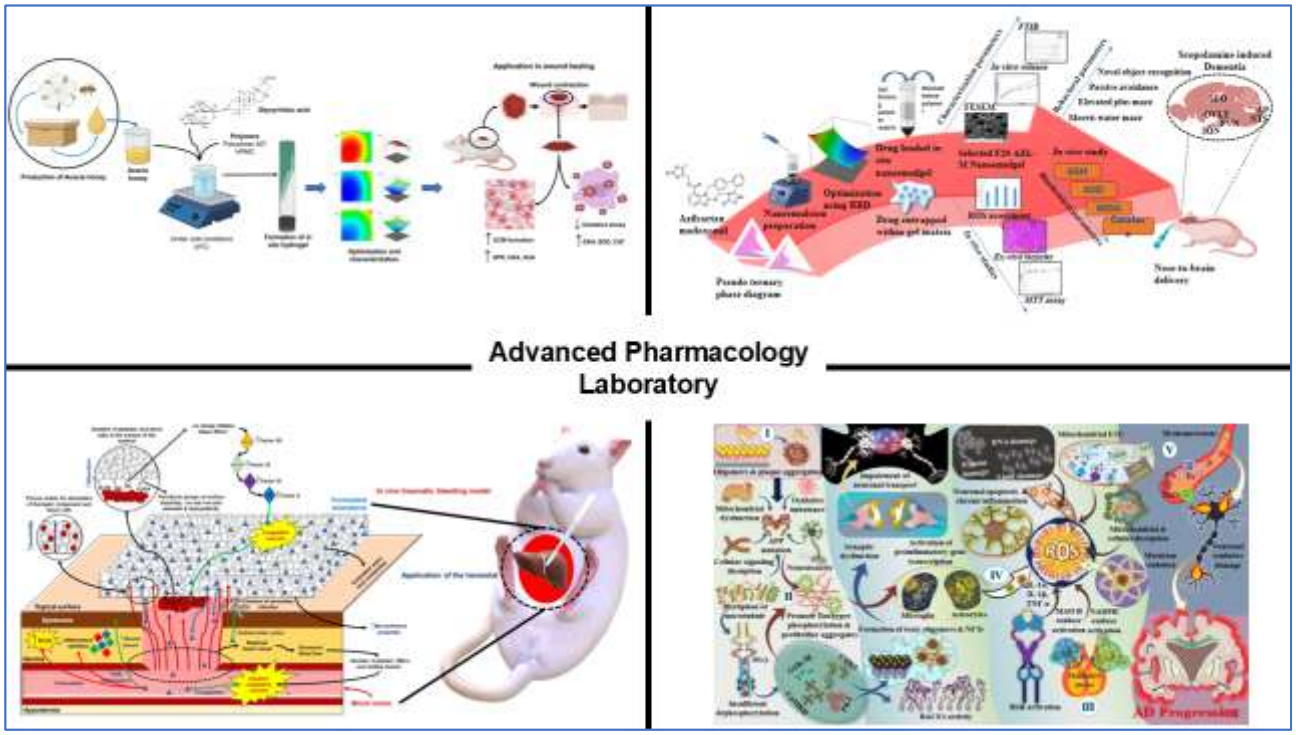
Research Group- Advanced Pharmacology Laboratory

- **Name of Principal Investigator/ Group Leader**: **Dr. Bapi Gorain**
- **Research Theme**: Advanced Pharmacology Laboratory
- **Broad Area of Research:**
  - Diabetic wounds, traumatic hemorrhages, and neurodegenerative diseases
  - Formulation development



- **Total Number of Publications by the group:** 164
- **Top 5 Article:**

1. Jha, B., Majie, A., Roy, K. and Gorain, B., 2025. Functional and molecular insights in topical wound healing by ascorbic acid. *Naunyn-Schmiedeberg's Archives of Pharmacology*, pp.1-26.
2. Roy, K., Majie, A., Jha, B., Chatterjee, A., Lim, W.M. and Gorain, B., 2025. Comparative physicochemical, microbiological, pharmacological, and toxicological evaluations of different varieties of honey targeting wound repairment. *Biocatalysis and Agricultural Biotechnology*, p.103544.
3. Chakraborty, S., Karmakar, V., Chatterjee, K., Chatterjee, A., Dwivedi, M. and **Gorain, B.**, 2025. Chitosan nanoparticle-mediated nose-to-brain delivery of naringenin: Attenuating memory decline in experimental animals via behavioural assessment and modulation of biochemical parameters. *International Journal of Biological Macromolecules*, *286*, p.138336.
4. Jha, B., Majie, A., Roy, K., Lim, W.M. and Gorain, B., 2024. Glycyrrhizic acid-loaded poloxamer and HPMC-Based in situ forming gel of Acacia Honey for Improved Wound Dressing: Formulation optimization and characterization for Wound Treatment. *ACS Applied Bio Materials*, *8*(1), pp.310-328.

5. Karmakar, V., Gorain, B., 2023. Potential molecular pathways of angiotensin receptor blockers in the brain toward cognitive improvement in dementia. *Drug Discovery Today,* 29(1):103850.

- **Patents by the group:**

Sl. No	Title and Inventors	Application No. & Date	Status
1	Selective COX-2 inhibition of 2-(substituted benzyl)-3,5,6,7-tetrahydro-4H-cyclopenta[4,5]thieno[2,3-d]pyrimidin-4-ones and 4-fluoro-n-(4-oxo-3,5,6,7-tetrahydro-4H-cyclopenta[4,5]thieno[2,3-d]pyrimidin-2-yl)benzamide as anti-inflammatory agents. Inventors: Katharigatta N. Venugopala, Pran Kishore Deb, Raghu Prasad Mailavaram, Nizar A. Al-Shar'i, Swastika Ganguly, **Bapi Gorain**, Annie Lee Pei Wen, Goh Hui Shan.	US12227516B1; 18.02.2025	Granted
2	Thieno [2, 3-d] pyrimidines as COX-2 inhibitors. Inventors: Katharigatta N Venugopala, Pran Kishore Deb, Raghu Prasad Mailavaram, Nizar A Al-Shar'i, Swastika Ganguly, **Bapi Gorain**, Lim Tse Mun, Jamie Kow Kean Hing.	11932656; 19.03.2024	Granted

- **Research Projects:**

Title	Role (PI/ Co-PI)	Funding Agency	Amount (in Lacs)	Duration
Tailoring bioactive nano-constituent embedded fish waste-derived collagen/polycaprolactone nanofiber to promote rapid hemostasis in the management of traumatic conditions	PI	Indian Council of Medical Research, Govt. of India, New Delhi, India	51	3 years
Protein nanoparticles integrated biodegradable microneedle patch: Preclinical investigation on extended therapeutic effect of apremilast through localized intradermal delivery for Psoriasis	Co-PI	Indian Council of Medical Research, Govt. of India, New Delhi, India	27	3 years
Mechanistic insight of healing diabetic wound by different varieties of honey via regulating the expression of adenosine monophosphate-activated protein kinase (AMPK), hypoxia inducible factor-1α (HIF-1α), and inflammatory cytokines, with special emphasis on identification of active component in honey	PI	Department of Science and Technology-Science and Engineering Research Board (DST-SERB)	29.4	3 years
Wound healing potential of naringin via regulating the expression of adenosine monophosphate-activated protein kinase (AMPK) and hypoxia inducible factor-1α (HIF-1α) in experimentally induced diabetic animals	PI	Seed money project, Birla Institute of Technology, Mesra, Ranchi	5	3 years
Biomaterial based nanofiber loaded with deferoxamine for as potential wound healing dressing for diabetic foot ulcer	PI	Taylor's University, Malaysia	RM 50,000	-

Project 1 : Mechanistic insight of healing diabetic wound by different varieties of honey via regulating the expression of adenosine monophosphate-activated protein kinase (AMPK), hypoxia inducible factor-1α (HIF-1α), and inflammatory cytokines, with special emphasis on identification of active component in honey

Diabetic wounds are a severe complication of diabetes mellitus, often leading to infections and non-traumatic limb amputations. Current treatments are limited, and the rising prevalence of diabetes increases the urgency for effective wound management strategies. Honey, known for its antimicrobial, anti-inflammatory, and wound-healing properties, has shown promise in various commercial products. However, the precise molecular mechanisms-particularly their influence on key regulators like AMPK, HIF-1α, and inflammatory cytokines-remain inadequately explored. Understanding these pathways is crucial for optimizing therapeutic efficacy. Therefore, there is a need to systematically evaluate different honey varieties to identify potent candidates and their active components for diabetic wound healing.

- This project bridges ethnopharmacology and modern science, promoting evidence-based integration of traditional remedies into mainstream diabetic wound management.
- Identification of potent honey varieties and their bioactive components can lead to the formulation of effective natural-based therapeutics for diabetic wound healing.
- Insights into AMPK, HIF-1α, and inflammatory modulation can aid in designing mechanism-driven wound care products with improved efficacy.
- Effective honey-based thermosensitive hydrogels may accelerate healing, reducing chronic wound complications.

Strategy/ Approach/ Technique/ Experiments used to solve

• LC-MS to determine the phytochemical constituents of different honey varieties and perform in silico studies (network pharmacology, molecular docking, and dynamics).
• Optimization and development of thermosensitive hydrogel with P407 and HPMC by loading different varieties of honey based on gelation time, gelation temperature, and viscosity.
• *In vitro* studies of the optimized formulation – antimicrobial, antioxidant, and anti-inflammatory studies.
• *In vivo* studies of the optimized formulation in diabetic wound-induced SD rats.
• *Ex vivo* antioxidant and anti-inflammatory studies, and histopathological studies.

Publication/patent:

1. Jha, B., Majie, A., Roy, K. and Gorain, B., 2025. Functional and molecular insights in topical wound healing by ascorbic acid. Naunyn-Schmiedeberg's Archives of Pharmacology, pp.1-26.
2. Roy, K., Majie, A., Jha, B., Chatterjee, A., Lim, W.M. and Gorain, B., 2025. Comparative physicochemical, microbiological, pharmacological, and toxicological evaluations of different varieties of honey targeting wound repairment. Biocatalysis and Agricultural Biotechnology, p.103544.
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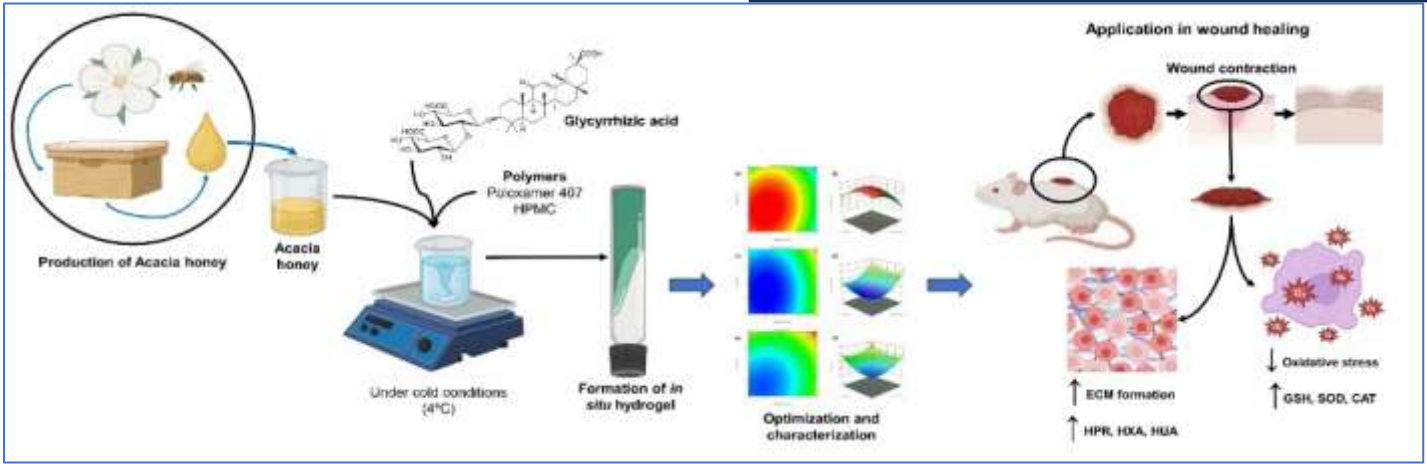


Project 2: Tailoring bioactive nano-constituent embedded fish waste-derived collagen/ polycaprolactone nanofiber to promote rapid hemostasis in the management of traumatic conditions

Problem Statement:

Traumatic hemorrhage leads to early deaths from hypovolemic shock and late deaths from coagulopathy, immunosuppression, and sepsis, often resulting in multi-organ failure. Excessive inflammation (SIRS), disrupted coagulation (TIC), and oxidative stress worsen outcomes. Conventional treatments may aggravate late-stage complications like immunosuppression and secondary infections. Therefore, regulating coagulation, immune response, and infection control is essential. This study aims to develop an effective hemostatic and immunomodulatory strategy to reduce mortality in hemorrhagic trauma. Simultaneously, utilizing fish waste—rich in collagen—offers an eco-friendly approach for developing therapeutic biomaterials, addressing both clinical needs and environmental sustainability in India's 4 mMT annual fish waste challenge.

Strategy/ Approach/ Technique/ Experiments used to solve

I. Identification of molecular targets of thymoquinone for hemostasis based on network pharmacology, molecular docking, and molecular dynamics approach

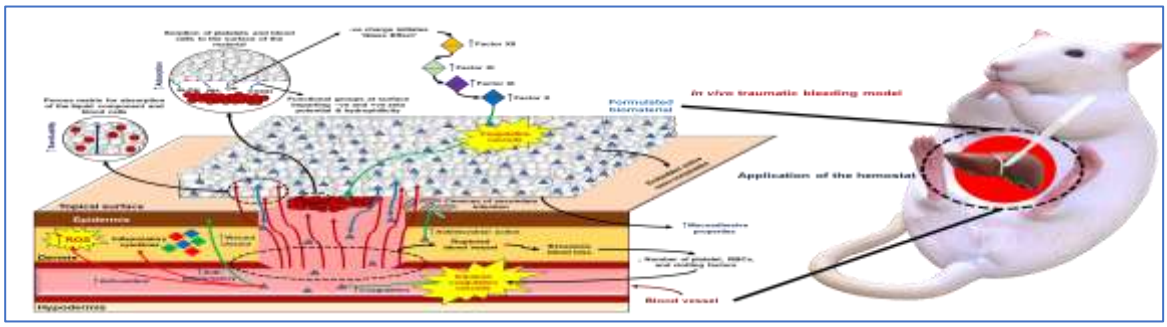
II. Development, optimization, and characterization of thymoquinone-loaded cubosomes (TQC) and TQC-loaded collagen/polycaprolactone nanofiber mat (TQC-CoPCL NFM)

III. *In-vitro* assessment of the fabricated TQC-CoPCL NFM to establish coagulability, compatibility, and antimicrobial potential

IV. *In-vivo* evaluation of TQ-CoPCL NFM in the animal models for management of hemostasis and to estimate the

Applications:

- Development of Bioactive Hemostatic Agents: Utilization of collagen from fish waste can lead to novel, sustainable, and cost-effective hemostatic materials for rapid blood clotting in traumatic injuries.
- Integrated Immunomodulatory Therapy: Formulation of therapeutics that balance pro- and anti-inflammatory responses, potentially preventing complications like sepsis and multi-organ failure.
- Management of Trauma-Induced Coagulopathy (TIC): The project offers a targeted approach to control early hypocoagulability and late hypercoagulability phases, reducing trauma-related mortality.
- Sustainable Waste Valorization: Converts over 4 million metric tons of fish waste in India into high-value biomedical products, promoting environmental sustainability and circular bioeconomy.
- Improved Clinical Outcomes in Emergency Medicine: Provides a multifunctional therapeutic solution that enhances trauma care efficiency, especially in resource-limited or battlefield settings.



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