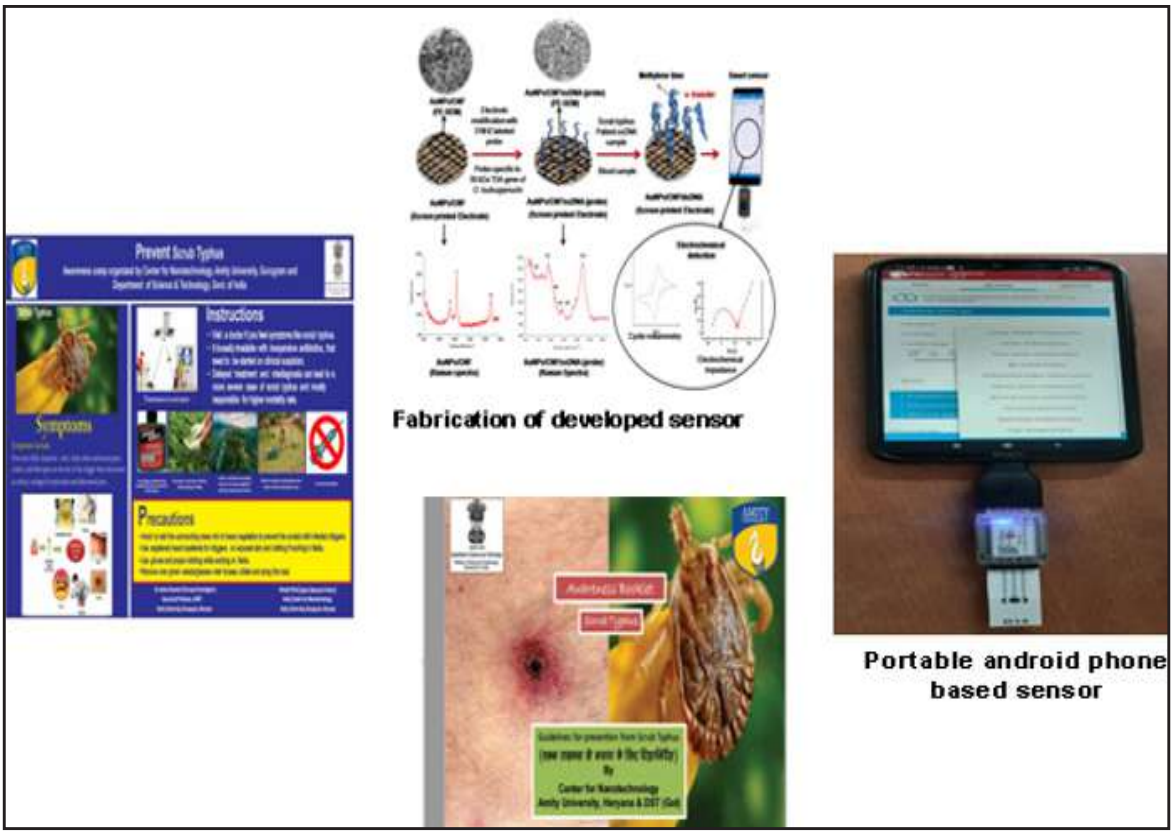
Prevent Scrub Typhus
Instructions
Symptoms
Precautions
Fabrication of developed sensor
Portable android phone based sensor

DESIGNER FOOD TO MANAGE TYPE-2 DIABETES CONDITIONS

User Groups:

Individuals with type 2 diabetes, researchers, food industry

Description and Functionality:

The developed technology is a symbiotic-designed food product, "Synbiotic Curd," made from selected *Lactobacillus* strains and a low glycemic index prebiotic. The product aims to regulate and manage type 2 diabetes by improving gut microbial composition and intestinal hormone modulatory potential. It is an affordable, safe, and sustainable dietary intervention for diabetic patients to manage their lifestyle.

Technical Description:

To investigate alternative dietary interventions for managing diabetes, *Lactobacillus* strains were isolated from various sources, including human milk, goat milk, fermented milk products, and faecal samples from healthy human babies. The isolated strains were evaluated for their potential to stimulate the secretion of intestinal hormones such as GLP-1, GIP, and PYY, as well as their expression potential in specialized STC-1pGIPneo cells. The selected strains were used to develop a special type of food containing a low glycemic prebiotic, like yoghurt. The developed product was further validated for its intestinal hormone modulatory potential and found to improve gut bacteria balance and regulate intestinal hormones.

Technology Readiness Level (TRL):

The technology is at a level of TRL-4 and can be transferred to interested parties on mutually agreeable terms.

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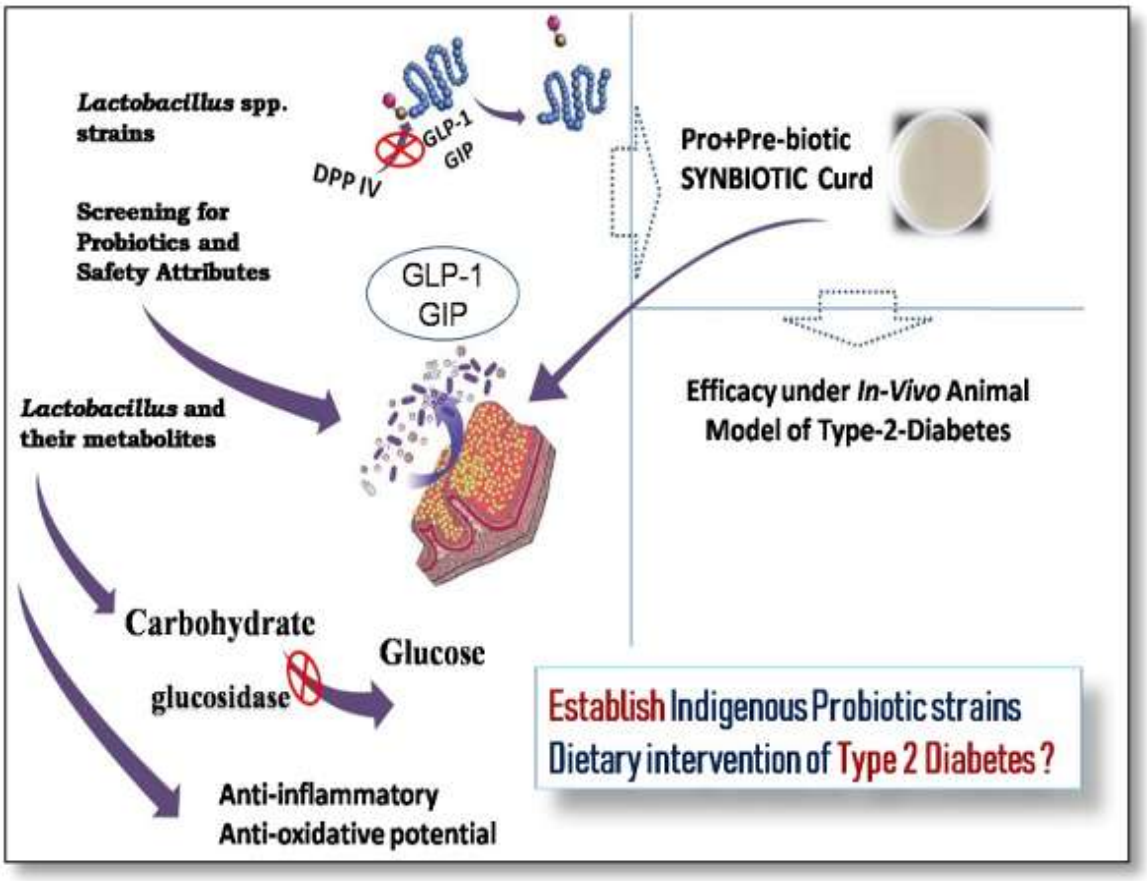
Lactobacillus spp. strains
GLP-1
GIP
DPP IV
Screening for Probiotics and Safety Attributes
GLP-1
GIP
Pro+Pre-biotic SYNBIOTIC Curd
Efficacy under In-Vivo Animal Model of Type-2-Diabetes
Lactobacillus and their metabolites
Carbohydrate
glucosidase
Glucose
Anti-inflammatory
Anti-oxidative potential
Establish Indigenous Probiotic strains
Dietary intervention of Type 2 Diabetes ?

ECO-FRIENDLY FORMULATION TO CONTROL VECTOR MOSQUITO POPULATION FOR DENGUE

User Groups:

Population affected by mosquito-borne diseases, including rural and urban areas.

Description and Functionality:

The technology is developed by combining chemical insecticides and entomopathogenic fungi to create a synergistic combination that reduces the dependency on synthetic chemical compounds and increases the effectiveness of mosquito control. The developed formulation contains LC10 dose of imidacloprid or malathion and *B. bassiana* or *M. anisopliae*. It reduces the usage of chemical insecticides up to 4 times from the current level, thereby reducing environmental pollution and development of insecticide resistance.

Technical Description:

The technology combines chemical insecticides and entomopathogenic fungi to create a synergistic combination. The imidacloprid and malathion exposure modulate vector mosquito larvae's biochemical and immune markers. The increased toxicity of *B. bassiana* and *M. anisopliae* observed in the present study may be attributed to the immuno-suppressive condition created by exposure to low dosages of malathion and imidacloprid. Using biopesticides in the developed formulation makes it an eco-friendly approach.

Technology Readiness Level (TRL) and Cost:

The technology is currently at a stage of TRL-6. The approximate technology licensing cost is ₹2 Lakhs, and the industrial scale investment cost is around ₹5 Lakhs.

Technology Developer:
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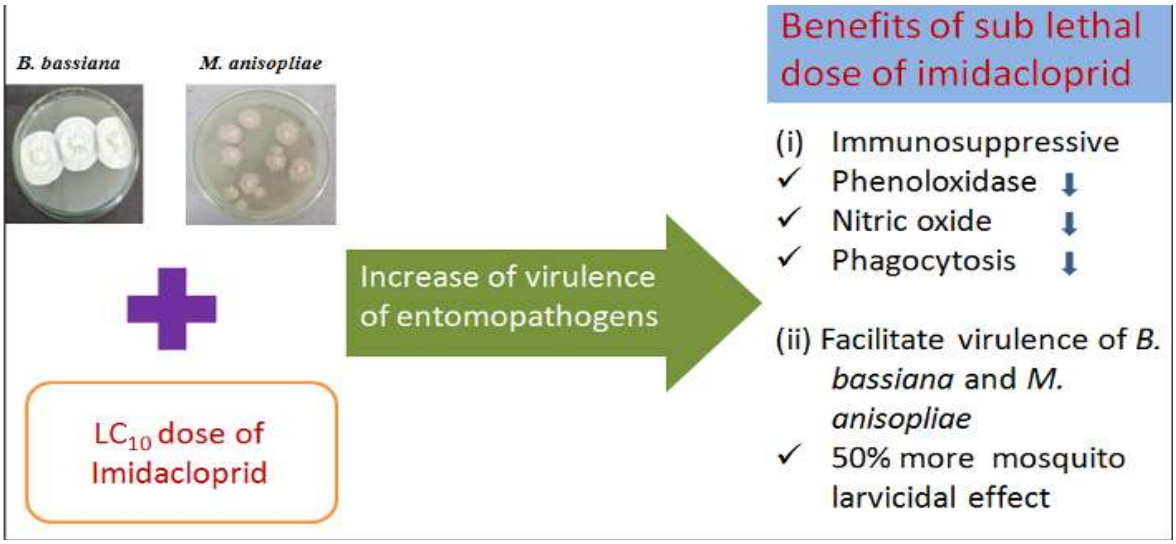
B. bassiana
M. anisopliae
LC10 dose of Imidacloprid
Increase of virulence of entomopathogens
Benefits of sub lethal dose of imidacloprid
(i) Immunosuppressive
✓ Phenoloxidase ⬇
✓ Nitric oxide ⬇
✓ Phagocytosis ⬇
(ii) Facilitate virulence of B. bassiana and M. anisopliae
✓ 50% more mosquito larvicidal effect

PROBIOTIC MAP TO DIAGNOSE PATIENTS WITH GLUTEN ALLERGY & CELIAC DISEASE

User Groups:

People suffering from gluten allergy and celiac disease, medical professionals and diagnostic centres.

Description and Functionality:

Celiac disease is a chronic digestive and immune disorder triggered by consumption of gluten-containing products causing reduced absorption of nutrients in the small intestines. A probiotic map for diagnosing gluten allergy and celiac disease has been developed. The map is generated from the faecal samples of patients and identifies the absence of *Lactobacillus* and *Bifidobacterium* species, which are associated with gluten allergy. It can be used to compare the microbiota of healthy individuals, allergic patients, and people with other gastrointestinal problems. It can provide a specific and non-invasive diagnostic method for gluten allergy.

Technical Description:

The probiotic map is generated by evaluating the microbiota of faecal matter from healthy individuals, allergic patients, and people with other gastrointestinal problems. The absence of *Lactobacillus* and *Bifidobacterium* species in the faecal matter can indicate gluten allergy. The technique is non-invasive and can be used as a specific and efficient diagnostic method for gluten allergy and celiac disease.

Technology Readiness Level (TRL):

The technology is at the level of TRL-6 and can be negotiated for commercialization at mutually agreeable terms.

Technology Developer
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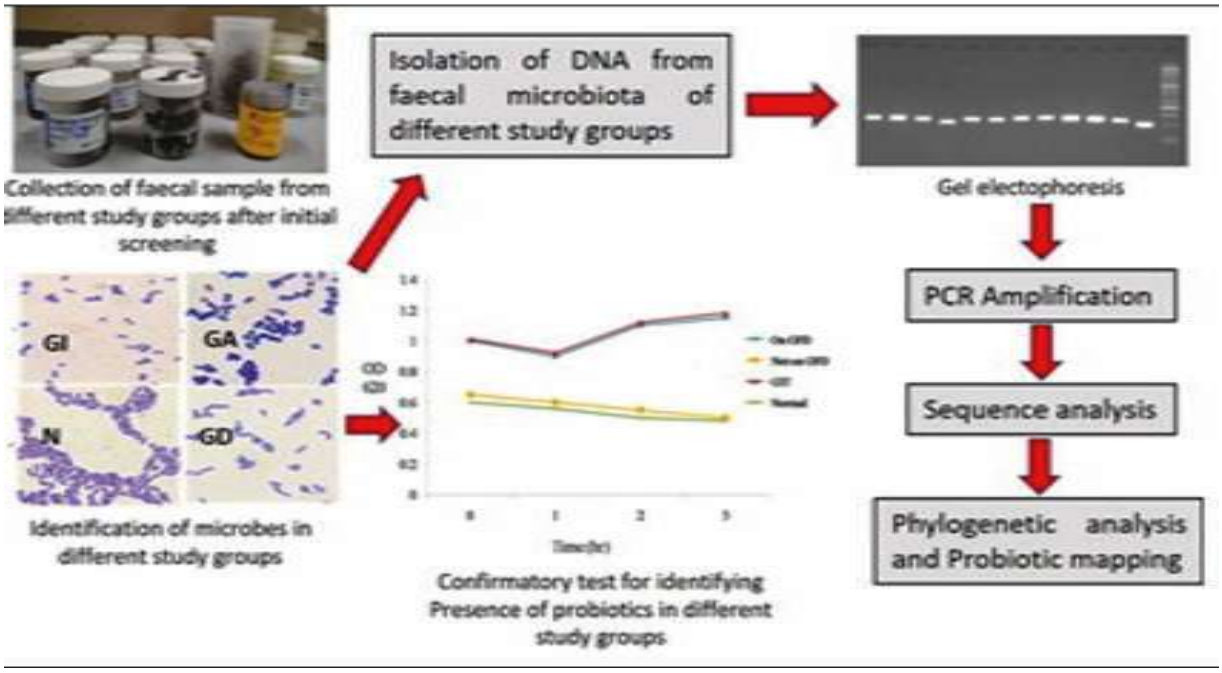
Isolation of DNA from faecal microbiota of different study groups
Collection of faecal sample from different study groups after initial screening
Gel electophoresis
PCR Amplification
Sequence analysis
Phylogenetic analysis and Probiotic mapping
GI
GA
N
GD
Identification of microbes in different study groups
Confirmatory test for identifying Presence of probiotics in different study groups

INDIGENOUS 2D & 3D RETINAL IMAGING DEVICE

User Groups:

Patients suffering from glaucoma, Ophthalmologists, healthcare providers.

Description and Functionality:

Glaucoma, a group of eye disorders, is the second most common cause of blindness globally, followed by cataracts. It occurs due to the obstruction of the optic nerves, which impedes the transmission of visual information to the brain. Early detection of this condition is crucial for effective treatment as the available treatments only slow down the progression of vision loss and cannot restore lost vision. A fundus camera and its computational algorithm for diagnosing glau-coma have been successfully developed indigenously.

Technical Description:

The technology uses three different models to provide information such as the diameter of the optic disc, cup-to-disc ratio, and bowl and disc area. These models also create a 2D, anaglyph, and 3D reconstruction of the optic disc region by extracting frames from a video. The 3D model pro-vides physicians with detailed information on nerve head damage that cannot be obtained through conventional 2D methods. The computer code is developed using a Python-based platform and tested with normal and glaucomatous images in online databases. The development of an instru-ment to record the image of the CFI is underway with collaboration with an ophthalmologist, and the Santhi Gears hospital in Coimbatore.

Technology Readiness Level (TRL) and Cost:

The technology is at the level of TRL-7, and the development of the instrument is underway. The approximate total cost of the industrial scale investment is ₹5 Lakhs.

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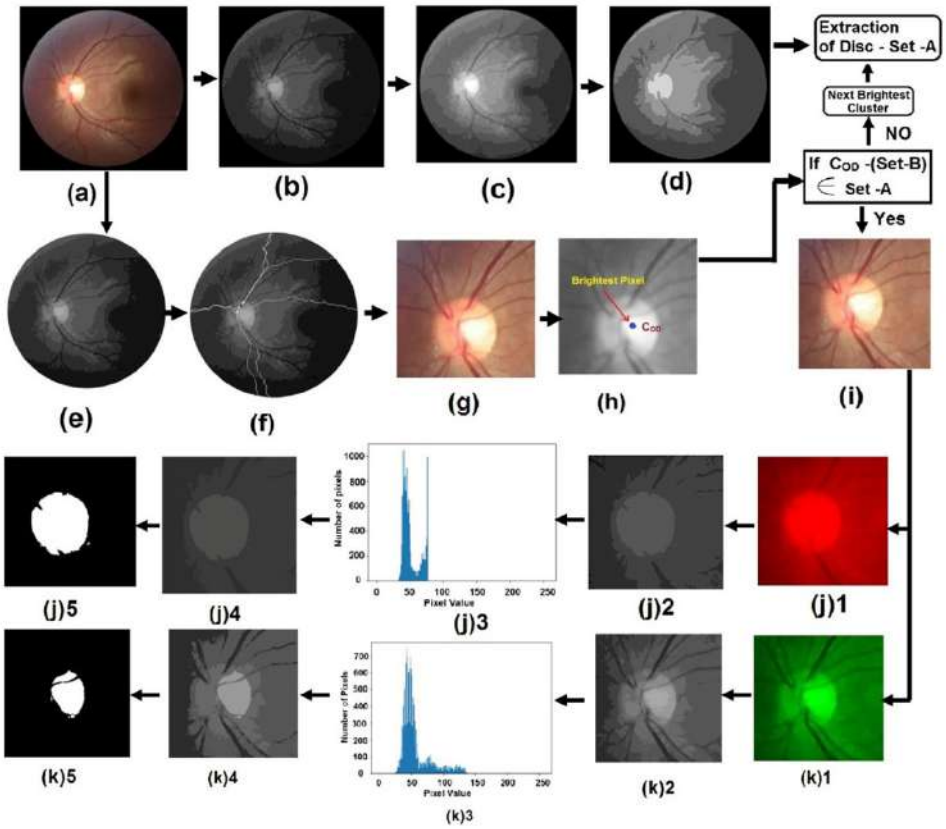
Development of a new model to diagnose glaucoma from retinal image with exudates



NANOCOATED VACCINE FEED FOR FISHERIES

User Groups:

Fish farmers, fish traders, aquaculture industry, researchers

Description and Functionality:

Human activities harm natural resources and threaten aquaculture systems by causing various bacterial diseases. One such bacterium, *Aeromonas hydrophilla,* commonly found in freshwater, causes severe damage to fish populations. Controlling bacterial growth is challenging in aquaculture, but vaccinating fish against the pathogen can be a practical, healthy, and sustainable solution. This innovative technology offers a sustainable solution for safeguarding the mass fish population from *A. hydrophila* infection and minimising the economic losses associated with disease outbreaks in aquaculture.

Technical Description:

A biofilm from *A. hydrophila* has been prepared and incorporated into fish feed, developing a "vaccinated feed". The vaccinated feed enhances antibody production in fishes and provides protection against different *A. hydrophila* strains. The vaccine is delivered via chitosan nanoparticles, which are added to the fish feed, leading to improved immunity and villi size in the fish. To achieve this, the technology employs the reverse vaccinology approach to identify the protective proteins in the whole-cell *A. hydrophila* biofilm vaccine. Four levels of chitosan nanoparticles have been tested to determine the optimal dose for efficient vaccine delivery.

Technology Readiness Level (TRL) and Cost:

The technology is at a stage of TRL-5, and the approximate technology licensing cost is ₹8-10 Lakhs. The total industrial scale investment cost is estimated to be around ₹30-40 Lakhs.

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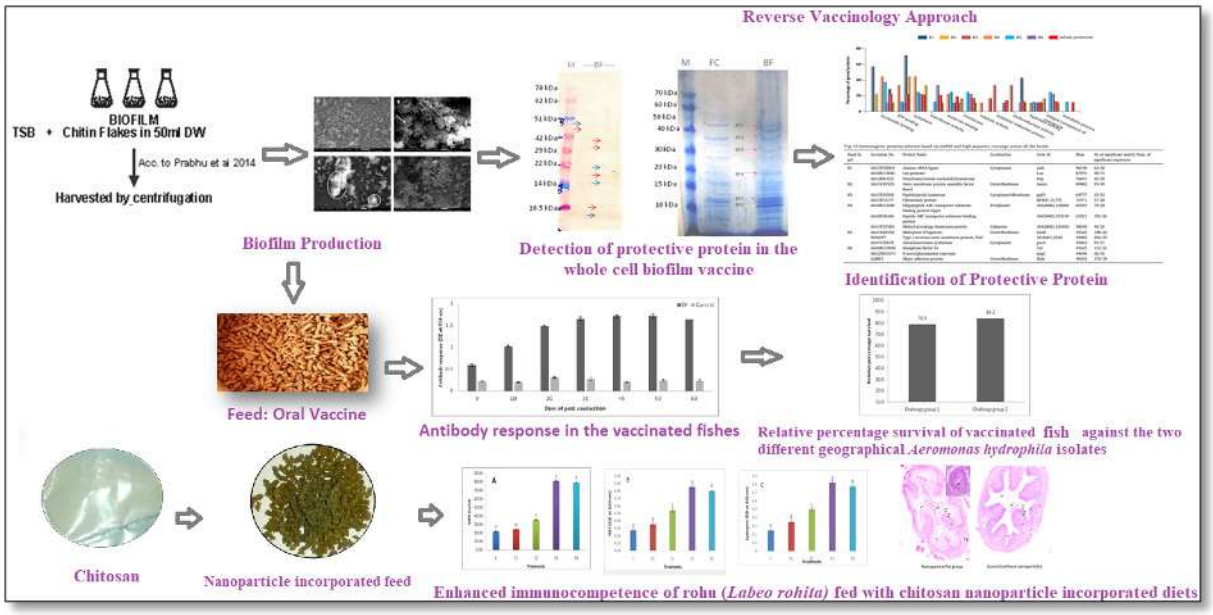
Reverse Vaccinology Approach
BIOFILM
TSB + Chitin Flakes in 50ml DW
Acc. to Prabhu et al 2014
Harvested by centrifugation
Biofilm Production
Detection of protective protein in the whole cell biofilm vaccine
Identification of Protective Protein
Feed: Oral Vaccine
Antibody response in the vaccinated fishes
Relative percentage survival of vaccinated fish against the two different geographical Aeromonas hydrophila isolates
Chitosan
Nanoparticle incorporated feed
Enhanced immunocompetence of rohu (Labeo rohita) fed with chitosan nanoparticle incorporated diets

HERBAL FORMULATION TO MANAGE MOSQUITO POPULATION

User Groups:

General public, especially rural and marginal communities, hospitals and public works department

Description and Functionality:

The technology involves use of bioactive agents from plant extracts, which act as a toxic agent to mosquito vectors. The plant extracts were prepared in different solvents and tested against selected mosquito species to determine the most potent combination. The technology is eco-friendly and efficacious towards target organisms. It addresses SDG-3, 'good health and well-being' by mitigating mosquito larvae and preventing the escalation of mosquito-borne diseases.

Technical Description:

A number of plants were selected, and the extracts were prepared using different solvents (hexane, methanol, and water). Based on their mechanism of damaging larvae, three potent plants were identified *Piper nigrum* hexane extract (PNH), *Camellia sinensis* water extract (CSA), and *Moringa oleifera* water extract (MOA). The plant compositions were used in different proportions to test their larvicidal activity against *Aedes aegypti, Anopheles stephensi*, and Culex quinquefasciatus mosquitoes. Using Design Expert®, perturbation graphs were plotted to achieve 100% mortality for all mosquito species. This resulted in generating one combination Aa13i for *A. aegypti*, three combinations (Cq13i, Cq13ii, and Cq13iii) for *C. quinquefasciatus*, and two combinations (As17i and As17ii) for *A. stephensi.* Aa13i, Cq13ii, and As17ii combinations showed 100% mortality against their respective species.

Technology Readiness Level (TRL) and Cost:

The formulation has been tested in the laboratory and patented in India (patent no.: 407183), and at a level of TRL-5. The approximate technology licensing cost is ₹5-10 Lakhs and the industrial scale investment cost comes around ₹15-20 Lakhs.

Technology Developer:
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RAPID DETECTION METHOD FOR INVASIVE FUNGAL INFECTIONS

User Groups:

Medical professionals, and patients with chronic liver or immunodeficiency diseases.

Description and Functionality:

The diagnosis of invasive fungal infections (IFIs) caused by a broad range of mycotic agents is quite challenging. The knowledge is limited on invasive fungal infections in liver diseases such as cirrhosis, acute/chronic liver failure, pancreatitis, gastrointestinal neoplasms, and liver transplantation. To address this issue, a serological and molecular method for the rapid detection of IFIs in patients with chronic liver disease or other immunodeficiency diseases has been developed. The developed methods allow for early detection of IFIs, which can have serious clinical repercussions if left untreated.

Technical Description:

Developing serological and molecular methods for rapid detection of IFIs, along with conventional laboratory procedures, could improve patient care. The method was developed by examining various forms of IFIs and active surveillance was performed to diagnose cases of IFIs, isolate etiological agents, and understand risk factors. Additionally, medical history, including any underlying disease or immunodeficiency, and treatment records, including antibiotics, steroids, and immunosuppressive drugs were recorded. The minimum inhibitory concentrations (MICs) were determined following the M38-A2 (CLSI guidelines), and real-time PCR was conducted for molecular detection.

Technology Readiness Level (TRL):

The developed serological and molecular methods for rapid detection of IFI are at a level of TRL-6 and ready for negotiation at mutually agreeable terms for commercial prospection.

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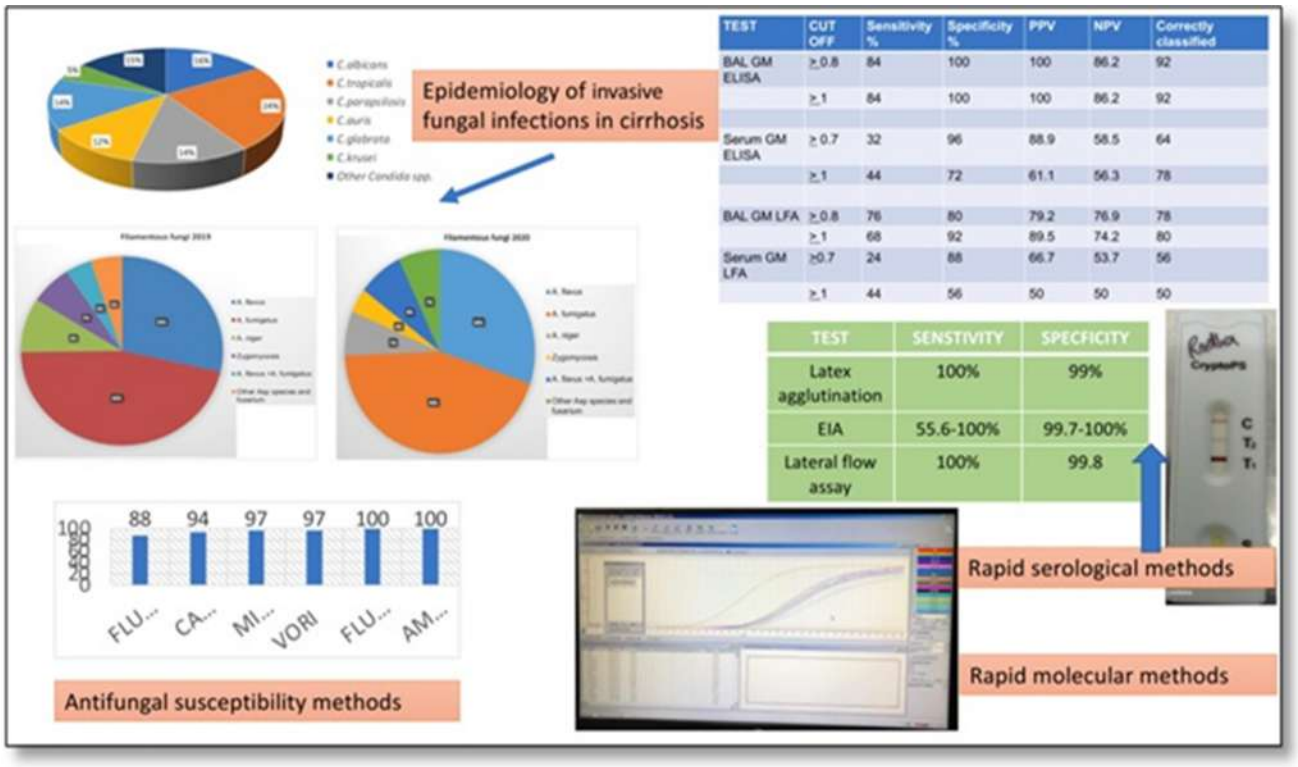

TEST	CUT OFF	Sensitivity %	Specificity %	PPV	NPV	Correctly classified
BAL GM ELISA	≥ 0.8	84	100	100	86.2	92
	≥ 1	84	100	100	86.2	92
Serum GM ELISA	≥ 0.7	32	96	88.9	58.5	64
	≥ 1	44	72	61.1	56.3	78
BAL GM LFA	≥ 0.8	76	80	79.2	76.9	78
	≥ 1	68	92	89.5	74.2	80
Serum GM LFA	≥0.7	24	88	66.7	53.7	56
	≥ 1	44	56	50	50	50

TEST	SENSTIVITY	SPECFICITY
Latex agglutination	100%	99%
EIA	55.6-100%	99.7-100%
Lateral flow assay	100%	99.8

CUSTOMIZED DENTAL BRACES USING CERAMIC MOULDING PROCESS

User Groups:

Dentists, Orthodontists, Patients with misaligned teeth

Description and Functionality:

Dental brackets are used to correct misaligned teeth by applying continuous pressure over the time. The current ceramic attachments are imported and are priced approximately 5 times higher than its metal counterparts. Its average density is approx. 3.8 g/cc and it has been tested for biocompatibility and suitablity for use in paitents. These tooth-coloured alumina brackets offer functionality similar to imported at a much lower cost and its cost is 60-70% lower.

Technical Description:

The mesh-shaped alumina brackets were developed by ceramic injection molding using an in-house developed alumina raw material. The prototype brackets were designed with an average density of 98% of theoretical alumina density. This technology can be applied to develop both micro and macro level components for surgical devices such as endoscopic electrode insulators, cardiac pacemakers, dental implants, prosthetic replacements, and much more. Micro-ceramic injection molding technology can be used to create micro and macro-level components such as micro gears, micro channels, and microstructured surfaces.

Technology Readiness Level (TRL) and Cost:

The developed technology is at a level of TRL-7 and have an industrial scale cost of approx ₹15,000/- per set of 20 attachments for single teeth. Industrial scale investment cost would be approximately ₹55 Lakhs for capital and recurring expenses.

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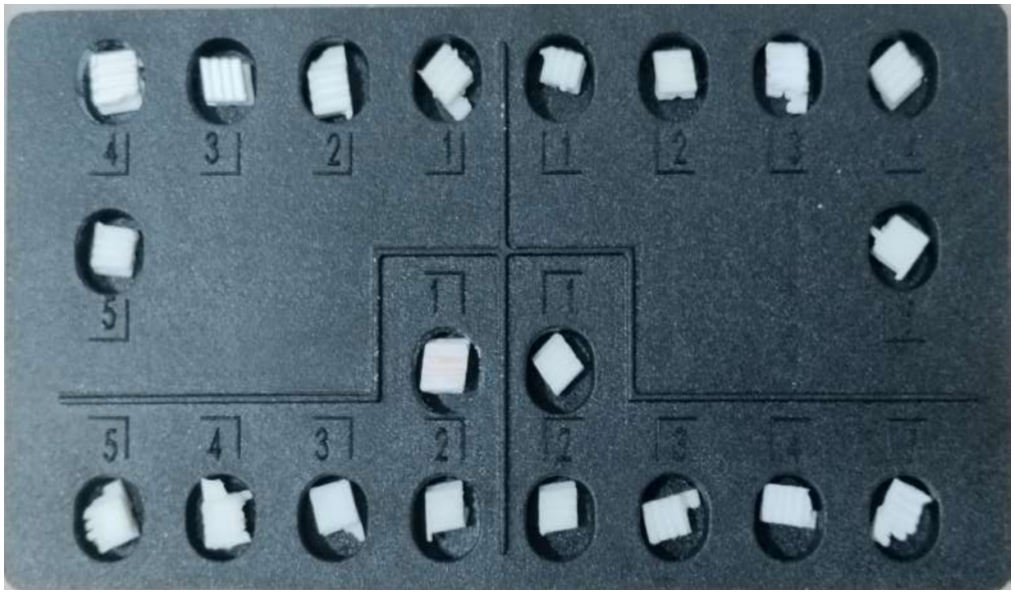

QUICK AND EASY CERVICAL CANCER DETECTION KIT

User Groups:

Women, Medical professionals, Healthcare providers, Research institutes

Description and Functionality:

The human papillomavirus (HPV) is the causal organism of invasive cervical cancer. The challenges in early detection of HPV are due to sophisticated equipment and laboratory skills required for the conventional PCR-based method. The development of a Loop-Mediated Isothermal Amplification (LAMP) assay-based detection kit for HPV testing is a simple, rapid, specific, and inexpensive nucleic acid amplification method that can be used in resource-limited environments.

Technical Description:

The LAMP assay-based detection kit for HPV testing provides isothermal temperature for target gene amplification, making it adaptable to resource-limited environments. The technology uses six different primers specifically designed to recognise eight distinct regions on the target gene (HPV L1 or L2 region), making the assay extremely specific. The developed kit aimed to detect high-risk HPV infection at an early stage among women, which would offer a cost-effective diagnostic method in settings with limited resources.

Technology Readiness Level (TRL):

The technology is at a level of TRL-7, and a fully functional and operational technology tested in a relevant environment.

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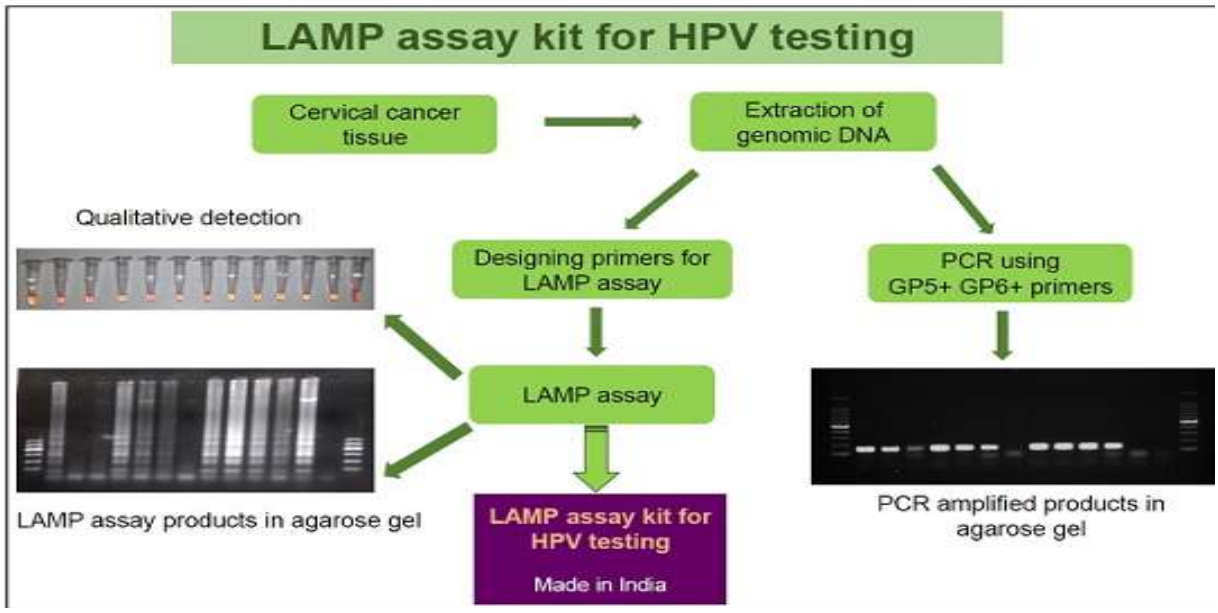
LAMP assay kit for HPV testing
Cervical cancer tissue
Extraction of genomic DNA
Qualitative detection
Designing primers for LAMP assay
PCR using GP5+ GP6+ primers
LAMP assay
LAMP assay products in agarose gel
LAMP assay kit for HPV testing
Made in India
PCR amplified products in agarose gel

STEM CELL THERAPY FOR JOINT PAIN ASSOCIATED OSTEOARTHRITIS

User Groups:

Individuals suffering from osteoarthritis, patients in need of articular cartilage regeneration, hospitals and research institutions

Description and Functionality:

The technology uses mesenchymal stem cells (MSCs) isolated from the infrapatellar fat pad (IFP) of the knee joint for cartilage tissue engineering. The study investigates whether inflammation could compromise the functional potential of IFP-MSCs, and repurposing of the antidiabetic drug metformin could reduce inflammation in IFP-MSC. Successful preclinical studies would pave the way for future clinical trials, which if successful, would greatly benefit society.

Technical Description:

The study investigates the role of IFP-MSCs for articular cartilage regeneration. It explores the mechanism behind the progenitor cell function, highlighting the role of senescence. A particular type of MSCs derived from the knee joint's infrapatellar fat pad (IFP-MSCs) has shown remarkable potential in regenerating articular cartilage. The results showed that inflammation induced by IL-1β reduced the proliferative and differentiation potential of IFP-MSCs and increased cellular senescence markers. Metformin reduced the expression of senescence and inflammation markers during IFP-MSC differentiation. Inflammation negatively affects IFP-MSC function, but metformin could potentially be repurposed to reduce inflammation in IFP-MSCs. The study suggests that metformin could be used as senotheraputic in progenitor cell differentiation to reduce inflammation.

Technology Readiness Level (TRL) and Cost:

The technology is at the proof-of-concept stage with a current TRL of 3. The expected licensing cost is approximately ₹10-15 Lakhs.

Technology Developer
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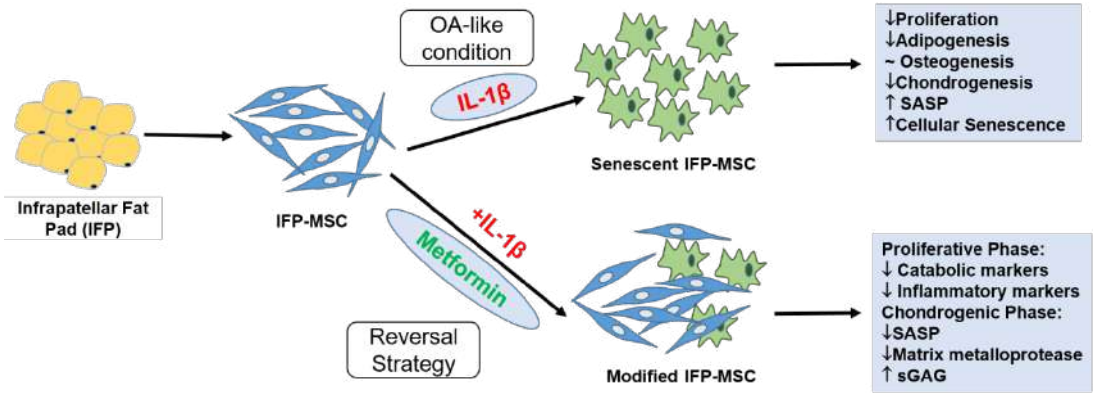

Title: Rectification of Adipose Stem Cell Dysfunction in Osteoarthritis for Autologous Cell Therapy

DISSOLVABLE MICRO-NEEDLES FOR EFFICIENT VACCINE DELIVERY

User Groups:

Healthcare professionals, vaccine manufacturers, government healthcare agencies.

Description and Functionality:

The vaccination process in a large country like India is costly, time consuming and labour intensive. Development of adjuvants and their delivery in a effective manner are needed to build a robust healthcare system. The technology is focused on developing dissolvable polymer microneedles (DMNs) as a novel pro-adjuvant-based vaccine delivery system. The DMNs contain microscopic polymeric needles of Poly (cardanol) adjuvant immunogen that can be used for sustained release of vaccines. This approach aims to provide a minimally invasive and painless vaccination method, which can be administered via a single-step "poke and release" mechanism.

Technical Description:

The matrix of DMNs contains Poly (cardanol) adjuvant-immunogen and an array of microscopic polymeric needles. These DMNs are designed to achieve a sustained antigen delivery by controlling their release kinetics. When inserted into the animal skin, the aqueous environment inside the skin facilitates the matrix degradation of DMNs, releasing their payload. DMNs can enhance immunity against debilitating diseases and have the potential to improve India's vaccination drive by advancing transdermal drug delivery technology. PDMS micro molding using micro-machined molds is the conventional method used for DMN fabrication. However, current microneedle fabrication techniques are limited due to the need for expensive tools to generate the necessary master molds. Therefore, the developed DMNs can play a significant role in vaccine delivery system.

Technology Readiness Level (TRL):

The technology is currently at a proof-of-concept stage and a level of TRL-3.

Technology Developer
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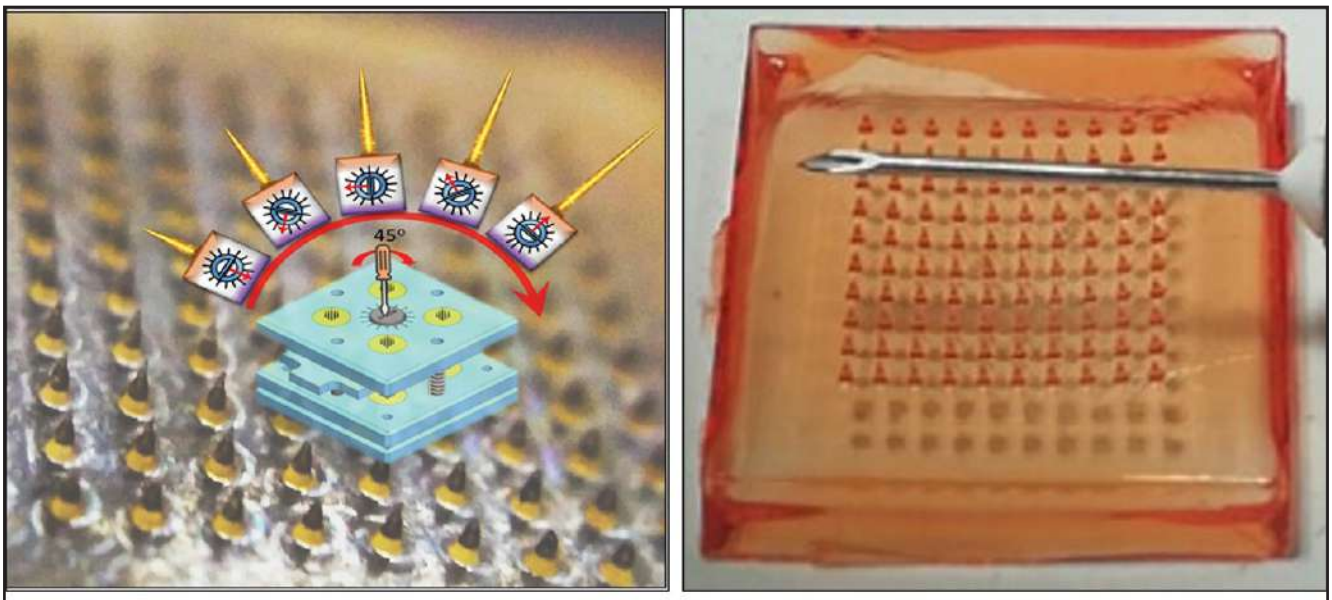

Scalable fabrication of dissolvable microneedles with adjustable aspect ratio molding platform

AN INHALER FOR TREATING LONG-TERM TUBERCULOSIS

User Groups:

Tuberculosis patients, healthcare providers, research institutes

Description and Functionality:

The technology aims to develop a patient-friendly and side-effect free dry powder inhaler for chronic tuberculosis patients. The dry powder technology is an efficient system for pulmonary drug delivery, as it contains a fine powder that can be easily inhaled and provide reproducible drug delivery. The technology has advantages over existing market products due to faster drug absorption, high bioavailability and local action of the drug in the respiratory tract.

Technical Description:

The biodegradable prototype of dry powder inhalable formulation containing Rifampicin, Ethambutol and Ofloxacin has been developed using a design approach, and the ratio of excipients optimized based on particle size, zeta potential and release behaviour. A novel "NOSE ONLY" drug delivery device has been fabricated and validated for delivering the dose to the lung tissue using ambient regulated air pressure pump in rodents.

Technology Readiness Level (TRL):

The *in-vivo* studies for this technology have been completed and it is currently at a level of TRL-5.

Technology Developer
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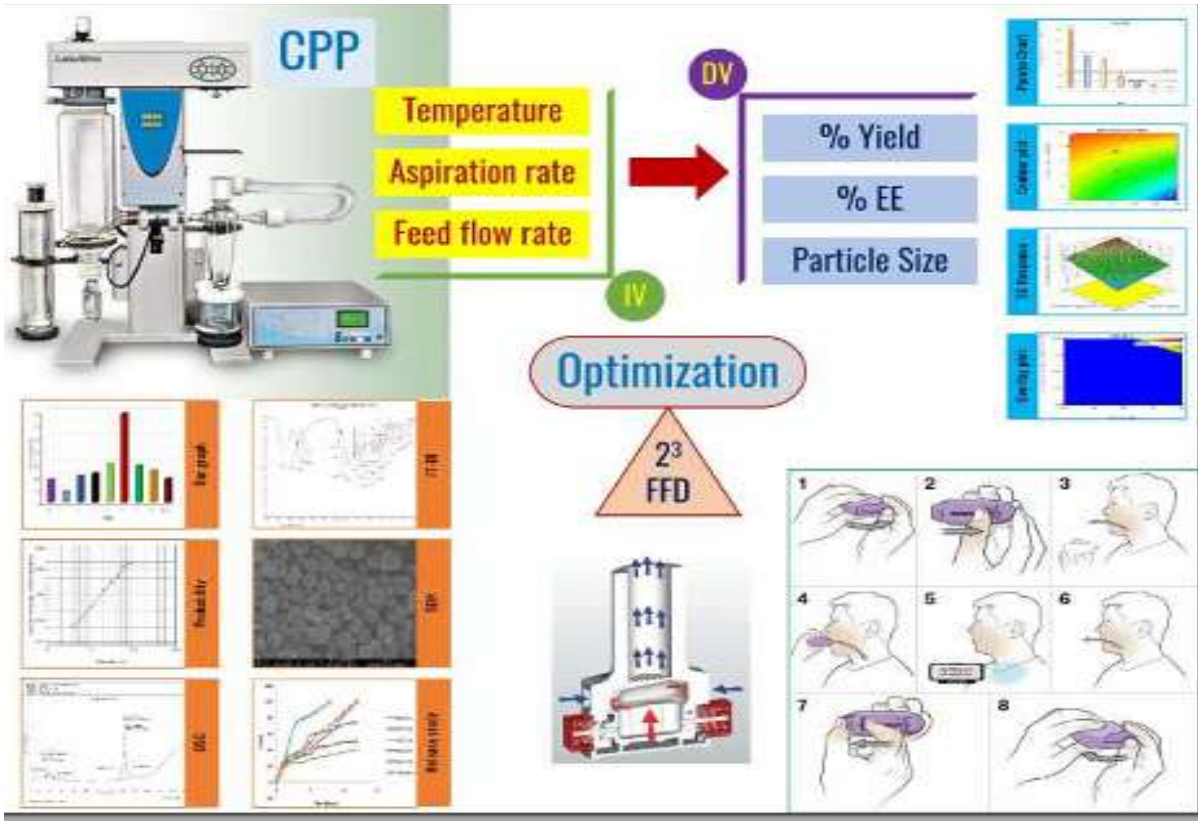
CPP
Temperature
Aspiration rate
Feed flow rate
IV
DV
% Yield
% EE
Particle Size
Optimization
2³
FFD

JUTE FABRIC-BASED SYNTHETIC PLASTER CAST FOR ORTHOPAEDIC IMMOBILIZATION

User Groups and Description:

Orthopaedic patients, medical industry, hospitals

Description and Functionality:

The currently used glass fabric-based plaster casts are costly, unsafe to handle and not easily degradable causing environmental hazard. A jute-based plaster cast has been developed as an alternative to the glass fabric-based synthetic plaster cast, to remove disposal problems and harmful dust generation caused by the glass fabric-based plaster cast. It is user-friendly; cause no skin irritation problems, easy to dispose off and a cost-effective option. Furthermore, it has shown comparable properties to market-available synthetic plaster.

Technical Description:

Four steps are involved in the preparation of jute-based plaster cast. The jute fabric is modified by silane treatment method followed by synthesis of the isocyanate-terminated polyurethane prepolymer. The hydrophobicity of the treated fabric was evaluated by measuring the water contact angle and moisture recovery of the property. The prepolymer is coated onto the surface of the modified jute fabric to prepare the jute-based plaster cast. The developed plaster cast is packeged in a metallised aluminium pouch under vacuum. The mechanical properties of the treated material, including tensile strength, tear strength, and percentage elongation, were assessed for its mechanical properties. The application trial of the developed plaster cast was performed at Safdarjung hospital, Delhi.

Technology Readiness Level (TRL) & Cost:

The technology is at a stage of TRL-6. The technology licensing cost is ₹10 Lakhs, while the industrial scale investment costs are around ₹15 Lakhs.

Technology Developer
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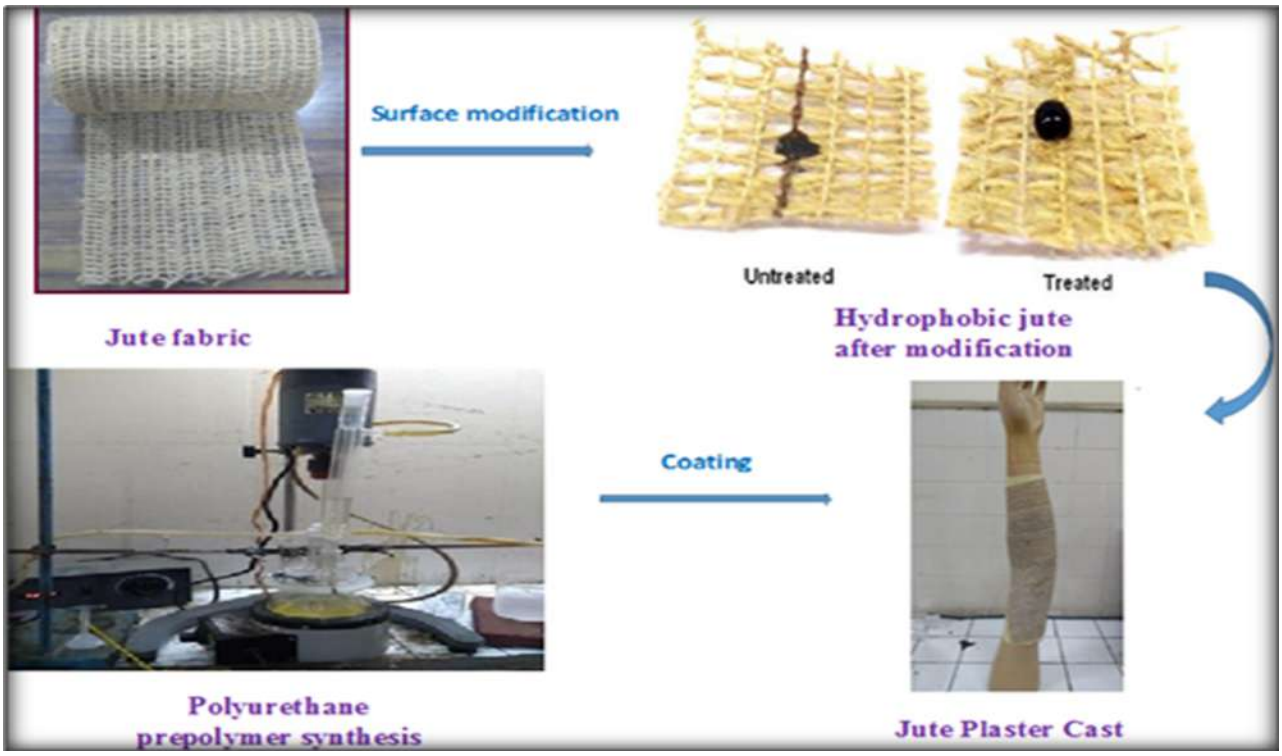
Surface modification
Untreated
Treated
Jute fabric
Hydrophobic jute
after modification
Coating
Polyurethane
prepolymer synthesis
Jute Plaster Cast

RAPID DETECTION METHOD FOR PESTICIDES IN FOOD PRODUCTS

User Groups:

General Public, Food Processing Industries, Food Safety Regulators, Farmers

Description and Functionality:

A simple and rapid methodology for detecting pesticides in food products to reduce the hazards of pesticide residues is very important. The existing technologies for identification of pesticides are time-consuming, expensive and require skilled manpower. The proposed methodology is a simple, nanoparticles based colorimetric method for the detection of imidacloprid and monocrotophos pesticides which is rapid, sensitive and easy to use.

Technical Description:

The method is based on aggregation of nanoparticles in the presence of pesticides, which leads to a colour change in the nanoparticles solution. The stable nanoparticles used in the method are wine-red in colour and show important optical properties in UV-visible spectroscopy. The change in colour of the nanoparticles solution from red to blue indicates the presence of pesticides, making it a simple and effective method for detecting pesticide residues in food products. It is a simple and effective method for detecting pesticide residues in food products.

Technology Readiness Level (TRL):

The technology is ready with proof of concept, has been tested and proven to work in a laboratory setting and at a level of TRL-3

Technology Developer
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BIO-DESULFURIZATION OF CRUDE OIL USING MICROORGANISMS

User Groups:
Oil refineries, Automobile industry

Description and Functionality:
The high sulfur content in crude oil leads to significant amounts of sulfur-oxides (SOx) emission during combustion, resulting in environmental pollution. Biodesulfurisation (BDS) is a low-cost and safe alternative for reducing sulfur content in crude oil and refined liquid hydrocarbon fuels, compared to existing techniques.

Technical description:
The developed technology utilizes the bio-desulfurisation method using a bacterial strain *Gordonia sp.* IITR100 immobilised in Polyurethane Foam (PUF) carrier for reducing sulfur from crude oil and refined liquid hydrocarbon fuels. The bacterium was found to reduce a model compound- dibenzothiophene by around 76%.

Technology Readiness Level (TRL):
The technology is in its initial phase, and at a level of TRL-3.

Technology Developer
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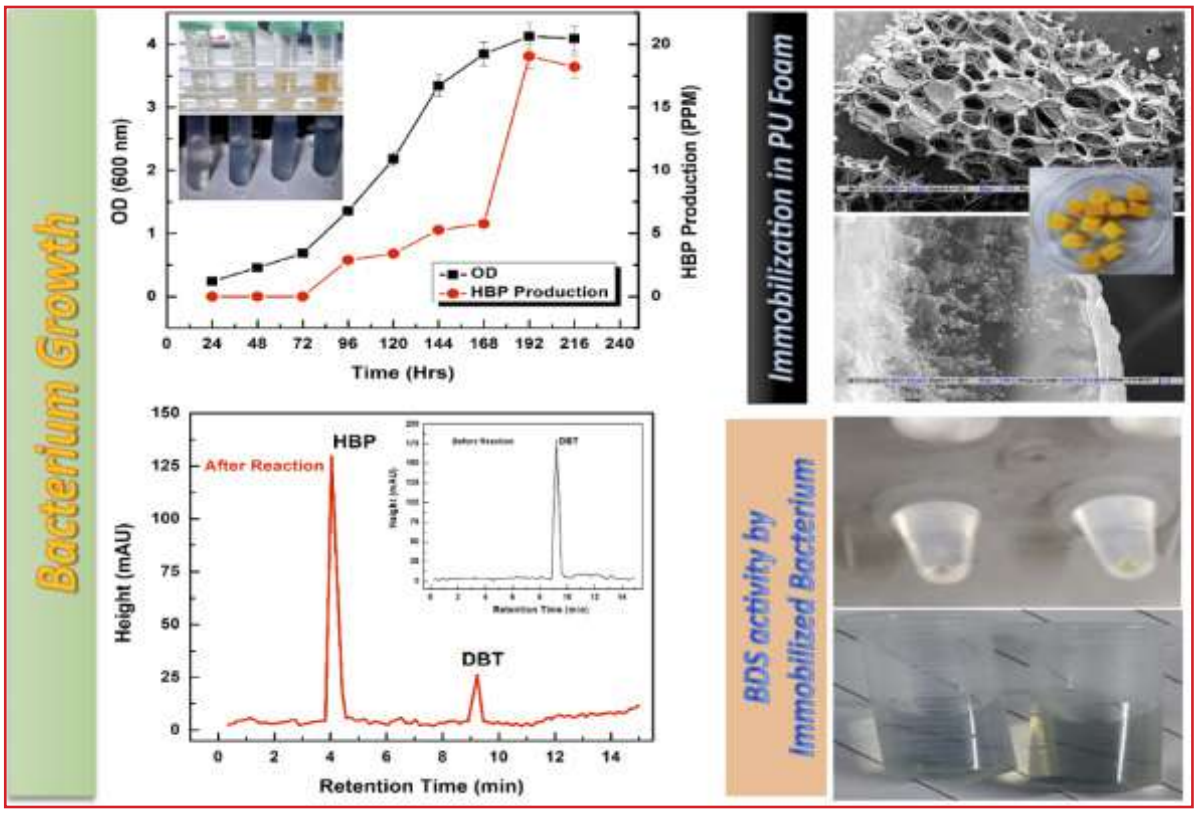
Bacterium Growth
OD (600 nm)
HBP Production (PPM)
Time (Hrs)
OD
HBP Production
Height (mAU)
HBP
After Reaction
DBT
Retention Time (min)
Immobilization in PU Foam
BDS activity by Immobilized Bacterium

Technologies for Agriculture Sector

ENHANCING THE SHELF LIFE OF PEARL MILLET

User Groups:

Farmers, Consumers, Food and Bakery industries

Description and Functionality:

Pearl millet is a nutritious crop with low agricultural inputs and well-adapted to hot and dry conditions. However, the poor storage practices used for pearl millet flour makes it more susceptible for rancidity which affects the shelf-life. A simple technology has been developed through various processing methods to prevent rancidity and enhance the shelf life of pearl millet flour. From the treated pearl millet flour in this technique, a range of value-added food products like biscuits, breads, and muffins can be made.

Technical Description:

The technology involves subjecting pearl millet grain to various processing methods such as blanching, germination, microwave treatment, toasting, and pearling. The research outcomes have shown that these methods increase the storage stability of pearl millet flour. These methods can be applied to other millet flours also, to enhance their shelf life.

Technology Readiness Level (TRL):

The technology for increasing the shelf-life of pearl millet is in the research and development stage and at a level of TRL-3.

Technology Developer
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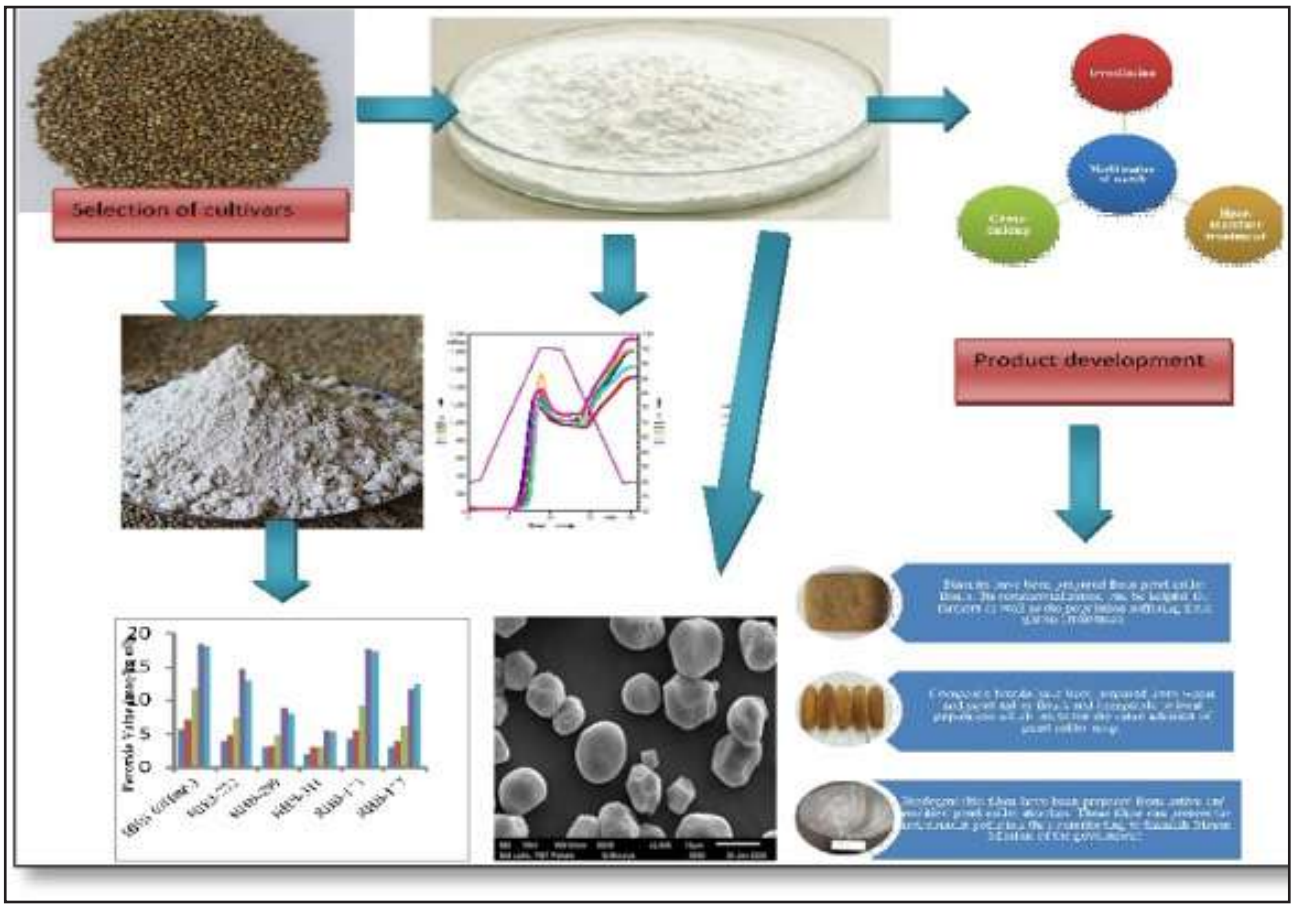
Selection of cultivars
Product development

BACTERIAL ENDOPHYTE-RICH BIO-FERTILISER FOR CHRYSANTHEMUM AND CARNATION

User Groups:

Farmers and Floriculture industry

Description and Functionality:

Chemical fertilisers have proven to be harmful to both mankind and the environment. Solutions for the hazards caused by chemical fertilisers can be mitigated through biological intervention using endophytic microbes. The technology involves isolating elite bacterial endophyte strains, testing them on net-house and field conditions, and creating a biofertilizer formulation that enhances the productivity of Chrysanthemums and Carnations while maintaining soil health.

Technical Description:

The biofertilizer technology involves isolating elite bacterial endophytic strains from Chrysanthemum and Carnation crops. The isolated endophytes RDO10 and N2S6 underwent field testing, which led to the development of an ecologically sustainable biofertilizer formulation. The field trials of this technology demonstrated its potential as an efficient, cost-effective, and environment friendly inoculant. It can reduce the on-site use of chemical fertilizers by up to 75%.

Technology Readiness Level (TRL):

The technology is in the research and development stage and at a level of TRL-4.

Technology Developer
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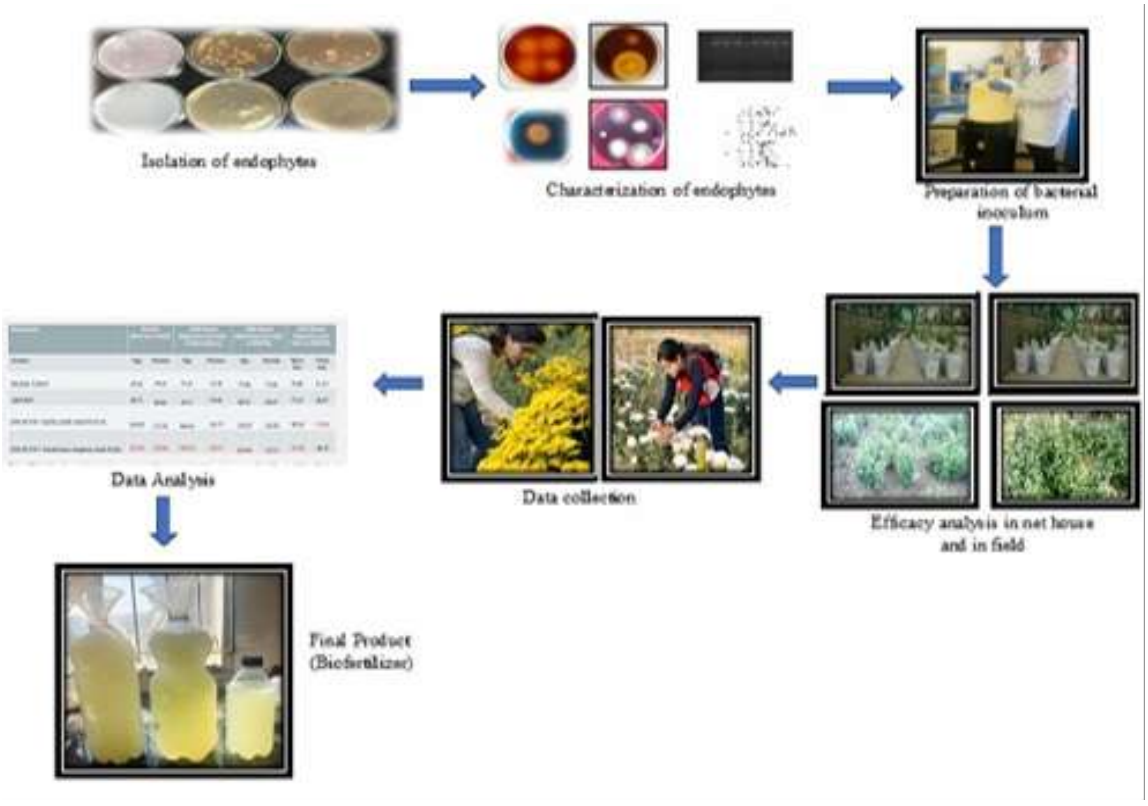
Isolation of endophytes
Characterization of endophytes
Preparation of bacterial inoculum
Efficacy analysis in net house and in field
Data collection
Data Analysis
Final Product (Biofertilizer)

CREATING GREEN SPACES WITH INDOOR VERTICAL GARDENING

User Groups:

Urban dwellers, architects, building developers, landscape designers.

Description and Functionality:

The technology developed is a soilless media-based indoor vertical gardening system using LED lights with optimum nutrient formulations for growing indoor plants. It aims to improve the indoor environment, air purification, people's well-being and work productivity by reducing stress and improving health conditions.

Technical Description:

The system uses soilless media consisting of cocopeat, perlite, and vermiculite in a specific ratio with four concentrations of Hoagland nutrient solution. The system uses LED lights with different intensities, and the five best plant species *Philodendron xanadu*, *Dracaena compacta* (green), *Spathiphyllum spp*., *Scindapsis aureus, Syngonium podophyllum,* and *Tradescantia zebrina* selected based on physiological and growth parameters.

Technology Readiness Level (TRL) and Cost:

The technology is currently in a proof-of-concept phase and at a level of TRL-3. The approximate cost of the technology, along with the installation of LED light is ₹2,249 per square meter.

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Selection of best 6 plant species and the best nutrient formulation on the basis of various growth, physiological, leaf nutrient parameters studied
Installation of Lighting System
Evaluation of the selected indoor ornamental plant species with different nutrient concentrations for fertigation during the first year under indoor conditions
Product development
Installation of artificial LED lighting system on vertical frames containing selected plant species and best nutrient formulation for second and the third year and standardizing optimum light intensity for healthy growth of each plant

COMMUNITY-BASED ORGANIC FARMING AND VALUE-ADDED PRODUCTS FROM CASTOR

User Groups:

Farmers, Consumers, Self Help Groups

Description and Functionality:

Castor is an important non-edible oilseed crop with great utilitarian value in industry, agriculture and pharmaceutical sectors. For growing castor in North Eastern region of India, different combinations of organic manures were tested and suitable manure was identified. The farmers identified desirable economic traits and developed technology for value-added products such as hair oil, oil cake fertilizer, spray etc.

Technical Description:

Organic cultivation strategies were developed for cultivating castor crops, including two major landraces of *Ricinus communis* (red and green-stemmed varieties). These strategies incorporate locally available manures to improve crop yield and quality. The red-stem landrace has higher oil content than the green-stem landrace. The castor produced by the organic farming was used in manufacture of different value-added products including oil cake fertilizer, castor spray, hair oil, castor soap, and castor ointment etc.

Technology Readiness Level (TRL) and Cost:

The technology is at a level of TRL-6. The approximate technology licensing cost is ₹2 Lakhs and the total industrial scale investment cost is around ₹15-20 Lakhs.

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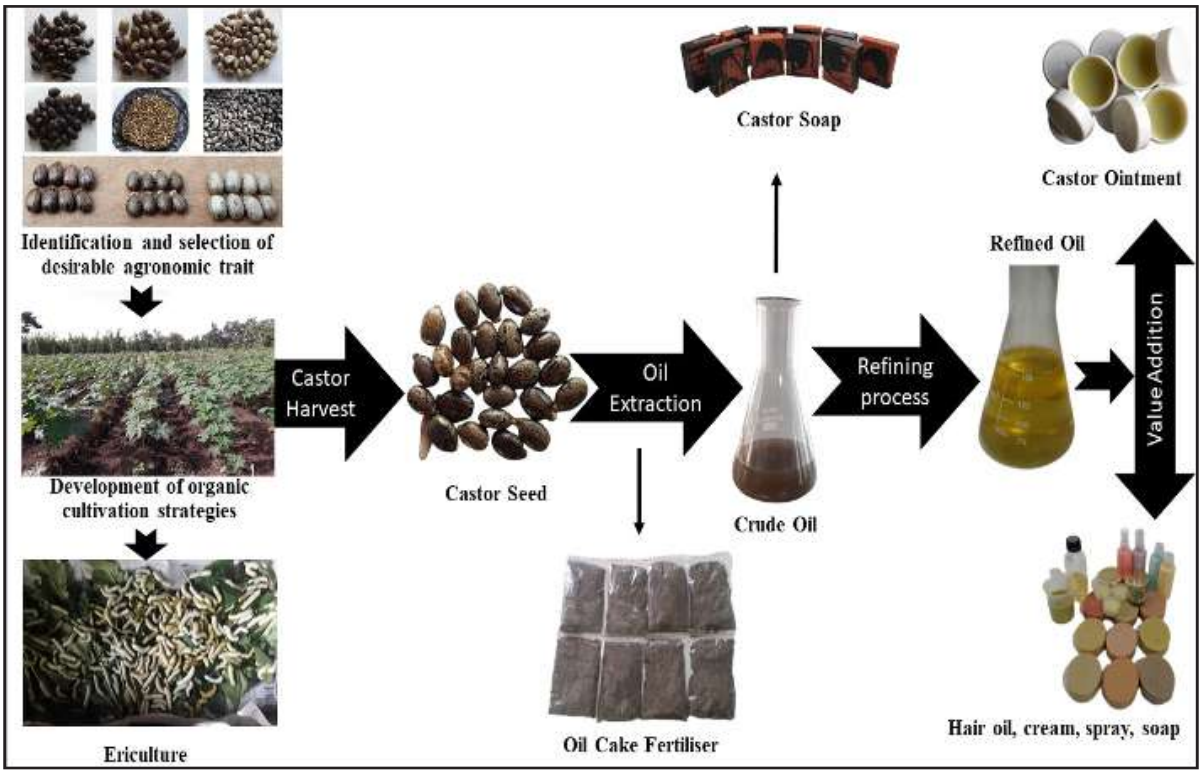
Identification and selection of desirable agronomic trait
Development of organic cultivation strategies
Ericulture
Castor Harvest
Castor Seed
Oil Extraction
Oil Cake Fertiliser
Castor Soap
Crude Oil
Refining process
Refined Oil
Castor Ointment
Value Addition
Hair oil, cream, spray, soap

EFFECTIVE SOLUTIONS FOR CONTROLLING MOTH AND FLY POPULATIONS

User Groups:

Farmers and economically weaker sections

Description and Functionality:

The rice farming community in Assam faces a significant challenge with moth infestations, which severely damages 60-80% of the crop. Conventional methods for controlling moths involve using chemical insecticides, which are not very effective and also harm the quality of the grains. A wettable powder was developed from the fungus Beauveria bassiana to control moths. The fungus was mass-produced using a liquid medium (PDB) supplemented with various nutrients.

Technical Description:

Fungal isolates were obtained from the yellow tail tussock moth (*Somena scintillans*) and black fly (*Aleurocanthus woglumi*) and characterized. An indigenous strain of *B. bassiana* was cultured on a liquid medium (PDB) supplemented with various nutrients. The efficacy of the *B. bassiana* wettable powder formulation was evaluated using a standardized sticker and spreader, coconut oil (0.5%) and tween-80 (0.01%). Different application methods were tested under laboratory conditions, including seed and soil treatment, and foliar application at varying doses (5, 10, and 15 gm per litre of water). Finally, the effective dose was tested against major rice pests leaf folder, case worm, rice hispa, whorl maggot, and stem borer, resulting in 31.80-85.00% suppression 15-20 days after treatment.

Technology Readiness Level (TRL) & Cost:

The technology is at a level of TRL-6. The technology licensing cost is approximately ₹3-5 Lakhs and industrial scale investment cost comes around ₹10-12 Lakhs.

Technology Developer
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REJUVENATING THE POWER OF COFFEE PLANTATION

User Groups:
Coffee cultivators, rural and marginal farmers

Description and Functionality:
The aim of developing this technology is to standardize and introduce a new cultivation technique for coffee plants to enhance productivity and quality. The traditional replanting method is expensive and time-consuming due to the strong root systems that are difficult to remove, cost-intensive labour, and unavailability of quality planting material. A simple 'rejuvenation technique' has been adopted from the Coffee Board.

Technical Description:
The technique utilises a rejuvenation procedure involving top cutting, grafting, and bottom cutting. Superior mother plants are selected to collect scion material for grafting. Top or field grafting is the most suitable method for converting old, unproductive or off-type plants into productive ones by grafting with desirable scions. Since the root system is already well-established, the top-grafted plant grows vigorously and starts bearing fruit within two years of grafting.

Technology Readiness Level (TRL):
The technology is at a stage of TRL-6.

Technology Developer
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BACTERIAL TREATMENT TO MANAGE APPLE SCAB

User Groups:

Farmers, consumers, and food processing industry

Description and Functionality:

Apple growers commonly face the challenge of pathogen-induced losses, with *Venturia inaequalis* being a prevalent pathogen causing scab disease. This disease is responsible for nearly 14% of worldwide production losses. The excessive use of fungicides for crop protection causes economic burden and health issues. A biological approach of bacterial endophytic treatment, has been employed to control *Venturia inaequalis*. The technology reduces the cost of cultivation, improves the economic conditions of farmers, and benefit consumers by providing healthier food.

Technical description:

Amplified ribosomal DNA restriction and sequence analysis led to a total of seventy-one fungistatic isolates against *Venturia inaequalis*. The developed scion wood can be used to select the germplasm with a good microbial load of fungistatic strains. An ecologically sound technology has been devised to avoid the accumulation of pesticides in our food chain besides reducing the cost of cultivation of apples.

Technology Readiness Level (TRL) and Cost:

The technology is at a level of TRL-5, and the approximate technology licensing cost is ₹10 Lakhs, whereas the industrial scale investment cost comes around ₹50 Lakhs.

Technology Developer
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STANDARDIZED TISSUE CULTURE TECHNIQUE FOR GROWING DWARF CHERRY TREES

User Groups:

Farmers, agriculturalists, plant tissue culture laboratories.

Description and Functionality:

The cultivation of cherries face various challenges, including the large size of the tree, long gestation period, and difficulties in managing and harvesting the fruits. These factors have hindered the cultivation of cherries to their maximum potential. To overcome these challenges, a dwarf rootstock of cherry was identified and established its in-vitro propagation protocol. Introducing this dwarf variety would reduce drudgery regarding management and the time to harvest the fruit.

Technical Description:

To overcome the challenges of cherry cultivation, a dwarf rootstock of cherry called Gisela 5 was identified, and a protocol for its *in-vitro* propagation has been established. A multiplication medium (T13) containing 1.0% BA, 0.5% GA3, and 0.15% IBA was developed. Adding BA in medium enhanced the multiplication rate of Gisela 5 shoots and therefore highlighted its crucial role. Healthy shoots were observed with good rooting after adding kinetin.

Technology Readiness Level (TRL):

The standardised protocol for *in-vitro* micropropagation of cherry rootstock Gisela is at TRL-7 and ready for adoption.

Technology Developer
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PACKAGE OF PRACTICE TO CULTIVATE HIGH-VALUE MEDICINAL HERBS IN THE HIMALAYAN REGION

User Groups:

Farmers, orchardists, pharmaceutical and herbal drug industries.

Description and Functionality:

The overexploitation and degradation of medicinal plants in hilly areas have led to economic constraints and a scarcity of raw materials for the pharmaceutical and herbal drug industries. To address this issue, micropropagation techniques were employed to multiply medicinal plant species rapidly.

Technical Description:

The technology involves micropropagation techniques for rapid multiplication of medicinal plant species such as *Swertia chirayiata, Dactylorhiza hatagirea,* and *Valeriana jatamansi* through micropropagation followed by quantification of bioactive compounds before hardening and transplantation. The technique is demonstrated to the targeted beneficiaries to conserve the native flora of Himalayas.

Technology Readiness Level (TRL) and Cost:

The technology is a level of TRL-5. The approximate technology cost for 1000 plantlets is around ₹7000-8000. The industrial scale investment cost can be ₹ 8-10 Lakhs per plant tissue culture unit along with a greenhouse.

Technology Developer
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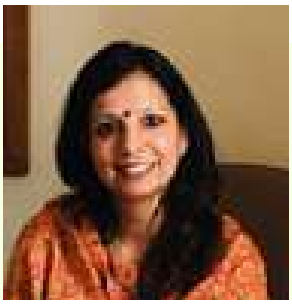

GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR BIO-PROSPECTION OF WILD EDIBLE PLANTS

User Groups:

Local communities in the Indian Himalayan Region (IHR), scientific community, NGOs

Description and Functionality:

The residents of the Indian Himalayas face extreme hardships due to unpredictable climatic conditions affecting agriculture, shelter, and livelihood opportunities. Conventional crops fail to meet the nutritional requirements of the inhabitants, leading to a gap between demand and timely supply of food material. To bridge this gap, neglected and underutilized wild edible plants can provide excellent nutritional support and alleviate malnutrition in marginal communities. Geographical Information Systems (GIS) tools help in the bio-prospection of these plants.

Technical Description:

Geographical Information Systems (GIS) technology has been applied for the bio-prospection of wild edible plants in the IHR. The present technology uses modern GIS techniques to explore the locally available wild edible plants, revealing their nutraceutical value with high levels of vitamin C and fibre, which are lesser known in other parts of the country.

Technology Readiness Level (TRL):

The technology is currently in a developmental stage and at a level of TRL-3

Technology Developer
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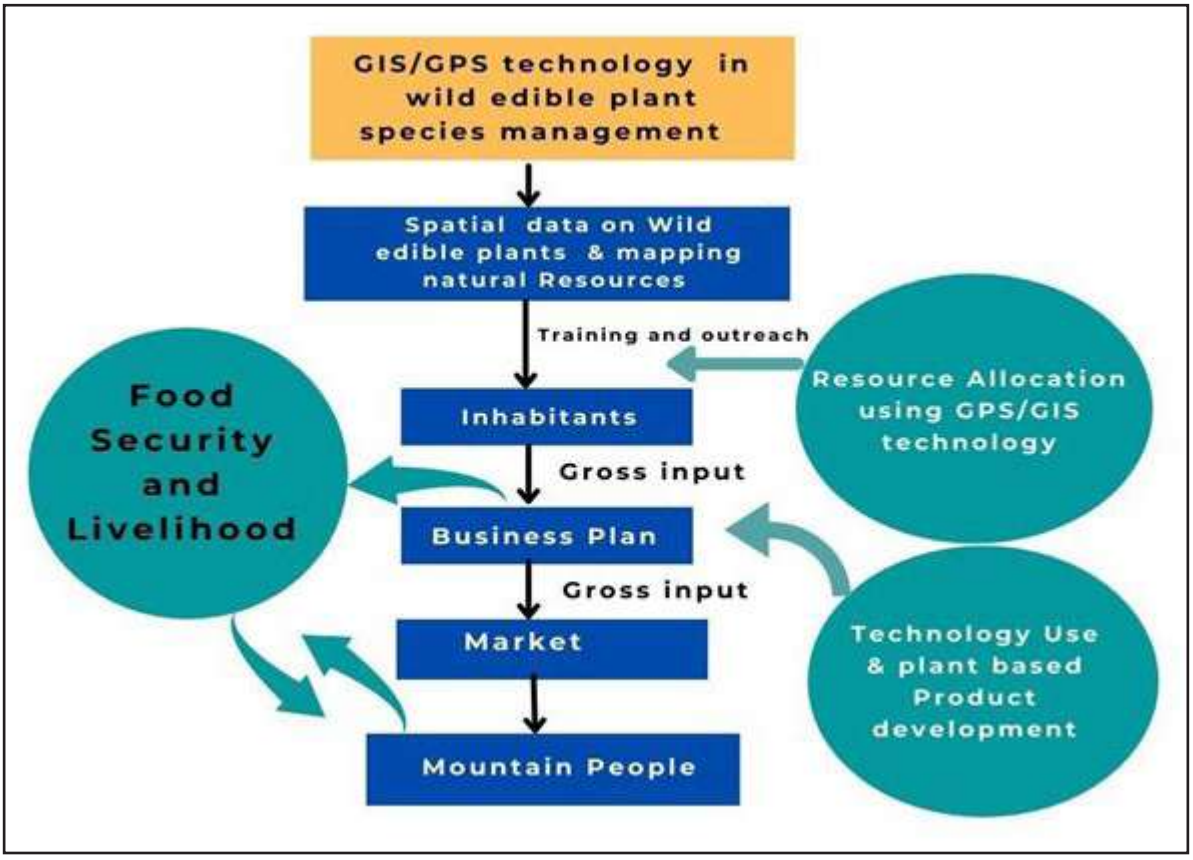
GIS/GPS technology in wild edible plant species management
Spatial data on Wild edible plants & mapping natural Resources
Training and outreach
Resource Allocation using GPS/GIS technology
Food Security and Livelihood
Inhabitants
Gross input
Business Plan
Gross input
Market
Technology Use & plant based Product development
Mountain People

QUALITY PLANTING MATERIAL (QPM) FOR LOCATION-SPECIFIC COMMERCIAL CULTIVATION OF *PLUMBAGO ZEYLANICA*

User Groups:

Medicinal plant growers, herbal drug industry, research institutes

Description and Functionality:

The technology aims to identify and cultivate elite germplasms of highly demanded medicinal plant *Plumbago zeylanica* in specific agro-climatic zones to ensure a sustainable supply of quality raw material to herbal drug industries. The study involves field collection, pharmacognostic analysis, chemical profiling and evaluation of antifungal potential of collected samples. Multi-location trial for identifying suitable agro-climatic conditions for growing QPM of *P. zeylanica* was also undertaken.

Technical Description:

Fifty-two germplasms of *Plumbago zeylanica* (roots) were collected from Central India, Indus Plain, Gangetic Plains, Eastern Ghats, Western Himalayas, and Western Ghats. Chemical profiling against the bioactive marker 'plumbagin' was done through High-Performance Thin layer Chromatography (HPTLC). Four QPM (Quality Planting Material) NBP-50 (Sarguja, Chattishgarh, Central India), NBP-36 (Kendrapara, Odisha Eastern Ghats), NBP- 25 (Bankura, WB Gangetic planes) and NBP-41 (Western Himalayas Kathua, Jammu) were identified. Under multi-location studies, field demonstration was conducted at Chitrakoot region and the NBRI garden, Lucknow. NBP-50 (P6) and NBP-51 (P7) extracts showed maximum anti-fungal potential.

Technology Readiness Level (TRL):

The technology is in the developmental stage and at a level of TRL-3.

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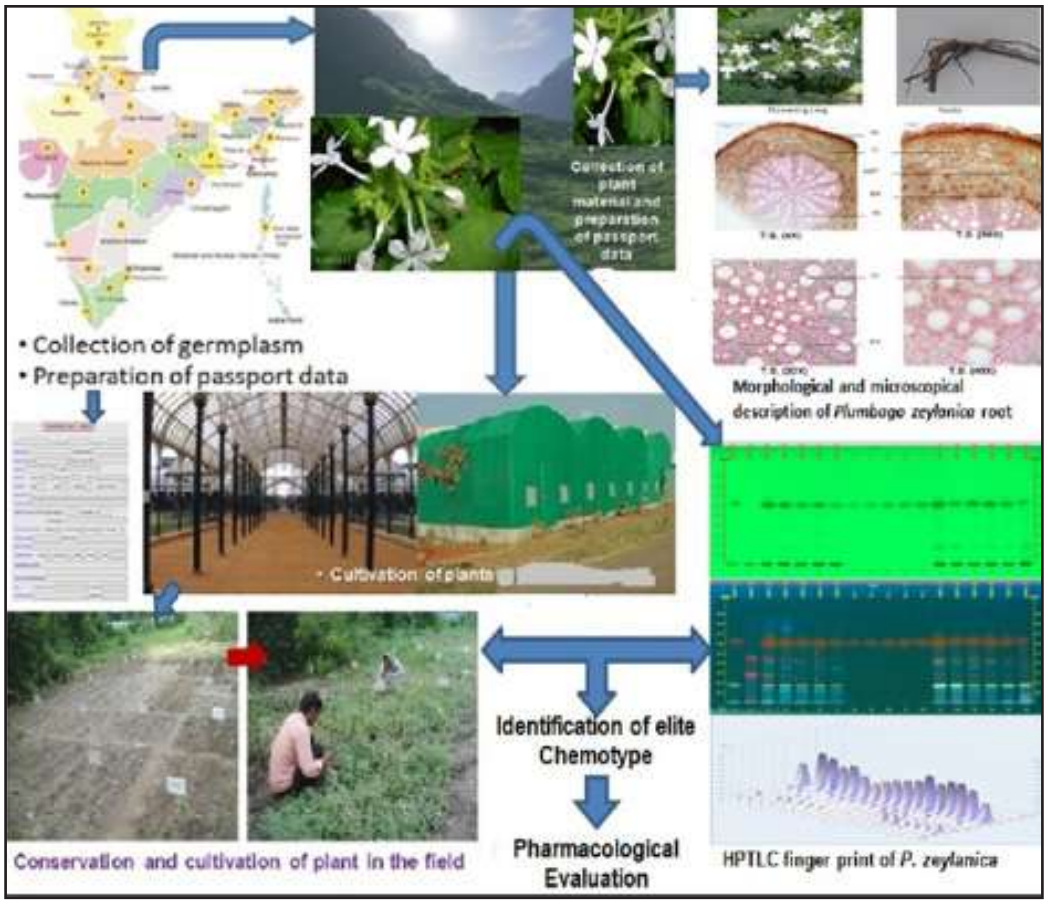
• Collection of germplasm
• Preparation of passport data
Collection of plant material and preparation of passport data
Morphological and microscopical description of Plumbago zeylanica root
• Cultivation of plants
Identification of elite Chemotype
Pharmacological Evaluation
Conservation and cultivation of plant in the field
HPTLC finger print of P. zeylanica

PACKAGE OF PRACTICE TO CULTIVATE EXOTIC VEGETABLES

User Groups:

Low-income farmers, Vegetable vendors, consumers

Description and Functionality:

Traditional rice and wheat farming adds residues to the soil and pollutes the environment when burnt. Cultivating exotic vegetables is an alternative to traditional farming, with summer and winter crops selected for their qualitative and quantitative qualities. Cultivating these vegetables attract local people to buy fresh produce and also generate employment among rural people.

Technical Description:

The technology involves the optimization of cultivation of exotic vegetables such as zucchini, cherry tomato, seedless cucumber, red and yellow capsicum, lettuce, broccoli, romensco, pakchoi, Chinese cabbage and red cabbage under suitable conditions in green house as well as open field. Seedless cucumber and broccoli were found to be the best-growing crops in the selected area.

Technology Readiness Level (TRL) and Cost:

The technology is at a level of TRL-6. The approximate investment cost is within ₹5 Lakhs for growing selected vegetables under a greenhouse, and the cost of cultivation in open fields is within ₹1 Lakh.

Technology Developer
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Technologies for Energy and Engineering Sector

HYBRID SOLAR DESALINATION SYSTEM FOR WATER PURIFICATION

User Groups:

Potable water provider industry, demineralized water industries, schools and colleges.

Description and Functionality:

The different kinds of pollution in the water available for drinking is alarming, creating a dire need for purification. The desalination of the saline water in arid and semi-arid regions of the country is a challenge. A desalination plant operated by solar energy to generate potable water has been developed. The lab scale prototype developed can generate 50 litre per day of potable water from saline water which can be increased.

Technical Description:

The system uses solar energy, and the components include a humidifier, dehumidifier (water-cooled exchanger), air heater (flat plate collector), water heater (flat plate collector), and flashing evaporation unit. Mixing tank has been used to supply the water into the different systems. In this technology, the low output of distillate using solar energy in the existing systems has been addressed.

Technology Readiness Level (TRL) and Cost:

The technology is at a stage of TRL-6, and the approximate technology licensing cost is ₹10 Lakhs, while the industrial scale investment cost is around ₹50 Lakhs.

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48MP AI QUAD CAMERA
Shot on realme 5s

BATTERY-SUPER CAPACITOR SYNERGY FOR ENERGY STORAGE

User Groups:
Households, Commercial establishments.

Description and Functionality:
As technology advances and portable, renewable, and sustainable energy sources become more prevalent, there is a growing need to balance energy demand and production. This has led to an increased demand for energy storage solutions, which are critical for household and commercial purposes. The developed technology combines high-power supercapacitors and energy-dense batteries to create a sustainable energy storage system that utilizes both benefits. This technology can reduce reliance on fossil fuels, lowering carbon footprints and mitigating increase in global temperature.

Technical Description:
The technology combines two or more energy storage systems into a single storage system, specifically for photovoltaic (PV) applications. This sustainable energy storage solution utilizes high-power supercapacitors and energy-dense batteries, leveraging their benefits. By incorporating renewable solar energy, the hybrid system offers improved battery lifespan, reduced required battery capacity, and lower investment and maintenance costs for the PV system. The hybrid system can also reduce battery disposal pollution by extending the primary battery storage longevity, resulting in economic benefits for users in terms of maintenance and replacement costs. Additionally, optimal battery sizing can minimize the high initial capital investment required for PV panels.

Technology Readiness Level (TRL):
The technology is at a level of TRL-6 and can be negotiated for commercial prospection at mutually agreeable terms.

Technology Developer
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INTEGRATED UMBRELLA AIDED WALKING STICK FOR ELDERLY

User Groups:

Elderly and specially-abled people

Description and Functionality:

The innovation involves the design of user-friendly and ergonomic walking sticks and umbrellas. These features are intended to enhance the functionality and usability of the walking sticks, making them more convenient and efficient for elderly and specially-abled users.

Technical Description:

The innovation is based on initial prototypes developed as design solutions. Unlike existing walking sticks in the Indian market, which are rigid and directed, the proposed walking sticks incorporate additional features such as lighting solutions, GSM module integration, GPS tracking, and Arduino technology. Direct Observation and Activity Analysis methods have been used to conduct a user study to identify the limitations and advantages of commercially available existing walking sticks and umbrellas. The feedback was analysed qualitatively and quantitatively to refine the design further.

Technology Readiness Level (TRL) & Cost:

The innovation is at a stage of TRL-6, with patent applications already filed. The approximate technology licensing cost for the walking sticks is ₹10 Lakhs, considering long-term investment and production from an industrial perspective.

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Prototype 1 Prototype 2 Prototype 3

Walking Stick Prototypes

ICT-ENABLED MOBILE APPLICATION FOR E-COMMERCE

User Groups:

Women in rural areas, Self-Help Groups (SHGs)

Description and Functionality:

There are different e-commerce mobile applications for different purposes, however, no one caters to the needs of SHGs working in rural areas. The Thirumathikart mobile application and its associated applications (Thirumathikart seller and Thirumathikart logistics) empower women in rural areas by promoting products developed by SHGs such organic vegetables and fruits. Thirumathikart Seller application allows registered SHGs to establish their enterprises and promote products.

Technical Description:

The Thirumathikart and its associated applications are mobile-based applications designed to run on smartphones or tablets. Thirumathikart application for buyers acts as a platform for customers to find and purchase SHG products. Customers can purchase products through Internet banking, Cash on Delivery (COD), and Unified Payments Interface (UPI). Thirumathikart also allows customers to gift SHG products to others.

Technology Readiness Level (TRL) & Cost:

The technology is at a stage of TRL-6. The approximate technology licensing cost is ₹25 Lakhs.

Technology Developer

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VALUE-ADDED CUTTING FLUID DEVELOPMENT FOR INDUSTRIAL APPLICATION

User Groups:

Mechanical cutting industries, Industrial manufacturers, Environmental organizations

Description and Functionality:

The technology aims to develop a biodegradable cutting fluid for mechanical cutting operations, utilizing vegetable oils and biodegradable emulsifiers as alternatives to mineral and petroleum-based cutting fluids. The biodegradable cutting fluid is safe for workers and does not pose health and safety risks associated with conventional cutting fluids.

Technical Description:

Natural oils used as base oils in the formulation of cutting fluids provide high lubricity, flash point, and fire point, making them suitable for metal machining operations at high temperatures. The technology has been developed through test analysis of over 2000 formulations. It utilizes non-edible oils as base oils and food-grade surfactants to create biodegradable cutting fluids. These cutting fluids do not contain carcinogenic additives commonly found in conventional cutting fluids, making them safer for workers and the environment.

Technology Readiness Level (TRL):

The technology is at a level of TRL-5 and can be negotiated for commercial prospection at mutually agreeable terms.

Technology Developer
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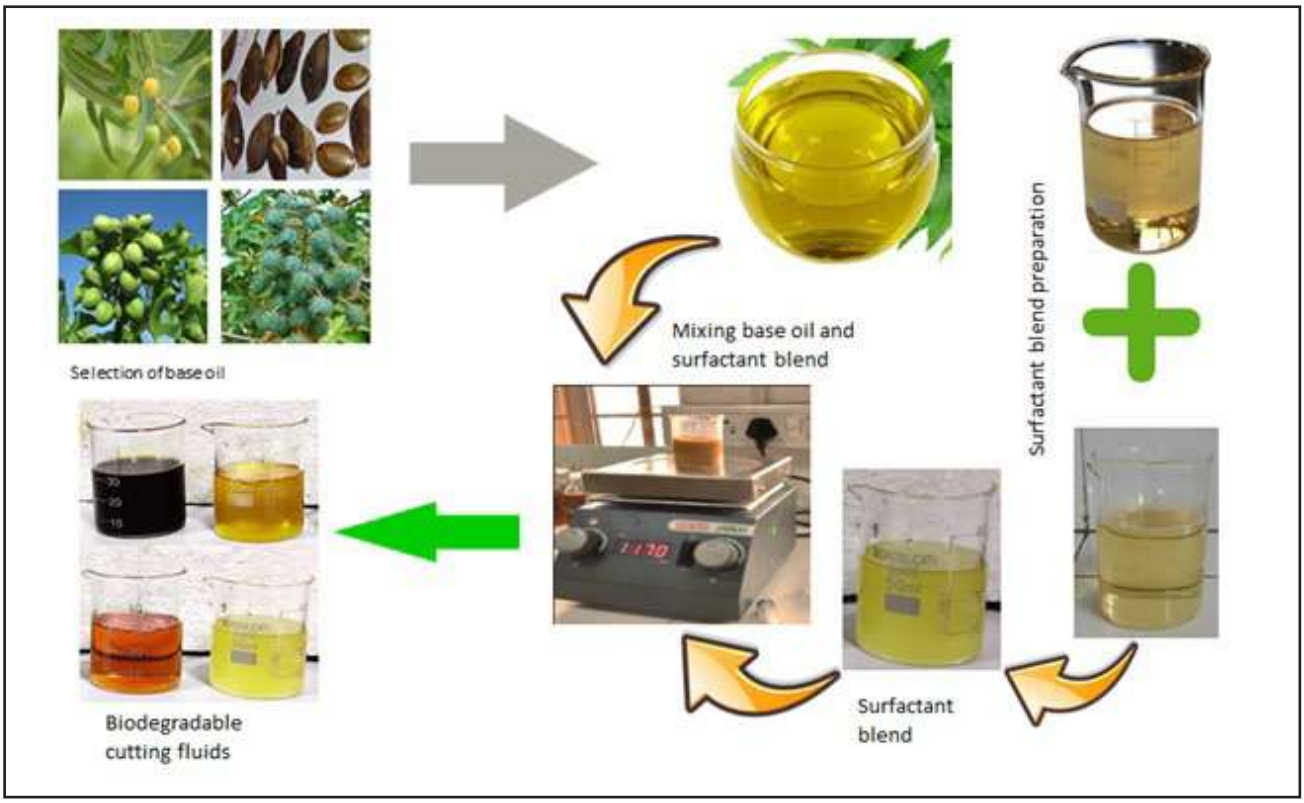
Selection of base oil
Mixing base oil and surfactant blend
Surfactant blend preparation
Surfactant blend
Biodegradable cutting fluids

HAND PRESSED MACHINE FOR AFFORDABLE CONSTRUCTION MATERIALS USING WASTE FOUNDRY SAND AND RED MUD

User Groups:

Construction industry, Mining industry, Foundry industry, Brick making units

Description and Functionality:

The aim of developing this technology is to minimize the environmental impact caused by the aluminium and foundry industry by converting their wastes into useful construction materials. A hand-pressed machine called 'MARDINI' has been developed for the industrial production of these bricks, with a standard mould size. The technology has multiple societal and environmental impacts, including value addition from solid industrial waste in civil construction, utilization of other commercial waste as admixtures, and carbon footprint reduction in brick manufacturing.

Technical Description:

The technology utilizes waste materials, such as waste foundry sand (WFS), red mud (RM), and ground granulated blast furnace slag (GGBS), for the production of low-cost stabilized bricks. The mix proportions of red mud and waste foundry sand are optimized, and the efficacy of GGBS and fly ash as stabilizers are established. The technology also involves using GGBS as a supplementary material to improve the compressive strength of the bricks. A hand-pressed machine called 'MARDINI' has been developed for the industrial production of the bricks, and the standard mould size is 230x110x100 mm.

Technology Readiness Level (TRL) & Cost:

The technology is at a level of TRL-5. The cost of machine comes around ₹1 Lakh and the technology licensing cost is ₹ 5 Lakhs.

Technology Developer
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LOW-COST BUILDING BRICKS FOR RURAL AREAS

User Groups:

Self-help groups, MSME units, Metallurgical industries, Mining units

Description and Functionality:

The technology involves the utilization of mining and industrial wastes for manufacturing building bricks blocks, and tiles, for low-cost housing materials. The process utilizes chemical reactions of oxide mineral constituents of the raw materials under atmospheric conditions to develop hydrated mineral phases as a binding medium.

Technical Description:

The process utilizes chemical reactions of oxide mineral constituents of the raw materials under atmospheric conditions to develop hydrated mineral phases as a binding medium. The process is flexible and can utilize other waste and byproducts, such as metallurgical slag, broken stones, refractory and building material debris. Mineral cementation is a multi-component reaction process that forms two-dimensional layer structures of silicon-oxygen tetrahedra with OH-bearing characteristics, similar to the hydration of Portland cement and other cementitious materials. The binding strength develops through hydraulic reaction in the presence of water.

Technology Readiness Level (TRL) & Cost:

The technology is at a level of TRL-6 and ready for commercialization. The technology licensing cost is approximately ₹50,000/- + tax for MSME units. The total industrial scale investment cost for a unit with a 6000 bricks/day capacity is around ₹40 Lakhs.

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Red mud
Clay
Laterite
Moorum
Fly ash
Iron tailing
Boiler ash
Bottom ash
JAROSITE
Gypsum
Granite sludge
Mine over burdenn

IMPROVED MANUAL EQUIPMENT FOR MANUFACTURING BAMBOO STRIPS FOR ARTISANS

User Groups:

Bamboo craftsmen, MSMEs and artisans.

Description and Functionality:

There are several sections in our society who are involved in labour intensive and time-consuming occupations. The present technology addresses the problem of drudgery faced by bamboo craftsmen in Assam by designing and developing hand-operated equipment for manufacturing bamboo stripes.

Technical Description:

The equipment includes manual and electric-operated saw cutters, splitting machines, thinning machines, inner and side node removal tools, thinning and slicing, and dhoop stick-making machines. The technology has been transferred to MSME Guwahati, and the developed technology is made available to artisans. Technology helps artisans' economic development by providing tools and equipment for faster and more quality manufacturing.

Technology Readiness Level (TRL) and Cost:

The technology is currently at a level of TRL-6, and the licensing cost is ₹10 Lakhs, while industrial scale investment comes to around ₹20 Lakhs.

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NATURAL FIBRE COMPOSITE FOR HOUSES IN HILLY TERRAIN USING LOCALLY AVAILABLE RESOURCES

User Groups:

People living in hilly areas, Construction companies and industries.

Description and Functionality:

In mountainous regions, people traditionally build houses using locally available resources such as wood, bamboo, grasses, and other materials. However, with the advent of synthetic materials for construction, it has become increasingly prevalent and detrimental to the hilly environment. The technology developed is a natural fiber composite made from bamboo fibre waste, Euphorbia latex, and polyester resin, which can replace wood in making partition panels for houses and industries, roofs of village huts, bullock carts, etc.

Technical Description:

The natural fiber composite is made from bamboo fiber waste, dry mass of Euphorbia latex, and polyester resin. It was found that replacing 30% of polyester resin with *Euphorbia coagulum* in the bamboo fiber composite gives the best results for physico-mechanical properties. The technology provides an opportunity to replace petroleum-based derivatives with Euphorbia latex in preparing natural fiber composites.

Technology Readiness Level (TRL) & Cost:

The technology is at a stage of TRL-5. The approximate cost for licensing the technology is ₹5 lakhs, and the industrial scale investment cost is around ₹25 lakhs.

Technology Developer
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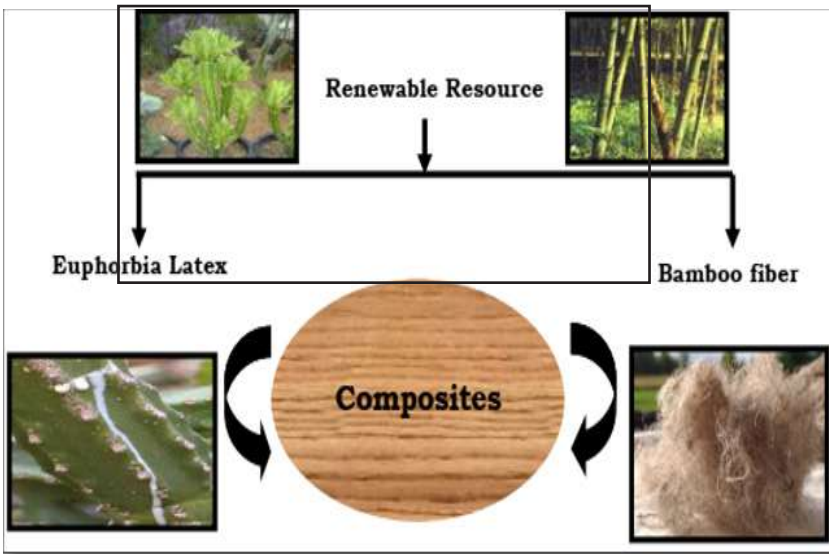
Renewable Resource
Euphorbia Latex
Bamboo fiber
Composites

Technologies for Waste to Wealth

SLAUGHTERHOUSE WASTE: AN ECONOMICAL SOURCE OF PROTEIN

User Groups:

Farmers, Livestock Owners, Feed Manufacturers, Slaughter House Owners.

Description and Functionality:

Rumen digesta, a significant waste generated by slaughterhouses, is a major cause of environmental pollution and disposal problems. A new process has been developed to convert rumen digesta waste from slaughterhouses into a cost-effective and nutrient-rich feed for livestock and poultry.

Technical Description:

The process of developing livestock feed involves treating the waste with sun drying and autoclaving to eliminate pathogens and reduce moisture. Once treated, the rumen digesta is milled and packed to create a feed that can be mixed with other ingredients to prepare a balanced recipe.

Technology Readiness Level (TRL):

The technology is at a readiness level of TRL-5 and can be negotiated for commercial prospection at mutually agreeable terms.

Technology Developer
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DIGESTBIN: AEROBIC DECOMPOSER FOR FLOWERS

User Groups:

Women and marginal communities, poultry farms, vendors, and temple management.

Description and Functionality:

In India, several hundred kilograms of flowers come out as waste from the temples and flower mandis on a daily basis. This waste creates a problem of disposal and is mostly dumped in the water-bodies or municipality yards. The technology addresses the issue of waste management of flowers offered in temples and unsold flowers from vendors.

Technical Description:

The flowers are collected and subjected to extraction to create a supplement for poultry feed. The flowers are extracted for lutein, and the composting process is done through aerobic composting using a self-made digester called "digestbin.". Products are created using composted flowers, such as candles, incense sticks, handwash, fabric dye, and poultry feed enriched with lutein.

Technology Readiness Level (TRL) and Cost:

The technology is at a stage of TRL-5, esti-mating ₹ 5 Lakhs as the approximate technology licensing cost while the total industri-al scale investment cost is ₹15 Lakhs.

Technology Developer
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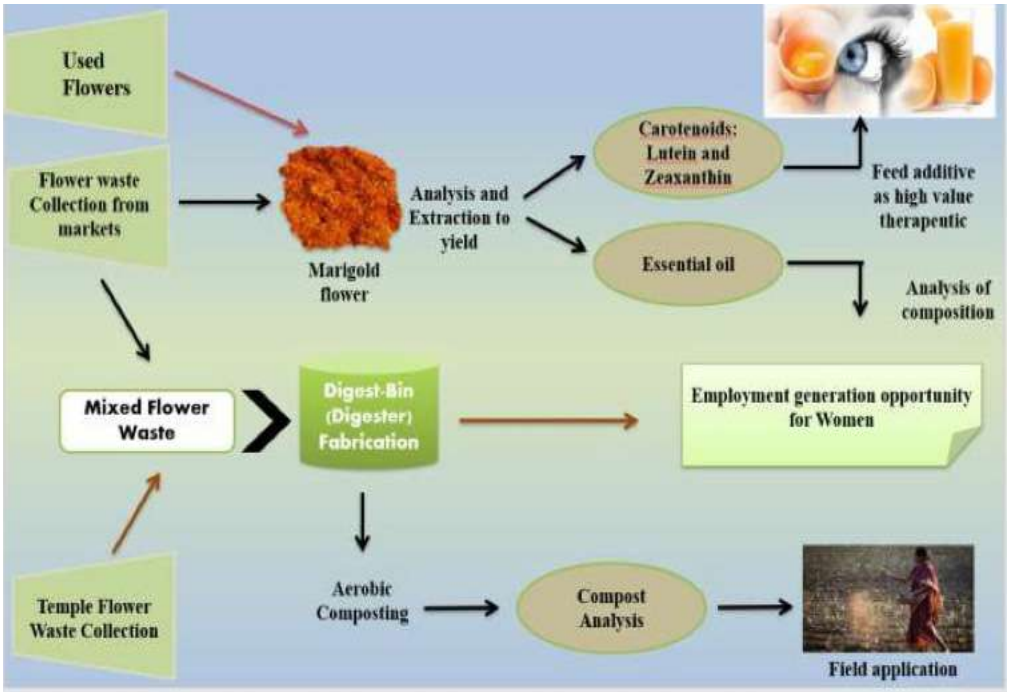
Used Flowers
Flower waste Collection from markets
Marigold flower
Analysis and Extraction to yield
Carotenoids: Lutein and Zeaxanthin
Feed additive as high value therapeutic
Essential oil
Analysis of composition
Mixed Flower Waste
Digest-Bin (Digester) Fabrication
Employment generation opportunity for Women
Temple Flower Waste Collection
Aerobic Composting
Compost Analysis
Field application

TRICHODERMA PRODUCTION WITH AGRICULTURAL WASTE

User Groups:

Farmers, individuals working for organic crop production.

Description and Functionality:

A large amount of agricultural waste is produced on a regular basis which is either burnt or discarded leading to pollution. The developed technology uses agriculture waste/substrates for the mass production of Trichoderma, a beneficial biocontrol agent widely used for management of soil borne diseases of plants.

Technical Description:

For mass production of *Trichoderma,* several combinations were tested and the best results were observed using a substrate of 25gm rice bran + 25gm Mustard cake + 10% sugarcane juice, which yielded 13.33X104/gm at 30 Days after Inoculation (DAI) and 20.49X106/gm at 60 DAI for *Trichoderma harzianum*, and 12.17X106/gm at 60 DAI for *Trichoderma asperellum*. By applying *Trichoderma* to crops, plant growth can be improved, soil-borne diseases can be reduced, and better yields can be achieved, resulting in sustainable and environmentally friendly crop production.

Technology Readiness Level (TRL) and Cost:

The technology is at a level of TRL-6 and can be negotiated for commercial prospection at mutually agreeable terms. The total industrial scale investment cost will be around ₹5 Lakhs.

Technology Developer
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ARTIFICIAL DYE FOR COLOURFUL COCOONS

User Groups:

Silkworm producers, farmers, and women entrepreneurs.

Description and Functionality:

Silkworms require a highly selective diet and prefer mulberry trees to thrive. However, due to the limited availability of mulberry trees, it is necessary to find alternative options to feed the silkworms and enhance their productivity. An artificial and coloured diet was developed for silkworms that provides complete nutrition required for the silkworm at par with the natural mulberry leaf and maintains the quality and quantity of produced cocoons.

Technical Description:

The colourful cocoons are produced by consuming an artificial diet enriched with various natural colouring agents like lutein, turmeric, rhodamine B, methyl orange, malchite green, dimethyl anthraquinine etc. The artificial diet has been standardised for the concentration and effectiveness of diet and dyes. The parameters covering cocoon weight, shell weight, filament length, denier, renditta, and raw silk recovery have been evaluated. The technology can generate revenue for the landless farmers who do not have mulberry gardens to continue with the sericulture, reduce labour requirement for mulberry cultivation by up to 70%, and reduce water consumption in irrigation by 85%.

Technology Readiness Level (TRL) and Cost:

The technology is at a TRL-4, and the approximate licensing cost will be ₹2 Lakhs. The industrial scale investment cost is around ₹25-30 Lakhs.

Technology Developer
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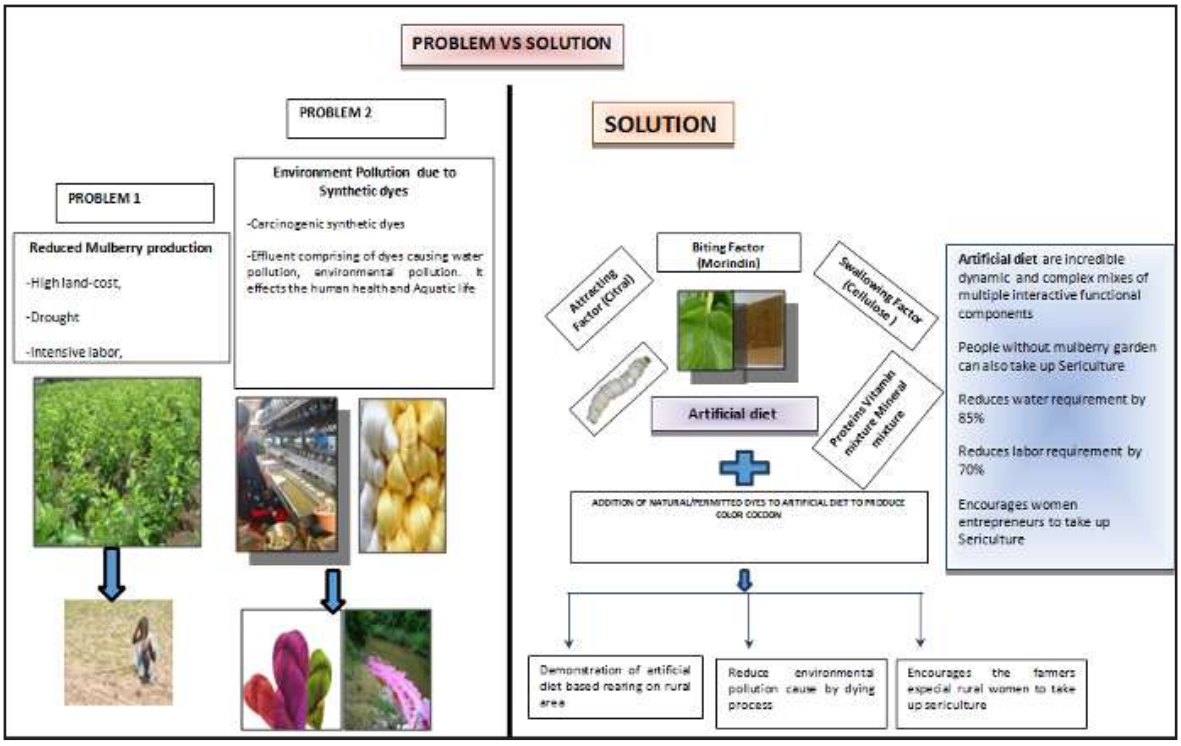
PROBLEM VS SOLUTION
PROBLEM 1
Reduced Mulberry production
-High land-cost,
-Drought
-Intensive labor,
PROBLEM 2
Environment Pollution due to Synthetic dyes
-Carcinogenic synthetic dyes
-Effluent comprising of dyes causing water pollution, environmental pollution. It effects the human health and Aquatic life
SOLUTION
Biting Factor (Morindin)
Attracting Factor (Citral)
Swallowing Factor (Cellulose)
Proteins Vitamin mixture Mineral mixture
Artificial diet
ADDITION OF NATURAL/PERMITTED DYES TO ARTIFICIAL DIET TO PRODUCE COLOR COCOON
Artificial diet are incredible dynamic and complex mixes of multiple interactive functional components
People without mulberry garden can also take up Sericulture
Reduces water requirement by 85%
Reduces labor requirement by 70%
Encourages women entrepreneurs to take up Sericulture
Demonstration of artificial diet based rearing on rural area
Reduce environmental pollution cause by dying process
Encourages the farmers especial rural women to take up sericulture

EDIBLE ACTIVE FILM AND COATINGS FOR PROLONGED SHELF LIFE OF FRUIT AND VEGETABLES

User Groups:

Fruit growers, wholesale vendors, and distributors.

Description and Functionality:

Preserving the freshness of fruits and vegetables during transportation and storage is daunting as they tend to perish quickly. This challenges farmers, traders, and consumers to maintain quality and prevent damage over an extended period. While chemical compounds are often used to avoid decay, they are not always safe for human consumption. Pullulan-based active edible coating formulations were developed to extend the shelf life of non-climacteric and climacteric fruits by approximately 20 days. The technology also includes creating pullulan-based edible films that offer good physical, thermal, and mechanical properties to use in the shelf-life preservation of fresh produce. The technology is tested against other soft and tender fruit preservation and transportation.

Technical Description:

Pullulan-based active edible coating formulations were developed with calcium chloride (1% w/v) and lemon juice (2% v/v) to keep perishable fruits fresh during transportation and storage. Edible thin films were made using polysaccharides, plasticisers, and additives to determine physical and optical parameters and morphological and biodegradable properties. Fruit dipping was optimised, wherein fruits are dipped in 10% pullulan for 10 minutes and are shade dried, packed, and transported. The pullulan-based edible coating formulations were developed and validated by coating Rastali, Chakkarakeli bananas, and Totapuri Mangoes.

Technology Readiness Level (TRL) and Cost:

The technology is at a stage of TRL-6. The licensing cost for this technology is ₹25 Lakhs, and the industrial scale investment cost is around ₹30-40 Lakhs. The price of the technology is ₹3/ kg.

Technology Developer
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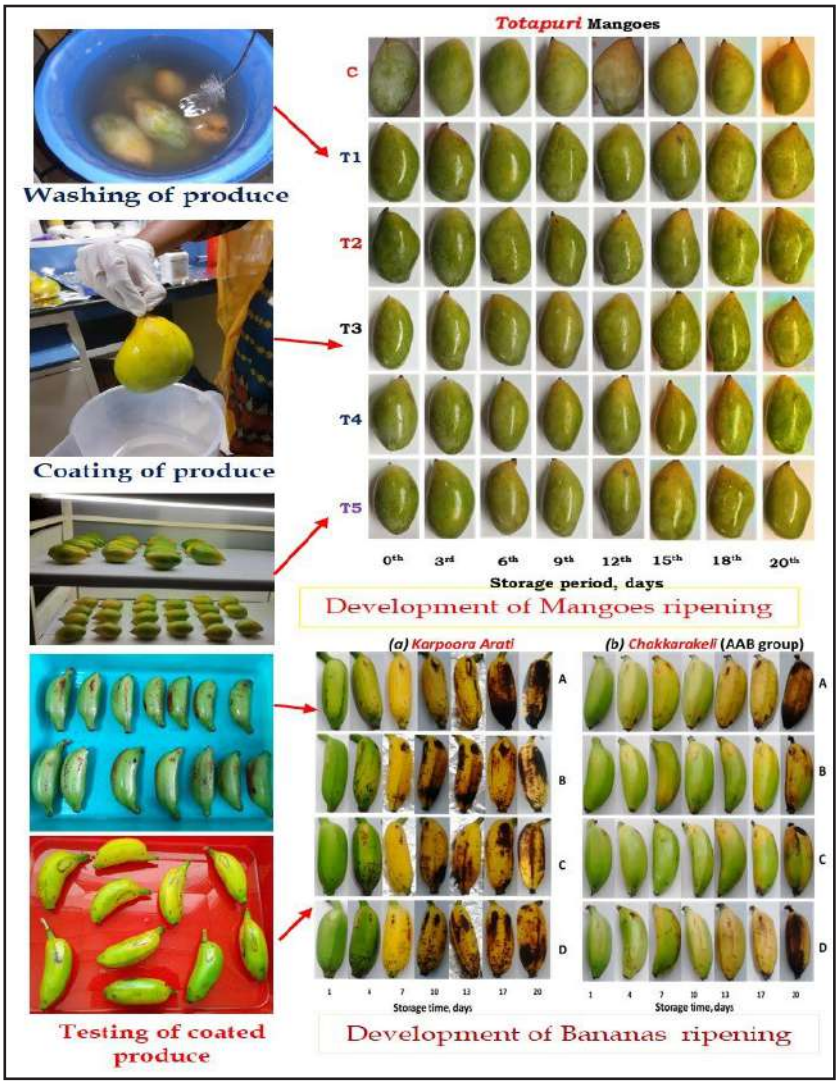
Totapuri Mangoes
C
T1
T2
T3
T4
T5
0th
3rd
6th
9th
12th
15th
18th
20th
Storage period, days
Development of Mangoes ripening
Washing of produce
Coating of produce
Testing of coated produce
(a) Karpoora Arati
(b) Chakkarakeli (AAB group)
A
B
C
D
Storage time, days
Development of Bananas ripening

SOLAR LED TRAP: KEEPING INSECT PESTS AWAY FROM MUGA SILKWORMS

User Groups:

Muga silk producers and farmers

Description and Functionality:

Using chemical insecticides is strictly prohibited in muga-rearing fields, which limits the control measures for various insect pests. As a result, there is a need for the development of environment friendly technologies to manage these pests in the muga ecosystem without causing any harm to the silkworm or its host plant. The device uses solar LED light of different colours to attract insects, which are then trapped using transparent sheets with tangled foot glue.

Technical Description:

The solar LED light traps were wrapped with transparent plastic sheets with tangled foot glue. The attracted insect pests were trapped in the glue. LED light of five different colours (white, yellow, blue, red, and green) of 1.3 W and a UV suction trap were installed in the field to control insect pests in the muga ecosystem.

Technology Readiness Level (TRL) and Cost:

The technology is at a stage of TRL-6 and ready to be transferred to the industry. The approximate technology licensing cost is ₹5-8 Lakhs, and the industrial scale investment is around ₹10-15 Lakhs.

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Yellow light
Red light
Blue light
Green light

PROTEIN SUPPLEMENTS FROM DAIRY WASTE

User Groups:
Small-scale dairy units, milk producers

Description and Functionality:
The technology aims to utilise whey protein produced during paneer production, which is usually discarded or minimally used. The technology involves a two-step approach to precipitate whey proteins from dairy whey using heat and electrolyte treatments.

Technical Description:
Dairy whey is heated at pH 4 and ionic strength of 7 mM for 30 minutes, followed by polyelectrolyte treatment using carboxymethyl cellulose solution (0.15 % w/v). The protein precipitate is then separated by centrifugation or muslin cloth, and the resulting whey protein powder (WPP) is dried in a hot air oven at 50°C. In product development, WPP-fortified biscuits were prepared by the traditional creaming method, in which WPP replaced 50% (w/w) wheat flour. The resulting WPP can be used to prepare fortified biscuits. This technology aims to enhance the income of small dairy owners and provide nutrition to children.

Technology Readiness Level (TRL) and Cost:
The technology is at TRL level-4, and the approximate technology licensing cost is ₹50,000. The total industrial investment cost is also ₹50,000.

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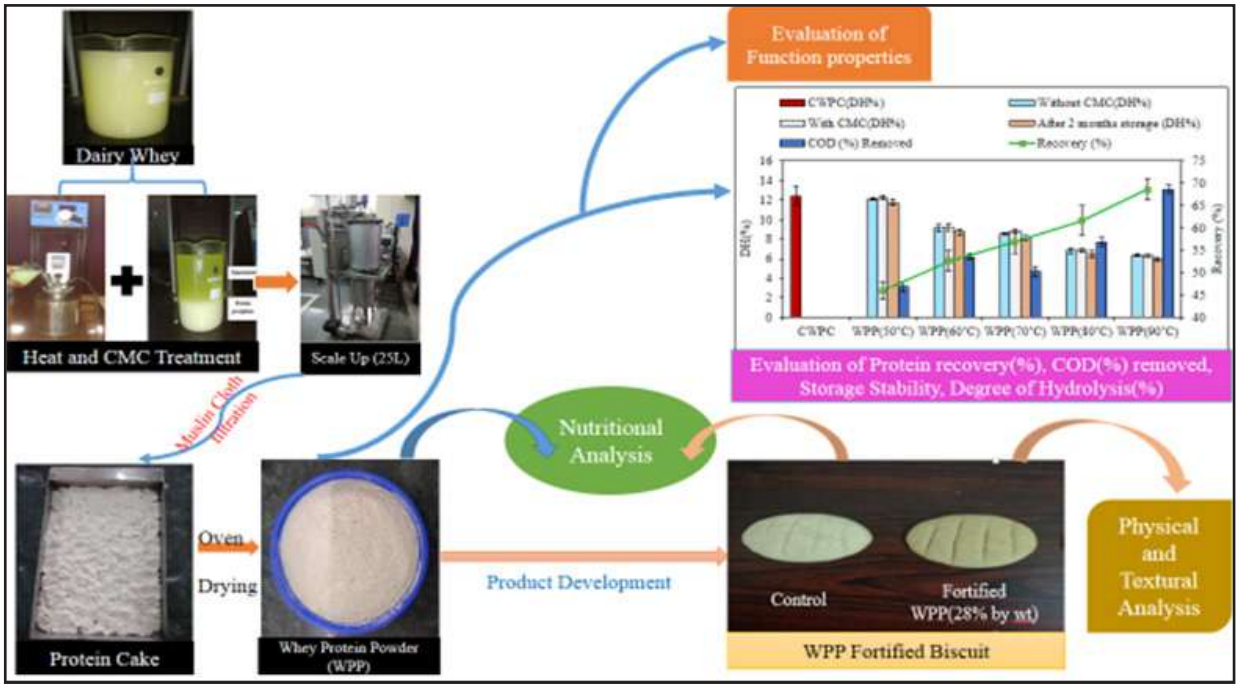
Dairy Whey
Heat and CMC Treatment
Scale Up (25L)
Muslin Cloth filtration
Evaluation of Function properties
Evaluation of Protein recovery(%), COD(%) removed, Storage Stability, Degree of Hydrolysis(%)
Nutritional Analysis
Oven
Drying
Protein Cake
Whey Protein Powder (WPP)
Product Development
Control
Fortified WPP(28% by wt)
WPP Fortified Biscuit
Physical and Textural Analysis

TEXTILE REINFORCED CONCRETE MEDIAN BARRIER

User Groups:

Construction industry, Road and highway authorities, Municipal waste management authorities, Entrepreneurs

Description and Functionality:

A high-performance cementitious binder has been developed to construct textile-reinforced concrete median barriers. The suitability of the textile-reinforced concrete panels and beams with glass and basalt textiles has been investigated experimentally for their use in median barriers.

Technical Description:

The technology uses a high-performance cementitious binder for textile-reinforced concrete median barriers, which uses alkali-resistant glass and basalt textiles as reinforcement. The design has two types of median obstacles, one with a double-sided slope and the other with a single one. A process, along with a special mold and machine/equipment, has been developed to mass-produce textile-reinforced concrete median barriers. Furthermore, a plantation scheme that utilizes processed compost from municipal solid waste has been proposed for use with median obstacles, which was found to be more effective than the conventional soil scheme.

Technology Readiness Level (TRL) and Cost:

The technology is at a level of TRL-5. The approximate technology licensing cost is ₹8-10 Lakhs, and the industrial investment cost is around ₹25-30 Lakhs.

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