Unlocking Protein Resource Opportunities to Evolve Ireland's Nutrition

PRESENTED BY: Dr. Sinead Fitzsimons

17th October 2022

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Background

- **U-Protein** - **U**nlocking **P**rotein **R**esource **O**pportunity **T**o **E**volve **I**relands **N**utrition

- DAFM funded - 5 years (Nov 2020 - Oct 2025)

- Objective - to re-engineer Ireland's agro-ecological system through greater diversification and biotransformation of protein resources, to deliver sustainability, bio-circularity and quality nutrition.

BIOECONOMY IRELAND WEEK OCTOBER 17-23 2022

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Department of Agriculture, Food and the Marine

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Overview

Alternative Proteins for the Irish Agri-Ecosystem

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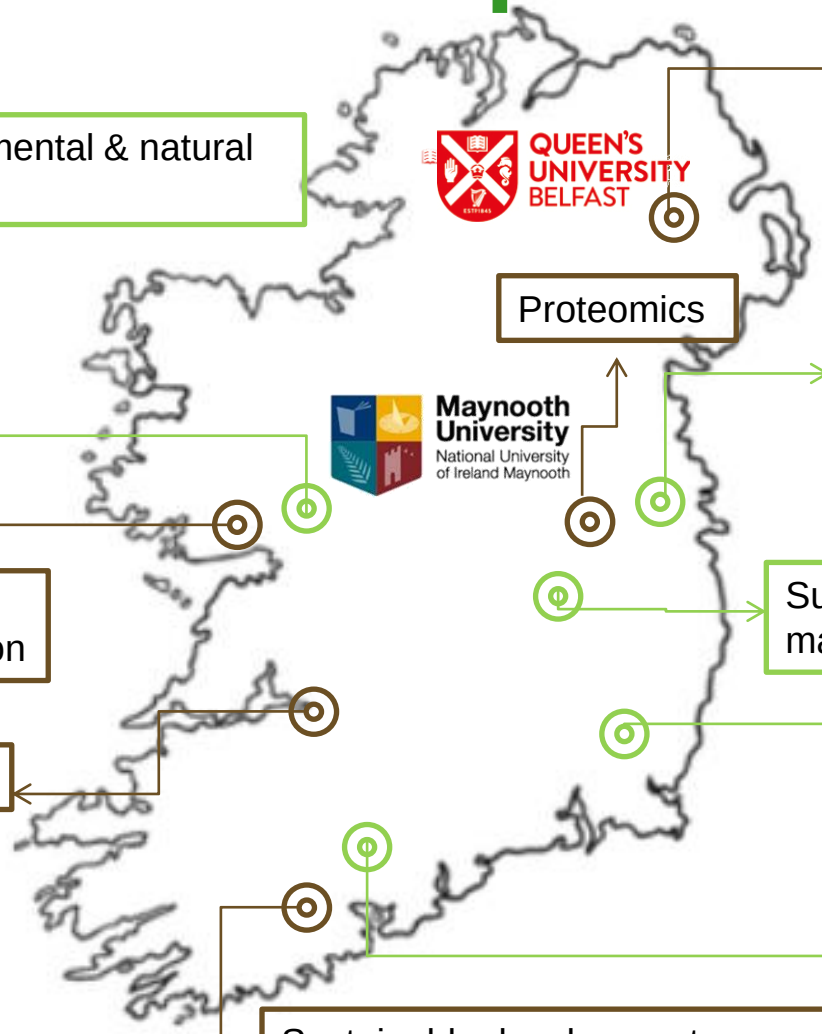
Consortium & Expertise



5 Teagasc centres

5 Universities

Agricultural, environmental & natural resource economics

QUEEN'S UNIVERSITY BELFAST

Dietary interventions
Nutrient Regulation

Proteomics

Maynooth University
National University of Ireland Maynooth

Marine research
Phytochemical
Novel Food Processing Technologies
Novel Food Preservation Technologies
Fresh and Processed Meat
Wheat / flour Chemistry and Technology

NUI Galway
OÉ Gaillimh

Biotransformation
Anaerobic Digestion

Sustainable production and management of protein crops

Soils, land use and sustainability

Enzyme hydrolysis

UNIVERSITY OF LIMERICK
OLLSCOIL LUIMNIGH

Grassland/Grazing management
Protein Chemistry / Functionality
Food Structure / Microstructure
Food Digestion
Process Engineering
Formulation Science
Scale up
Biotransformation
Food Preservation

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

Sustainable development
Protein Functionality
Formulation Science
Safety and sensory evaluation

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Department of Agriculture, Food and the Marine

AB InBev

BIM Ireland's Seafood Development Agency

AARHUS UNIVERSITY

glanbia IRELAND

pepsi

dairygold Golden Valleys, Growing Naturally

GOLDCROP

ImmCell

LLa-BioEconomy Research & Advisory

CARBERY

SEEDTECH An Arvum Group Company

BEOTANICS

CSIRO

Abbott Nutrition

KEPAK

KERRY

Criteria for Selection of “Crops”

- Grow in Ireland
- Potential for Extraction
- Potential for Residual Biomass Optimisation
- Protein Quality and Safety
- Good Sensory Properties Potential
- Potential for Circularity

Note: Crops = Grassland; Cereals; Legumes; Niche Crops & Marine

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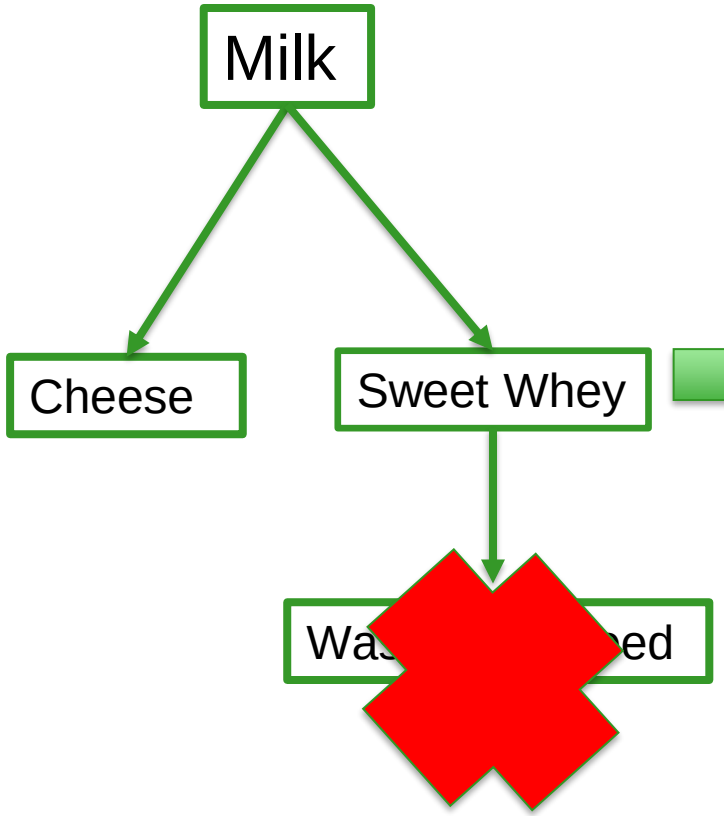
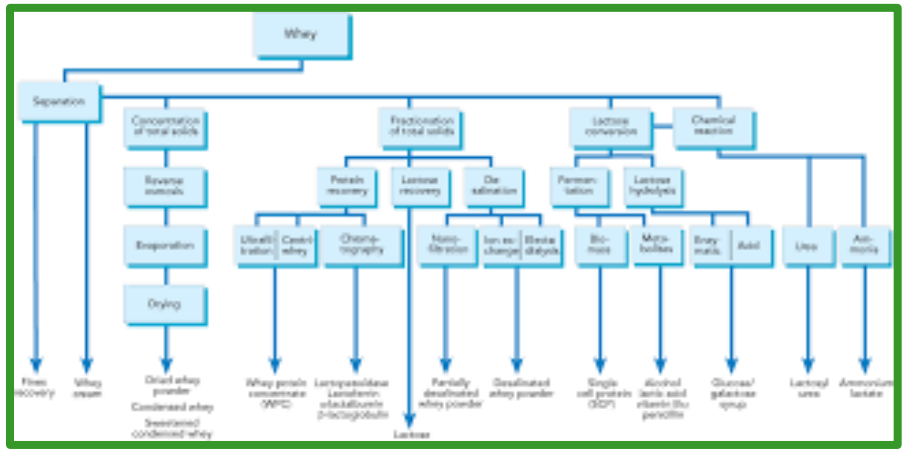
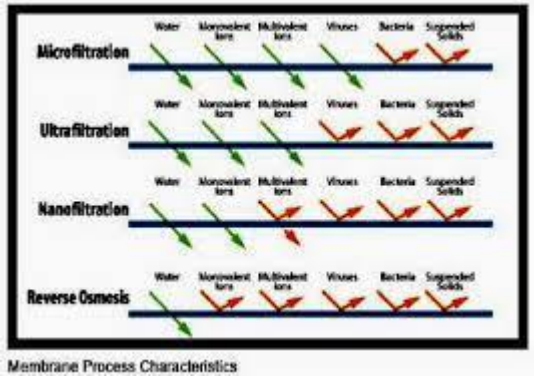
Dairy Analogy







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“Crops” Selected

Crops

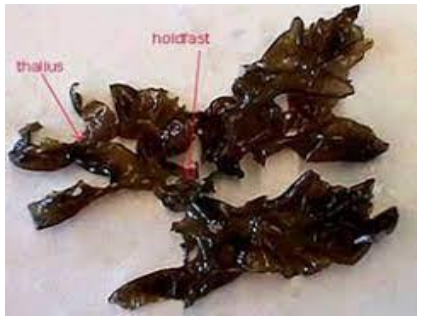
- Faba Beans -13 Varieties
- Peas -3 winter and 10 spring
- Lupin -5 varieties
- Oca
- Mashua
- Yacon

Grasses

- Mixed species sward
- Selected Foliage

Sea weed

- Porphyra sp. (Nori)
- Ulva sp. (Ulva lactuca – sea lettuce)
- Chondrus crispus (Irish mosss)



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Case Study 1 - Fava Beans

- 13 Varieties available
- 7 Varieties prioritised
  - Grow in Ireland Lynx & Tundra
  - Low anti-nutrient vicine / convicine
- Protein Extracted via 2 processes (1 x standard, 1 x patentable)
- Protein levels achieved up to 90% Protein
- Extraction Yield 71.4%
- Process optimised and will be used for other crops

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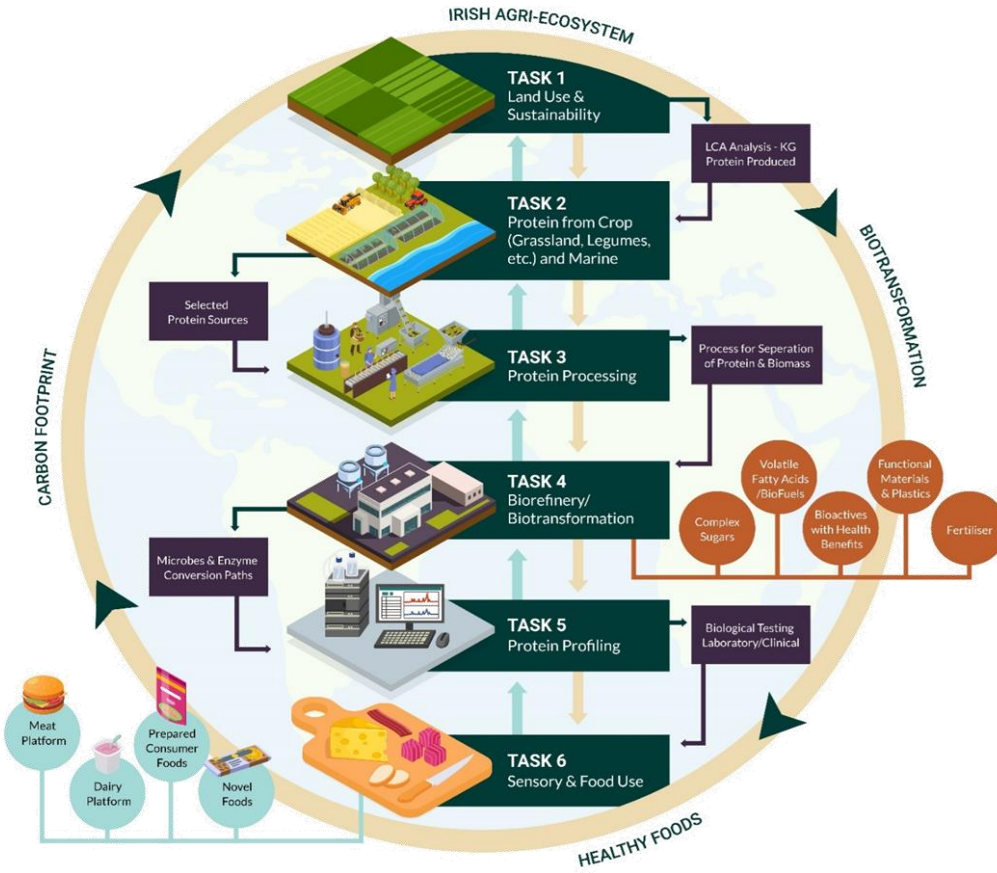
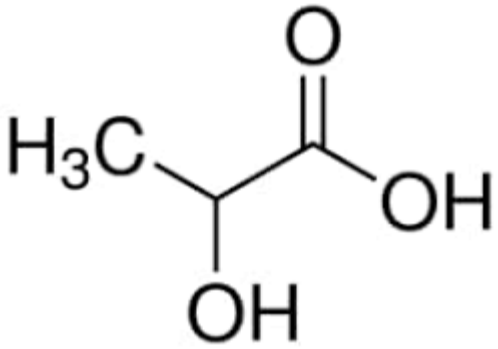
Fava Beans

- Residual Biomass sent to Task 4
- Microbial biobank for biotransformation
- 2 strains identified for production of lactic acid from fava bean residual biomass
- Strains to produce colour being identified





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Case Study 2 - Oca and Mashua

- Oca is an Andean tuber that is the second most widely cultivated tuber after potato
- Mashua is also an Andean tuber crop fourth most widely cultivated after potato in the Andean region
- Suited to growth conditions in Ireland
- Good protein profile

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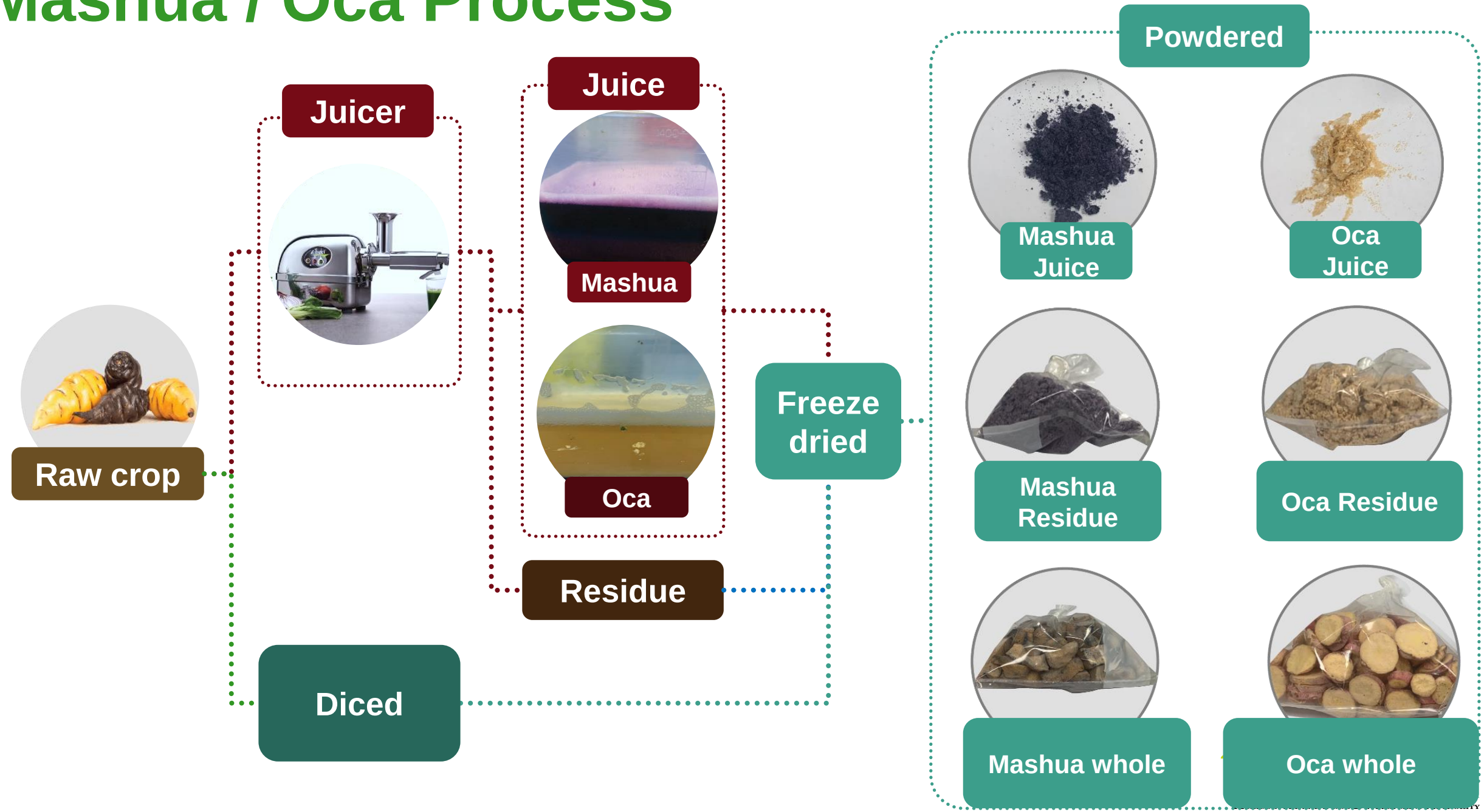
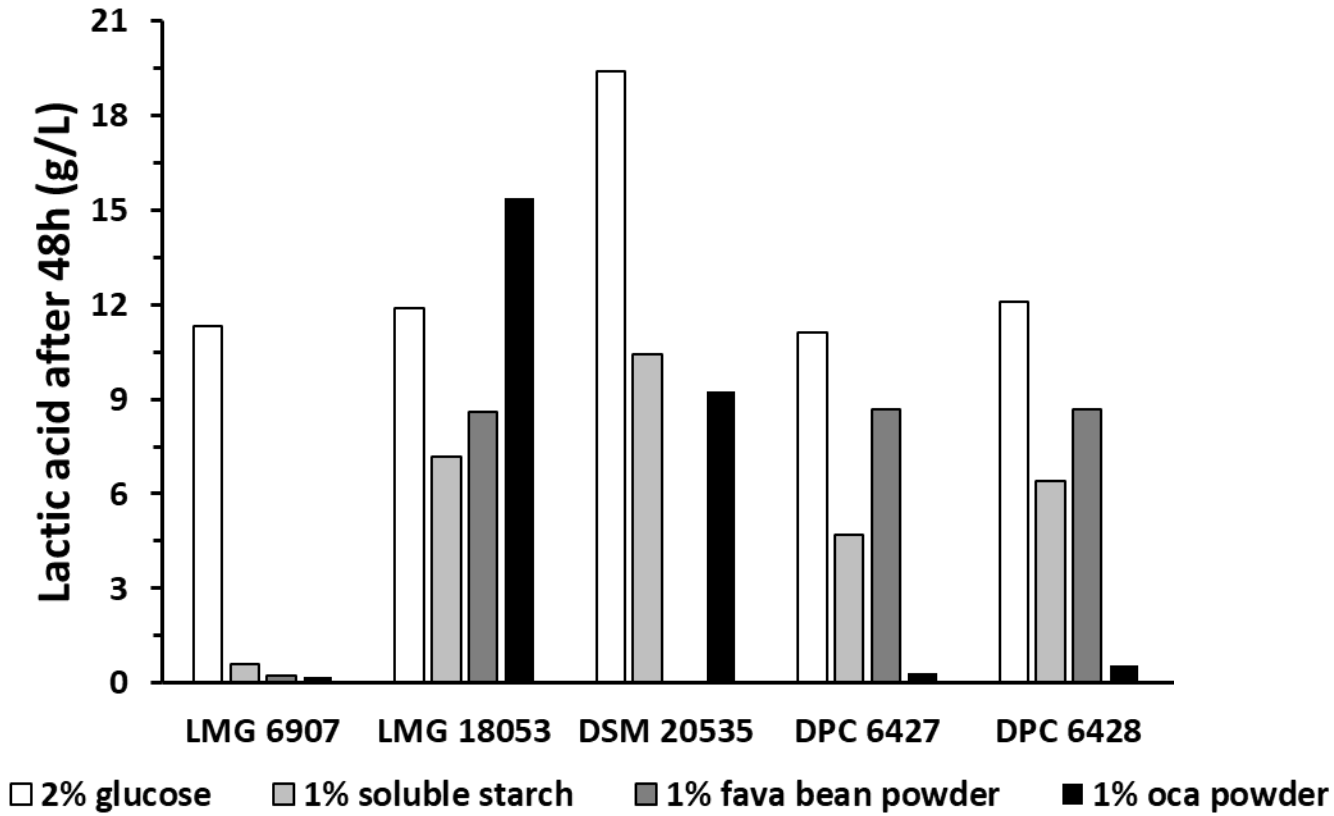
Mashua / Oca Process



Valorization of starchy plant waste

*Starchy waste from beans or tubers (**left**) is digested by bacteria screened for their ability to digest starch (**centre, right**)*



*Starch in plant waste can be transformed into high concentrations of lactic acid (**grey and black bars**)*

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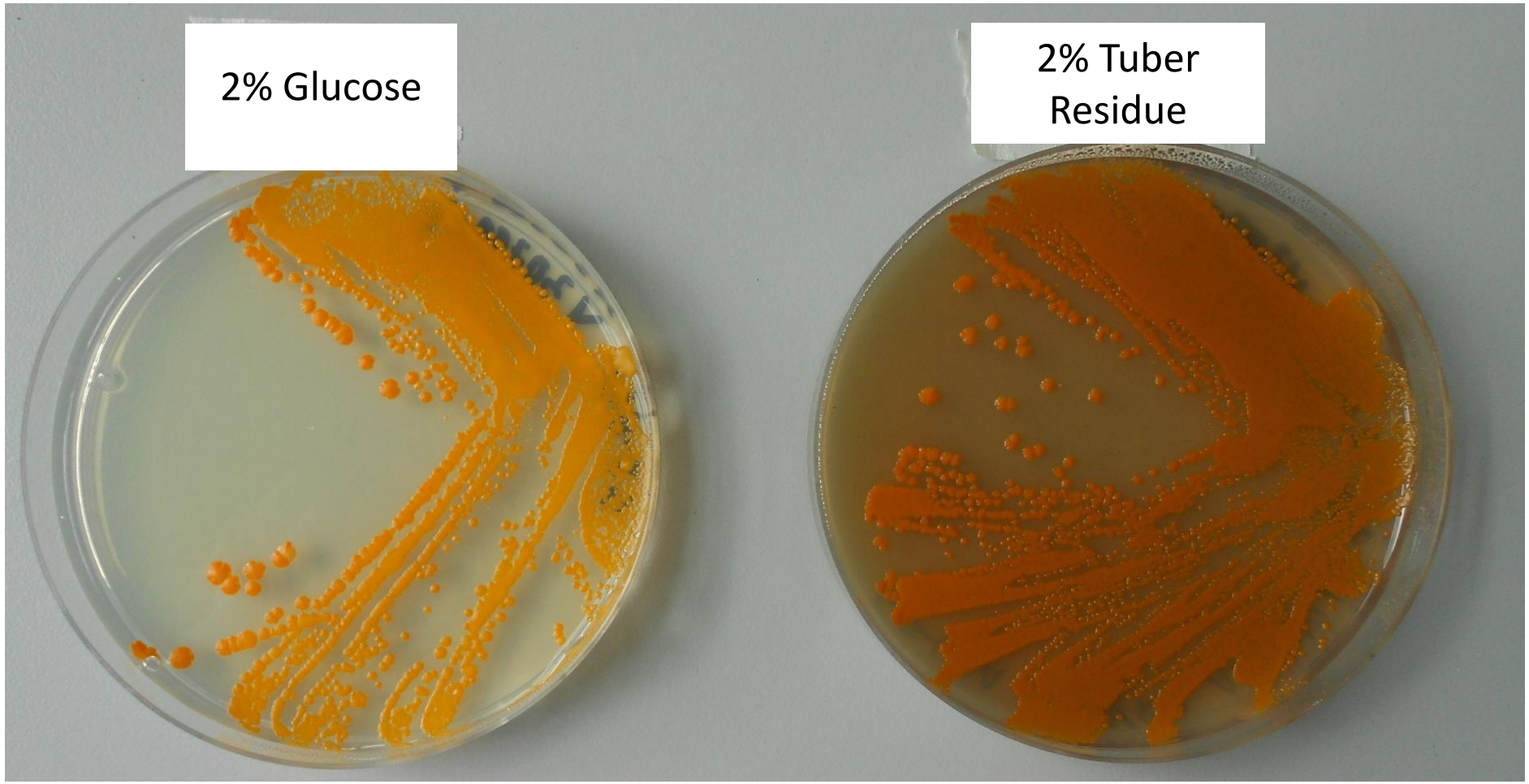
Valorization of fructans from tuber residue



*Yeast engineered to produce the food pigment β-carotene (**left**) can consume fructans from tuber residue (**right**) and produce carotene with no decrease in pigmentation*

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Biomass Valorisation

Agricultural Land

Feedstock/Protein sources
(Faba Beans, Grass, Mashua, Oca)

Plant-based Proteins

Biomass residues

Biorefinery

Production of BIOGAS

Volatile Fatty Acids

Downstream processing

Applications

- Biofuels
- Bulk Chemicals
- Bioplastics
- Electricity
- Pharmaceutical Industry
- Textile Industry

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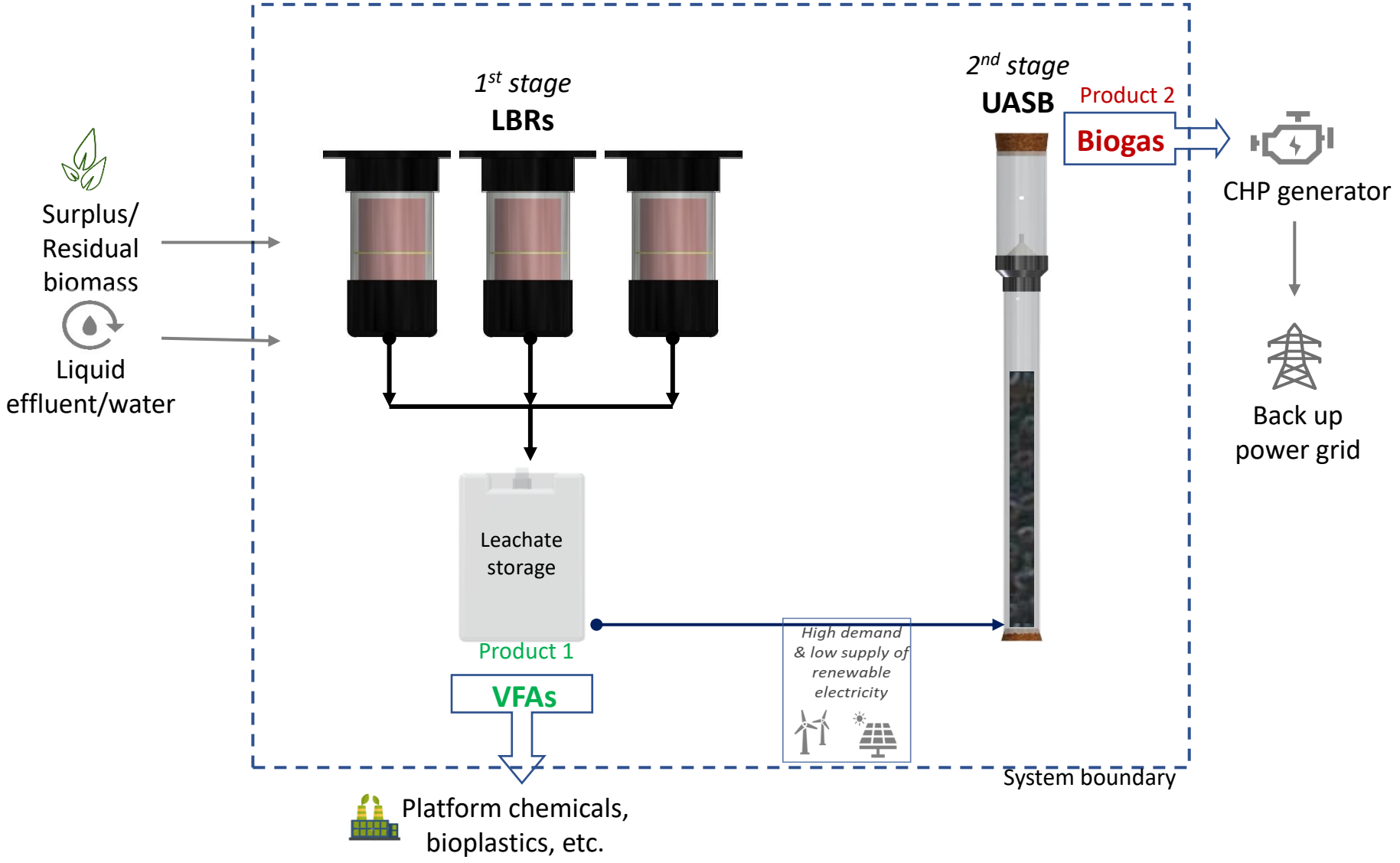
Bio-refinery: two stage anaerobic digestion process



Legend	
LBR	Leach Bed Reactor
UASB	Upflow Anaerobic Sludge Blanket
CHP	Combined Heat Power
VFA	Volatile Fatty Acids

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What is happening in other Tasks?

- Extracted protein analysed for its amino acid profile & peptides profile
- Crops for 2023 harvest selected, 2024 planning
- Protein functionality, Food formulation
- LCA and Land Use for crops – data loop
- In-vitro digestion;
  - Digestible Indispensable Amino Acid Score (DIASS)
  - INFOGEST models
- Human trials to evaluate the human metabolic

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Outputs

- New novel protein products
- Digestibility score
- Biomass transformation products
- Land use models
- LCA /Kg Protein

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Project Co-ordinator	Mark Fenelon	
Principle Investigator	Ewen Mullins	
	Lead	**Co-Lead**
Task 1	Thia Hennessey (UCC)	Lilian O' Sullivan (Teagasc)
Task 2	Deirdre Hennessey (Teagasc)	Sheila Alves (Teagasc)
Task 3	Eoin Murphy (Teagasc)	Brijesh Tiwari (Teagasc)
Task 4	Olivia McAuliffe (Teagasc)	Vincent O' Flaherty (NUIG)
Task 5	Andre Brodkorb (Teagasc)	Brian Green (QUB)
Task 6	Ruth Hamill (Teagasc)	Seamus O'Mahony (UCC)
Task 7	Sinead Fitzsimons (Teagasc)	Mark Fenelon (Teagasc)

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THANK YOU

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