The potential of New Zealand *Porphyra* and *Pyropia* seaweeds (karengo) as food ingredients

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CAWTHRON

What is karengo?

- Karengo/parengo are a group of seaweeds (macroalgae) traditionally eaten by Māori
- Several species of *Pyropia* and *Porphyra* in the order Bangiales
- Winter seasonal, inter-tidal, temperate latitudes
- Traditional food for many indigenous cultures

Laver (Wales)

Porphyra umbilicalis

Nori (Japan)

Pyropia yezoensis
Pyropia tenera
Pyropia haitensis

Karengo/Parengo (Aotearoa/NZ)

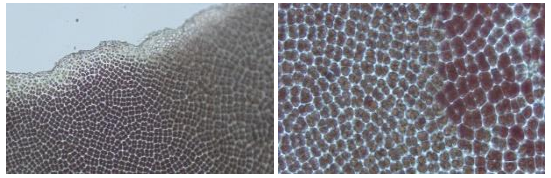
Pyropia viridiidentata
Pyropia cinnamomea
Clymene coleana + many others

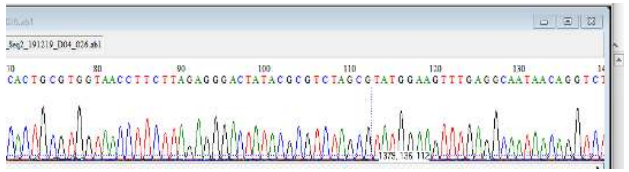
Purpose of our research on karengo

- Address knowledge gaps for karengo
  - food-related attributes
  - life cycle
  - environmental stressors
- Support iwi in their kaitiakitanga and other priorities regarding karengo
- Support development of a sustainable commercial enterprise based on karengo

He tipu moana he oranga tangata:
Revealing karengo as a high-value functional food

- Surveyed and sampled karengo at several locations and times over two winters (Paul South, Cawthron)
- Morphological and DNA sequence analysis (Rita Lee, Cawthron)
- Compositional analysis (Cawthron Analytical testing labs)
- Metabolomic analysis (K. Fraser, AgResearch)
- Bioactivity analysis (O Gasser and J Tang, Malaghan Instit; H Hosakawa, U of Hokkaido)





Species identified

Pyropia viridentata

Porphyra "GRB108"

Pyropia cinnamomea

Pyropia plicata

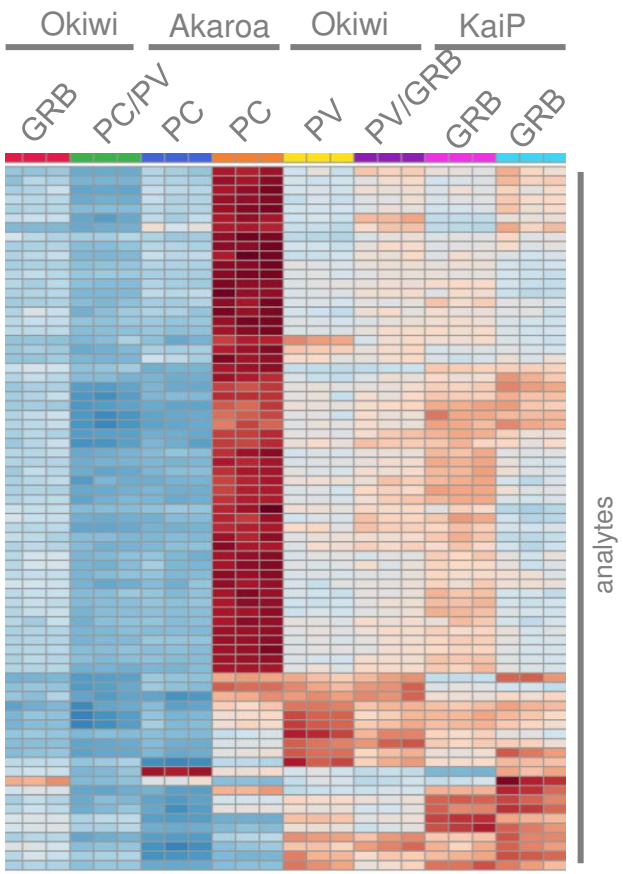
Pyropia rakiura

Porphyra "GRB 368"

Compositional analysis

- *Py viridiidentata*, *Py cinammomea* and *Porphyra* GRB complex all have:
  - High protein (30-35%)
  - High levels of the omega-3 fatty acid, EPA (1-2%)
  - High dietary fibre (50%)
  - Good levels of micronutrients Fe, Ca, I, vitamin B12

- Metabolomics revealed differences:
  - Among species
  - Between locations
  - At different stages of season



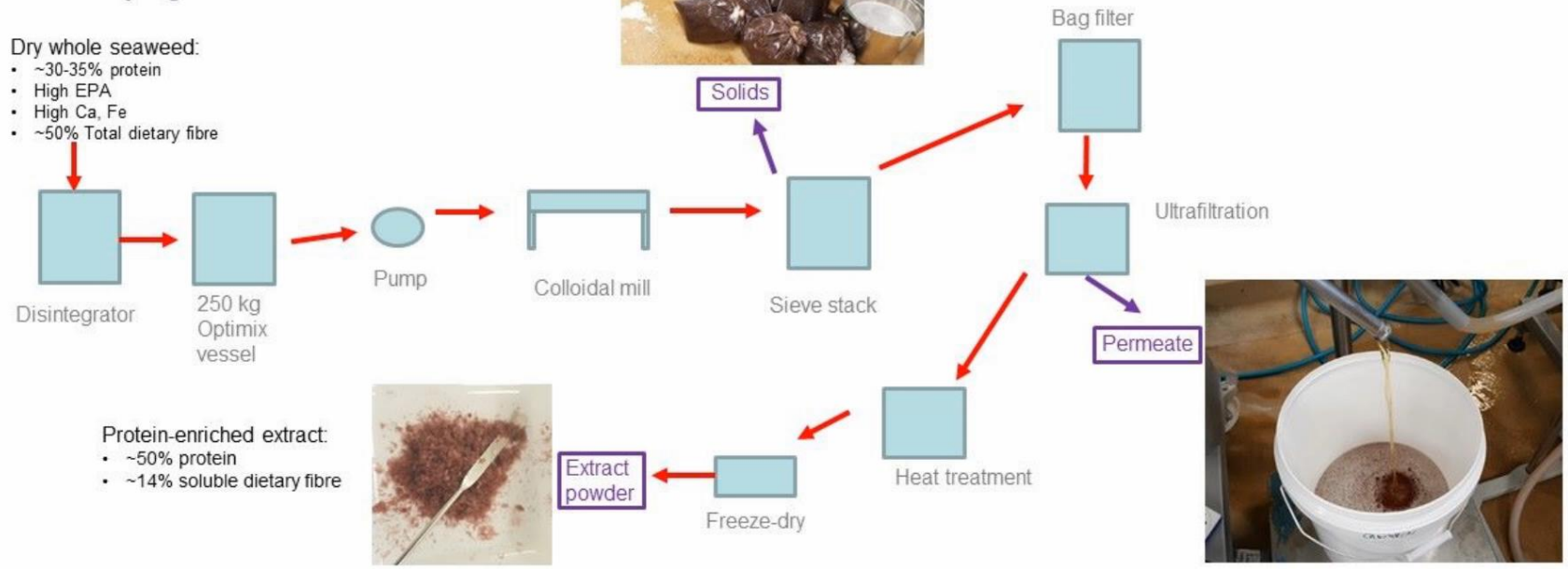
Realising the value of algae as a source of alternative protein

- A collaboration with:
  - Riddet Institute
  - Plant&Food Research
  - University of Auckland
  - Three institutes within A-Star, Singapore
- Karengo-based technical objectives:
  - Develop a scalable process for extracting protein from *Pyropia*/*Porphya*
  - Determine digestibility and bioavailability
  - Evaluate food-related physico-chemical properties
  - Establish effect of extracts on gut function and energy metabolism in people

Extraction process

PROTEIN EXTRACTION – PILOT PLANT

- Development trials
  - Rehydration
  - Liquid phase separation
  - Ultrafiltration
  - Drying



Emerging food ingredient concepts

Fine milled whole karengo	Dried aqueous extract	Dried filtered aqueous extract

Attributes:

• All components retained • Increased bioavailability	• Increased bioavailability • Protein enriched • High soluble dietary fibre • High salts and sugars	• Increased bioavailability • Protein enriched • High soluble dietary fibre • Low salts and sugars

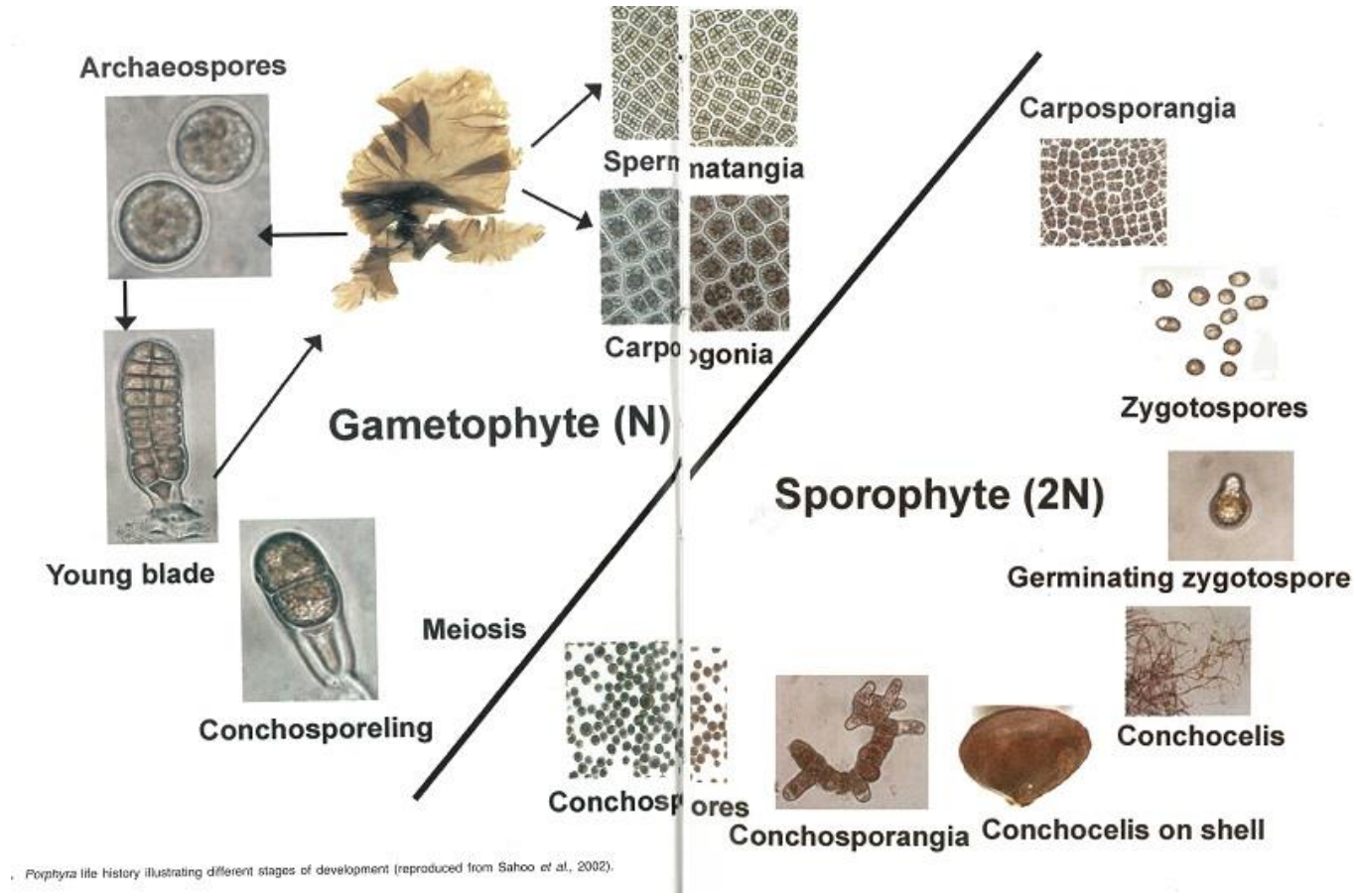
Pyropia/*Porphyra* farming

- Nori farming has been established in Japan for >300 years
- Today, global production is 1.2 M tonnes, almost all by aquaculture for use in sushi
  Ferdouse, FAO report “Global Status of Seaweed Production” 2018
- “*Porphyra* is the most valuable seaweed in the world”
  McHugh, FAO report “Guide to the Seaweed Industry” 2003

Porphyra/*Pyropia* life cycle

- The life cycle of *Porphyra* and *Pyropia* species are heteromorphic, with dispersion at two points

Winter (annual)



Porphyra life history illustrating different stages of development (reproduced from Sahoo et al., 2002).

Summer (perennial)

Karengo has been farmed in Aotearoa/NZ

- Methods for karengo farming were developed and implemented in Bluff Harbour in the 1990s.
- The effort paused due to lack of capital
- Karengo farming was revived in Bluff in winter 2021 and 2022

Seeding of shells

Conchocelis culture

Seeding of nets

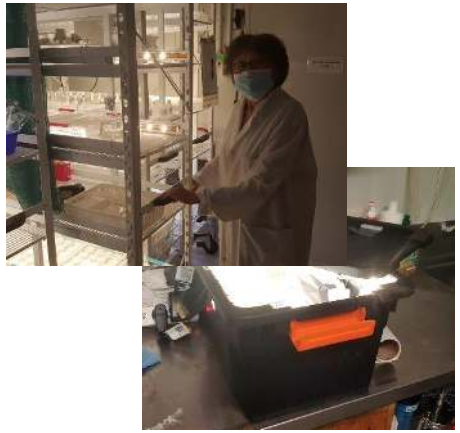
Growing blades

Karengo farming in Bluff, 2021-2022

Developing karengo aquaculture

- Establish optimal culturing conditions and control of reproductive cycle
- Evaluate potential for farming NZ species:
  - Quantify conchospore production and biomass accumulation
  - Adapt Asian expertise with nori
  - Evaluate potential farming sites
- Field-test methods and infrastructure

Lab-based

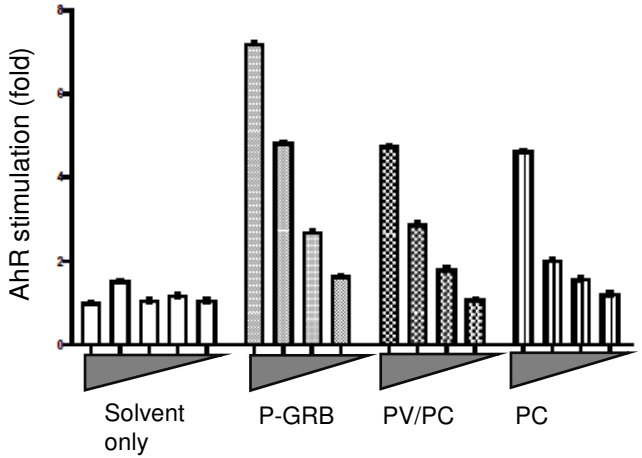


Research hatchery-based

Field-based

Can karengo support an industry in Aotearoa?

- Commercial viability will require a low-volume, high-value route to market:
  - RTE tonic, snacks
  - Ingredients for restaurants
  - Ingredients in novel manufactured foods
- Supporting findings:
  - Composition analysis supports nutritional and digestive health benefits
  - Bioactivity suggests possible anti-inflammatory and immune health benefits
  - Metabolomics supports unique attributes
- Challenges:
  - Biomass production - farming
  - Demonstrating health benefits (and creating high value)



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