

An Indian-Australian research partnership

Project Title: **Application of Continuous Flow Processing in Valorisation of Fruit and Vegetable Waste**

Project Number **IMURA0953**

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Research Clusters:

Research Themes:

Highlight which of the Academy's CLUSTERS this project will address?
(Please nominate JUST **one**. For more information, see www.iitbmonash.org)

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

Define the problem

Continuous flow technology has been gaining considerable attention for process intensification in recent years. Essentially, batch reactions that require considerable time to execute and present significant challenges when seeking to scale up, allow many of the limitations to be overcome. Continuous flow conditions allow reactions to be undertaken much more rapidly, offering improved mixing, mass transfer, thermal control, pressurized processing, decreased variation, potential to undertake electrochemical conversions, automation and process monitoring with modern analytical technology. This generally leads to improved yields from reactions and also addresses many principles of green chemistry that industry is keen to implement.

Continuous flow technology has generally been used in synthetic organic chemistry. Recently, there has been growing interest in the use of biocatalysts in continuous flow systems and these systems present some interesting challenges that need to be investigated. (Britton et al., *Chem Soc Rev.* 2018, 47(15): 5891–5918. doi:10.1039/c7cs00906b). A large part of the challenges involve the often heterogeneous nature of biocatalysed reactions. This has consequently led to many reactions in flow systems utilising immobilized enzymes for continuous chemical manufacturing. (Thompson et al., *Org. Process Res. Dev.* 2019, 23 (1), 9–18).

Over the past 7 years, a significant research program has been conducted at IITB and Monash through the IITB-Monash Academy, focusing on the valorisation of discarded biomass or underutilised biomass from various fruit and vegetable food processing industries (Banerjee et al 2018, Talekar et al 2017, Talekar et al 2018) Extraction of valuable components (eg pectin, lipids, proteins, polyphenols) from peels and seeds, for example, has utilised enzymes to degrade selected components of the biomass, thus releasing the compounds of interest. This chemistry has all been conducted in batch reactions systems with varying degrees of success. The possibility of converting some of these batch reactions to flow systems will offer potential advantages for improving yields and enhancing the commercial viability of the technology developed to-date.

Project aims

Define the aims of the project

This project will involve the application of flow chemistry technology with a focus, (though not

exclusive) on the use of biocatalysts to develop more efficient approaches for depolymerisation of natural polymers found in plant derived materials, focusing on the extraction and isolation of valuable components from discarded food processing biomass. This project would involve process optimization and techno-economic feasibility analysis of the optimized process/es.

Expected outcomes

Highlight the expected outcomes of the project

1. Development of a novel process to extract valuable compounds from fruits and veg. waste.
2. Through proper information dissemination, it is expected that the project outputs will increase interest and investment from potential stake holders (Farmers, consumers, food and chemical industries, state and central governments).
3. New commercial opportunities to valorise food by-products
4. Postgraduate training and graduates with experience to work in food valorisation

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The focus on finding new sustainable uses for the utilisation of food processing waste and other agricultural biomass sources, addresses the need for finding renewable feedstocks for **fuels, chemicals and materials**, applying **Green Chemistry** principles (which includes minimizing **Energy** footprint) maximising outputs from **Food** crops. Most of the products have applications in the **Pharmaceutical** Industry. **Biotechnology** route (for a model biorefinery) is the focus of the project.

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

The project requires someone with a strong background in chemistry and biotechnology, including a good background in analytical techniques needed to characterise organic chemicals and organic classes of compounds. Demonstrable skills and knowledge in the use of enzymes/biocatalysts will be an advantage, as will experience of flow chemistry techniques, though the latter is not a strict requirement.

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

Waste to Wealth, Green Chemistry, Flow Chemistry, Food Innovation