ARC CENTRE OF EXCELLENCE IN PLANTS FOR SPACE

PLANT-BASED FOODS

The ARC Centre of Excellence in Plants for Space (P4S) is developing technologies to enable humans to survive and thrive in space, reducing the dependence on constant resupply, and using this lens to transform the sustainability of food and bioresource production on Earth.

One of our core missions is to develop complete nutrtion plant-based foods.

Plants can produce most elements required for human nutrition, but not from a single source nor in the correct proportions. P4S aims to generate a small collection of plants that can support complete plant-based nutrition from sugars, proteins, fats, fibre, vitamins, and minerals. We aim to:

- Maximise fat content for caloric, nutritional, and taste impact by increasing and stabilising fat storage in leaves;
- Refine protein composition to optimise balance of essential amino acids;
- Tailor carbohydrate profiles to optimise starch (energy) and fibre content, e.g., by increasing β-glucan profiles to support healthy digestion, and
- Boost flavour, e.g., by sequestering salt, and remove anti-nutritives (e.g., phytates) to improve bioavailability.

No matter how nutritious, a salad-only diet is not very inspiring! A key element to our success will be a parallel focus on smart food structuring to create variety in texture, flavour, and aroma, targeting foods high in protein and/or fat to create 'cheese' or striated products resembling meat using strategies that include 3D food printing; and introducing umami flavour to plant foods.

We will also test foods for palatability, digestibility, and sensory appeal using cutting-edge biometric analyses on human tasters, and AI to predict and interpret human responses. This suite of approaches will allow us to tailor plant-based food products for consumers with specific digestive, nutritional, or psychological needs, e.g., the elderly.

CASE STUDY: DUCKWEED AS A COMPLETE FOOD

P4S has identified duckweed as an ideal candidate for high-value bioproduction. Duckweed can grow extremely rapidly (2-day doubling time), is entirely edible with a high protein (~20–45%) and fibre (~25%) content, and already has an excellent amino acid and micronutrient profile. On a per area basis, they produce ~60× the protein yield of soybean. In Thailand, duckweed is known as khai-nam (water eggs) and is eaten in soups and salads.

Duckweeds are perfectly suited to vertical farming, being simple to harvest and requiring no water circulation. Their flat profile allows dense stacking of shelving racks, and rapid growth allows continuous production.

P4S will optimise amino acid profiles in duckweed, which requires increases in lysine, phenylalanine, and histidine to meet long-term FAO nutrition guidelines; improve fat (triacylglycerol and oleic acid) content and stability; and enhance carbohydrate profiles to boost caloric content and digestibility.

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ABOUT PLANTS FOR SPACE

The ARC Centre of Excellence in Plants for Space (P4S) is a transdisciplinary endeavour involving multiple skillsets from systems and process engineering, plant biology, food chemistry, psychology, education and space law. Our international and national consortium has representation across a wide range of industries. This includes space, controlled environment agriculture, and food manufacturing.

We will have a standing load of 200 Australian based researchers by 2026 located in our foundational universities of the Universities of Adelaide, Flinders, Melbourne, La Trobe and Western Australia, and aim to train over 400 researchers by 2031. We will encourage entrepreneurship, and a spin in and spin out culture, to support growth in the Australian space industry. We also have a large outreach program to schools and the general public, with all of our researchers spending at least 10 days per annum on engagement activities.

We provide a nucleus of activity, network and pathway to collaborative industry-academic partnerships globally to perform transformative research, develop plant and food technologies to enable long-term space habitation, and provide new sustainable high-value bioproduction on Earth. We are open to leveraging our skillbase to engage in new opportunities. Contact us for more information.

PLANTS FOR SPACE PARTNERS

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The University of Adelaide
The University of Western Australia
La Trobe University
The University of Melbourne
Flinders University

International Universities
University of California, Berkeley
University of California, Davis
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Twist Bioscience
BioPlatforms Australia
Australian Genome Research Facility (AGRF)
Australian Plant Phenomics Network (APPN)

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