Singapore Institute of Food and Biotechnology Innovation

SIFBI

DRIVING EXCELLENCE IN FOOD AND BIOTECH INNOVATION

Cheryl Tan

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Singapore Institute of Food and Biotechnology Innovation

June 2023

Singapore Institute of Food and Biotechnology Innovation (SIFBI)

Our Mission & Vision

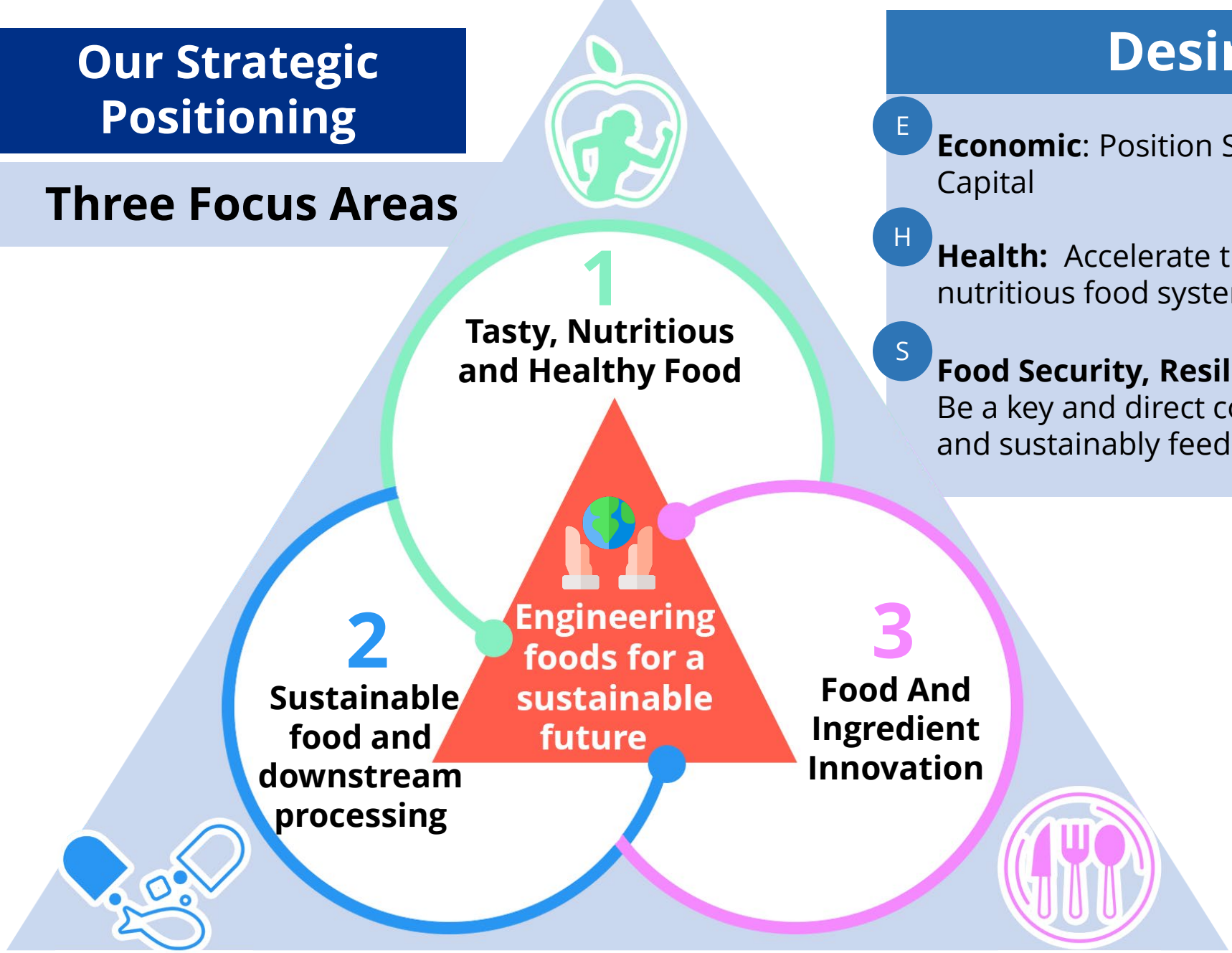
A global leader, driving innovation of nutritious future foods for a healthy, sustainable tomorrow

> *We deliver integrated solutions for Asian nutritional health, and sustainable foods and ingredients*

CREATING GROWTH, ENHANCING LIVES

Our Strategic Positioning

Three Focus Areas



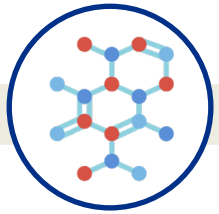
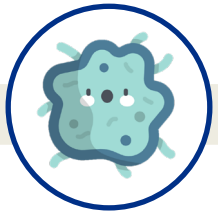
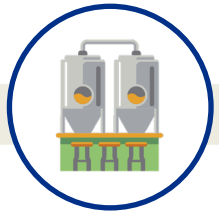
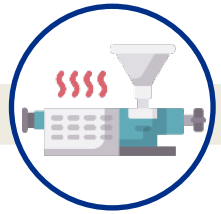
Desired Outcomes

E **Economic**: Position Singapore as Asia's Food Innovation Capital

H **Health:** Accelerate the development of sustainable nutritious food systems for the population

S **Food Security, Resilience & Sustainability**:
Be a key and direct contributor to the Singapore Food Story, and sustainably feed Singapore and other global urban cities

Integrated Set-up Across Innovation Value Chain


Capability Groups:

Discovery	Strain Engineering	Biotransformation	Food Process Engineering	Nutrition
Natural Product Library	Enzyme and Pathway Design	Solid-state Fermentation	Protein Texturization	Food Structure
Miniaturized Functional Assays	Enzyme Engineering	Submerged Fermentation & Downstream Processing	Food Ingredients	Sensory & Ingestive Behaviour
In-vitro Taste Analytics	Bacterial Engineering	Biocatalysis and Extraction	Microencapsulation and Shelf-life extension	Clinical Nutrition
	Fungal Engineering	Circular Bioeconomy	Cultured Meat Scaffolding	Bioactives and Human Health

Shared Analytics Platform

SIFBI-Temasek partnership

Food Tech Innovation Center (FTIC)

SIFBI hosts

Singapore Integrative Biosystems & Engineering Research (SIBER)

SIFBI hosts

Agri-tech & Aquaculture Horizontal Programme Office (A2HTPO)

CREATING GROWTH, ENHANCING LIVES

Scientific Leadership Team

Discovery	Strain Engineering	Biotransformation	Food Process Engineering	Nutrition
				
Dr. NG Siew Bee	Dr. ANG Ee Lui	Dr. Melanie WEINGARTEN	Dr. Raffael OSEN	Prof. Jeya Henry

Supported by **Shared Analytics Platform**

Dr. Yoganathan S/O KANAGASUNDARAM

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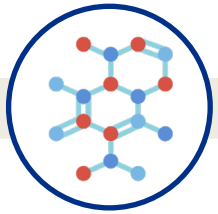
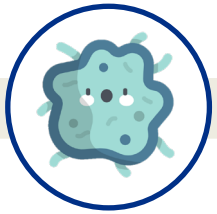


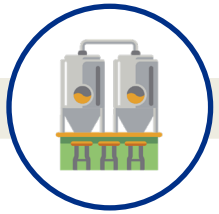
Discovery

New Molecules, Enzymes, Strains



Strain Engineering

Designing Cellular Factories



Biotransformation

Sustainable Production & Downstream Processing

Food Process Engineering

Texturization & Food Product Development

Nutrition

Clinical Nutrition, Health & Metabolic Diseases

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Discovery

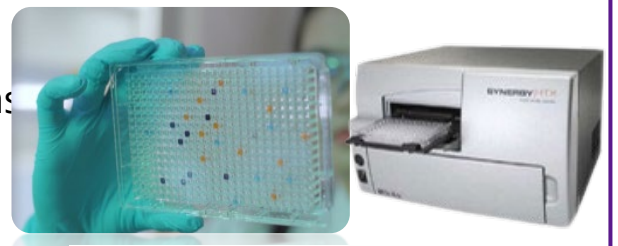
New Molecules, Enzymes, Strains

A*STAR Natural Product Library (NPL)

- Samples from over 100 countries
  - Acquired in accordance with **UN Convention on Biological Diversity**
- Plants and Microbial Collection
  - Specimens from 67% of known plant genera
  - Microbes and strains from diverse terrestrial and marine habitats
- Organic Extracts
  - Expanding LCMS profiling of extracts
- Metabolite Database

High Throughput Screening

- Automated screening systems and multi-mode microplate readers
- *In silico* screening for alternative producers
- Miniaturized biochemical and cellular assays



RESEARCH ARTICLE Open Access

Genomics-driven discovery of a biosynthetic gene cluster required for the synthesis of BII-Rafflesfungin from the fungus *Phoma sp. F3723*

Swati Sinha[1*†], Choy-Eng Nge[1†], Chung Yan Leong[1], Veronica Ng[1], Sharon Crasta[1], Mohammad Alfatah[1], Falicia Goh[1], Kia-Ngee Low[1], Huibin Zhang[2], Prakash Arumugam[1], Alexander Lezhava[2], Swaine L. Chen[2,3], Yoganathan Kanagasundaram[1], Siew Bee Ng[1], Frank Eisenhaber[1,4] and Birgit Eisenhaber[1*]

Taste Receptor Platform

- Panel of molecular tools to examine taste and sensation
  - *Sweet* – non-caloric sweeteners and sweetener enhancers
  - *Bitter* – block bitter notes to remove off-tasters
  - *Cooling* – natural alternatives to menthol

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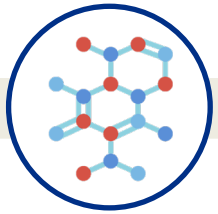
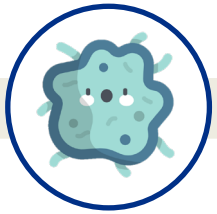


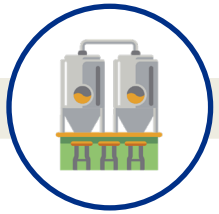
Discovery

New Molecules, Enzymes, Strains



Strain Engineering

Designing Cellular Factories



Biotransformation

Sustainable Production & Downstream Processing

Food Process Engineering

Texturization & Food Product Development

Nutrition

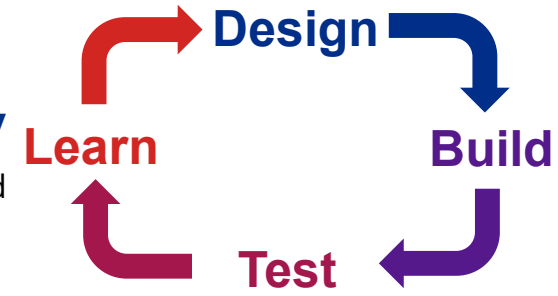
Clinical Nutrition, Health & Metabolic Diseases

Integrative capabilities

Toolbox Development

Bioinformatics guided discovery

Discover new genes and pathways



Pathway Assembly

Assembling large DNA fragments with high fidelity

CRISPR-mediated pathway activation

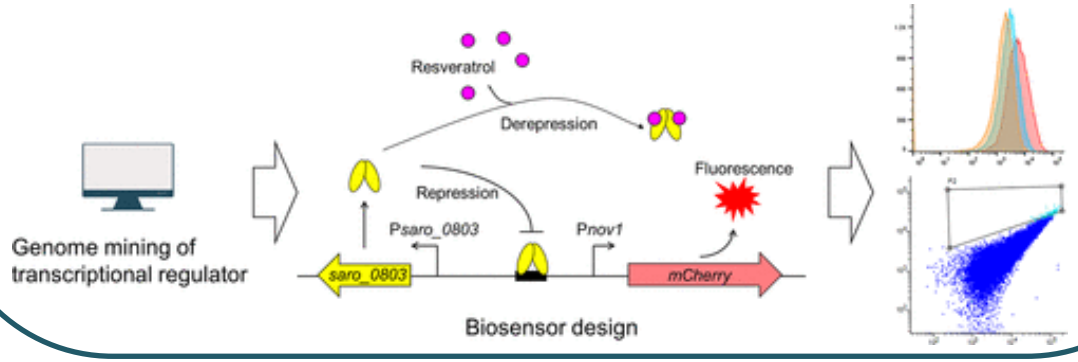
Uncover biosynthetic gene clusters

HTP Screening

Rapid detection and quantification of molecules of interest

Pathway Integration

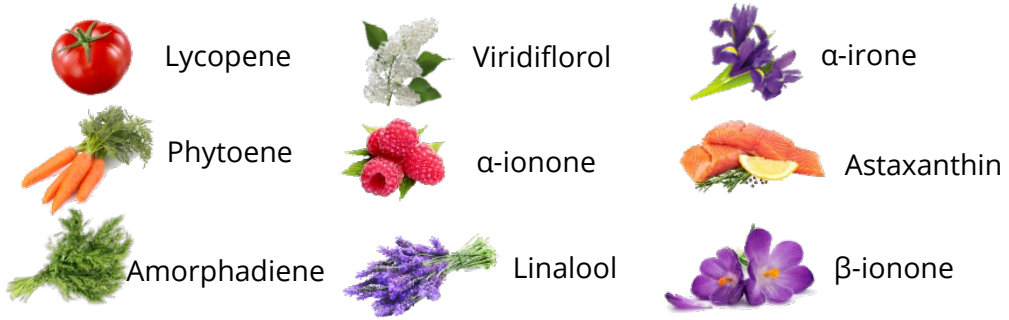
Chromosomal integration of biosynthetic pathways



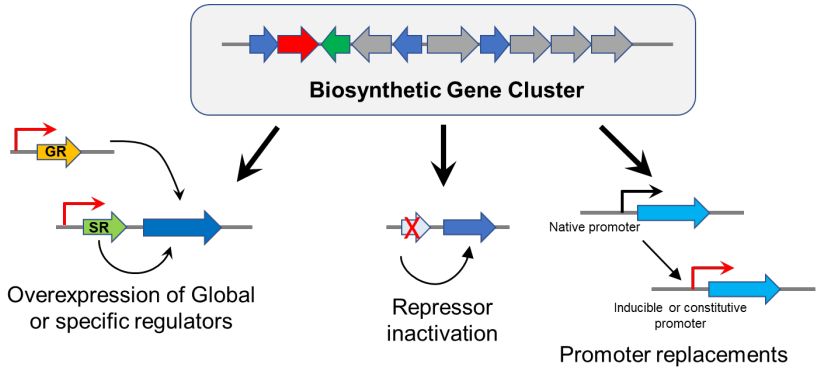
Platform Strain Engineering

Industrial Chassis Organisms

- Proprietary hosts tailor for the production of high value metabolites and achieving industrially-leading titers



Synbio Toolbox for native producers



CREATING GROWTH, ENHANCING LIVES

Discovery | Strain Engineering | Biotransformation | Food Process Engineering | Nutrition

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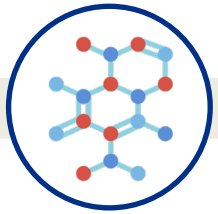

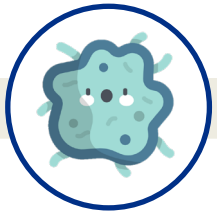

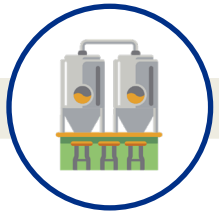

Discovery	Strain Engineering	Biotransformation	Food Process Engineering	Nutrition
New Molecules, Enzymes, Strains	Designing Cellular Factories	Sustainable Production & Downstream Processing	Texturization & Food Product Development	Clinical Nutrition, Health & Metabolic Diseases

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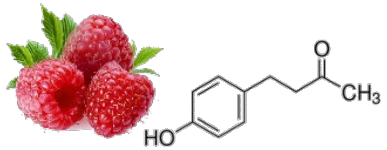
Biotransformation

Four Pillars of Sustainable Production

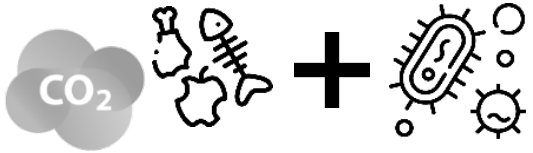
Solid-State Fermentation

- Consortia Fermentation
- Coffee and Cocoa Fermentation
- Fungal Fermentation



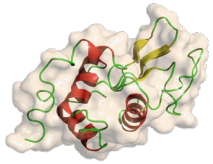
Submerged Fermentation & Downstream Processing

- Bacteria and (Red) Yeast Fermentation
- Carbon Capture and Utilisation
- Anaerobic Fermentation



Biocatalysis and Extraction

- Enzyme Development
- Non-GMO Expertise



Circular Bioeconomy

- SIFBI Flagship – Circular Bioeconomy
- Anaerobic Fermentation

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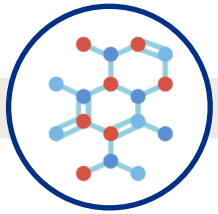
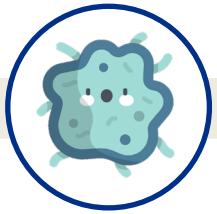


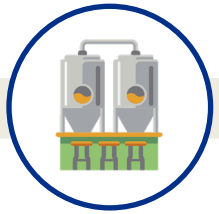
Discovery

New Molecules, Enzymes, Strains



Strain Engineering

Designing Cellular Factories



Biotransformation

Sustainable Production & Downstream Processing

Food Process Engineering

Texturization & Food Product Development

Nutrition

Clinical Nutrition, Health & Metabolic Diseases

Food Process Engineering

Revolutionizing Modern Foods

- **Multidisciplinary team** with expertise in food science and technology, biophysics, polymer chemistry and tissue engineering, track record in translational R&D
- **Building Lab- and pilot scale** facilities for developing tasty, healthy, sustainable and affordable future foods

1. Food Ingredients Development

- Mild wet and dry **fractionation** to affect technofunctional, sensory and nutritional properties
- Synthesis methods to control **protein nanoparticles** size and stable emulsion systems
- **Imaging techniques** for structure analysis

2. Food Ingredients Structuring

- **Extrusion** texturization of biopolymers
- Texture modulation in heat-set **hydrocolloid gels**
- **Scaffold engineering** for cultured meat structuring
- Expanding and differentiating skeletal muscle

3. Product Formulation and Prototype Manufacturing

- **Microencapsulation** for targeted delivery of bioactives
- Studying protein-polyphenol interactions
- **Edible coatings** for improved shelf life

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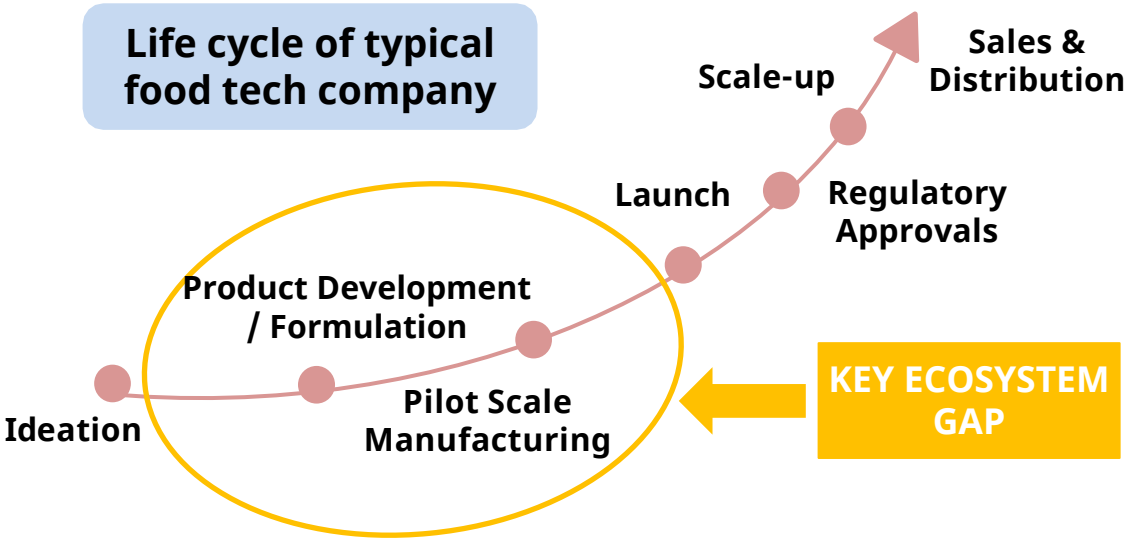
Food Tech Innovation Centre
– Addressing Ecosystem Gap in Supporting SME and Start-up Scale up


THE STRAITS TIMES BUSINESS

Temasek in food tech innovation venture with A*Star



Infrastructure Offerings

Services Offerings

Infrastructure Offerings	Services Offerings
Pilot Scale Facilities for Fermentation	R&D-to-scale Advisory Services
Extrusion Texturization	Product Development, Market Research
Prototype Manufacturing	Ecosystem Wayfinding
Wet Labs and Test Kitchen	Admin Support

- **Provide essential facilities to FoodTechs at lower cost**
- **Accelerate commercialisation and market entry**

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Food Tech Innovation Centre (FTIC) – Capability overview

CREATING GROWTH, ENHANCING LIVES

Working with SMEs and Plant/Microbial Protein Companies in:

- Developing techniques in fermentation, DSP, protein fractionation & extrusion
- Analytical platform for ingredients functionality characterisation and optimization
- Strain engineering
- Process development scale up

Fermentation Lab

Lab / pilot scale
Fermenter size: 1mL – 200L

Analytical support
GCMS, HPLC, etc

DSP
Extraction unit, freeze dryer, filtration system, etc.

Fermentation & DSP

- Fermentation bioprocess using synthetic media / agrifood side stream
- Delivery of purified protein in kg-scale

Extrusion & Food Processing Pilot Plant

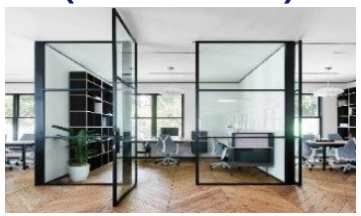
HPP system, pilot scale extruder (100kg/h), drying unit, etc.

Food Processing & Formulation

- Fractionation of plant protein and agrifood side stream for novel ingredients
- Pilot scale production of plant protein ingredients
- Textured protein production
- Mechanistic process analysis, sensor integration, equipment optimization

Shared R&D Labs

Private Suites (Office / Lab)



Co-working & event space

Analytical Labs, Demo Kitchen, Event Space

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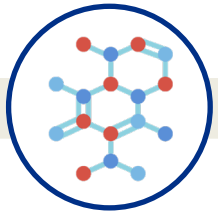
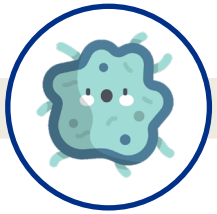


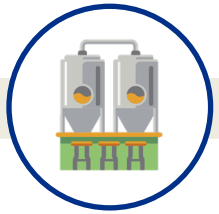
Discovery

New Molecules, Enzymes, Strains



Strain Engineering

Designing Cellular Factories



Biotransformation

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CREATING GROWTH, ENHANCING LIVES

Nutrition

Translational science to guide food product development with an impact on population health with focus on the **Asian Phenotype**

1. Food Structure

- ✓ Molecular configuration
- ✓ Digestion & metabolism of carbohydrates, protein and lipids
- ✓ Satiety and Energy intake
- ✓ Functional ingredients

2. Sensory and Ingestive Behavior

- ✓ Cognitive influences: *Packaging, labelling*
- ✓ Consumer acceptance
- ✓ Sensory analysis
- ✓ Oral Processing: *Mastication*
- ✓ Reformulation for energy/sugar reduction

3. Clinical Nutrition

- ✓ Absorption
- ✓ Physiological effects: *Metabolic responses e.g. obesity, insulin sensitivity, glucose / lipids metabolism*
- ✓ Glycaemic index studies
- ✓ Healthy aging