THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CREATE CHANGE

Biofortified Foods:
Sustainable, wholesome, colourful & delicious microalgae

Professor Peer Schenk

Algae Biotechnology Laboratory

Schenk Lab

Marine Algae and Microalgae

Australia is a major agricultural producer and exporter from a mix of irrigation and dry-land farming. However, as in most food exporting countries, climate change is predicted to cause decreased rainfall, exacerbating existing challenges to freshwater availability and protein production.

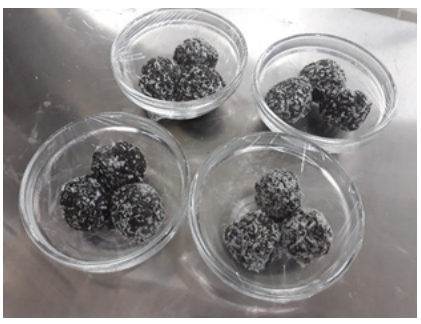
Marine microalgae and macroalgae assimilate carbon dioxide using the sun's energy, generate 50% of the planet's oxygen and are at the base of marine food webs. They grow faster and offer significantly higher annual protein yields per hectare than terrestrial crops such as soybean, pulse legumes, and wheat. They can play a significant role in the provision of non-allergenic plant-based protein with balanced amino acid profiles.

Algae Caviar Dip

Algae are globally diverse, but with a particularly high diversity in Australia; many species are unique to this country. More than 30,000 microalgal and 13,000 macroalgal species have been reported globally offering many novel food production possibilities.

Marine algae do not require freshwater or existing arable land to be commercially farmed, preserving resources required for conventional food crops. Furthermore, they evolved in harsh environments, often exposed to high oxidative and free-radical stresses, which has led to the development of natural protective systems, such as the production of pigments (e.g. carotenes, chlorophylls, and phycobiliproteins) and polyphenols (e.g., catechins, flavanols, and phlorotannins), which can impart health benefits to the consumer.

Some strains in species such as the microalgae *Isochrysis*, *Nannochloropsis* and *Phaeodactylum*, and the *Thraustochytrids*, are rich in omega-3 fatty acids.



Algae Protein Balls

The Schenk Lab at the University of Queensland together with industry partners have developed microalgal biomass production capability from bench–top scale through to pilot scale photobioreactors and raceway ponds; and are developing macroalgal production capability on structures in the sea as well as in tanks and ponds onshore. In addition, they and other Research Partners offer state-of-the art analytical capabilities used to profile the biochemical components of algae.

Co-Production Principal

Cultivating algae at scale for the exclusive production of low-value per kilogram protein-rich food ingredients is economically challenging as cost of operations can readily exceed revenues. The solution is to apply the principle of co-production, where a species of algae is cultivated to extract both a high-value product, such as omega-3 fatty acids, phycocyanin or carotenoids, to ensure farm profitability and strong return on investment, and a low-value protein-rich by-product suitable as a plant-based alternative to animal protein.

Photosynthetic marine microalgae are most commonly cultivated either in open outdoor raceway ponds or in closed photobioreactors. Photobioreactors are more expensive to install and operate and are therefore not suitable for low-value per kilogram food production. Outdoor raceway ponds in high-sunshine regions like Australia have the advantage of lower capital requirements and lower operating costs

Algae Caviar

Sushi plates with algae caviar & biofortified wasabi mayonaise

Sesame Algae Balls

Nanno Rice

CASE STUDY: *Nannochloropsis*

In Brisbane, Research Partner UQ and Industry Partner Qponics Limited are cultivating Nannochloropsis, a very fast-growing species of marine microalgae for the co-production of EPA omega-3, a high-value product valued at about US$200 per kilogram as a food or nutraceutical ingredient, and high-protein biomass, a much lower value by-product remaining after oil extraction, suitable for use as a plant-based protein food ingredient.

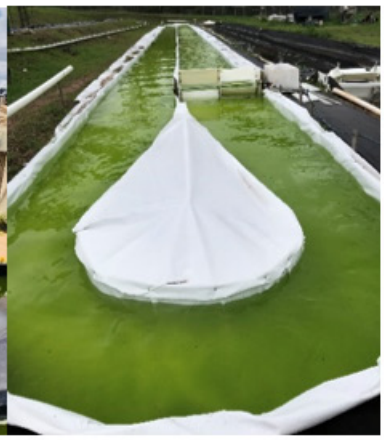
The central eastern coast of Australia north and south of Brisbane offers a "Goldilocks Zone" for outdoor raceway pond farming of marine microalgae. The region has summers that are not too hot and warm winters, an average of 7 hours of sunshine per day, and an abundance of affordable flat agricultural-zoned land adjacent to tidal rivers with the ideal salinity to cultivate marine microalgae. Qponics plans to build a large-scale commercial algae farm in the Northern Rivers region of New South Wales, capable of expanding production to more than 5,000 tonnes of algae-sourced protein per year.

Qponics has applied its $1 million CRC-Project grant to upgrade the R&D-scale marine microalgal farm at UQ into a small-scale commercial facility to demonstrate automated microalgal harvesting and processing technologies. The solar-powered upgrade includes a new 65m x 12m raceway pond, water storage tanks, and a shed to house a small-scale ultra-filtration system and centrifuge harvesting equipment.

Research Partners within the Schenk Lab at the University of Queensland have expertise in 'green chemistry" oil extraction process and these are under review.

Biofortified *Nannochloropsis* bread

Biofortified algae muffins



For further details, please contact:

Prof. Peer Schenk p.schenk@uq.edu.au;

School of Agriculture and Food Sciences,

The University of Queensland,

Brisbane, Queensland 4072, Australia.

www.schenklab.com

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