IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Bioactives and Natural Dyes From Food and Agricultural Waste Sources**	
Project Number	**IMURA0744**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address? *(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*	
1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	*Earth Sciences and Civil Engineering (Geo, Water, Climate)*
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*

Research Themes:

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	*Advanced computational engineering, simulation and manufacture*
2	*Infrastructure Engineering*
3	*Clean Energy*
4	*Water*
5	*Nanotechnology*

7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*	6	*Biotechnology and Stem Cell Research*
8	*HSS, Design, Management*	7	*Humanities and social sciences*
		8	Design

The research problem

The Food and Agriculture Organization of the United Nations has published detailed estimates of the extent of Food Waste throughout the world, analysed against different sectors (eg vegetables, fruit, cereals, different meat forms etc). It has been estimated that the wasted food alone would feed the 843 million people worldwide that are currently malnourished. The "wasted" biomass associated with food production is generated at all stages of the life cycle of food products, including farm production, transport, storage, processing and ultimate consumption. This project will focus on selected waste streams associated with significant food crops that are relevant to both Australia and India. It will build on the existing IITB-Monash group working on food and agricultural by-product valorisation, led by Amit Arora (IITB) and Tony Patti (Monash).
The proposed project will utilise waste where bioactives, natural dyes, chemical components with nutritional components and/or industrial chemical feedstocks potential can be identified.

Particular areas of focus will include waste from vegetable/fruit processing including carrots, potato and beetroot processing. In addition, both Australia and India produces significant quantities of oilseed crops each year, including soy, sunflower and cottonseed. Canola production is now the largest oilseed crop in Australia, representing well over half of Australian oilseed production.
Okara is waste generated in the soy industry and there is a lack of information on the potential usage of okara in the food production, with the main current use being animal feed.
Canola meal has potential use for in the aquaculture industry as a protein/carbohydrate source for fishmeal. The proteins in canola waste may also be used to produce biodegradable surfactants and adhesives. The potential for other oilseed wastes for such applications has not been fully explored.
Beetroot waste from the processing industry has great potential for dye applications and dietary fibre.
Natural green dyes in high demand in the food industry could be sourced by exploiting natural reactions between flavonoids and amino acid/proteins, all potentially available from food by-products.
The approach used in this project will utilise the previous knowledge in our groups, where detailed assessment of the chemical composition of the "waste" components, followed by innovative approaches to separation and isolation of target components and assessment of their potential applications. This will extend to the well-established bio-refinery approach aiming to produce a wider range of valuable products and creating a more sustainable global agricultural industry.

Project aims

1. Mapping of potential plant based substrates (native to India and Australia) for bioactives, natural dyes and other valuable components, currently being underutilised or discarded in the food industry.
2. Development of pathways to extract high value chemical components.
3. Ascertaining functionality of extracts and components for industrial applications.
4. Identify and where possible, develop new applications for plant components eg bio-based surfactants, adhesives, polymer composites and feedstocks for green solvents
5. Assessment of techno-economic feasibility of the developed processes

Expected outcomes

Highlight the expected outcomes of the project

The project will deliver following outcomes:
1. Protocols for optimal recovery of high value components from biomass feedstock, particularly oil-seed waste and vegetable/fruit waste where natural dyes can be sourced or generated.
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).
3. New commercial opportunities to valorise food by-products
4. Postgraduate training and graduates with experience to work in food valorisation and future biorefinery employment opportunities

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.

This project definitely covers Green Chemistry (green processes for chemical recovery and transformations, Food (valorisation of waste biomass from food production), Pharmaceuticals (bioactive compounds from plants) and potentially, Biotechnology (enzyme processing may be applied), Nanotechnology (applications of new chemicals) and Clean Energy (biofuels and biogas production are options for waste biomass utilisation)

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.

Applicants should have at least a four-year degree in Chemistry/Food Science/Biotechnology or Chemical Engineering with first class honours or equivalent. This project requires strong understanding of organic chemistry and organic transformations, particularly natural products chemistry, biochemistry and biochemical engineering principles. It is highly desirable for applicants to have a good understanding and experience with analytical techniques and interpretation of the outputs from NMR, HPLC, Gas Chromatography, Mass Spectrometry UV Spectroscopy and FTIR.

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.

Biorefinery, Food, Biotechnology, Natural Products