

**DSM**

BRIGHT SCIENCE. BRIGHTER LIVING.

# Omega 3 fatty acids from marine micro-algae

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[www.dsmnutritionalproducts.com](http://www.dsmnutritionalproducts.com)



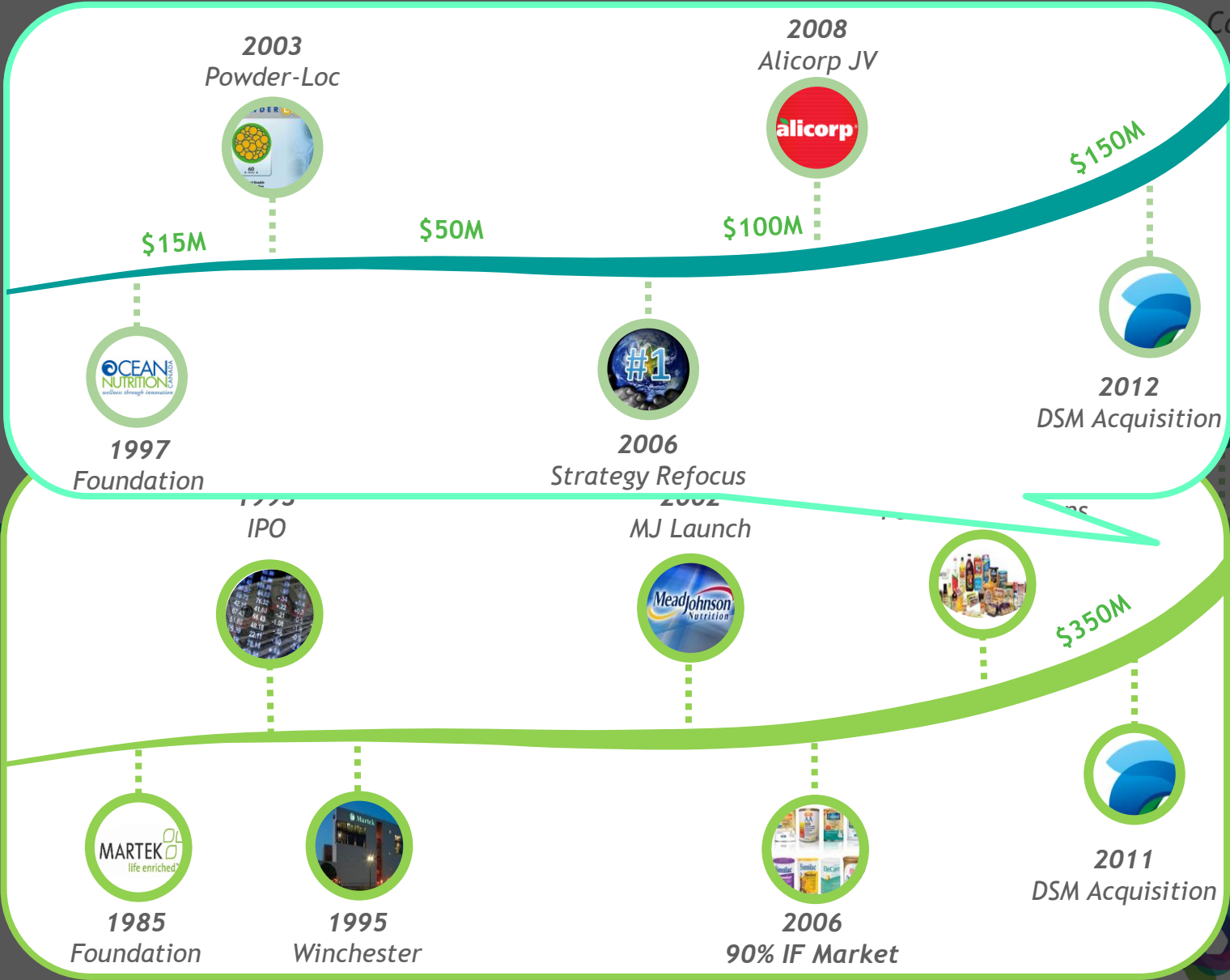
# Programme

- DSM Nutritional Lipids
- An introduction to microalgae
- An introduction to Omega 3 fatty acids
- The production of algal oils rich in DHA
- Regulatory Aspects
- *Life'sOmega*<sup>™</sup>, a new algal oil with both DHA and EPA



# DSM Nutritional Lipids

# CATEGORY TIMELINE



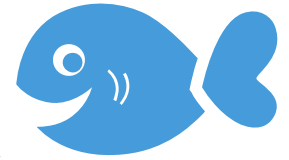
2012  
Nutritional Lipids  
Category Formed



2012  
Nutrition  
Acquisition



# Unparalleled Omega-3 Portfolio



life's Infant Oils

life's DSH Oils

life's Forms

MEG-3<sup>®</sup> Natural Oils

MEG-3<sup>®</sup> Concentrates

MEG-3<sup>®</sup> Forms

SCIENCE



*Patented and clinically  
proven marine based  
natural health products  
for use in food or  
supplements*



# NUTRITIONAL LIPIDS PRODUCTION SITES

Arcadia, WI



Belvidere, NJ



Mulgrave, NS



Halifax/Dartmouth, NS



Kingstree, SC



Piura, Peru



ARA, EPA, DHA

Vegetarian Algal Source,  
Purified Fish Oil



**DSM**

BRIGHT SCIENCE. BRIGHTER LIVING.

Provides a **complete range** of the **most trusted nutritional lipid solutions** addressing a **full spectrum of health benefits** and **life stages**.

Prenatal - Senior - All  
Stages of Life

General Wellness, Brain &  
Eye Health, Heart Health



# An introduction to Microalgae

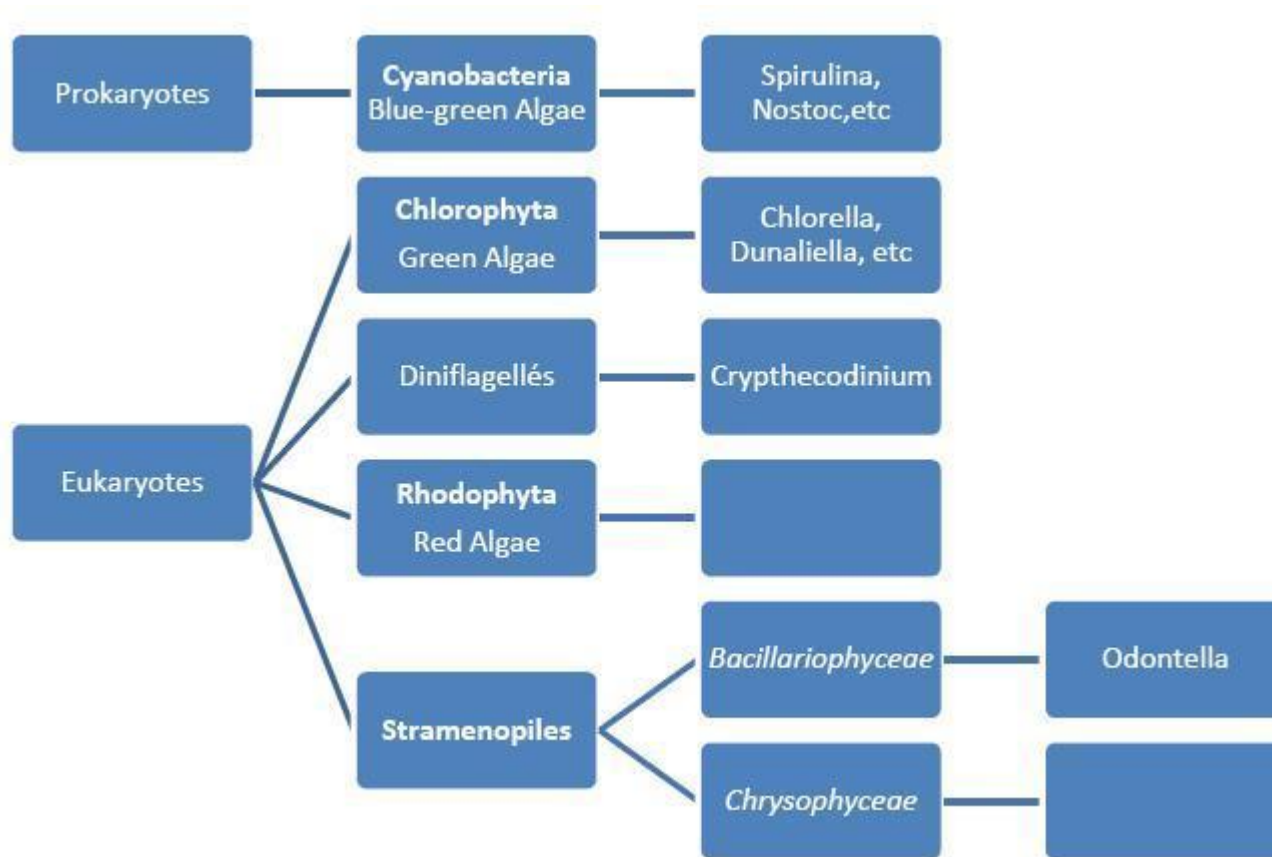


# An introduction to Microalgae

- The term microalgae covers all microscopic algae - unicellular and filamentous
- The value of commercial products produced from microalgae has been estimated at 600 million Euros per annum
- Human Nutrition represents 74% of the market value.
- There are 2 basic types:
  - Autotrophic - which require a light source for growth
  - Heterotrophic - utilise organic compounds as nutrients

(Source: Tramoy P. et al, 2011, Microalgae and Applications Outlook)

# Classification of Microalgae




Source: [www.cbdm.com](http://www.cbdm.com) accessed 11.11.2011

# Why use micro-algae to produce food ingredients

- Higher growth rate and higher biomass density in comparison to land based crops
- Source of rare, key bioactive nutrients normally only found in the marine environment. An alternative to extraction from fish.
- Fermentation substrates are low cost and from renewable resources.
- Do not compete for land space
- Can fix carbon dioxide
- Can be used to absorb contaminants (e.g. heavy metals and phosphorous)

# An introduction to Omega 3 fatty acids

# YOUR BODY NEEDS OMEGA-3

- 
- a very good fat, polyunsaturated and essential
  - critical to overall health and well-being at all stages of life
  - includes EPA + DHA, scientifically proven for brain, heart, and overall health
  - primarily from fish and algae consumption

# YOUR BODY NEEDS OMEGA-3

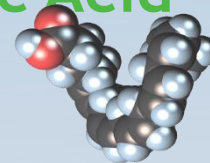


## ALA Alpha-linolenic

*Primarily from flax (linseed) /  
canola (rapeseed)*

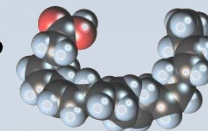
## EPA Eicosapentaenoic Acid

*Primarily from fish*



## DHA Docosahexaenoic Acid

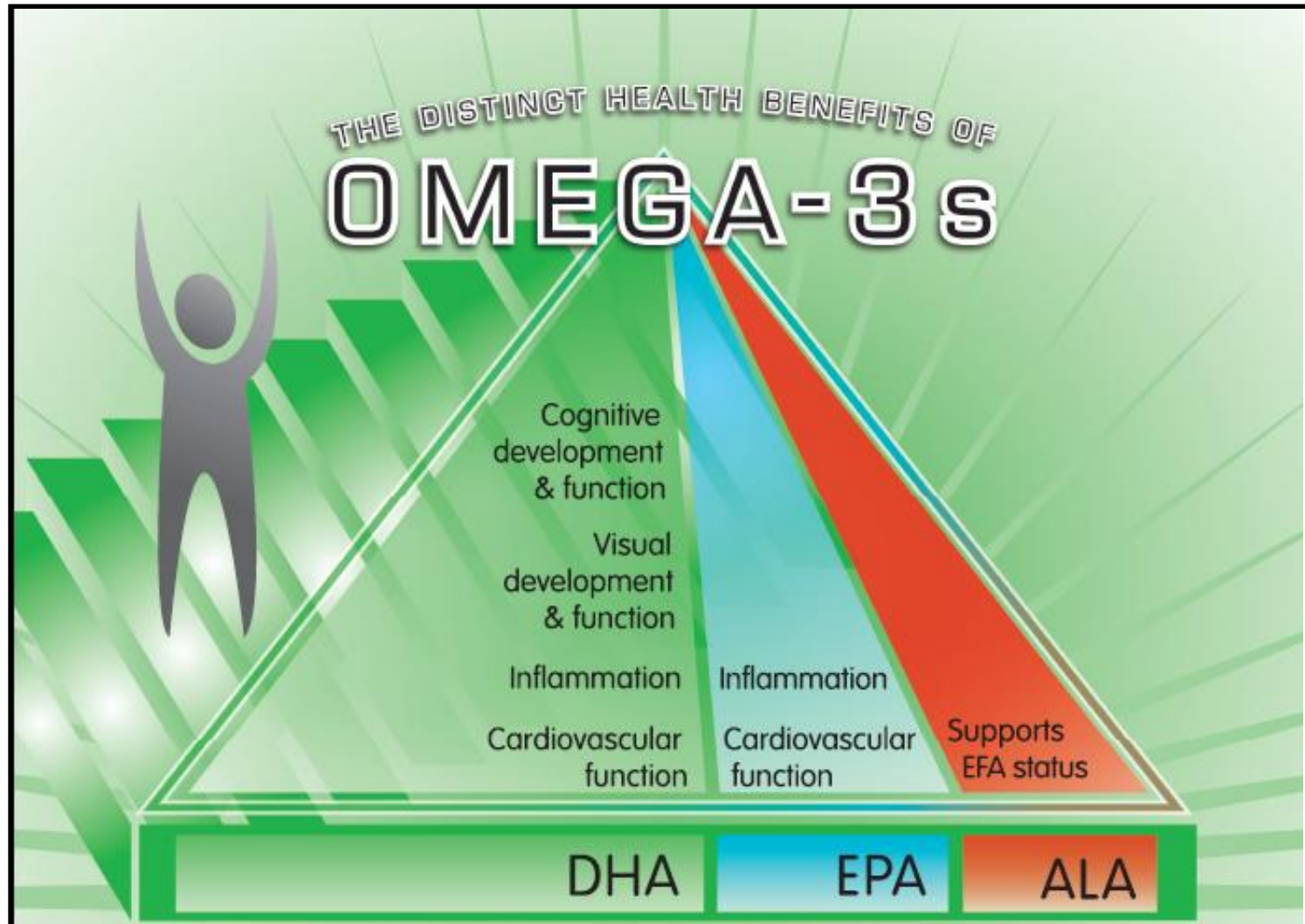
*Primarily from fish / algae*



*majority of science for heart, brain health  
and normal growth & development*



# Omega-3 Fatty Acids Are Not The Same



# ISSFAL Official Statement Number 5, 2009

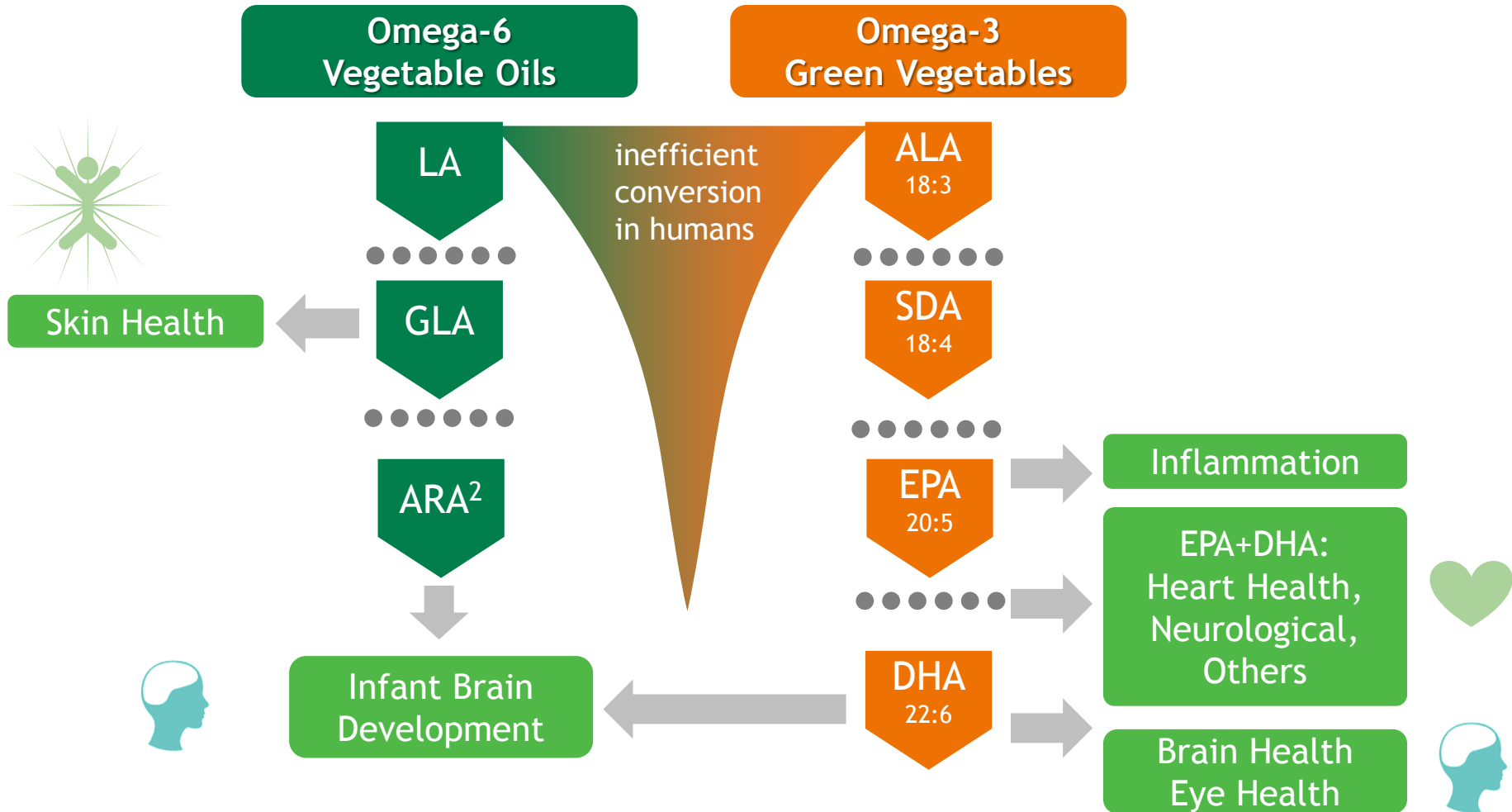
On “ $\alpha$ -Linolenic Acid Supplementation and Conversion to n-3 Long Chain Polyunsaturated Fatty Acids in Humans”:

With no other changes in diet, **improvement of blood DHA status can be achieved with dietary supplements of preformed DHA, but not with supplementation of ALA, EPA, or other precursors.**

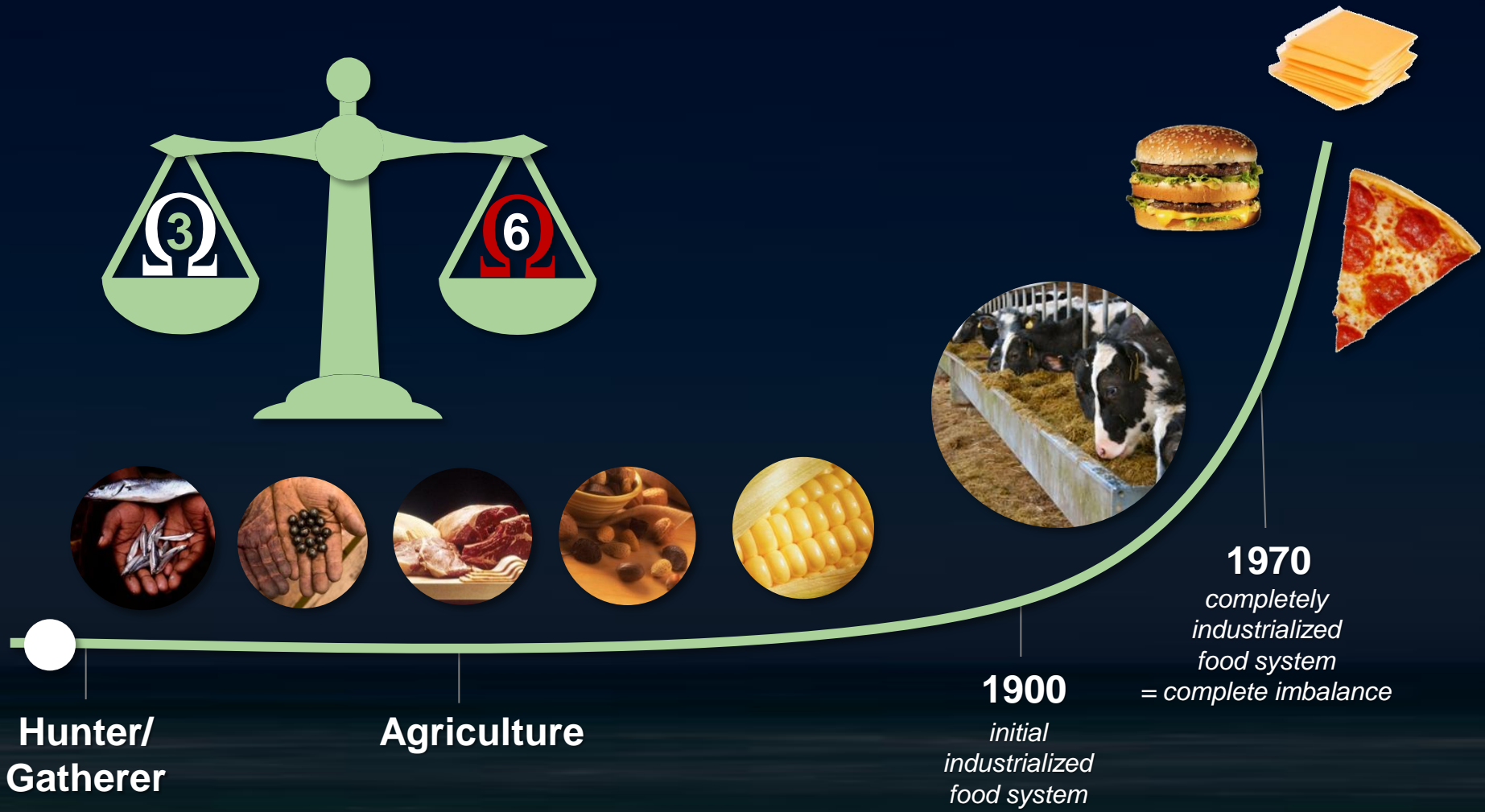
(International Society for the Study of Fatty Acids and Lipids, 2009)



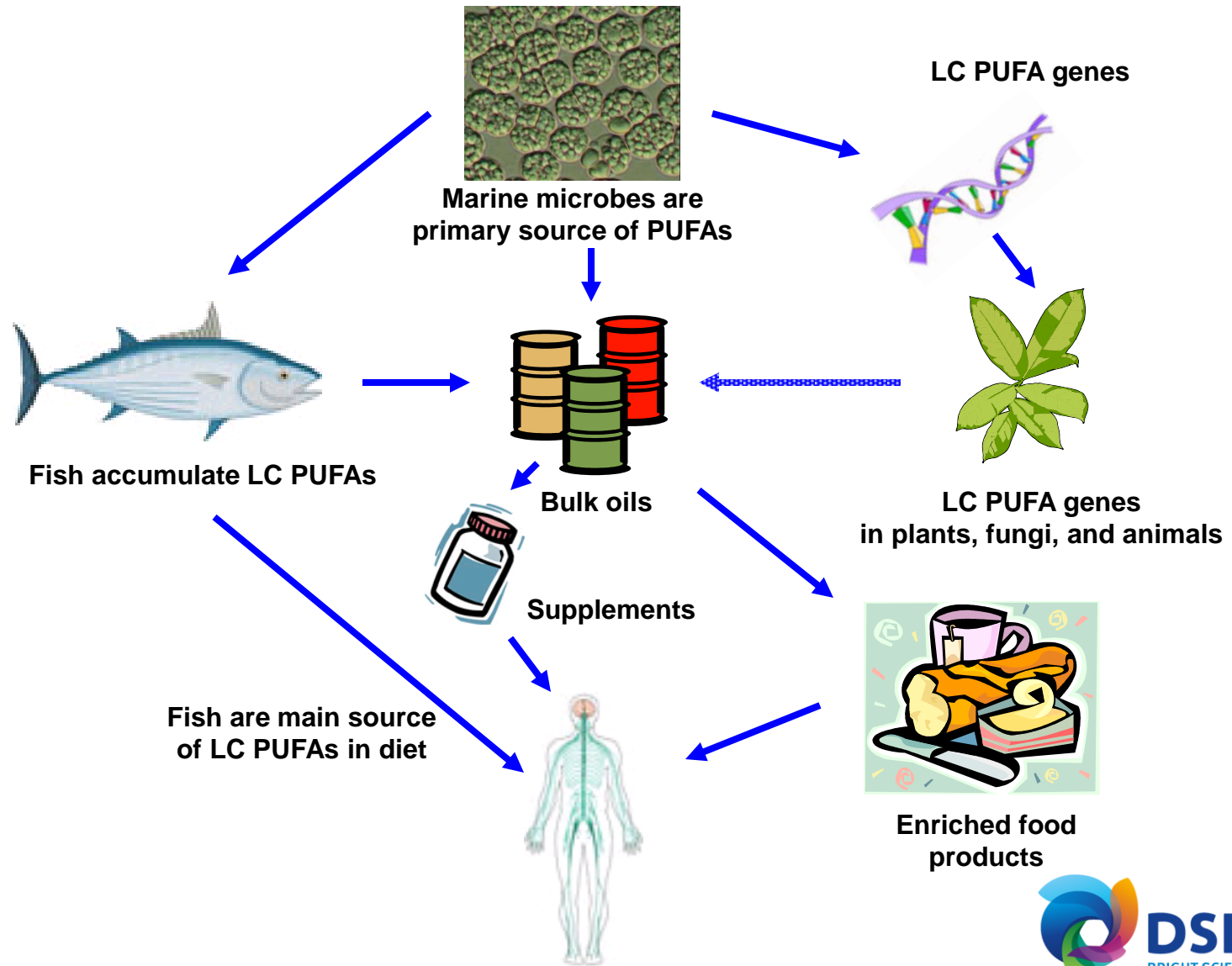
# Ω-3 & Ω-6 METABOLISM + HEALTH BENEFITS



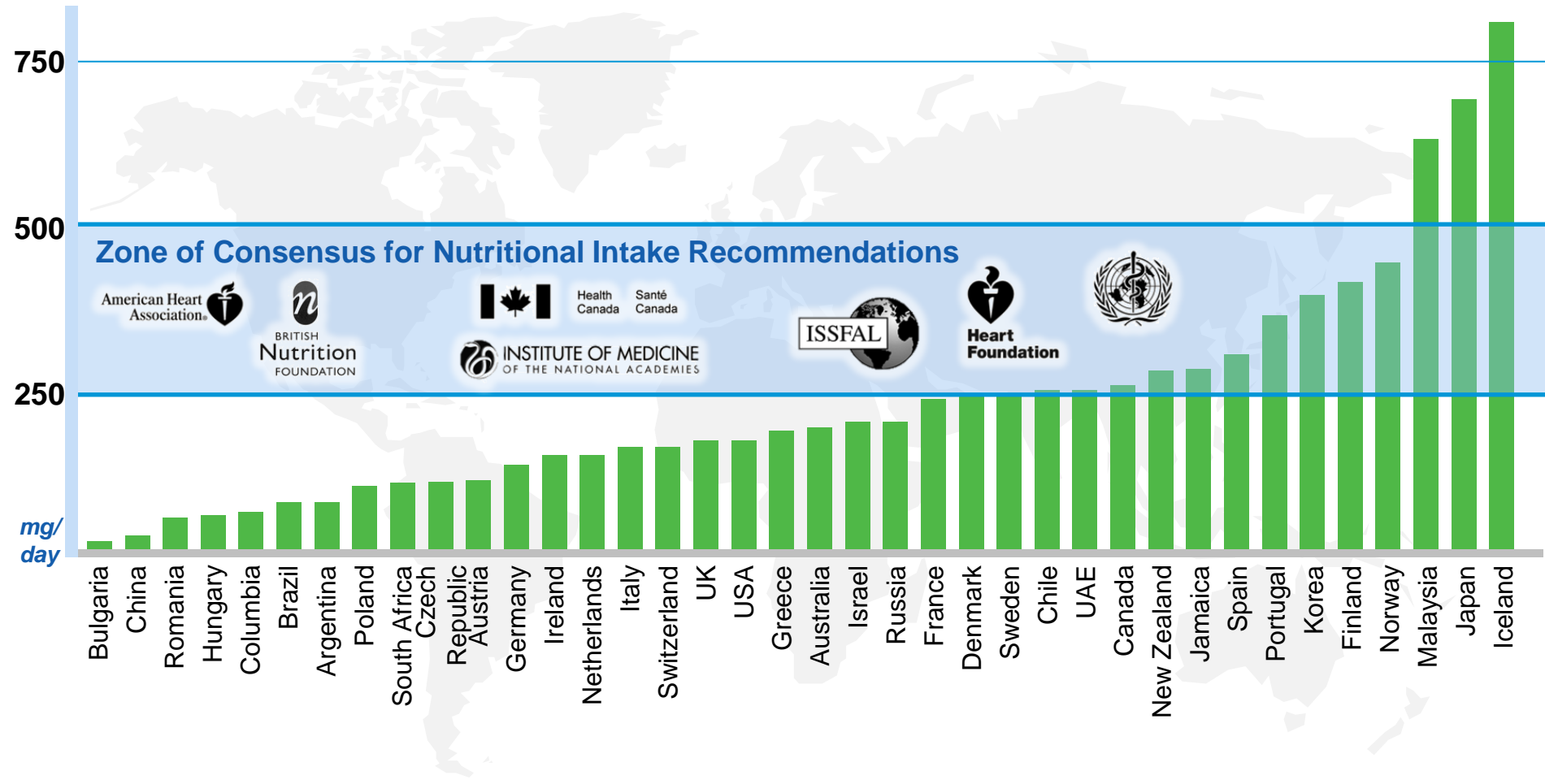
# IMPORTANT TO 'RE-BALANCE'



# Where do we get our Marine LC PUFA's?



# ESTIMATED AVERAGE DAILY INTAKES EPA and DHA



# OMEGA-3: A LIFETIME OF BENEFITS

*Ongoing Research*

Infant Eye & Brain development

Immunity

Mood

Eye Health

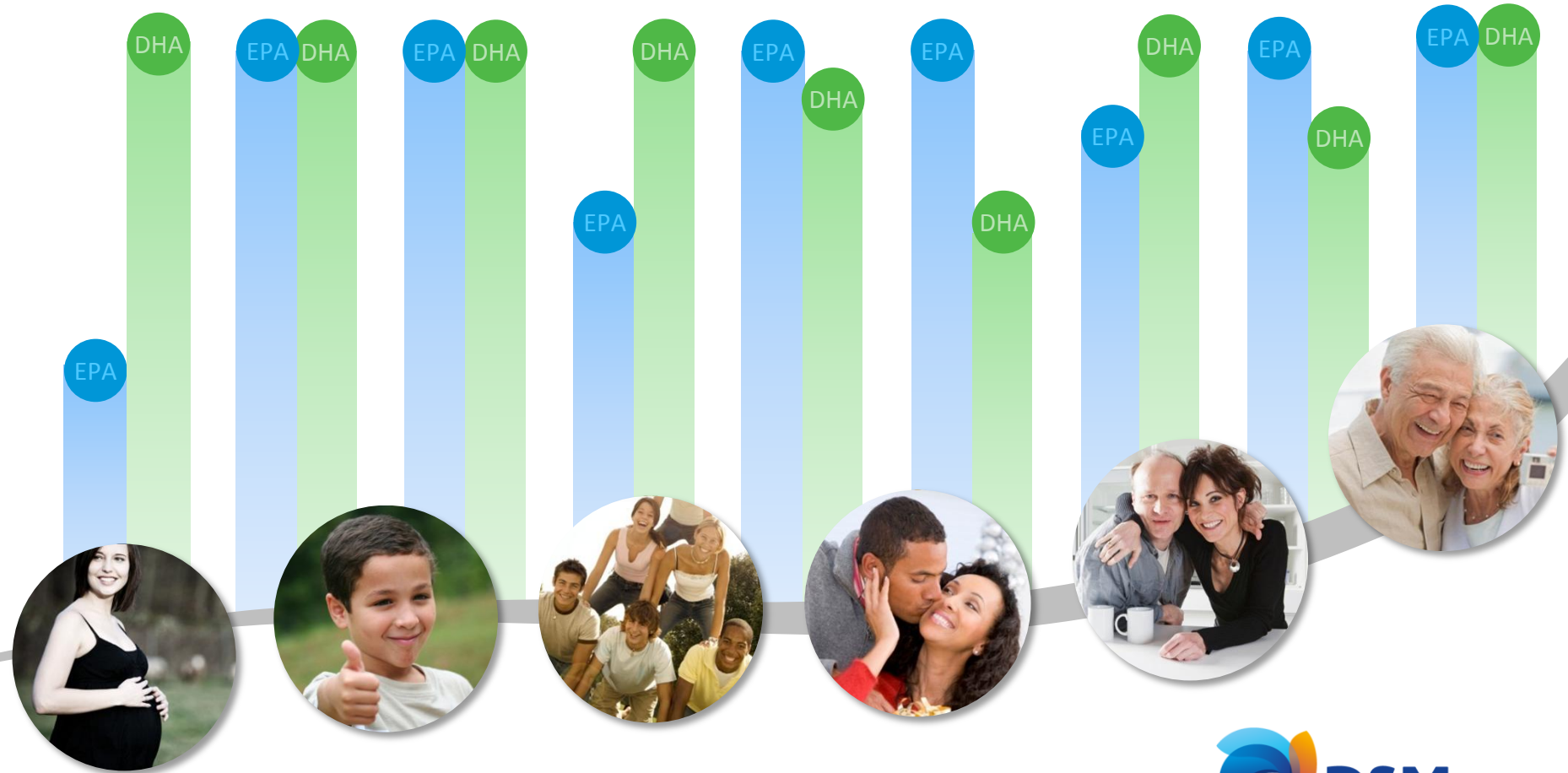
Heart Health

Joint Health

Cognition

Inflammation

Cancer (some types)



\*\*Disclaimer: Not for purposes of claims



# The production of algal oils rich in DHA

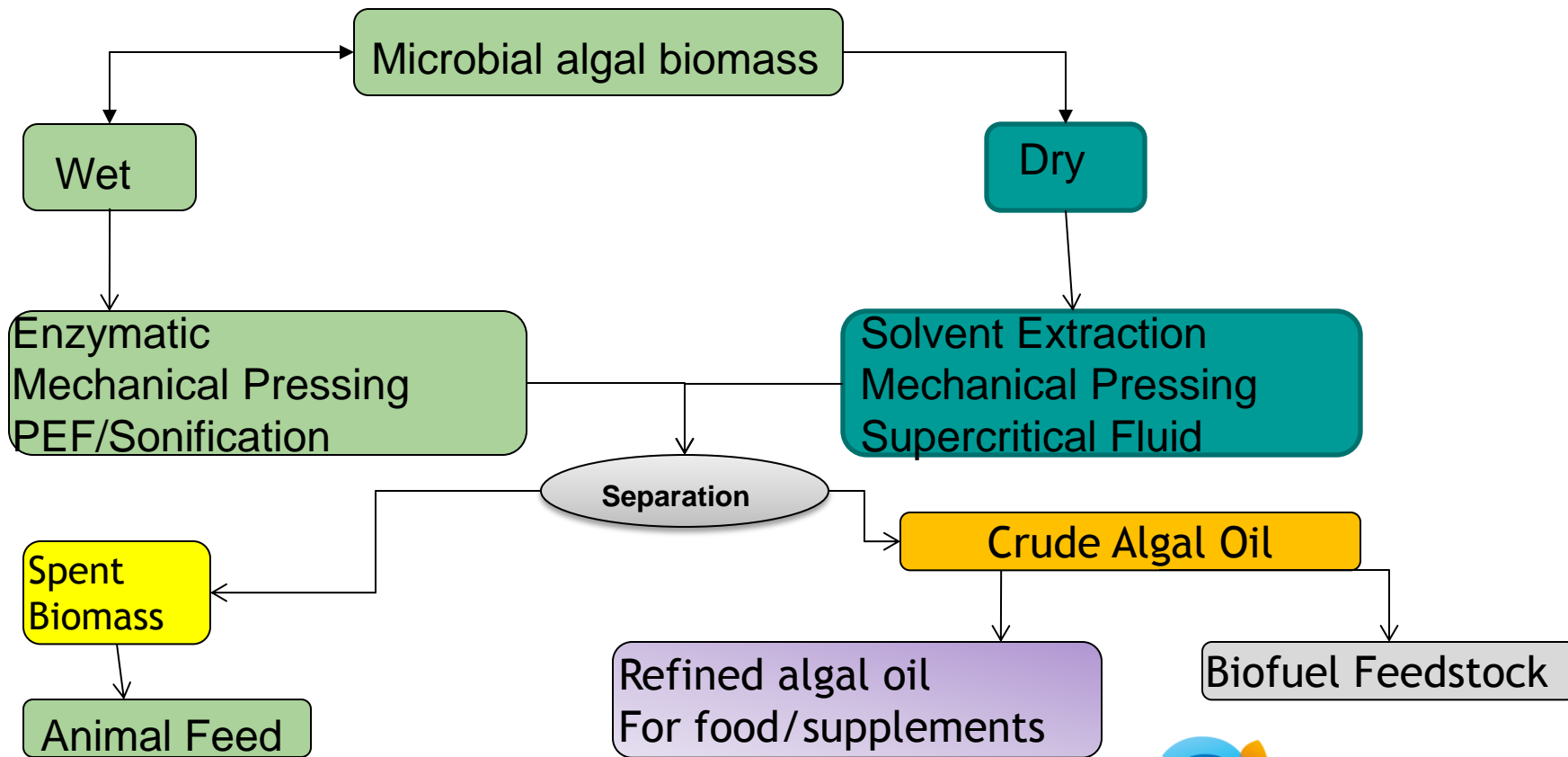
# Lipids from microalgae

- Microalgae produce between 1 - 70 % of their cell weight as lipids.
- Under certain specialised conditions, this lipid yield can be increased to over 90%
- GM technology can be enable long chain fatty acid production from the fermentation of yeast and bacteria - but yields are low

Micro-organism	% Oil	% Fatty Acid in Oil	Extraction method
<i>Cryptocodinium cohnii</i>	25.9	DHA 39.3%	Ultrasonic
<i>Spirulina platensis</i>	77.9	GLA 20.2%	SC-CO <sub>2</sub>
<i>Phaedodactylum tricorutum</i>	96.1	EPA 23.7%	Solvent
<i>Botryococcus braunii</i>	12.1	Oleic 65.3% Linolenic 19%	Solvent

Data extracted from Mercer and Armenta, Eur J Lipid Sci Technol 2011, 113:539-547

# Extraction/downstream processing of microbial oils



Derived from Mercer and Armenta ,2011 ,Eur J Lipid Sci Technol, 113:539-547



# Microalgal Oil Extraction Methods

Extraction method	Advantage	Limitation
Pressing	Simple, no solvents	Slow. Poor yields
Solvent Extraction	Solvents are inexpensive Yields improved and reproducible	Most suitable solvents are flammable. Toxicity issues. Recovery is expensive
Supercritical fluid	Safe, non-toxic solvents, simple	Expensive Complex scale up
Ultrasonic assisted	Reduced solvent consumption and extraction time	High power consumption Complex scale up

Derived from Mercer and Armenta ,2011 ,Eur J Lipid Sci Technol, 113:539-547

# life'sDHA™

HEALTHY ■ BRAIN ■ EYES ■ HEART

Excellent  
taste and  
odour

Made without  
contact to the  
marine  
environment

Sustainable

Plant-Based  
Source



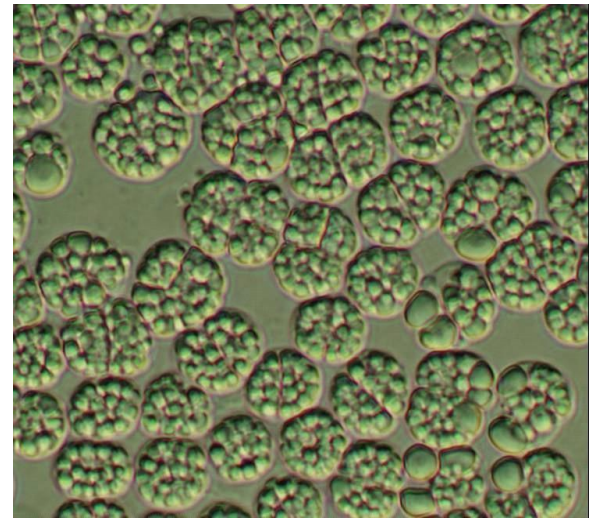
- *life'sDHA*™ oils are extracted from marine algae grown by fermentation in contained vessels.

# DSM's Algae

DSM Nutritional Products uses two types of marine micro-algae in their production of algal DHA oils.



*Crypthecodinium*



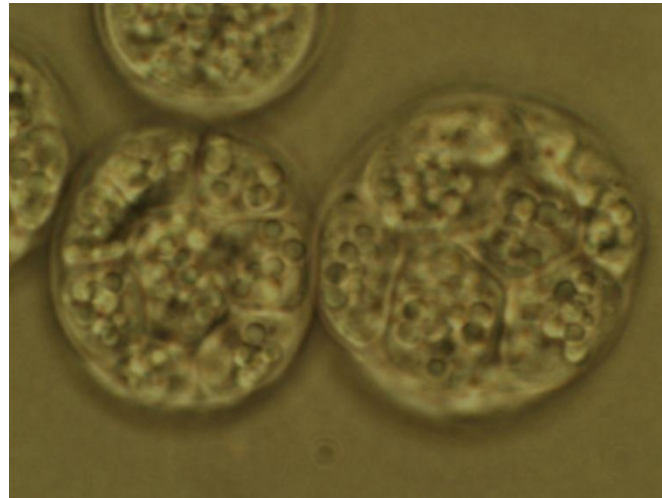
*Schizochytrium*

# Schizochytrium

- Marine Thraustochytrid (eukaryote - microalga)
- Widely dispersed in oceans
- Used for commercial production of DHA enriched oil and biomass
- Heterotrophic
- Specified in EU Novel foods approval

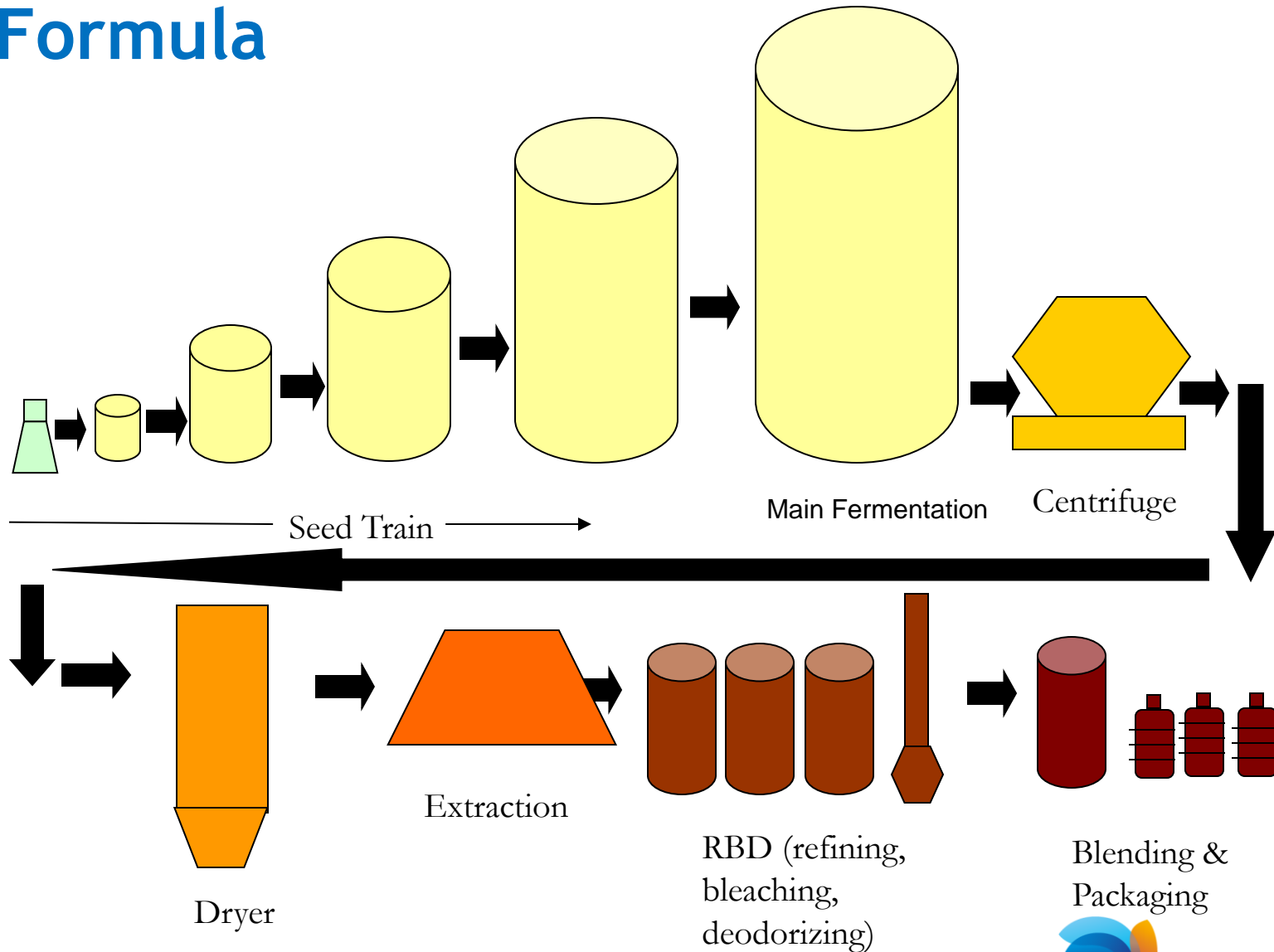
>50% of cell weight is  
Triglycerides

Fatty acid composition:  
37% DHA



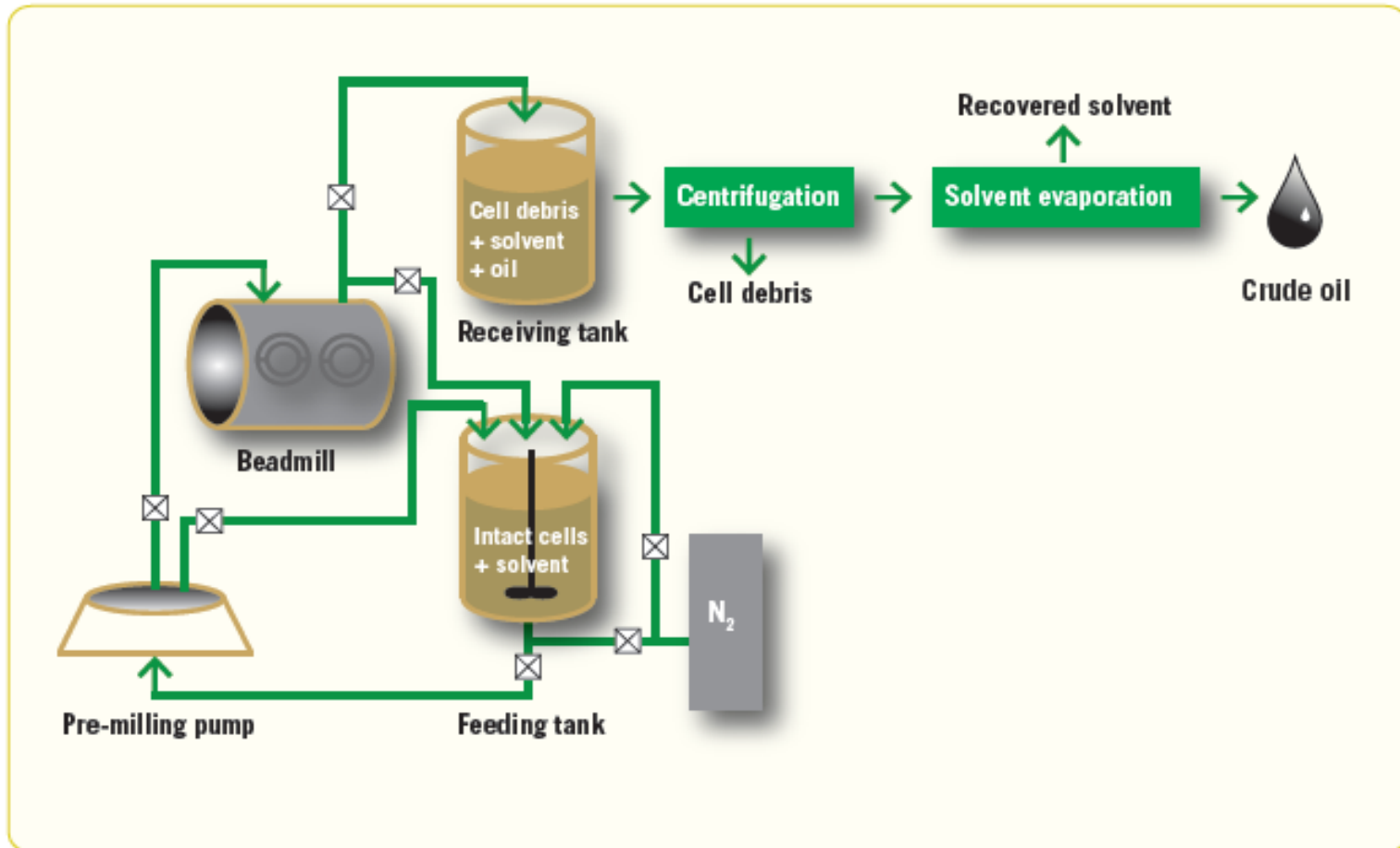
Courtesy of Casey Lippmeier, DSM Nutritional Products, Columbia, MA, USA

# DHA Oil Production Process for Infant Formula



\* Some steps are optional depending on the source material

# Typical method of oil extraction from algal cell biomass



Derived from Mercer and Armenta ,2011 ,Eur J Lipid Sci Technol, 113:539-547







***Trusted: The most trusted source of DHA, over 80 million babies nourished by life'sDHA, 99% of US Infant Formula***



***Proven: Over 100 clinical studies conducted using life'sDHA, Over 570 products launched worldwide***



***Global Leadership and Brand recognition***



***Integrated, controlled and sustainable supply chain***



***Unique Vegetarian source***





# Regulatory Aspects

# Authorised EU Article 13.1 Health Claims

Official Journal of the European Union 25.2.12, Commission regulation (EU) 432/2012 of 16<sup>th</sup> May 2012.

- DHA Contributes to the maintenance of normal brain function (250 mg/d).
- DHA Contributes to the maintenance of normal vision (250 mg/d).
- DHA + EPA Contributes to the maintenance of normal function of the heart (250 mg/d).

Official Journal of the European Union L160/4,  
Commission regulation (EU) 536/2013 of 12th June  
2013.

- DHA + EPA Contribute to the maintenance of normal blood pressure ( 3 g/d).
- DHA + EPA Contributes to the maintenance of normal triglyceride concentrations (2 g/d).
- DHA Contributes to the maintenance of normal blood triglyceride levels (2 g/d).

# Authorised EU Article 14 Health Claims for DHA

EFSA, 2010, EFSA Journal, 8(3):1461

“DHA intake contributes to the normal visual development of infants up to 12 months of age“

“DHA maternal intake contributes to the normal development of the eye of the foetus and breastfed infants”

“DHA maternal intake contributes to the normal brain development of the foetus and breastfed infants”

# Regulatory Approval of DSM Algal Oil in the European Union

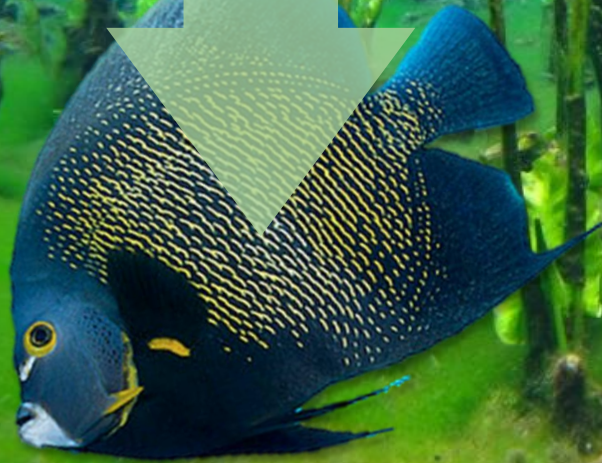
- DSM's algal oil DHASCO® has been approved for use in Infant Formula in the European Union under Commission Directive 2006/141/EC. This regulation states that when added, 1% of the total fat content should consist of n-3 LC-PUFA's and 2% of the fat content should be n-6 LC-PUFA's of which 1% is arachidonic acid (ARA). DHASCO® is also considered as a food in the EU (e.g., not a novel food) based on its "significant degree of use" prior to 1997.
- DSM's *Life'sDHA*™-S algal oil is approved for use as a novel food ingredient in specific food categories and dietary supplements (OJL 144/13, 12.6.2003; OJL 278/56, 23.10.2009). This algal oil must be labeled "DHA rich oil from the microalga *Schizochytrium* sp" under these regulations.

*life'sOmega*<sup>™</sup>, a new algal oil  
with both DHA and EPA



# Straight to the Source

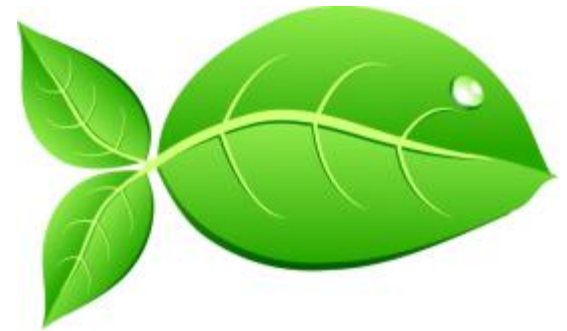
# vs.



# *Life'sOmega™*

## The Fishless DHA/EPA Omega-3 Oil

All the Health Benefits of DHA/EPA Omega-3



Premium, vegetarian and fish-free  
algal alternative to fish oil!



# Fatty Fish Naturally Contain DHA and EPA in a Ratio closer To *life'sOmega*<sup>™</sup> than most Traditional Fish Oils

Fish	DHA mg per 85g serving	EPA mg per 85g serving
Atlantic Salmon	950	250
Pacific Sardines	740	450
Sockeye Salmon	600	450
Rainbow Trout	440	400
Canned White Tuna	540	200
Canned Light Tuna	190	40
<i>life'sOmega</i> <sup>™</sup>	720 (per 3 g oil)	360 (per 3 g oil)



# Life'sOmega™: Novel Foods Approval

The EU Novel Foods approval can be found at:-

- [http://ec.europa.eu/food/food/biotechnology/novelfood/authorisations\\_en.htm](http://ec.europa.eu/food/food/biotechnology/novelfood/authorisations_en.htm)

“DHA and EPA rich oil from the microalgae *Schizochytrium*: dated 6 July 2012 (Food Standards Agency (UK) NFU 786)

- The ingredient declaration is same for our S Oil, i.e. ‘oil from the micro-algae *Schizochytrium sp.*’

# The “Fishless Fish Oil”: With all the Health Benefits of DHA/EPA Omega-3



- DSM-Nutritional Lipids has collected, identified and isolated a strain of algae with a fatty acid profile that is similar to fish oils from fatty fish
- DSM’s *life'sOmega*<sup>™</sup> : a sustainable, vegetarian and terrestrial algal alternative to fish oil
- While most people believe that fish produce their own DHA & EPA, it’s actually algae in their diet that makes them a rich source of omega-3s
- DSM goes right to the source, producing an oil from microalgae that is rich in DHA/EPA, delivering important heart benefits from the EPA and DHA.
- The *life'sOmega*<sup>™</sup> oil (60% LCPUFAn-3) contains: Min 50% DHA+EPA (500 mg/g). Min 30% DHA + Min 15% EPA (300 mg/g DHA+150 mg/g EPA).



# DSM algal oils

High quality DHA and EPA containing oils can be extracted from marine algae grown in contained fermenters that have:

- ❖ High purity
- ❖ Excellent organoleptic properties
- ❖ Excellent batch-to-batch consistency
- ❖ Freedom from marine contact
- ❖ Excellent sustainability credentials



# Summary:-

- Marine algae can be fermented in a contained environment to create biomass from which omega 3 fatty acid rich algal oils can be extracted.
- Algal sourced DHA, and more recently mixed DHA/EPA, have been commercially produced for use in supplements and foods
- Algal oils have excellent sustainability credentials and are produced in a highly controlled production environment. They also exhibit excellent taste/odour profiles.
- My thanks to my colleagues Roberto Armenta, Ruben Abril, Kirk Apt, Roberto Armenta, Bill Barclay, Paul Behrens, Jon Hansen, Casey Lippmeier, Jim Metz and Craig Weaver for providing me with detailed information on algal oil production and to my colleague Ed Nelson for reviewing the clinical content.



Thank you - Tak - Gracias - Grazie Mille -  
Merci - Spasebo - Danke - Dank u wel - -  
Dziekuje - Dekuji

DSM Nutritional Products - Premium Healthy Marine Oils from Fish  
and Algal Sources



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