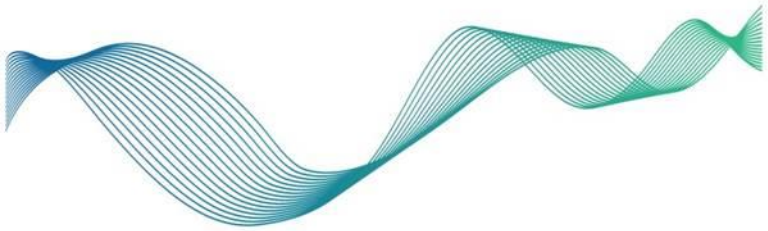
MarineBiotech



MARBiFEED

Enhanced biorefining methods for the production of marine biotoxins and microalgae fish feed

Jane Kilcoyne, **Stephen Burrell, Rafael Salas, Joe Silke, Fidel Delgado, Ignacio Albert, Maria Canga, Pearse McCarron, Francisco Rodríguez Hernández, Beatriz Reguera, Ingunn Samdal, Morten Sandvik, Christopher O. Miles.**

ERA-MBT 1st Transnational Joint Call: Biorefinery processes

21st November 2017

Marine Biotechnology ERA-NET (ERA-MBT) is funded under the European Commission's Seventh Framework Programme. Grant Agreement Number 604814
December 2013 - November 2017

THE CONSORTIUM

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Ingunn Samdal	Norwegian Veterinary Institute	Norway
Morten Sandvik	Norwegian Veterinary Institute	Norway
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Pearse McCarron	National Research Council	Canada
Fidel Delgado	Neoalgae	Spain

Project period: March 2016 to March 2019

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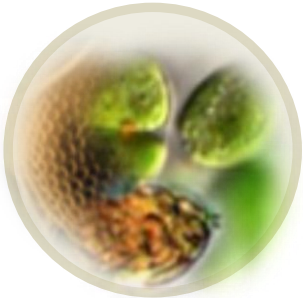
Marine biotoxins

Biodiscovery

Develop marketable products



Microalgae fish feed

Fish health

Support and grow aquaculture industry

Aquaculture

- Worth €3.4 billion (Europe) in 2012
- Employs >85,000 (EU)
- Important sector for coastal/rural communities
- Fastest growing food sector globally (5% to 50% fish since 1980s)
- Huge growth potential for Europe in the production of sustainable and high quality food for growing populations

Top species produced in EU:

1. Mussel
2. Trout
3. Salmon
4. Oyster
5. Carp
6. Sea Bream
7. Sea Bass

e | https://www.theguardian.com/sustainable-business/2017/jan/23/aquaculture-bivalves-oysters-factory-farming-environment

Guardian sustainable business

Why oysters, mussels and clams could hold the key to more ethical fish farming

Jennifer Jacquet

Aquaculture is fast becoming unsustainable and unnecessarily cruel. It's time to look to bivalves, the most environmentally sound animal species to farm

Contact author

@jenniferjacquet

Monday 23 January 2017
21.14 GMT

193 75

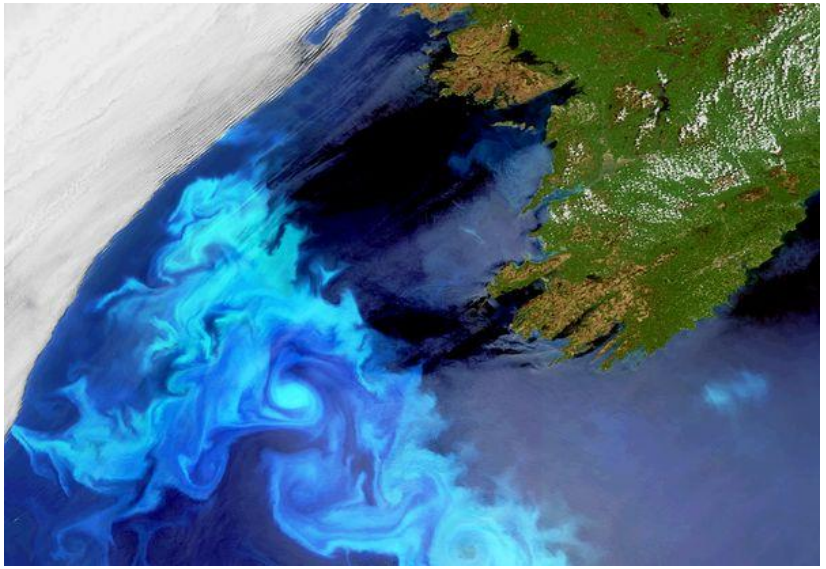
Shellfish Industry and Harmful Algal Blooms

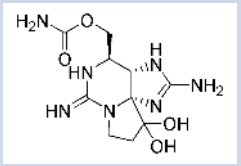
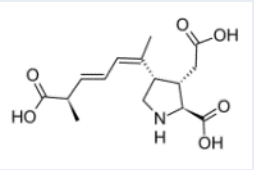
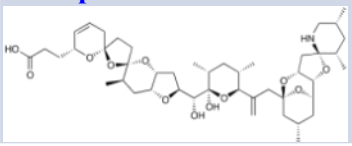
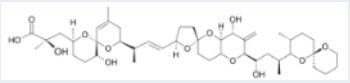
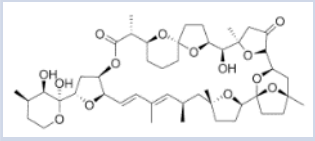
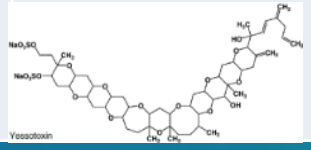
- Shellfish are filter feeders

- At certain times of the year phytoplankton blooms can produce biotoxins which can accumulate in shellfish

➢ Impact on mussel aquaculture (EU): ~ €23.2 M per annum*

*ECOHARM, 2003.



Classification	EU Regulated toxin	Causative organism(s)	Poisoning syndromes	Regulatory detection methods
Hydrophilic	**Saxitoxins** 	*Alexandrium* spp., *Gymnodinium catenatum*, *Pyrodinium bahamense*, certain cyanobacteria	Paralytic shellfish poisoning – **potent neurotoxin**	LC-FD
	Domoic Acid 	*Pseudo-nitzschia* spp., benthic diatoms	Amnesiac shellfish poisoning - **neurotoxin**	LC-PDA
Lipophilic	**Azaspiracids** 	*Azadinium* spp. *Amphidoma languida*	Azaspiracid shellfish poisoning	LC-MS/MS
	Okadaic acid group 	*Dinophysis* spp. and *Prorocentrum* spp.	Diarrhetic shellfish poisoning – **neurotoxic, immunotoxic and embyrotoxic**	LC-MS/MS
	Pectenotoxin 2 	*Dinophysis* spp. and *Protoperidinium* spp.	Diarrhetic shellfish poisoning – toxic by i.p. but not orally	LC-MS/MS
	Yessotoxin 	*Lingulodinium polyedrum*, *Protoceratium reticulatum*	Diarrhetic shellfish poisoning – toxic by i.p. but not orally	LC-MS/MS

Why isolate?

- Calibration standards (for accurate quantitation and detection)
  - Implementation of EU regulations
  - Protect human health
  - Supporting the shellfish industry (limiting losses, safe product)
- Other research – mitigation, pharmacology assay development, etc
- Marketable products (RMs and CRMs)
- Limited supplies

CRM	Cost (€) per µg
AZA1	120
AZA2	127
AZA3	144
OA	16
DTX1	25
DTX2	55
DA	1

Toxin sources?

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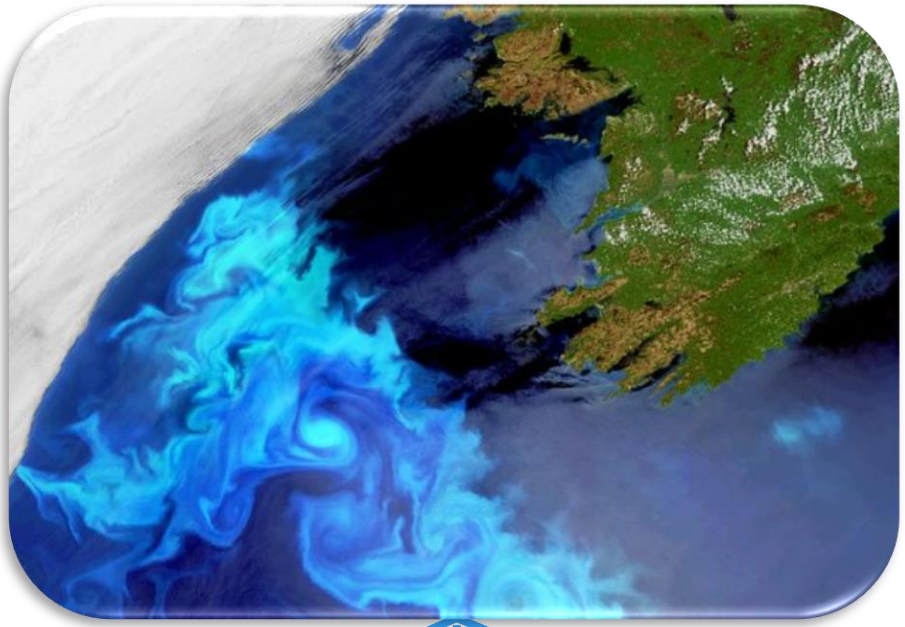


Microalgae culturing

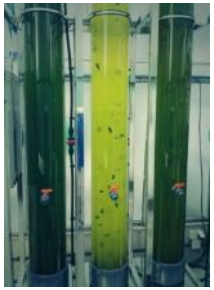
Dinophysis acuta (OA, DTX2)

Prorocentrum lima (OA and DTX1)

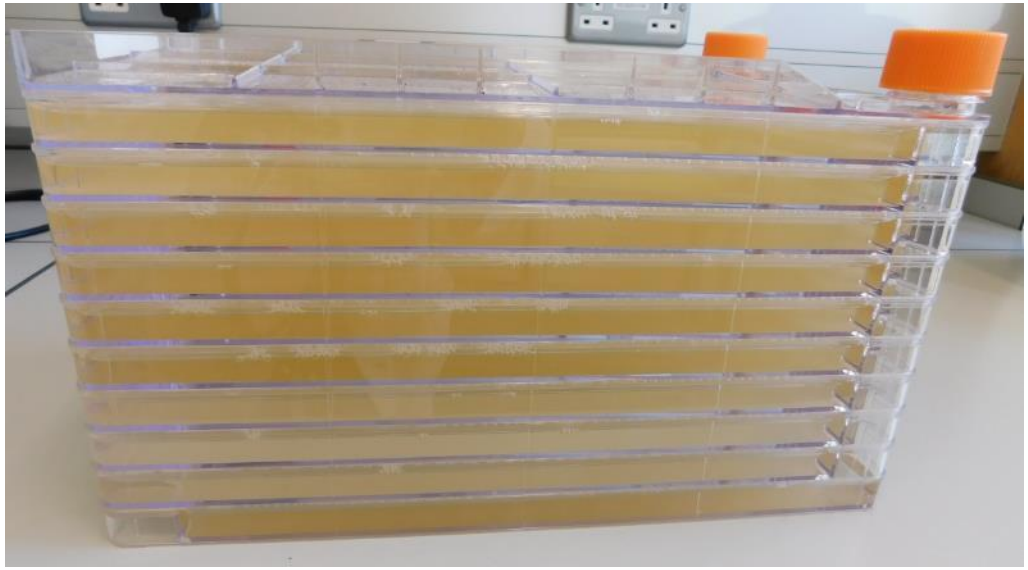
Azadinium spinosum (AZA1 and AZA2)

Pseudo-nitzchia australis (DA)

Optimisation of cell growth and toxin production



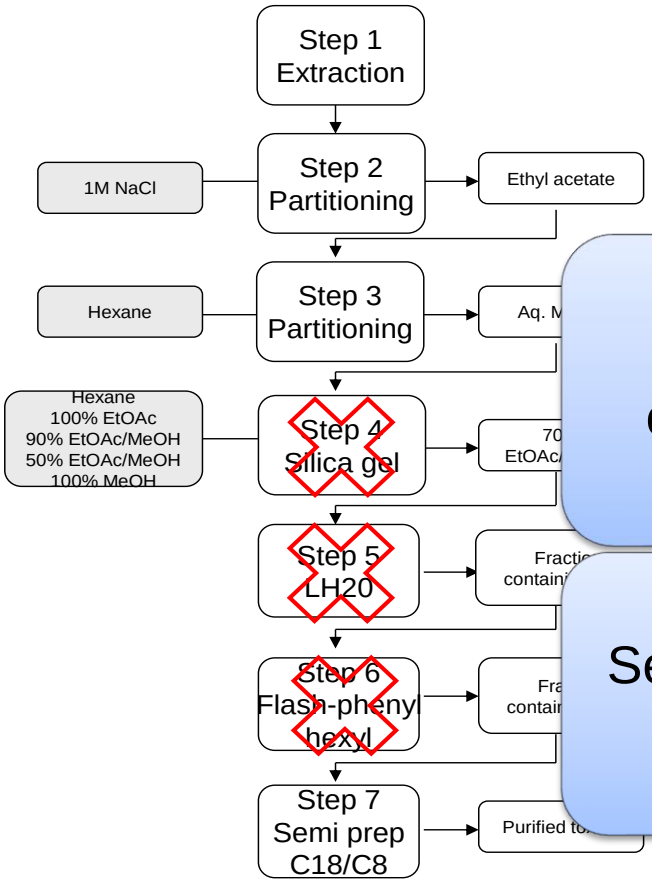
Microalgae culturing



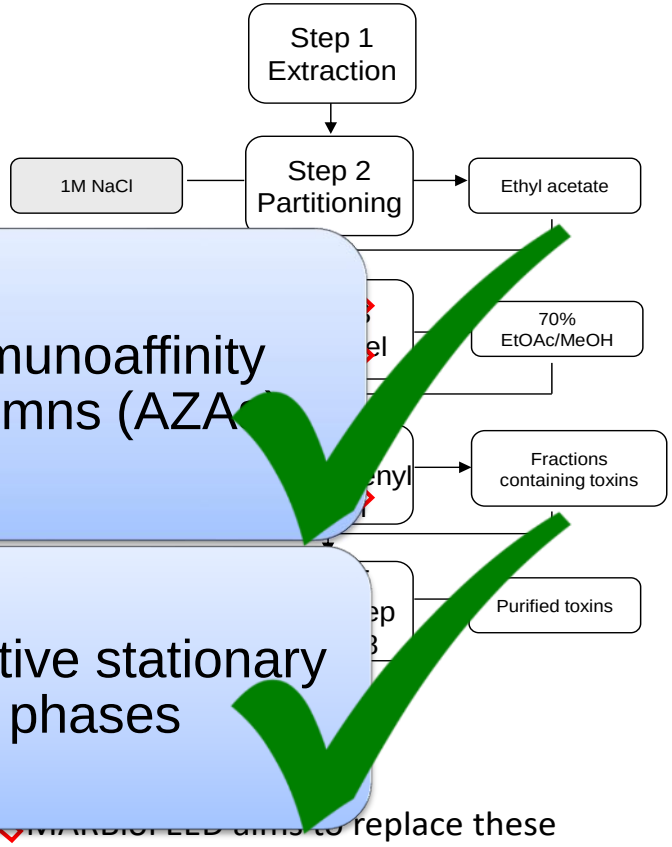
- Light
- Temperature
- CO_2
- Nutrients

Isolation of toxins

*Shellfish method



^Microalgae method



Immunoaffinity columns (AZA)

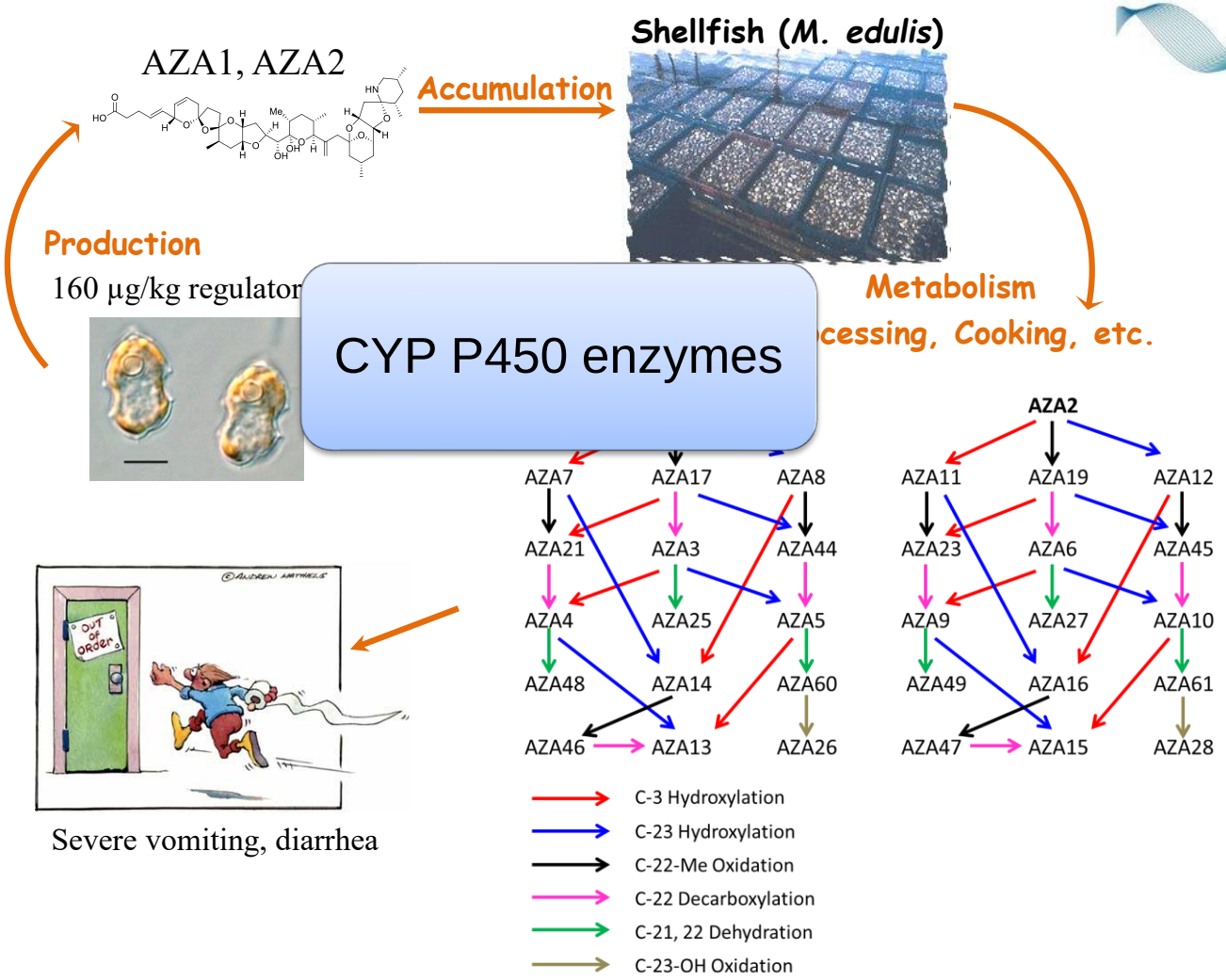
Selective stationary phases

MARBIOPEED aims to replace these steps (increasing yields) with one step that uses selective stationary phases

*Kilcoyne, J., Keogh, A., Clancy, G., LeBlanc, P., Burton, I., Quilliam, M. A., Hess, P., and Miles, C. O. (2012) *J. Agric. Food Chem. 60*, 2447–2455.

^Jauffrais, T., Kilcoyne, J., Séchet, V., Herrenknecht, C., Truquet, P., Hervé, F., Bérard, J. B., Nulty, C., Taylor, S., Tillmann, U., Miles, C. O., and Hess, P. (2012) *Mar. Drugs 10*, 1360–1382.

In vitro production of metabolites

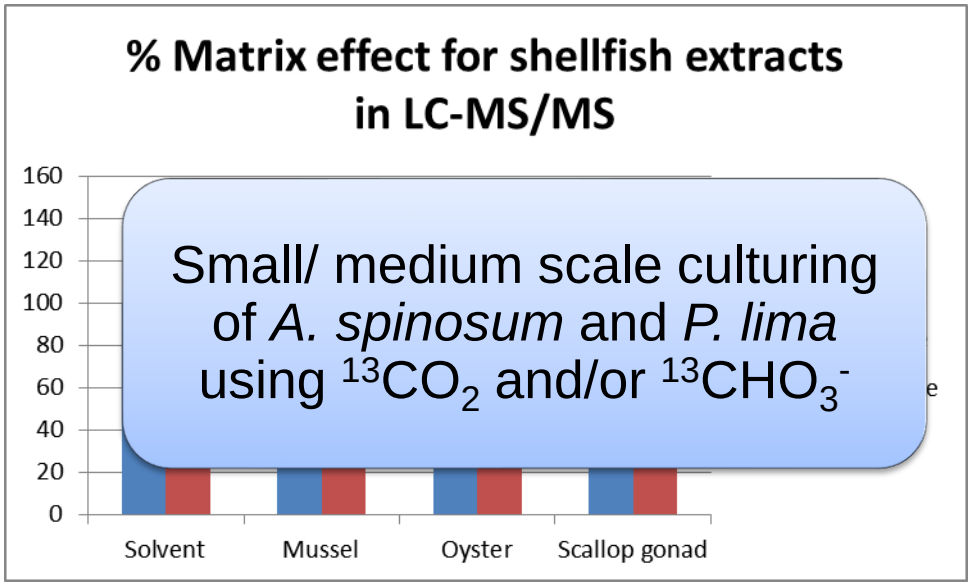


McCarron, P., Kilcoyne, J., Miles, C. O., and Hess, P. (2009) Formation of azaspiracids-3, -4, -6, and -9 via decarboxylation of carboxyazaspiracid metabolites from shellfish. *J. Agric. Food Chem. 57*, 160–169.

Kilcoyne, J., McCarron, P., Hess, P., and Miles, C. O. (2015) Effects of heating on proportions of azaspiracids 1–10 in mussels (*Mytilus edulis*) and identification of carboxylated precursors for azaspiracids 5, 10, 13 and 15. *J. Agric. Food Chem. 63*, 10980–10987.

Production of isotope-labelled toxins

- Regulatory method of analysis (LC-MS) is hindered by matrix interferences (analysis of crude samples)



- Use of isotopically labelled standards would correct for the inaccuracies caused by these interferences

- No supplies for isotopically labelled marine biotoxins (DA, AZAs and OA group) available

Food from the Sea

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Marine life

Fish to shrink by up to a quarter due to climate change, study reveals

Scientists predict 14-24% reduction in fish size by 2050 as ocean temperatures increase

Damian Carrington

@dpcarrington

Sunday 30 September 2012 18.00 BST

This article is 3 years old

Shares

53

Save for later

Food from the Land

https://www.theguardian.com/commentisfree/2015/mar/25/treating-soil-like-dirt-fatal-mistake-human-life

Soil
Opinion

We're treating soil like dirt. It's a fatal mistake, as our lives depend on it

George Monbiot

War, pestilence, even climate change, are trifles by comparison. Destroy the soil and we all starve

- Population expected to increase to 9.1 billion by 2050
- 6 m hectares new farmland required each year to meet demand
- 12 m hectares lost each year – soil degradation

Fish Farming and Fish Feed

- Terrestrial and marine sourced ingredients
- Marine sourced ingredients typically include small fish e.g. sardines, anchovies and herring that are rich in nutrients such as omega-3 fatty acids
- Issues with long term sustainability and rising costs.

PERSPECTIVE

Does aquaculture add resilience to the global food system?

Max Troell[a,b,1], Rosamond L. Naylor[c], Marc Metian[b], Malcolm Beveridge[d], Peter H. Tyedmers[e], Carl Folke[a,b], Kenneth J. Arrow[f], Scott Barrett[g], Anne-Sophie Crépin[a], Paul R. Ehrlich[h], Åsa Gren[a], Nils Kautsky[i], Simon A. Levin[j], Karine Nyborg[k], Henrik Österblom[b], Stephen Polasky[l], Marten Scheffer[m], Brian H. Walker[n], Tasos Xepapadeas[o], and Aart de Zeeuw[p]

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Edited by Bonnie J. McCay, Rutgers, The State University of New Jersey, New Brunswick, New Brunswick, NJ, and approved July 23, 2014 (received for review March 13, 2014)

- Microalgae great source of nutritious compounds e.g. fatty acids, proteins and vitamins
- Microalgae products (Europe) only ~ 5% of global market
- Sector is in its infancy
- Requirement for more research – increasing scale and reducing costs

Microalgae Fish Feed

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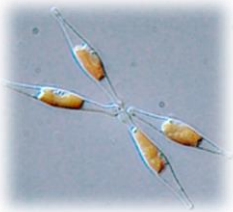
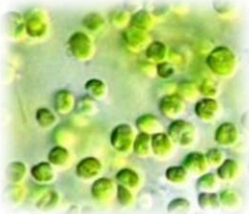
neo ALGAE
micro seaweed products


Phaeodactylum

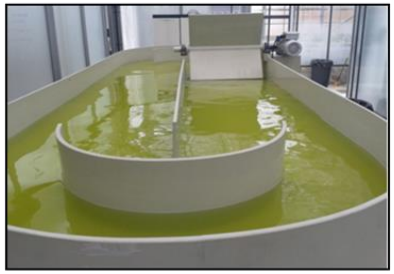

Nannochloropsis


Tetraselmis

Water preparation

Inoculate in PBR

Scaling-up



Small/Medium volume cultures

Harvesting

Processing biomass

Fish feed

Microalgae Fish Feed

NeoAlgae

neoalgae.es/en/shop/aquaculture/fish-food-nanno/

Fish feed enriched with microalgae

Home » Shop » Aquaculture » Fish feed enriched with microalgae

Nutritional composition

Crude protein 57%
Crude fat 11%
Crude ash 12%
Crude fiber 1,10%

neo ALGAE
micro seaweed products

Neoalgae Microseaweed Products S.L
C/ Fernando Morán Lavandera Nº 6 bajo 1
33205 Gijón - España

Fish feed enriched with microalgae

Select available options

Weight

Presentation Powder

Price 29,75 €

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Thanks for listening!

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Marine Institute
Foras na Mara

MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

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