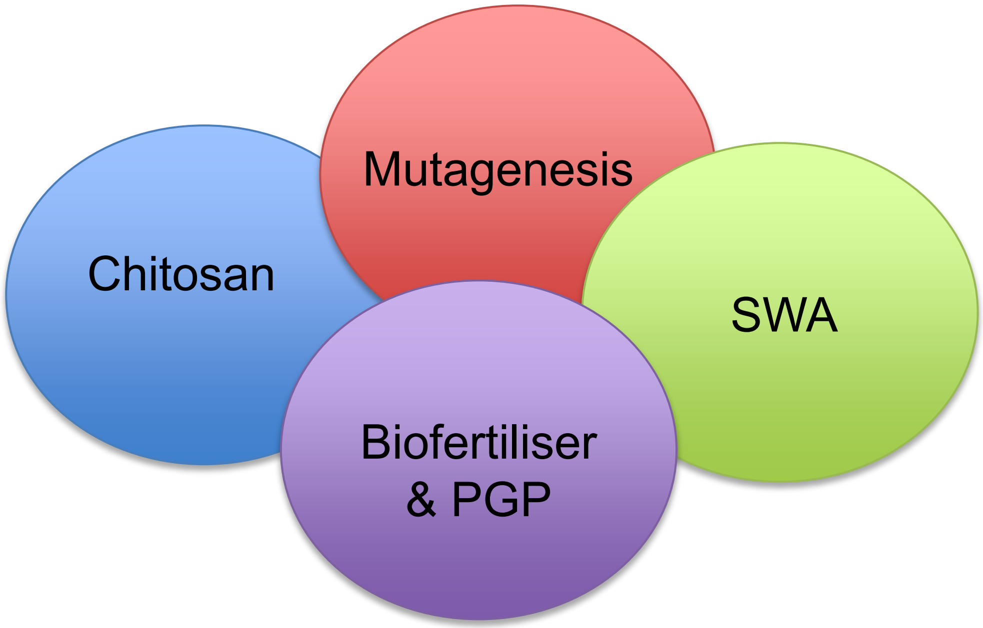
R&D area:

Group A: Agricultural Bio-stimulant



Group member:

Prof. Okazaki Shin (Japan)
Dr. Ruifu Zhang (China)
Dr. Phua Choo Kwai Hoe (Malaysia)
Dr. Rumella Simarmata (Indonesia)
Dr. Jean Louise. C. Damo (Philippines)
Ms. Sunjidmaa Otgonbayar (Mongolia)
Dr. Dang Van Phu (Vietnam)
Mr. Le Xuan Vinh (Vietnam)
Dr. Thitirat Rattanawongwiboon (Thailand)
Dr. Threeranan Tangthong (Thailand)
Ms. Pattra Lertsarawut (Thailand)

R&D area:

Mutagenesis

Mutagenesis microorganism on phosphate solubilising bacteria, silicate-solubilising bacteria; high temperature- tolerance and biological control (2025)

<u>Current status</u>

Malaysia

Mutagenesis involving phosphate solubilising microbes (PSB) and silicate-solubilising bacteria (SSB) are in progress. Obtained 3 potential PSB mutants. Three potential isolates SSB will be use in SSB mutagenesis.

Japan

Mutagenesis of Plant growth promoting *Bradyrhizobium* species has been completed and the mutants with high temperature-tolerance, better symbiotic abilities, and stronger nitrous oxide removal activities.

Vietnam

Irradiation and selection three superior mutant strains of *Trichoderma*: AM2 (derived from TVN-A0), HM2 (derived from TVN-H0), and KM2 (derived from VTCC 31435) with outstanding performance, genetic stability over at least five generations, and high potential for development of fast-dissolving tablet formulation, Radichoderma-FD, into biological control agents against rice diseases such as rice blast and sheath blight.

Remaining/New Challenges

1. Irradiation doses, number of screening generation, stability of the mutant strains, methods of mutagenesis.
2. Securing irradiation slots

Gaps in basic aspect

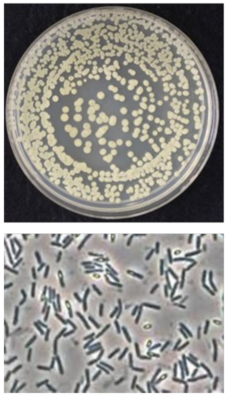
1. Identified the changes of the responsible genes due to mutagenesis
2. Screening strategy (Fast, effective, cost saving)

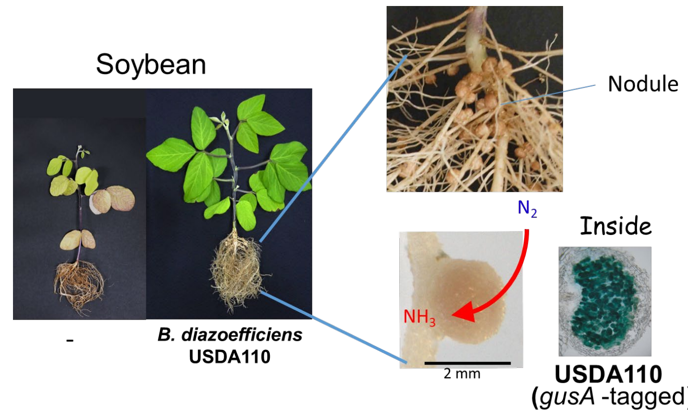
Gaps in application aspect

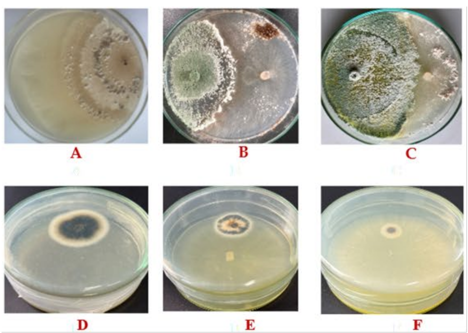
1. Cost for mutagenesis
2. Stabilities of the irradiated microbes
3. Public acceptance and awareness

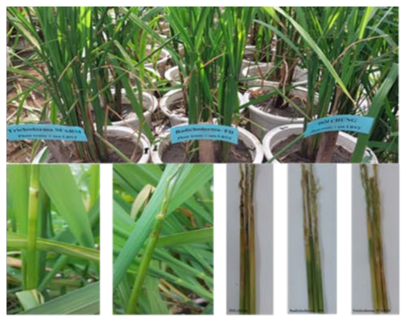
Implementation plan

1. Financial supports
2. Develop standard protocol for radiation mutagenesis
3. Cooperation of irradiation facilities
4. Field trial of the potential mutants



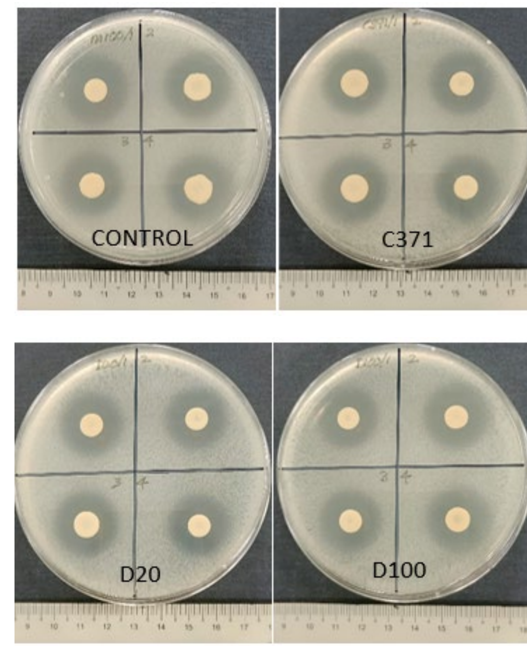




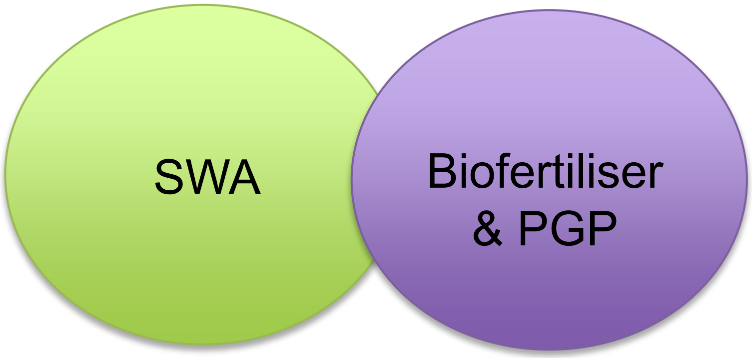


Triệu chứng bệnh đạo ôn cổ bông sau lây nhiễm 4 ngày

Nhiễm đạo ôn cổ bông – tưới chế phẩm **trước và sau** lây nhiễm



R&D area:



All of the member country reported different biofertilizer products, plant growth promoters and super water absorbents with significant effect on plant growth, improved soil health, increased crop yield, reduction in the utilization of chemical fertilizer up to 10-50%, economical benefits, and crop resilience to climate stress.

Current status

(China)

Obtained an excellent strain *Sinomonas gamaensis* NEAU-HV1 to promote pant growth and root development; Strain NEAU-HV1 was used to produce the bacterial inoculant and biofertilizer through large-scale fermentation. SWA was made from cassava via gamma irradiation, SWA significantly increased the efficiency of strain HV1-based biofertilizer under soil drought.

(Indonesia)

LCO-based Biofertilizer significantly increased the salt tolerance and the plant growth of *Paraserianthes falcataria, Glycine max*, and *Allium ascalonicum* L. LCO-SWA can promote the germination, the number of nodules in legume plants, the root colonization, and the performance of biofertilizer.

<u>Current status</u>

(Philippines)

Recent innovations in biofertilizer R&D include alternative carriers, integration with other bio-stimulants, and development of sustainable production protocol for biofertilizer technology. Current efforts emphasize farmer adoption, economical impact, waste valorization, and environmental benefits.

(Mongolia)

The combined application of *Azospirillium* based biofertilizer demonstrated synergistic effect of BF, PGP and SWA under greenhouse condition. This synergy offers an increase in crop productivity and yields of cucumber and soil improvements. Isolation and determination of four local *Bacillus* sp. strains from Mongolian agricultural soil. Now we analyzing efficient characteristic for plant growth of these bacteria.

Remaining/New Challenges

1. Reduction on costing of the product
2. Promotion and deployment of the products to the farmers
3. Prolonged the shelf life
4. Lack of testing data for various crops and agroecological zones
5. Study more on synergistic effect of biofertilizer with SWA, PGP/ Carragenan
6. Budget for R&D and testing
7. Quality, safety and efficiency of the products

Gap in basic aspect

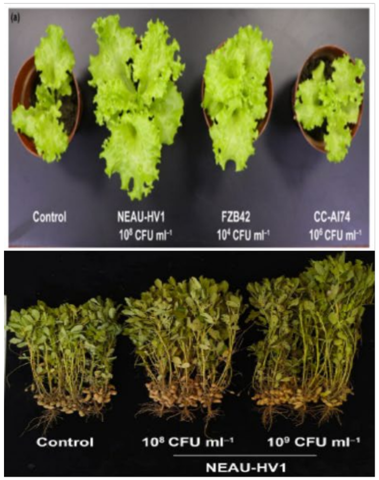
1. The effects of bacteria and fungi are not same on different site, different soil require different microbes, and BF
2. Development of New BF for stress soil condition
3. Formulation of the metabolites and microorganism

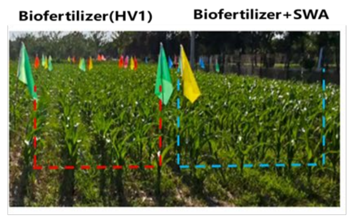
Gap in application aspect

1. Lack of cooperators/farmers for field test
2. Adapt to Climate change
3. Technology transfer from lab to Industry is still challenging (Policy support)
4. Difficulties in looking for stakeholders
5. Communication to farmers (Education / public awareness)

Implementation plan

1. Improved products (SWA, PGP, Biofertilizer)
2. Metagenomic, meta-transcriptomic, and metabolomic study for efficiency and correlation study.
3. Search for the suitable carrier for different type of biofertilizer (a consortium of bacteria, fungi, *etc.*),
4. Optimization of the production on the large scale
5. Improvement of equipment/techniques for biofertilizer production.
6. Promotion and application of PGPB, SWA and Biofertilizer
7. Soil microbiome analysis as affected by the application of PGPB, SWA, and Biofertilizer





Field trials of biofertilizers

Capacity building and farmer's field demonstration trials

Sustainable biofertilizer production

R&D area:

Chitosan

Radiation-modified chitosan for aquaculture and agricultural applications, focusing on low-molecular-weight chitosan as a functional additive to enhance immunity, growth performance, and disease resistance, as well as a plant growth promoter to improve growth, vigor, and stress tolerance in crops(2025)

<u>Current status</u>

Thailand

- Successful prepared of low molecular weight chitosan using gamma radiation and hydrogen peroxide
- Improved bioactivity, including antimicrobial and immune effects
- Completed laboratory-scale validation
- Developed a prototype formulation for plant growth promoter and aquafeed application

Vietnam

- Actively developed radiation-based chitosan biostimulants through degradation and modification processes
- Achieved commercial-scale production of oligochitosan as a plant growth promoter (PGP) under the trade names RIZASA and OLIGOCHITOSAN-5K

Remaining/New Challenges

1. Limited availability of long-term field data under real farming conditions
2. Ensuring product stability during storage and feed processing
3. Addressing regulatory and scale-up challenges for commercialization
4. Expanding pilot-scale validation under varied environmental and stress conditions
5. Conducting region-specific validation of biostimulant performance to address variability in agricultural environments

Gaps in basic aspect

1. Incomplete understanding of the molecular mechanisms about immune stimulation
2. Limited mechanistic linkage between radiation-modified materials and biological responses at the cellular and molecular levels.

Gaps in application aspect

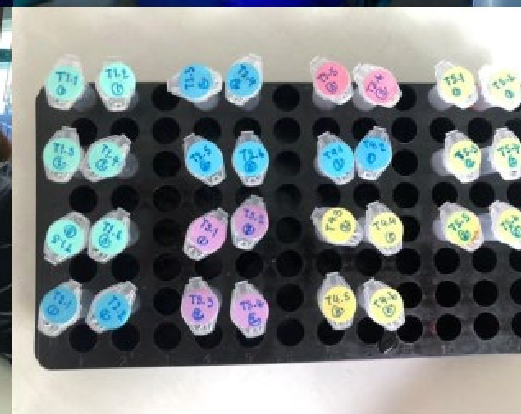
1. Lack of large-scale field trials in commercial aquaculture systems
2. Insufficient data on cost-effectiveness and farmer acceptance
3. Need for expanded pilot-scale validation under varied environmental and stress conditions
4. Limited region-specific field validation to confirm consistent biostimulant performance across different agricultural environments.

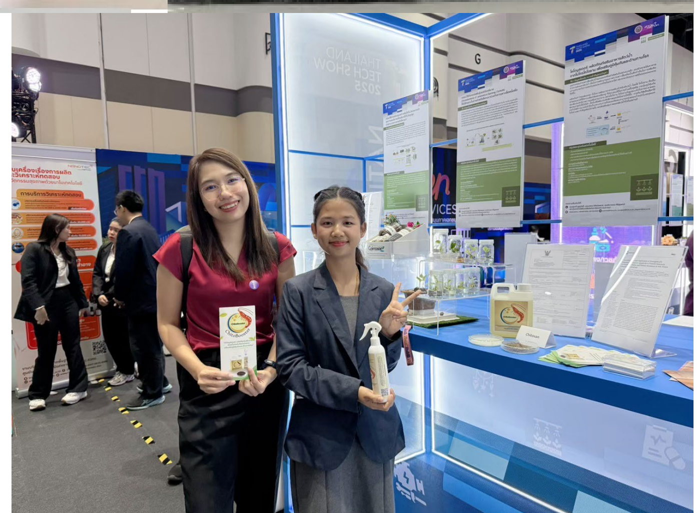
Implementation plan

1. Conduct field trials in Nile tilapia and extend to white shrimp culture
2. Optimize formulation for feed coating and stability
3. Collaborate with regional partners to share protocols and data
4. Prepare technical and regulatory documentation toward pilot-scale production
5. Advance production of radiation-modified oligosaccharides with optimized doses and improved process efficiency
6. Scale up agricultural validation of plant growth promoters (PGPs) and plant defense promoters (PDPs) across diverse crop and soil systems
7. Promote technology transfer, industrial licensing, and commercial production




49



Thank You
Terima Kasih
Cảm ơn
ありがとう
谢谢

ขอบคุณค่ะ

Maraming salamat

Баярлалаа

R&D area: Polymer Modification (2025)

Group member: Salma Sultana (Bangladesh), Hongjuan MA (China)

Current status

<Improvements from 2024> (specify the name of the country if needed)

- Our lab is now capable of removing both anionic and cationic dyes from aqueous solutions by means of adsorption and recovering them back into the aqueous media by means of desorption.
- The challenge still remains to achieve the dyes into solid form after recovery. Also, the industrial effluents still remain unventured.
- Green and Efficient Cotton Fabric Dyeing with Custom-Tailored Reactive Dyes via Electron Beam Irradiation was achieved.
- Rigid skeleton PEI fabric was fabricated with EB irradiation and used in the ^{99}Mo/^{99m}Tc generator.
- Hydrogel-encapsulated lithium-ion sieves-based photothermal fabric adsorbent was fabricated.

<Remaining/New Challenges>

- The color universality of radiation-induced graft dyeing requires further investigation. Not all colors can be achieved, and mixing-color dyeing encounter difficulties. The task of synthesizing the individual components in the specified color by the customer is quite challenging.
- Further research is needed on radiation-resistant and high-strength microspheres.

Gap in basic aspect

- The cost control issue in electron beam irradiation-modified materials.
- Proper facilities of characterization technique for the hydrogels is still a gap.

Gap in application aspect

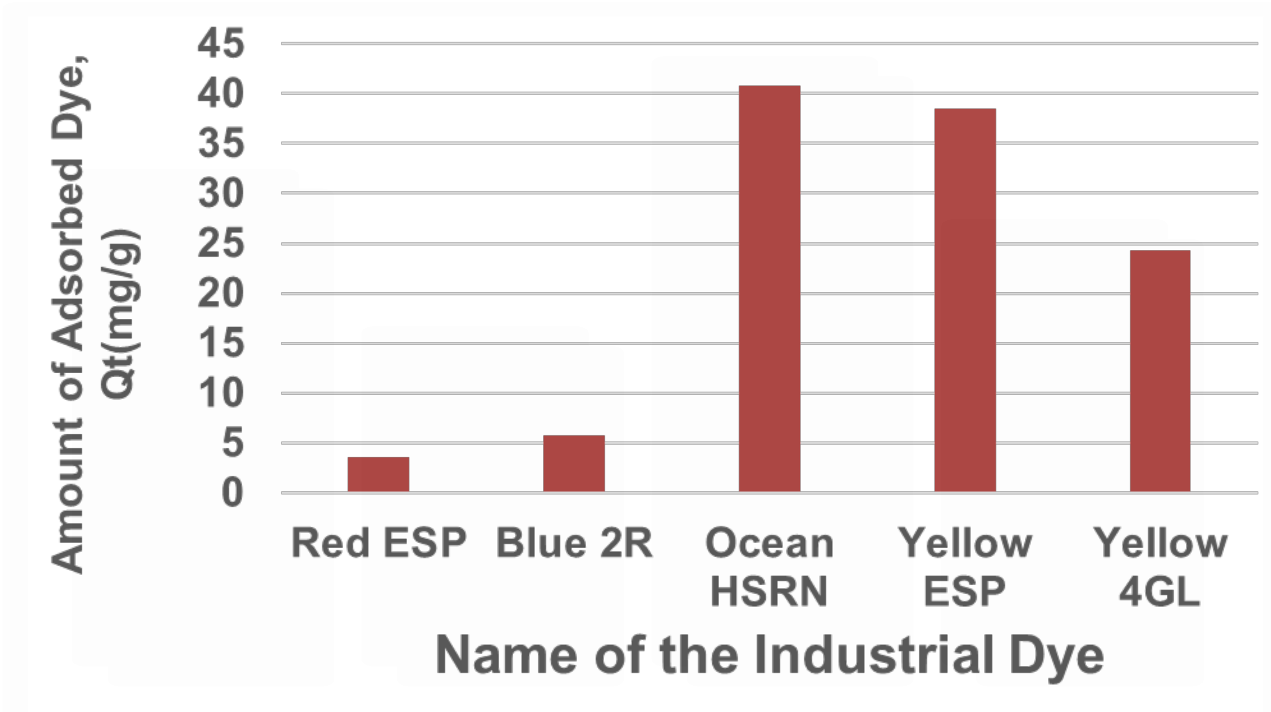
- The gap remains in finding a hydrogel that can equally remove both the cationic and anionic dyes by 90% from aqueous media. Also treatment of wastewater effluents is left unventured.
- The feasibility of continuous operation for fabrics in the electron beam irradiation grafting process requires further investigation.

Implementation plan

- Our plan is to collaborate with local laboratories of high-tech facilities to fill the gap of characterization. And we plan to create a amphoteric hydrogel that can remove both cationic and anionic pollutants from wastewater effluents.
- Carry out the scale-up verification of electron beam irradiation for dyeing, and conduct research on radiation dyeing of other types of fabrics, such as nylon and other materials.
- Prepare resin materials with appropriate particle sizes for the separation of medical isotopes.
- Large-scale production of photothermal conversion materials and their application in seawater desalination and the comprehensive utilization of marine resources.

R&D area: Polymer Modification (2025)

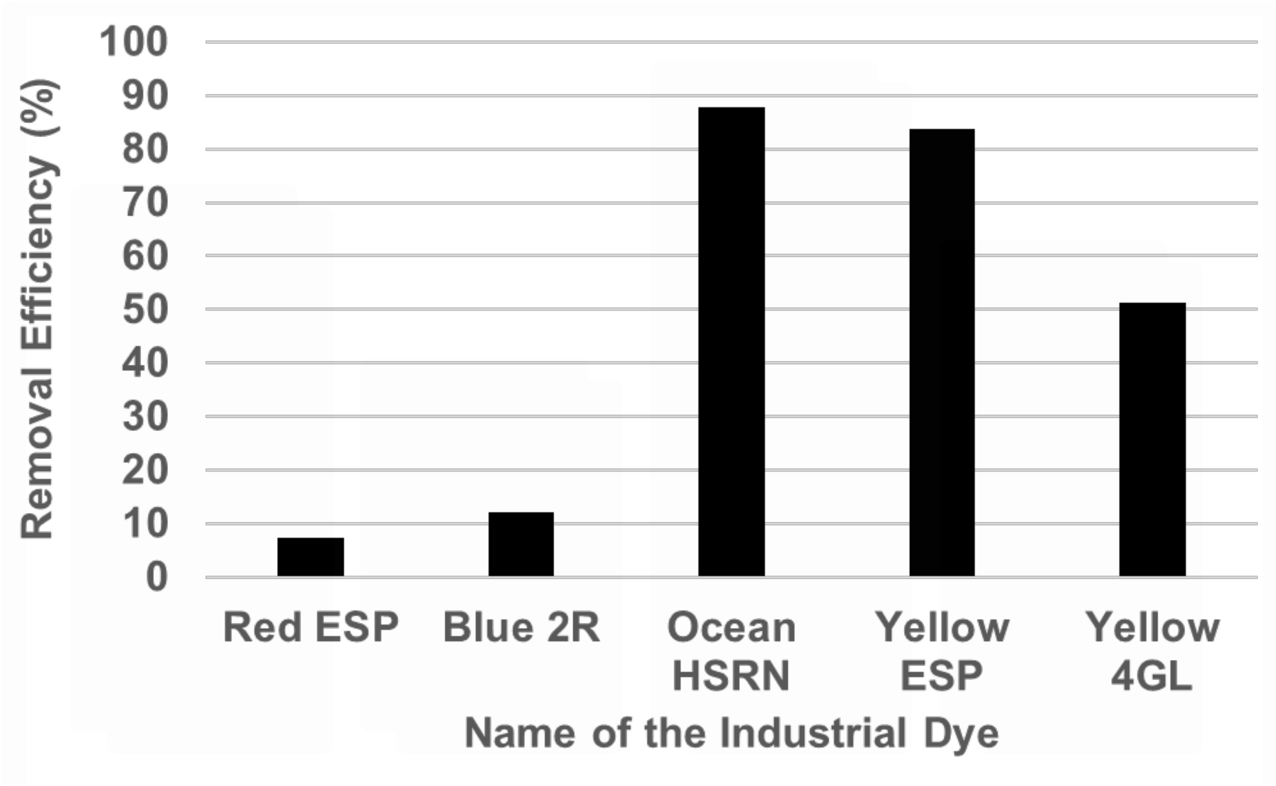
Group member: Salma Sultana (Bangladesh),



Adsorption capacity of optimized $CMCh_5AAm_{10}D_{10}MBA_{0.25}$ hydrogel for industrial dyes over 48 h (initial dye concentration was 100ppm)

R&D area: Polymer Modification (2025)

Group member: Salma Sultana (Bangladesh),

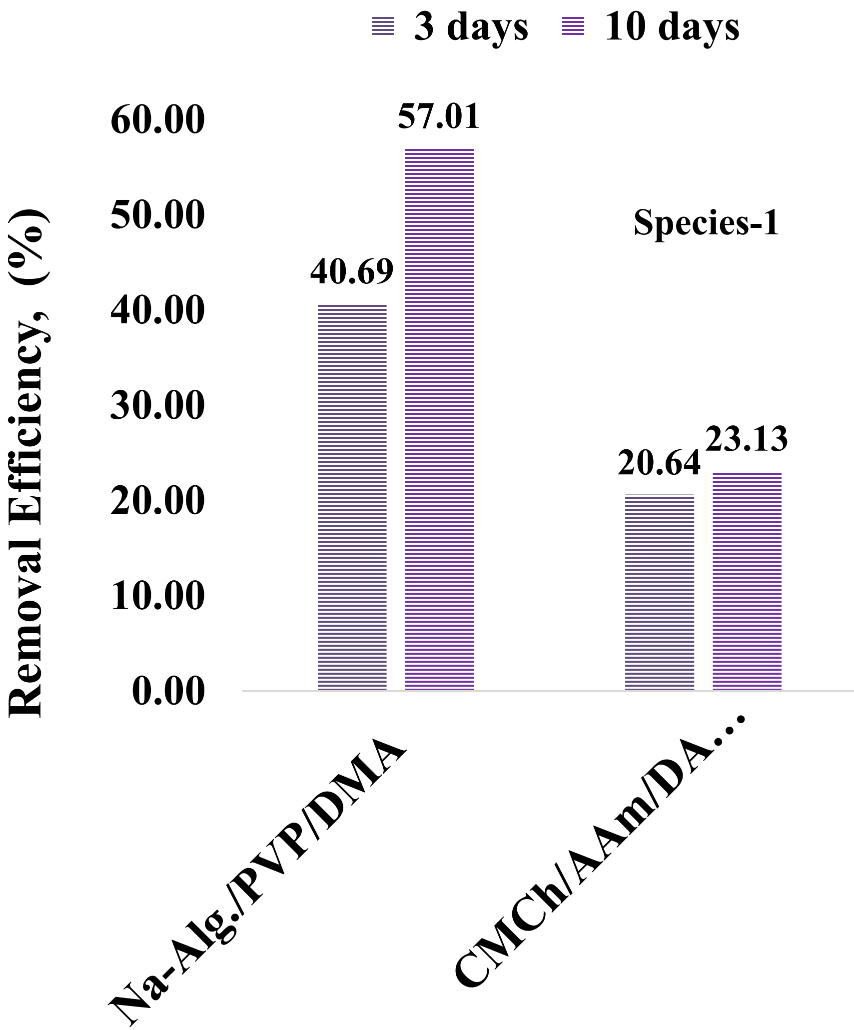


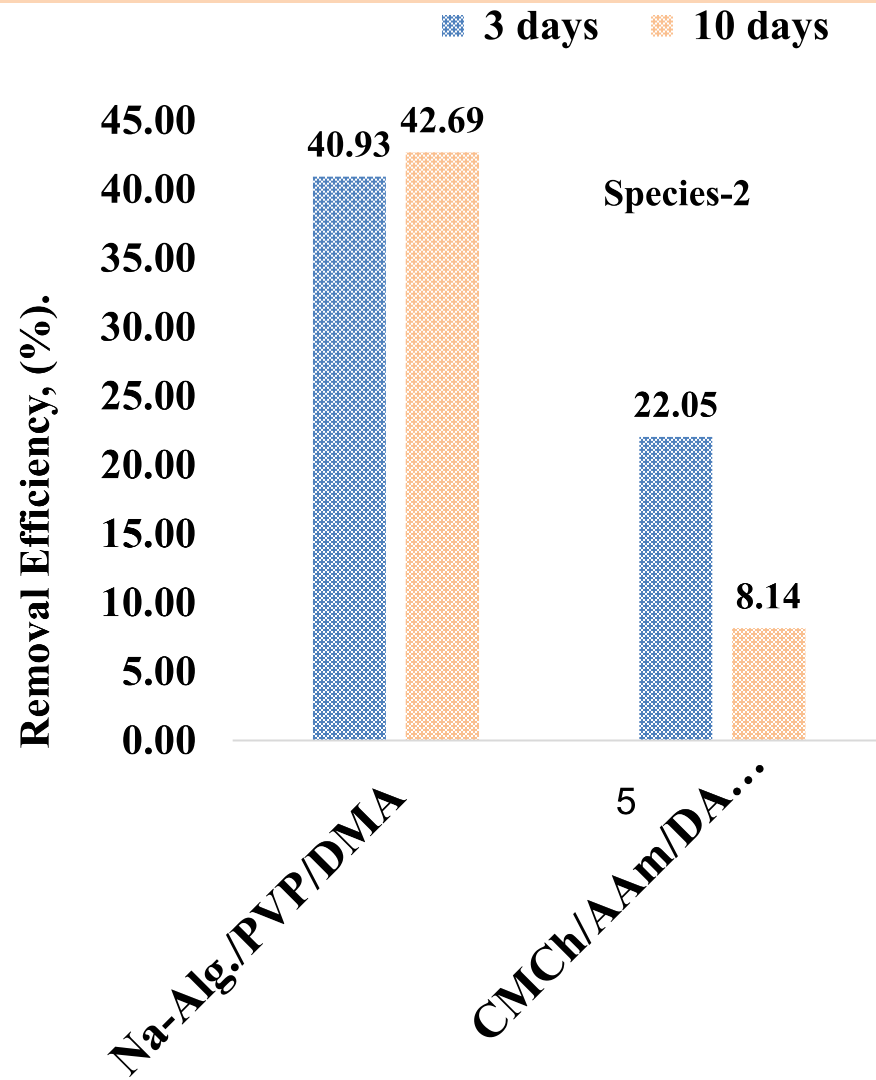
Removal Efficiency of optimized $CMCh_5AAm_{10}D_{10}MBA_{0.25}$ hydrogel for Industrial Dyes over 48 h (initial dye conc. was 100 ppm)

R&D area: Polymer Modification (2025)

Group member: Salma Sultana (Bangladesh),

Adsorption of Industrial Effluents





R&D area: Polymer Modification (2025)

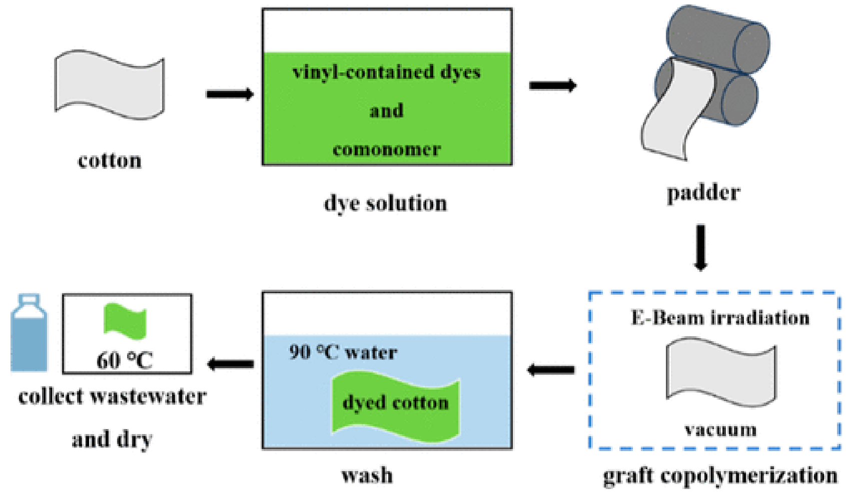
Group member: Salma Sultana (Bangladesh),

Adsorption of Industrial Effluents

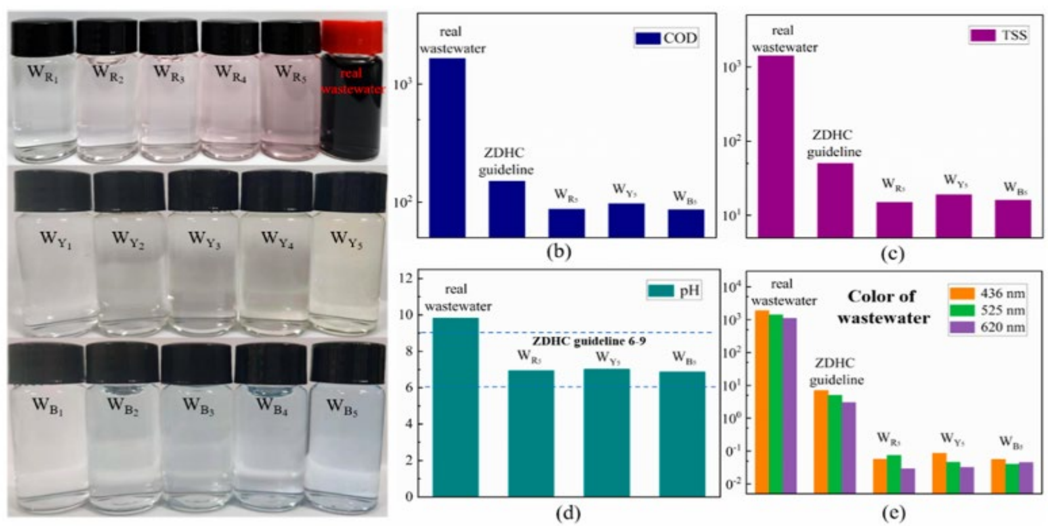
Industrial Effluents	Hydrogel	Removal Efficiency, $R_{eff.}$ (%) (3 days)	Removal Efficiency, $R_{eff.}$ (%) (10 days)
Species-1	Na-alg./PVP/DMA	40.69	57.01
	CMCh/AAm/DADMAC/MBA	20.64	23.13
Species-2	Na-alg./PVP/DMA	40.93	42.69
	CMCh/AAm/DADMAC/MBA	22.05	8.14

R&D area: Polymer Modification (2025)

Group member: Hongjuan MA (China),



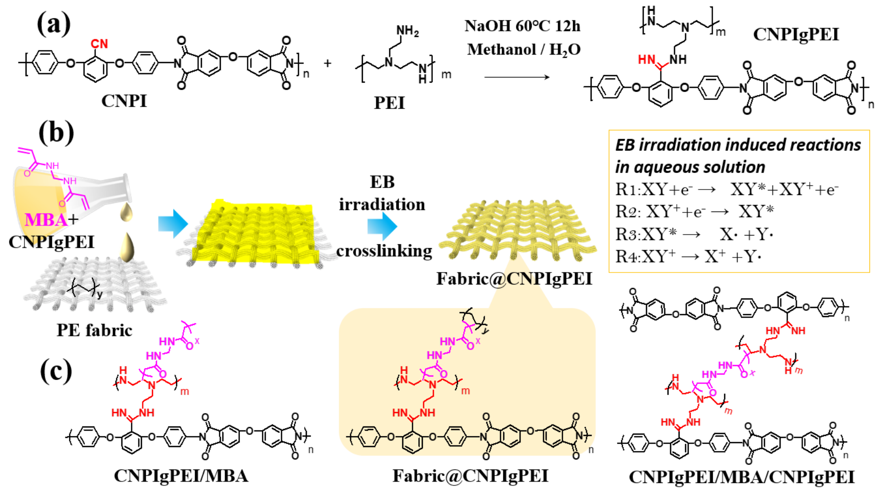
Dyeing with Vinyl-Contained Dye via E-Beam Irradiation



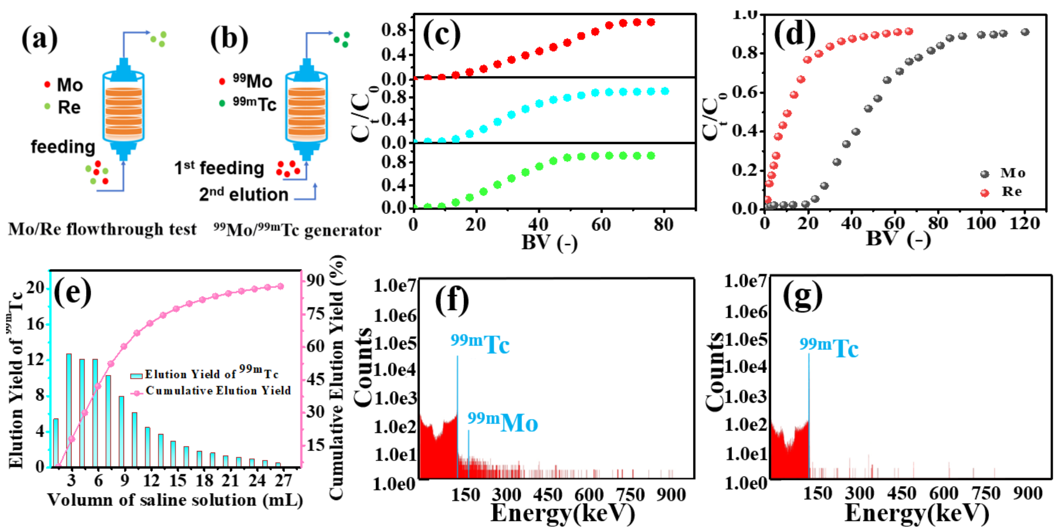
(a) Wastewater samples of dying and real wastewater, (b) COD, (c) TSS, (d) Ph, and (e) color of wastewater

R&D area: Polymer Modification (2025)

Group member: Hongjuan MA (China),



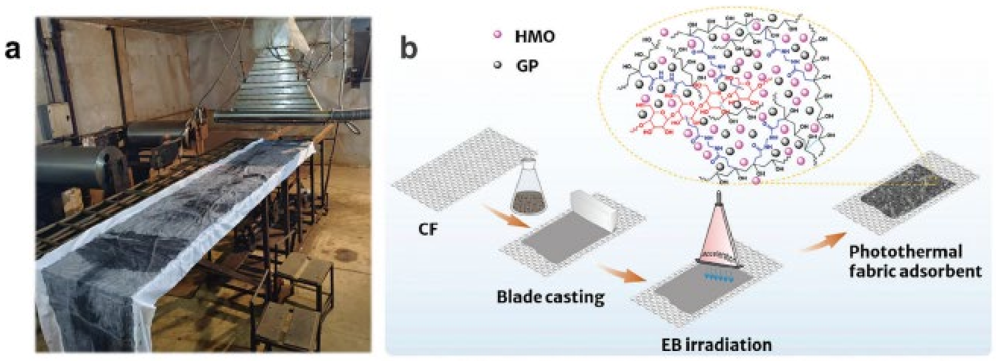
Synthesis and fabrication process of the Fabric@CNPIgPEI adsorbent; (insert) reaction under EB irradiation



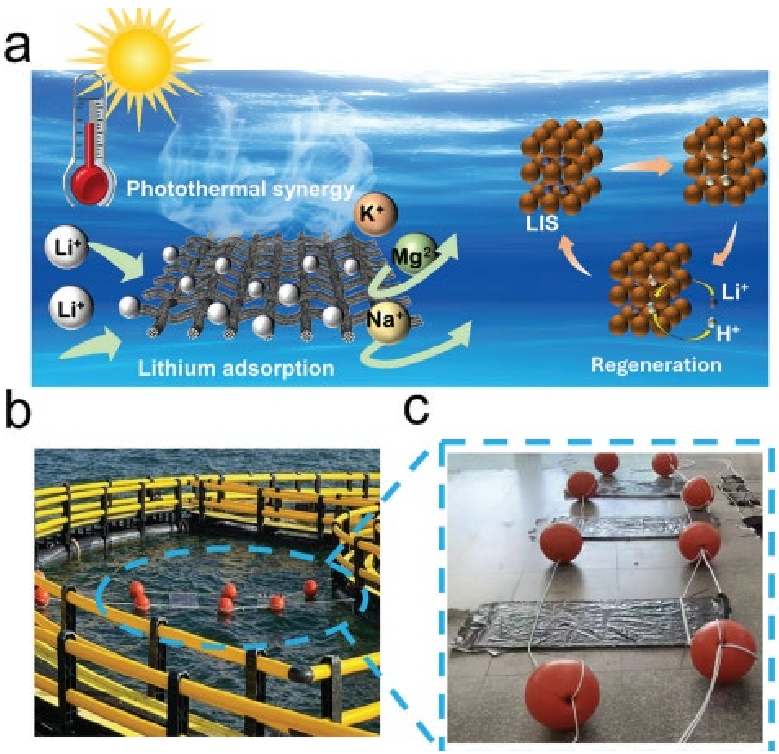
separation of ^{99m}Tc from ^{99}Mo with Fabric@CNPIgPEI-based system

R&D area: Polymer Modification (2025)

Group member: Hongjuan MA (China),



Electron accelerator and its auxiliary assemblies for photothermal fabric adsorbent preparation.



Schematic diagram of the photothermal synergistic lithium extraction mechanism.

R&D area: Recycle Plastic : Preparation of Concrete Block Using Irradiated Plastic Waste (PET Flakes)

Group member: Salma Sultana (Bangladesh),

Current status

<Improvements from 2024> (specify the name of the country if needed)

- ❖ In the lab scale, we have prepared (dimension 5cm × 5cm × 5cm) concrete blocks by mixing non-irradiated PET/ irradiated PET, cement, sand, and gravel. We have used up to 5% of PET in the blocks and have measured the compressive strength of the prepared blocks. It has been observed that 10g irradiated PET (5% of total weight, about 20% cement replacement) showed no significant loss of compressive strength(17.0MPa) compared to the control (19.7 MPa).
- ❖ We have optimized gravel and sand mesh size less the 0.25 mm, optimized the ratio of cement: sand: gravel as 2.2:3:5 and also optimized the radiation dose of PET(50 kGy).
- ❖ Sample with irradiated PET showed slightly higher compressive strength (17.0MPa) than with non- irradiated PET (15.0 MPa).
- ❖ Industrial Trial basis it has observed that compressive strength of prepared concrete blocks (dimension 22.2 cm X 11.0 cm X 6.0 cm) containing irradiated PET flakes (16.7% cement was replaced by PET, 2.5% of total weight) was higher (32.32 MPa) than that of regular concrete blocks (30,30 MPa)
- ❖ Our main achievement is that we observed no significant loss of compressive strength after addition of PET (in case of both non- irradiated and irradiated PET) compared to the control.
- ❖ In future, we found a suitable field to recycle waste PET and thereby we can reduce the environmental pollution by the unused waste PET.

R&D area: Recycle Plastic : Preparation of Concrete Block Using Irradiated Plastic Waste (PET Flakes)

Group member: Zhanat Baigazinov,

Current status

<Improvements from 2024> (specify the name of the country if needed)

- In 2024, the research results on radiation crosslinking of PE-100 polyethylene, obtained at the ELV-4 electron accelerator. The study confirmed the industrial applicability of radiation-modified polyethylene, demonstrating improved physical, thermal, and mechanical properties. Stable radiation crosslinking regimes (75–150 kGy) increased the degree of crosslinking from ~70% to ~80%. Currently we on production of radiation-modified polymer pipes for hot water supply.

Gap in basic aspect

- To using recycled polyethylene (up to 50%) to producing radiation-modified polymer pipes for hot water supply.

Gap in application aspect

- To cheek quality of radiation-modified polymer pipes made by secondary polyethylene (up to 50%) with for hot water supply physical, thermal, and mechanical properties.

Implementation plan

- To conduct a study on different combinations of using recycled materials and polyethylene to see the level radiation crosslinking and quality of physical, thermal, and mechanical properties of the pipes after irradiation with different dose (75–150 kGy).

Gap in basic aspect

We will pay effort to increase the amount of PET in the blocks more than 5%. Increase of PET in the blocks keeping the good compressing strength is a challenge.

Gap in application aspect

- For scaling up to pilot scale, mixing or grinding machines are needed to achieve a homogenous mixture of the component materials (e.g. PET flakes, gravel, sand, cement and water).
- With our universal testing equipment we can only measure compressive strength of small sized (dimension 5cm × 5cm × 5cm) blocks. We have plan to collaborate with Bangladesh University of Engineering & Technology (BUET) to measure the compressive strength of large size concrete blocks.
- Sometimes we have to stop our block production due to the radiation facility.
- We do not have any machines except UTM for carrying out the activity of plastic waste management.
- We need hardness and impact testers, an extruder for giving the shape of various materials of the melted polymers

Implementation plan

- We will attempt to investigate other properties of the concrete blocks, including workability, air content, tensile strength, and water absorption.
- Consult with some industries capable of producing concrete block
- We will pay effort to increase the amount of PET in the blocks more than 5%
- In future experiments further studies will be conducted on an industrial scale under different conditions to increase the use of waste plastics in blocks while maintaining the compressive strength of the product. The conservation of mechanical stability of the blocks for long period of time will be compared with regular blocks (without plastics) of Hatim Global Concrete Industries Ltd.
- We will continue to work jointly with Concrete Block Manufacturing Companies such as Hatim Global Concrete Industries Ltd. , and there are plans to sign MoU with them.

R&D area: Recycle Plastic (2025)
Group member: **Dr. Salma Sultana** (Bangladesh),

Preparation of γ-irradiated (50 kGy) & non-irradiated PET-concrete blocks

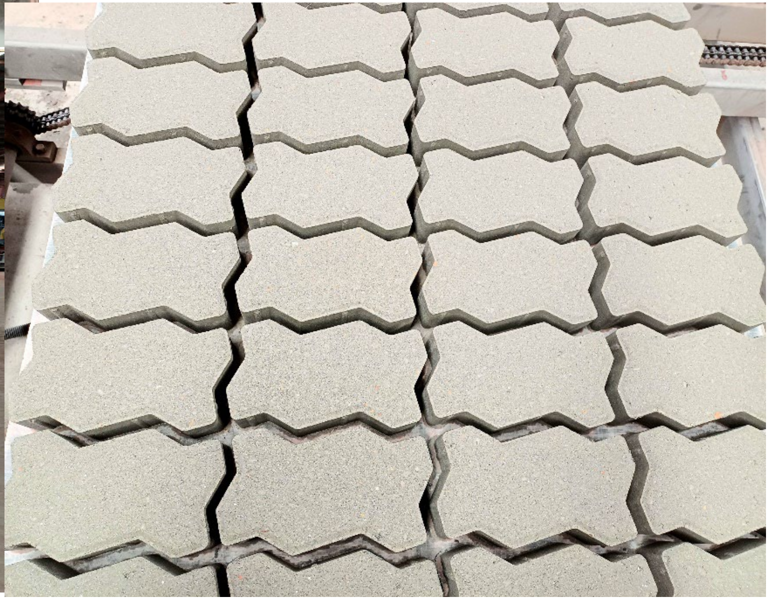
Within a Mould
gravel - cement - sand -water -PET (in gm)
115 : 50.6 : 67.5-68.5 : 52 : 1.5-10.0

Curing at R. T. for 28 days

Sample	Tensile strength (Mpa)
Control	15.5-19.7
Non-irradiated PET	14.0-15.0
Irradiated PET (50 kGy)	15.5-17.0

TRIAL PRODUCTION IN INDUSTRY

Dimension: 22.2 cm X 11.0 cm X 6.0 cm



R&D area: Recycle Plastic (2025)

Group member: **Dr. Salma Sultana** (Bangladesh)

TRIAL PRODUCTION IN INDUSTRY

Dimension: 22.2 X 11.0X 6.0 cm

Compressive Strength Testing Results (ASTM C39), aging time 28 Days			
	Concrete Block , with irradiated PET (replacing cement, 16.6%)	Concrete Block with irradiated PET (replacing sand, 4.5%)	Regular Concrete Block
Specimen Area(sq. mm)	**24420**	**24420**	**24420**
Average Weight of Sample (kg)	**3253**	**3137**	**3217**
Average Compressive Strength(MPa)	**32.32**	**25.88**	**30.30**

R&D area: Group C - Medical and Biological Application (2025)

<u>Group members:</u>

1. Tabassum Mumtaz (Bangladesh)
2. Farah Nurlidar (Indonesia)
3. Sadykov Adlet Altaevich (Kazakhstan)
4. Maznah Binti Mahmud (Malaysia)
5. Radnaabazar Chinzorig (Mongolia)
6. Charito T. Aranilla (The Philippines)
7. Sakchai Laksee (Thailand)
8. Nakajima Shogo (Japan)

R&D area: Group C: Medical and Biological Application (2025)

Current status

Bangladesh

Hydrogel for medical application

i) Anti-microbial activity of the chitosan and Chitosan-Ag Nanocomposite have been confirmed at 5 kGy.

ii) Hydrogel was prepared with varied thickness (1- 3 mm) using the fabricated multiple gel casting apparatus.

iii) Microbiological analysis as well as sterility dose optimization of several medical, pharmaceutical, food and feed products using Co-60 irradiator at GSD, IFRB has been conducted on regular basis.

Indonesia

The project is developing scaffolds from dextran and alginate for tissue engineering and drug delivery applications using gamma and EB irradiation.

Kazakhstan

Hydrogel for Medical Application, synergistic Effect among Plant Growth Promoters (PGP), Super Water Absorbents (SWA) and Biofertilizer (BF), PGP and SWA, inclusive Process Development.

R&D area: Group C: Medical and Biological Application (2025)

Malaysia

New project on **BIOHYBRID SCAFFOLD FOR 3D TISSUE CULTURE** proposed for 2026

Mongolia

Low-energy X-ray irradiation of basic vegetables, dried beef, and curds was studied.
SWA and hydrogel are produced in lab scale study.

Philippines - CMC Hydrogels as Hemostatic Agents

1.Secured Memorandum of Understanding or Agreement (MOU/MOA) with collaborators for the clinical trials and pilot scale studies.
2. Conducted production of 200 units each of granules and gauze investigational devices for the clinical trials at GMP-certified Lynx Nia Medica Inc.
3. Initiated Pilot Scale studies with the private company (Irradiation Solutions Inc.) with 10-Mev Electron Beam facility

Thailand

A project on radiation-induced synthesis of metallic nanohybrids functionalized with biopolymers for effective anticancer drug delivery systems (in Lab scale).

R&D area: Group C: Medical and Biological Application (2025)

Gap in basic aspect

Bangladesh

Lack of analytical tools and the gamma source's low activity may pose threat to continue the research work.

Malaysia

1. To understand the interaction between radiation (type and dose) and polymers (effect of hybrid polymer content/ratio, type, and molecular weight) in achieving the desired scaffold integrity.
2. Malaysia encountered an emergency shutdown of the electron-beam facility, so currently relying only on gamma radiation for scaffold development. Based on our experience, scaffolds are better prepared using electron-beam irradiation because it generates faster crosslinking reactions and typically achieves a higher crosslink density than gamma radiation.

Mongolia

Consumer acceptance + training; cost and business model for Small and Medium-sized Enterprises.

R&D area: Group C: Medical and Biological Application (2025)

Gap in basic aspect

Indonesia

1. No experiment data for hydrogel fabrication using EB and i*n vitro* and *in vivo* dexperiment

Kazakhstan

1. Laboratory to research and equipment to produce

Philippines

1. Optimization of pilot scale radiation processing parameters for crosslinking of CMC hydrogel using 10 MeV E-beam
2. Stability of hemostat product for a period of 5 years

Thailand

1. Mechanistic understanding: incomplete knowledge of how radiation dose/rate and polymer chemistry govern nucleation and hybrid architecture.
2. Reproducibility & standardization: inter-batch variability and lack of standardized protocols for radiation synthesis and polymer functionalization.
3. Stability & shelf life: limited long-term stability data for nanohybrid formulations under storage and physiological conditions.

R&D area: Group C: Medical and Biological Application (2025)

Gap in application aspect

Bangladesh,Kazakhstan, Malaysia, and Mongolia

No gap have been identified because we are still at the initial stage development (laboratory scale).

Indonesia

To fulfill the requirements from the government before can be applied

Philippines

Delay in conduct of clinical trials due to absence of FDA implementing rules and regulations for clinical trials of locally produced medical devices

Thailand

1. Preclinical gap: few comprehensive biodistribution, toxicity and efficacy studies that use standardized protocols relevant to clinical translation.
2. Regulatory pathway: regulatory requirements for radiation-synthesized nanomedicines are not well established locally; guidance and precedent are scarce.
3. Clinical trial readiness: lack of partnerships and infrastructure in Thailand for first-in-human studies of nanomedicine.

R&D area: Group C: Medical and Biological Application (2025)

Implementation Plan

Bangladesh

1. Device development to measure gel elasticity, elongation at break of produced composite hydrogel.
2. Comparative study of market/ commercially available wound dressing material with hydrogel.
3. The minimum dose for sterility of urine container, cumin and chilli (10 kGy), surgical thread (20kGy), rubber stopper and plastic container(10 KGy), maize starch (15kGy) and for nasal spray (1 kGy) has been assessed.

Indonesia

Conduct the in vivo test and trying to find a collaborator from medical field (doctor) who want to apply our product

Kazakhstan

It is planned to expand the customer base through vegetable growers, greenhouses, nurseries, and retail sales for indoor plants, garden, and vegetable garden.

R&D area: Group C: Medical and Biological Application (2025)

Implementation Plan

Malaysia

To understand the interaction between radiation (type and dose) and polymers (hybrid polymer content/ratio, type, molecular weight) in achieving the desired scaffold integrity, while adapting to current limitations in irradiation facilities.

1. define radiation parameter (dose, dose rate) and polymer (type, content, molecular weight.
2. plan for gamma cell irradiation since the dose rate of gamma irradiation quite low (1.24kGy/hour)
3. characterize scaffold properties.

Mongolia

1. The plan includes continuing the ongoing studies, including meat irradiation.
2. Seeking partnerships for facility access and funding opportunities.
3. Mechanism/kinetics of irradiated food/agricultural products need to be studied (example: Aflatoxin degradation).

R&D area: Group C: Medical and Biological Application (2025)

Implementation Plan

Philippines

1. Continue pilot scale dose mapping experiments
2. Establish radiation sterilization dose following ISO 11137-2 VDmax Method
3. Establish specifications for quality control of hemostat devices
4. Prepare and submit application for FDA Certificate of Product Registration to obtain permission to conduct clinical trials

Thailand

There is currently no plan to apply this in humans due to FDA and regulatory restrictions. Moreover, this system is being explored as a prototype for anticancer drug delivery, with the aim of further development in the future.

R&D area: Group C: Medical and Biological Application (2025)

SUMMARY OF DISCUSSIONS

Overall Current Status

1. Hydrogel development for tissue engineering and drug delivery applications has been established at the basic aspect in most country, except for the Philippines.
   - Indonesia and Thailand are in TRL 3
   - Malaysia, Kazakhstan, Bangladesh, Mongolia are in TRL 2;
   - The Philippines is in TRL 5.

2. Mongolia is doing food irradiation of basic vegetables, dried beef, and curds using low-energy X-ray (TRL 2).

R&D area: Group C: Medical and Biological Application (2025)

SUMMARY OF DISCUSSIONS

Gap in basic aspect

1. Malaysia and Kazakhstan are still establishing the protocol on the hydrogel production including dose and types of radiation.
2. Thailand is studying the stability & shelf life study of metallic nanohybrids.
3. Philippine and Indonesia is translating lab scale to pilot scale production for hemostatic agents and hydrogels
4. Bangladesh and Kazakhstan are lack of analytical tools and the gamma source’s low activity may pose threat to continue the research work.
5. Mongolia is conducting economic studies including consumer acceptance/training, business model for small and medium-sized enterprises.
6. Philippines is establishing pilot scale radiation processing parameters, shelf-life for 5 years and quality control specifications of hemostat products.

Gap in application aspect

1. Malaysia, Bangladesh, Mongolia and Kazakhstan are still in the initial stage development (Lab scale) and then no gap have been identified.
2. Indonesia, Philippines and Thailand still need to fulfill compliance to regulatory requirements from the government before can be applied.

R&D area: Group C: Medical and Biological Application (2025)

SUMMARY OF DISCUSSIONS

Implementation Plan (Main focus)

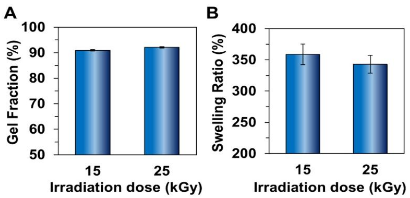
1. Comparative study of market/ commercially available wound dressing material with hydrogel (Bangladesh).
2. Conduct the in vivo test and find a collaborator from medical field for clinical trial. (Indonesia)
3. Expand the customer base through vegetable growers, greenhouses, nurseries, and retail sales for indoor plants, garden, and vegetable garden (Kazakhstan).
4. To understand the interaction between radiation (type and dose) and polymers (hybrid polymer content/ratio, type, molecular weight) in achieving the desired scaffold integrity, while adapting to current limitations in irradiation facilities. (Malaysia)
5. Continue the ongoing studies, including meat irradiation. Seeking partnerships for facility access and funding opportunities (Mongolia).
6. Continue pilot scale studies. Establish shelf-life of devices up to 5 years and comply the documentary requirements for FDA CMDR. (Philippines)
7. Further development of the prototype for anticancer drug delivery (Thailand).

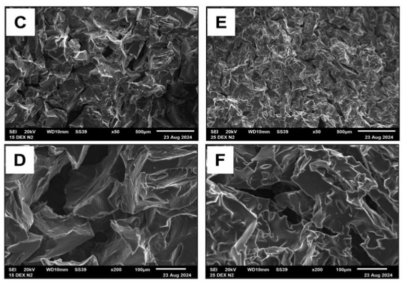
Production of water-absorbing superabsorbent to use it in agriculture and medicine - Kazakhstan

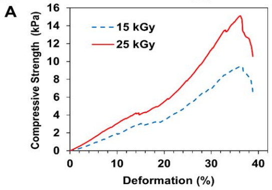
The fire-extinguishing substance is highly effective in combating fires due to its dual action, which is associated with the material's increased adhesion (cooling effect and cutting off oxygen access to the burning surface)

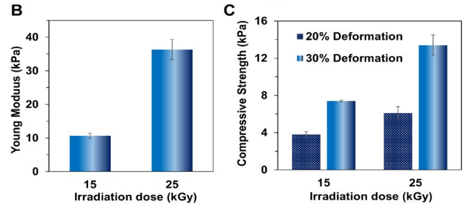
During the testing of the fire-extinguishing agent, it was found that the agent demonstrates a sufficiently strong cooling effect and does not evaporate compared to water.

Development of dextran hydrogels for drug delivery



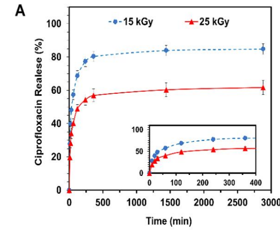


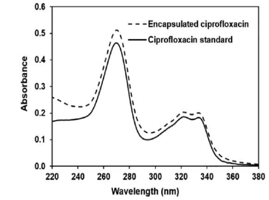


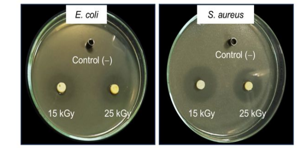


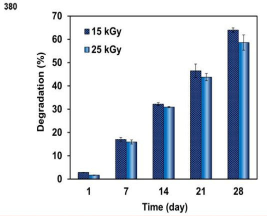
The 25 kGy demonstrated higher physical and mechanical properties because of higher network crosslinking density.

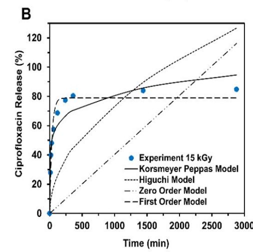
Development of dextran hydrogels for drug delivery

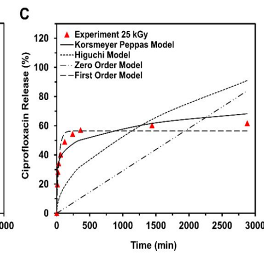






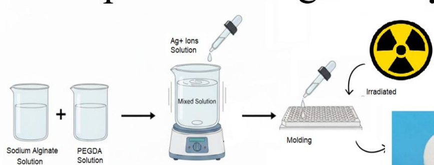


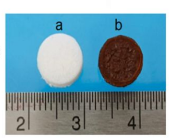


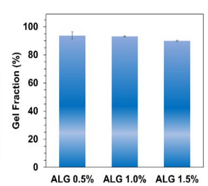


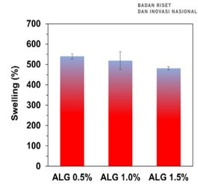
The 15 kGy released higher ciprofloxacin and degraded more easily than the 25 kGy hydrogel.

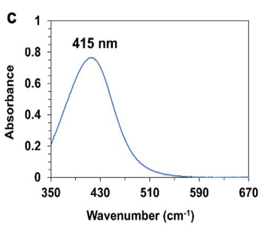
Development of Alginate hydrogels for wound dressing

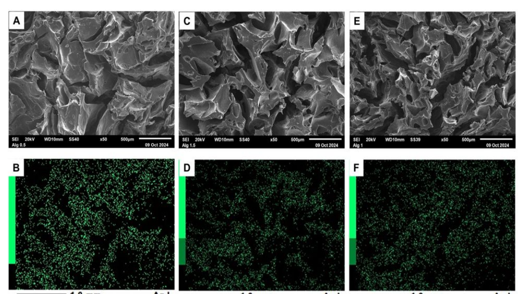






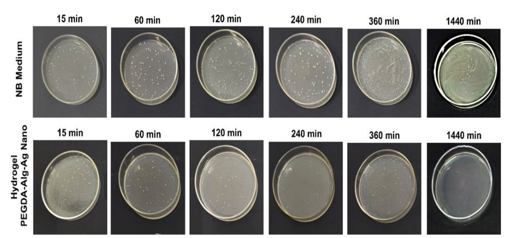


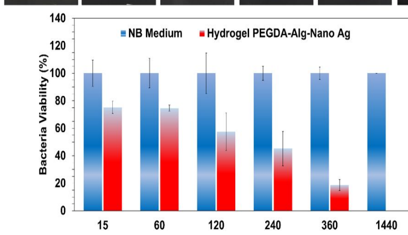




Silver nanoparticles formation and encapsulation occurred simultaneously with hydrogel formation.

Development of Alginate hydrogels for wound dressing

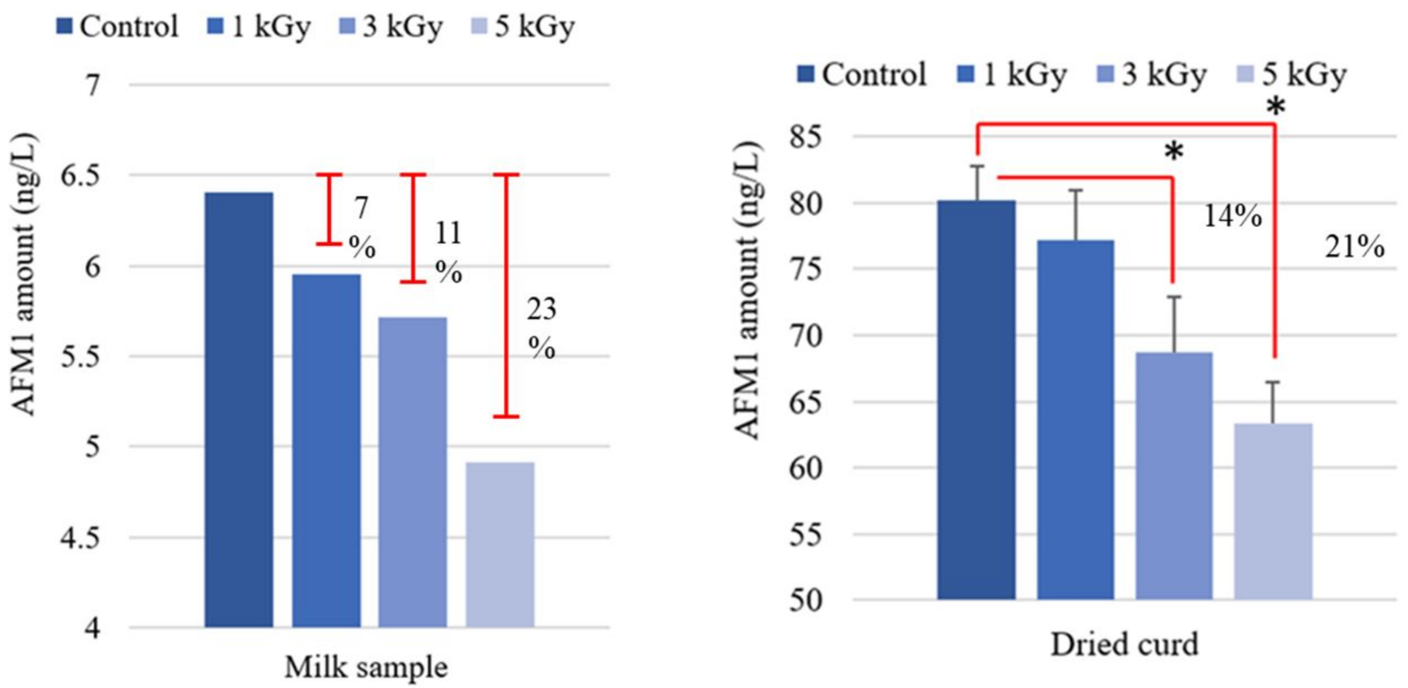




Concentration (mg/mL)	Cell Viability (%)	
	Alginate hydrogel	Nano silver-alginate hydrogel
390.625	108.2 ± 2.4	103.4 ± 3.4
781.25	94.5 ± 5.5	98.7 ± 7.8
1562.5	70.9 ± 5.3	97.9 ± 7.6
6250	62.8 ± 6.3	66.7 ± 7.7
25000	57.0 ± 1.5	13.6 ± 2.2
CC_{50}	>25000 ppm	9376 ppm

The AgNPS gradually released rather than in a single burst. When they accumulate around the bacterial cells, then disrupt bacterial metabolism. AgNPs hydrogel is non-toxic against fibroblast NIH/3T3 cells

The Effect of X-Ray Irradiation on the AFM1 Mycotoxin Levels in Mongolian curd

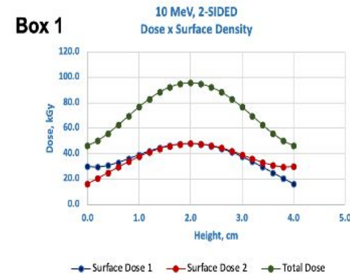


In a study involving commercially produced curds, irradiation with X-rays at doses of 1, 3, and 5 kGy led to a decrease in aflatoxin M1 levels. Specifically, the reduction was 3.8% at 1 kGy, 14.4% at 3 kGy, and 21% at 5 kGy. Similarly, milk treated with the same doses showed a decrease in aflatoxin M1 levels of 7% at 1 kGy, 10.7% at 3 kGy, and 23.3% at 5 kGy. Overall, greater reductions in aflatoxin levels were observed at the higher doses of 3 and 5 kGy.

Philippines - CMC Hemostats

Production of CMC granules and gauzed hemostat investigational devices in a GMP-certified company and e-beam sterilization of devices at 25 kGy

Theoretical Dose Depth

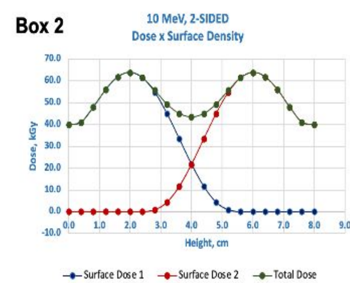


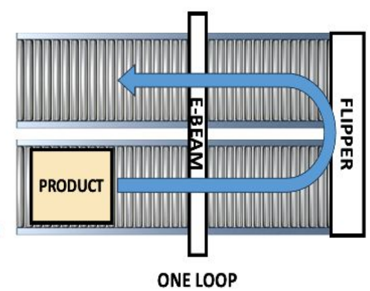
BOX 1 (60x40x20cm) with 10 kg CMC Paste (60x40x4cm):

- 15 kGy & 12 kW per loop
- conveyor speed=0.89 m/min
- 2-sided (rotate mode)
- 2 loops
- DUR = 2.1

BOX 2 (60x40x20cm) with 20 kg CMC Paste:

- 20 kGy & 12 kW per loop
- conveyor speed=0.68 m/min
- 2-sided (rotate mode)
- 2 loops
- DUR = 1.6



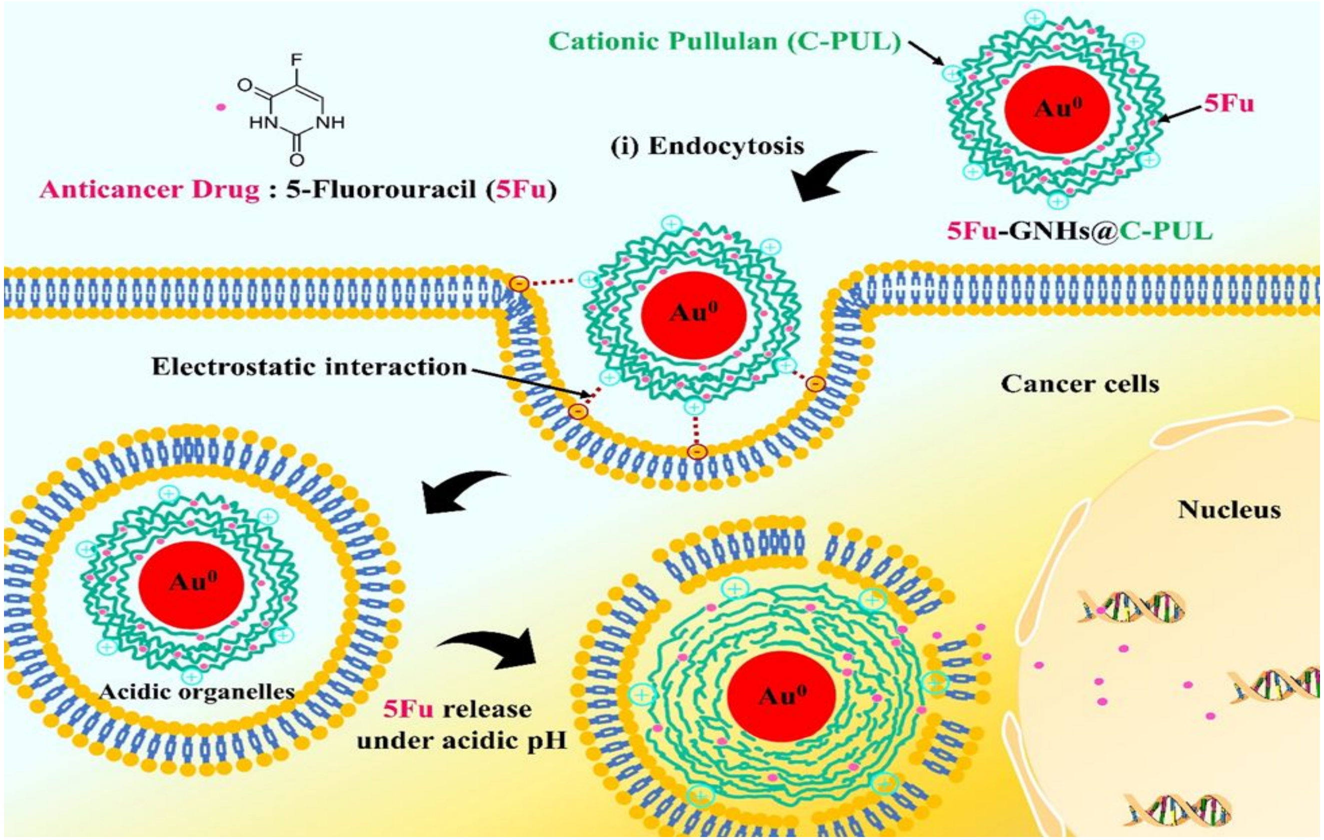


Actual Dose Measurements

Box 1
Surface : 25.2 kGy

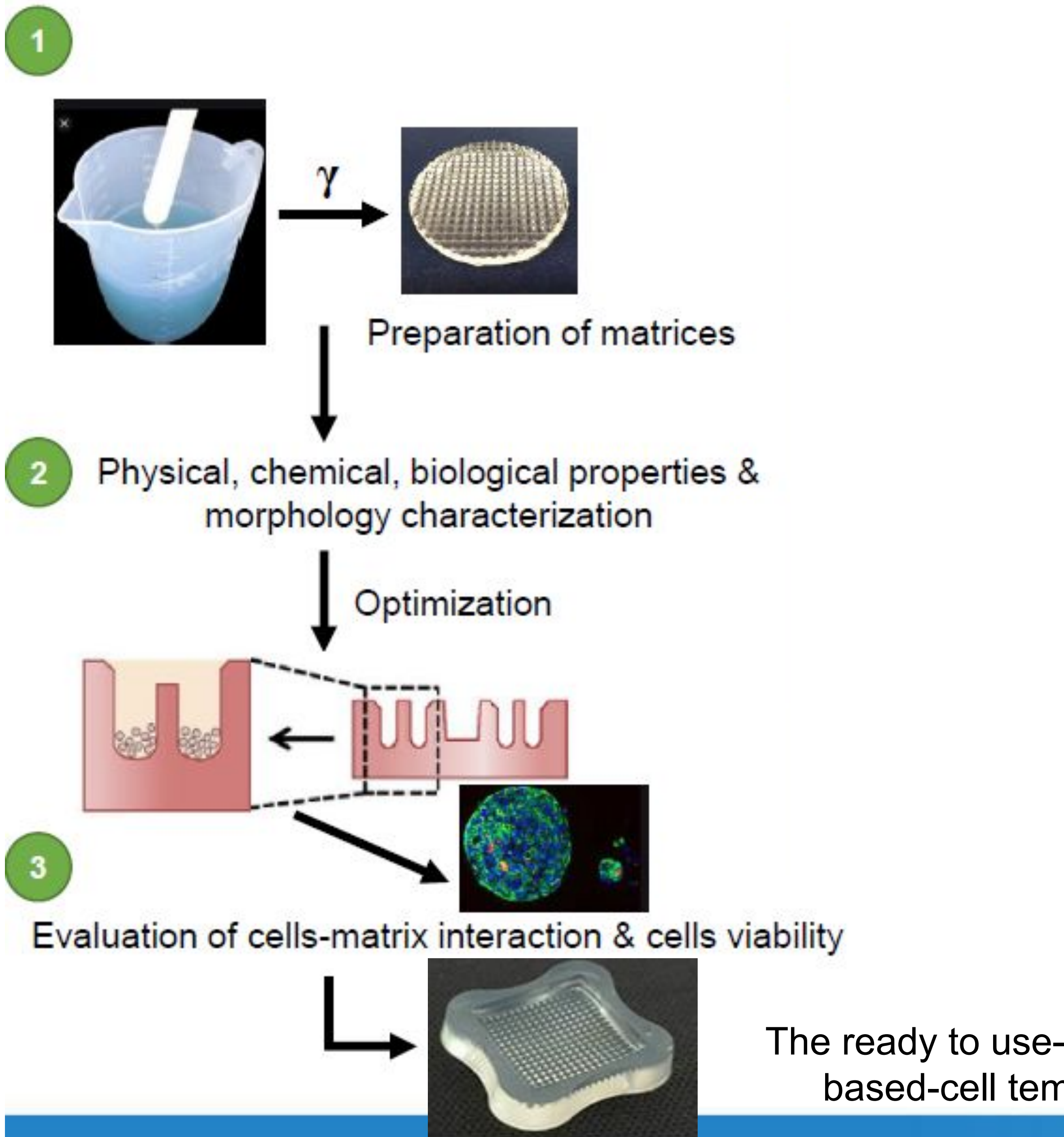
Box 2
Surface: 42.0 kGy
Middle: 5.4 kGy

Pilot scale study collaboration with a private 10 MeV E-beam facility



The proposed mechanism of action for 5Fu-GNHs@C-PUL as an effective anticancer drug delivery system in human breast cancer cells. (Thailand)

The proposed flow chart on the preparation of **BIOHYBRID SCAFFOLD FOR 3D TISSUE CULTURE (MALAYSIA)**



The ready to use-hydrogel based-cell template