Products from microalgae: The formulators perspective

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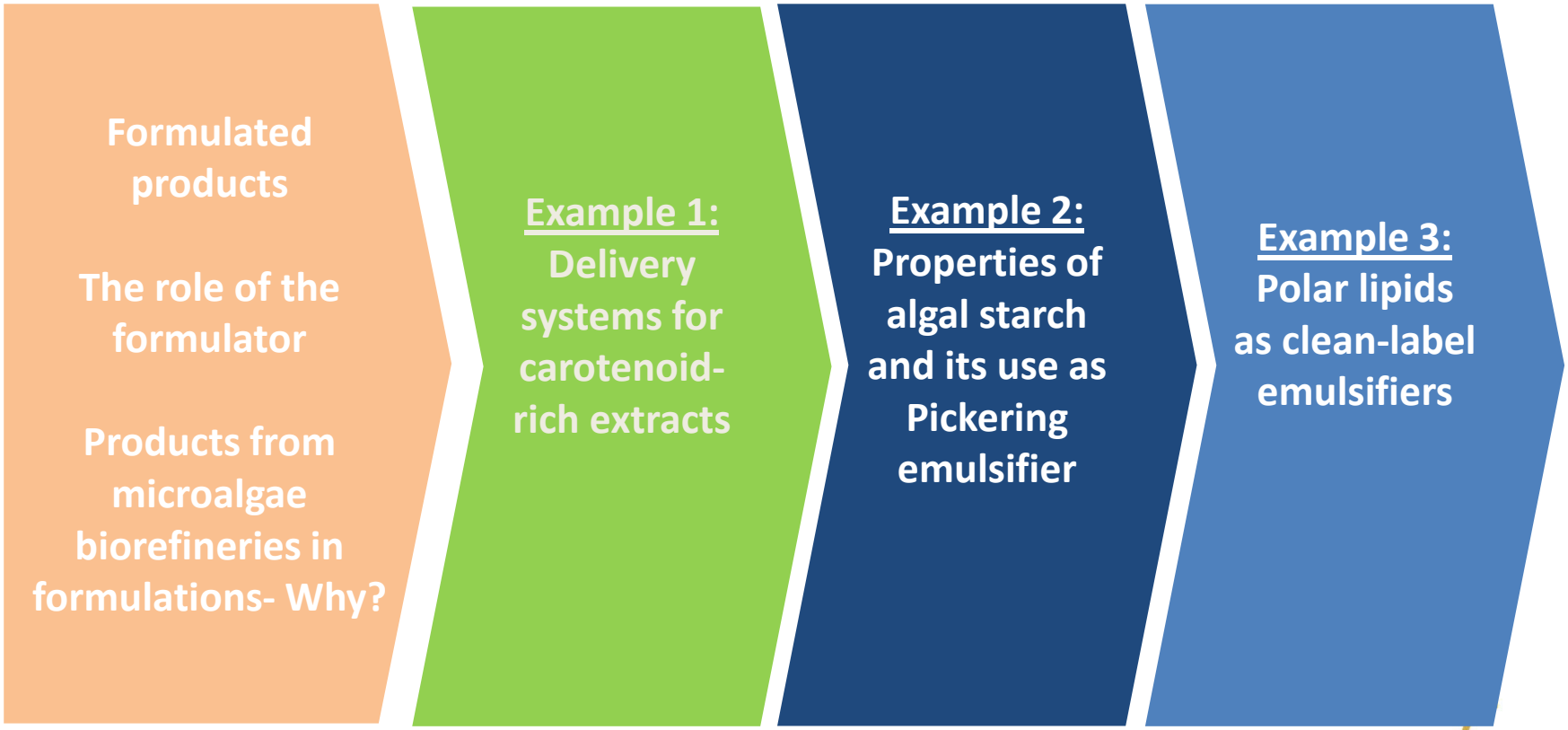
Outline

D-Factory products in formulations



Formulated Products

- Formulated product= 3 – 100 times higher than the value of ingredients
- The global emerging market for formulated in the order of €1,400 billion

The role of the formulator

Let´s take mayonnaise as an example…

Ingredients	Processing	Final product
What? How much? Why?	How? Order of addition? Why?	Right properties? Storage? Why?
Sustainable? Yardsticks?	Energy efficient? Resource efficient?	Recycling? Longer shelf-life?

Healthy

Eco

Clean label

Organic

All Natural

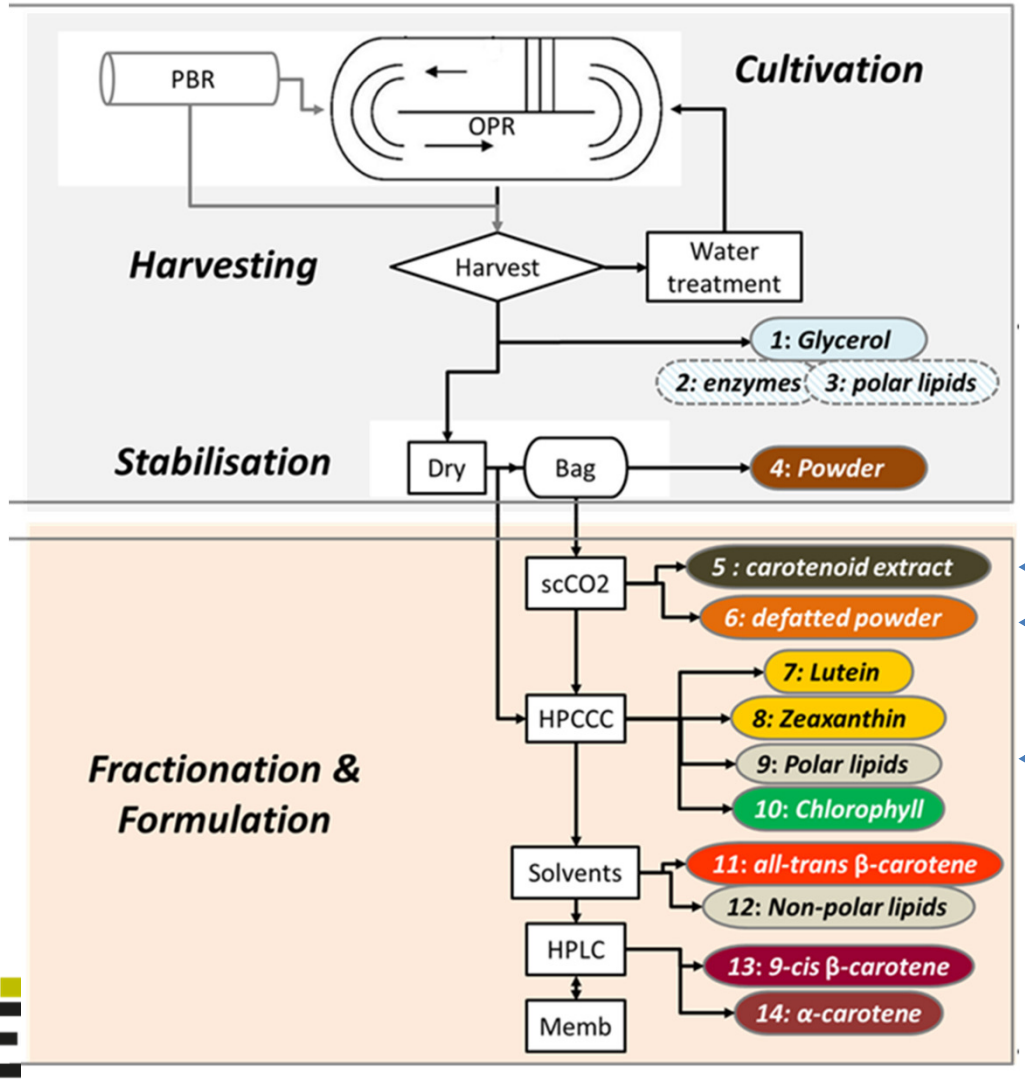
Products from microalgae biorefinaries in formulations- Why?

Biorefinery products → heterogeneity, purity and variability challenges

Demonstrating use in prototype formulated products:

- ✓ Early identification of limitations.
- ✓ Early assessment of technical value , performance, competitive edge.
- ✓ Early engagement of potential stakeholders.

D-Factory products ➡ Formulated products



Delivery systems for carotenoid-rich extracts

- Carotenoids - organic pigments
- Widely used in food supplements and colourants
- Many associated health benefits
- Products: Drinks, supplements, skin creams

!

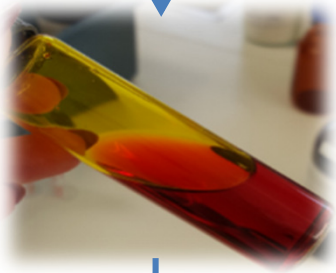
- Low solubilities in most common oils
- Prone to chemical degradation /oxidation

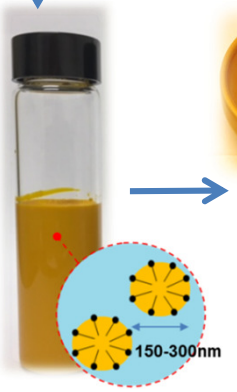
?

- Effect on solubility in carrier oils?
- Effect on chemical stability of caroteoids?
- Effect of physical stability of formulations?

Carotenoid-rich extract

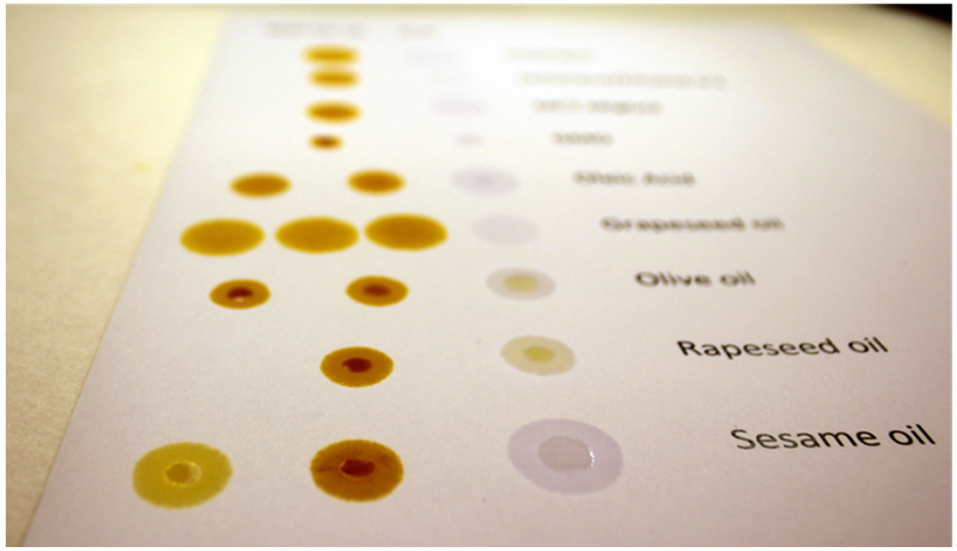
≥ 25-30% carotenoids
+ chlorophylls,
+ tri- and diglycerides





Solubility in carrier oils

Carotenoid-rich extract



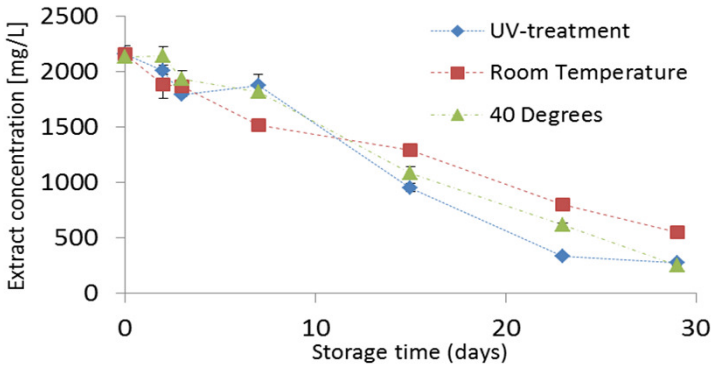
OILS	Carotenoid-rich Extract [%]
Grapeseed oil	4
Oleic acid	2.4
Rapeseed oil	2.1
Olive oil	1.5
Medium Chain Tryglic.	>1
Sesame oil	0.2
Glycerol Monooleate	0.1

- Higher solubility in oils than the high purity compounds
- Lutein and β-carotene (0.05% in grapeseed oil)

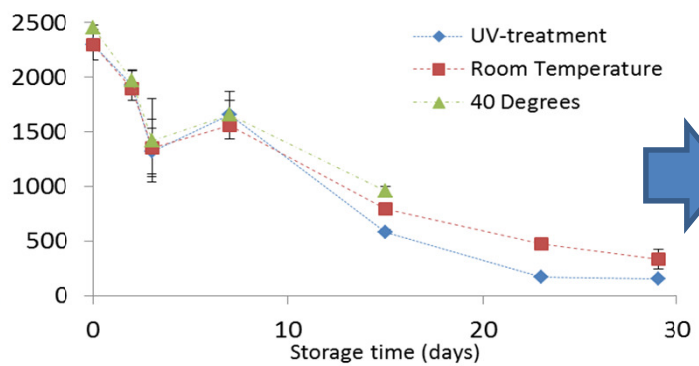
Stability of carotenoid extract in nano-carriers

Carotenoid-rich extract

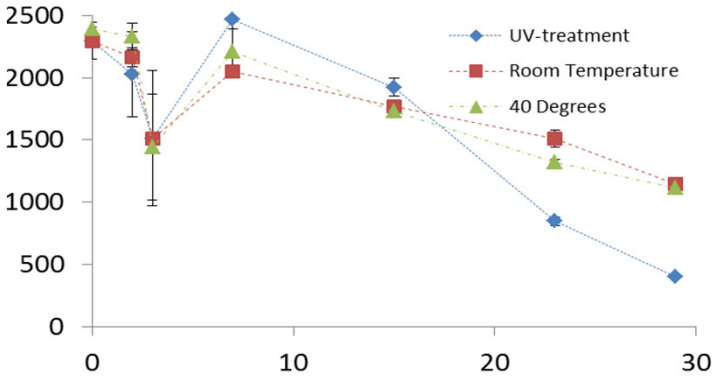
Stearic acid nano dispersion

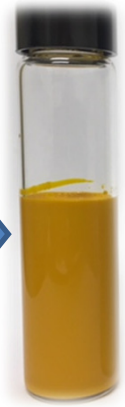


Carnuba wax nano dispersion



MC Triglyceride nano emulsion





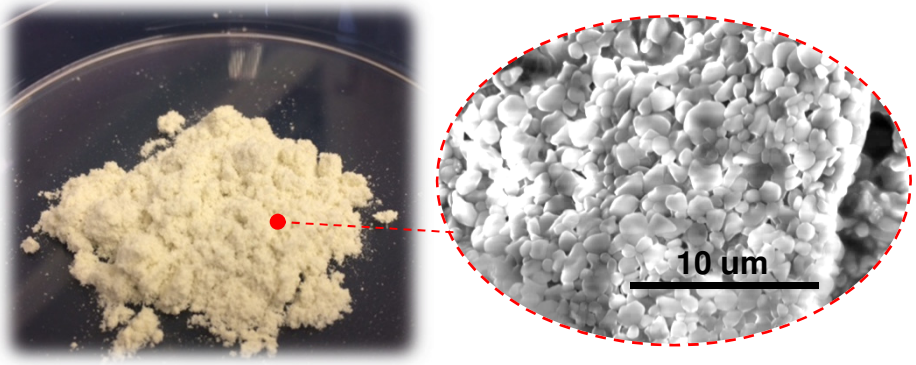
10% lipid/oil

2500 mg/L extract (0.025%)

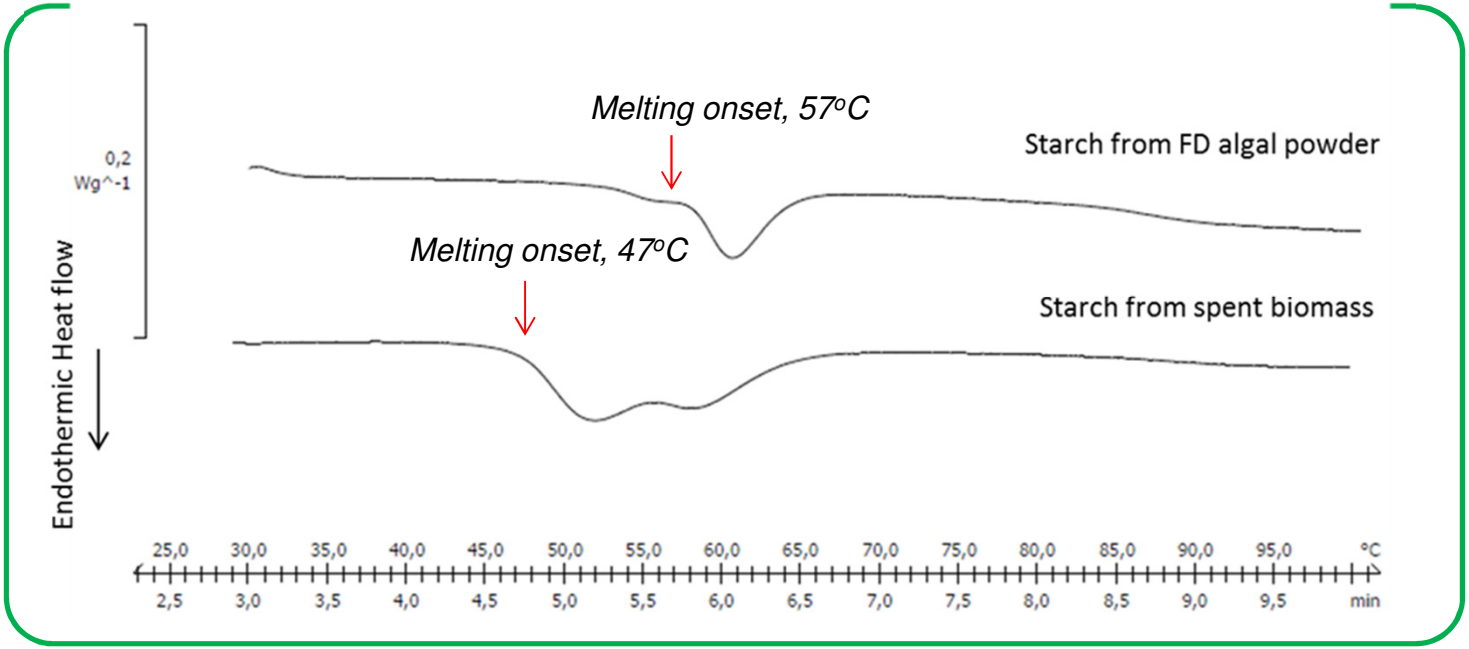
Emulsifier: Soy Lyso Lecithin

Starch from defatted powder

- 38 % of starch in defatted algal powder
- 73% isolated through separation process

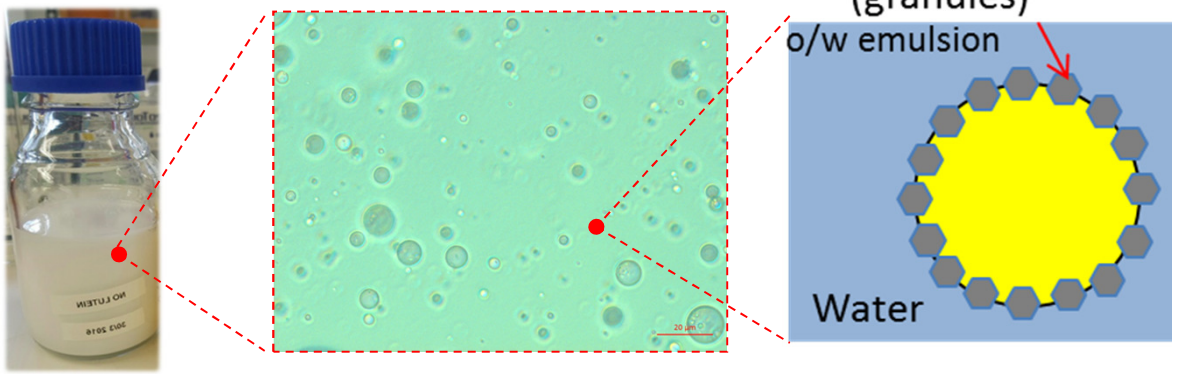


Thermogram of starch upon heating from 20 to 100°C (starch/water 1:3).

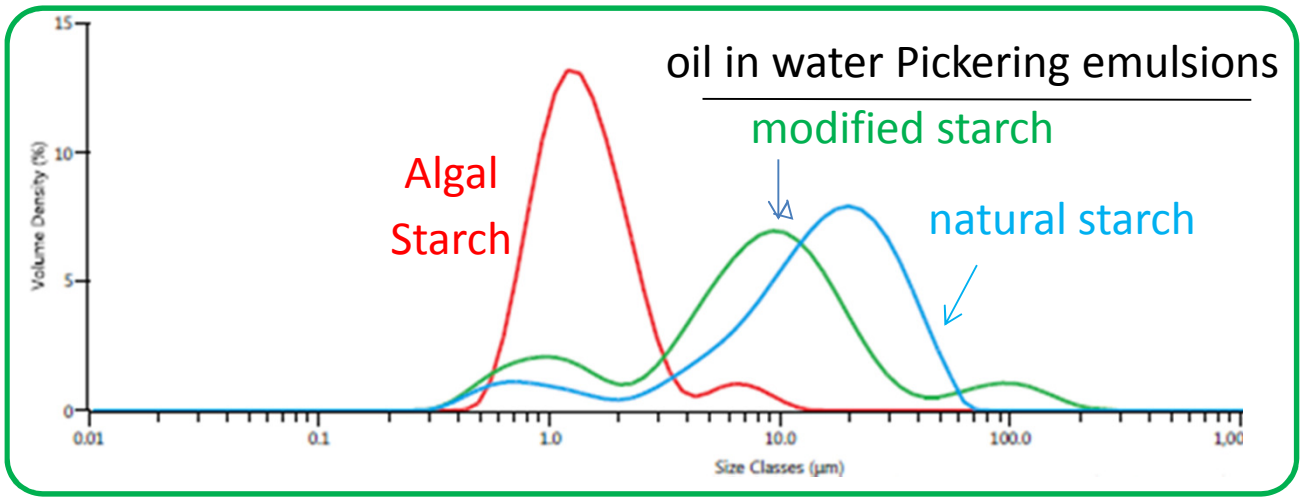


Starch from defatted powder

Use as Pickering emulsifier



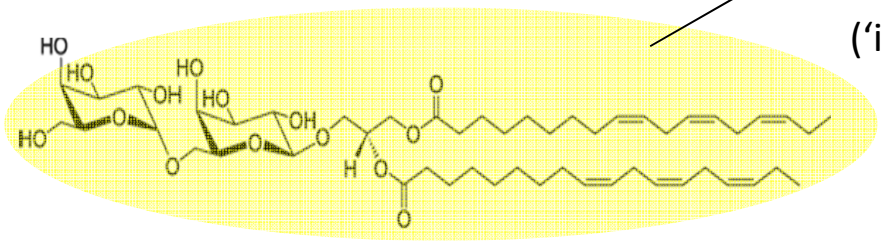
Drop size distribution (% V) of algal starch and oil in water Pickering emulsions



Polar lipids

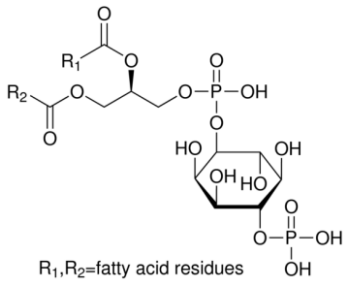
Major components of polar lipid fractions isolated from algal biomass

trigger natural appetite control mechanism ('ileal brake')

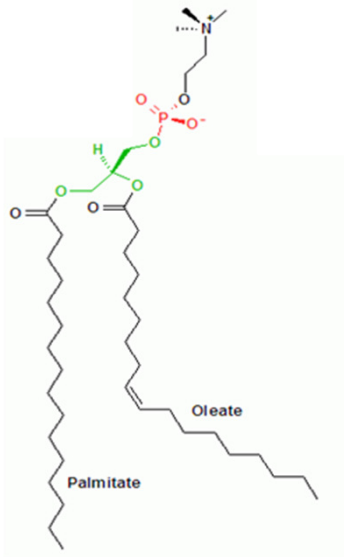


Glycolipids

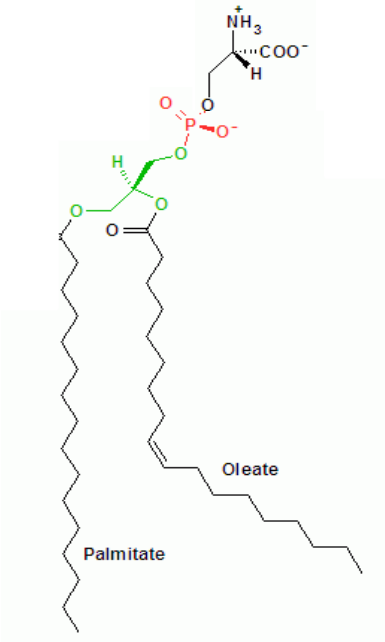
(e.g. DiGalactosyl-DiacylGlycerol)



Phosphoinositol-phospholipid



Phosphatiodylcholine (PC)

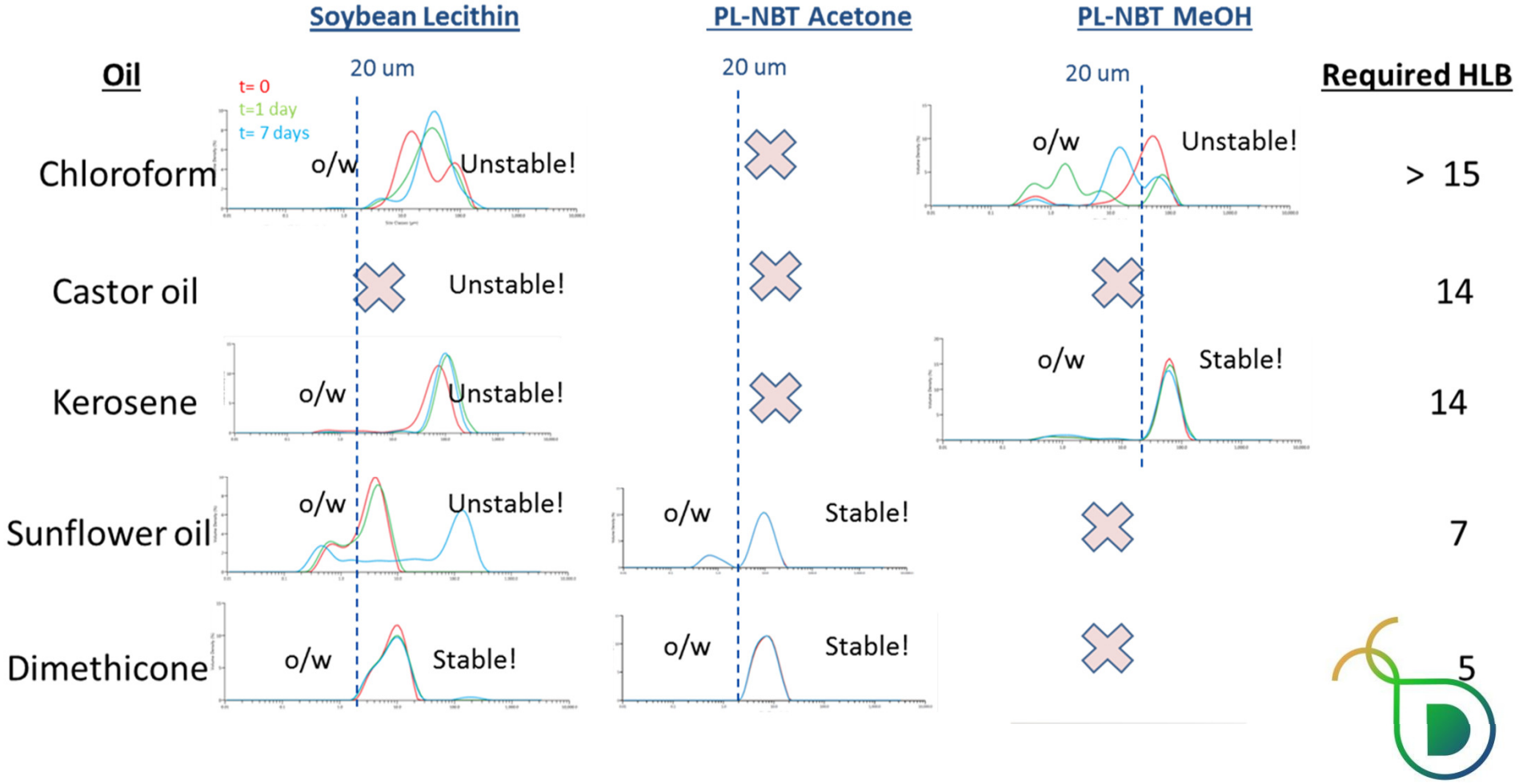


Phophatidylserine (PS)

Polar lipids as clean-label emulsifiers

Reference emulsifier

Algal polar lipids with different polarity



The take-home messages:

- Formulation industries are an interesting target for microalgae biorefinery products.
- Worth investing time in identifying and addressing technical challenges.
- Identified and tested suitable nano carrier systems for carotenoid-rich extracts.
- Demostrated use of algal starch as novel Pickering emulsifier.
- Demostrated emulsification properties of algal polar lipids.

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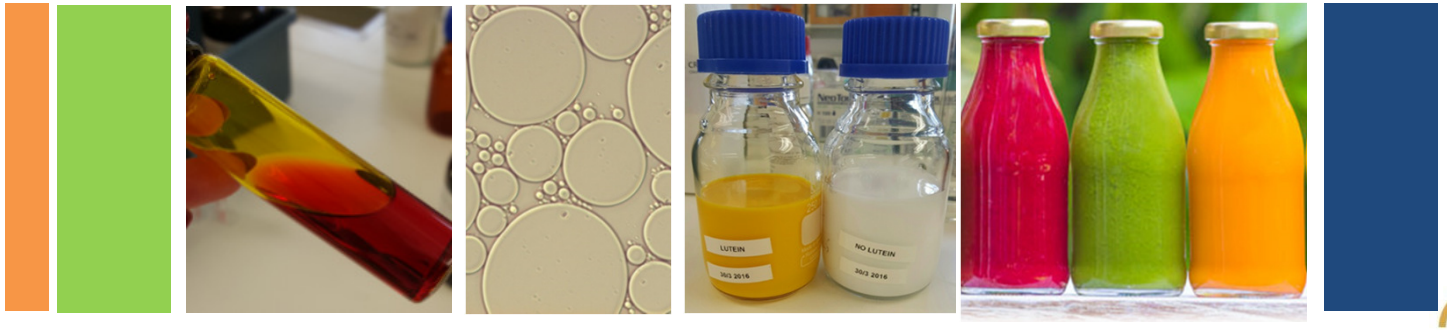
Lena Brive (RISE)

European Commission, FP7
D-Factory: THE MICRO ALGAE BIOREFINERY
(Contract no. 613870)
www.d-factoryalgae.eu

and to you for your attention!