Carotenoids in algae under stress (and the ASIB algae collection)

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The ASIB algae collection

Algensammlung, Institut für Botanik, Universität Innsbruck

- Earliest isolates are from the 1920s

- Expanded by H. PITSCHMANN and H. REISIGL in the early 1960s, W. VISCHER's culture collection from Basel (Switzerland) in 1975 and later by G. Vinatzer, H. Trenkwalder, K. Schwarz, G. Gärtner and B. Brunner.

- Today more than 700 isolates are maintained

- The collection is of soil, airborne and lichen algae mostly from the Alps, including high altitude alpine areas

- All strains are cultivated on agar slants (BBM) under 12:12h diurnal cycle of <5µmol quanta m^{-2} s^{-1} at 10 °C

- Cultures are available for research purpose

The ASIB algae collection

Algensammlung, Institut für Botanik, Universität Innsbruck

Institute of Botany collection, isolated by H. Pitschmann and H. Reisigl (1950s-70s) isolated from soil in various alpine areas

W. Vischer collection or Basel Collection (1920s-1950s; transmitted in 1975): strains isolated mostly from Switzerland, different localities, soil, rocks and other terrestrial habitats

G. Vinatzer collection (1975), strains isolated from soil, Dolomites, South Tyrol

H. Trenkwalder collection, (1975) strains isolated from soil, pine forest, Brixen, South Tyrol, Italy

These collections have included 156 'type' strains used for describing unique taxa

The ASIB algae collection

Algensammlung, Institut für Botanik, Universität Innsbruck

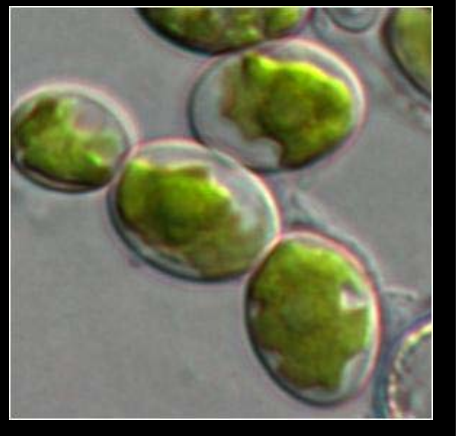
K. Schwarz collection (1975) strains isolated from soil, Isle of Lavsa, Croatia

G. Gärtner collection (1970s-1980s), strains were isolated from soil, bark of trees, rocks in Innsbruck, Tirol and vicinities

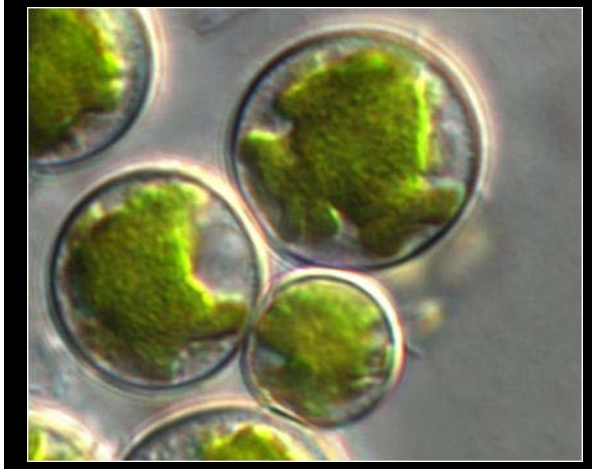
B. Brunner collection, (2012), strains were isolated from soil, alpine grasslands (2400-2700 msl), Obergurgl, Tirol

TYPE strains, golden part of the collection

Botrydiopsis callosa: NOT in other collections!
Chlorococcum vacuolatum (CCAP 213/8, SAG 213-8, UTEX 110)
Chloroidium cf. sacharophilum: NOT in other collections!
Coccomyxa brevis (CCAP 850/1, SAG 850-1, UTEX 152)
Gloeotilopsis sterilis (UTEX 1704)
Ignatius tetrasporus (UTEX 2012)
Leptosira obovata (CCAP 445/1, UTEX 319)
Scotiellopsis rubescens: NOT in other collections!
Spongiochloris excentrica (CCAP 280/1, SAG 280-1, UTEX 108)
Spongiochloris spongiosa (CCAP 3/1, SAG 280-2b, UTEX 1)
Stichococcus allas : NOT in other collections!



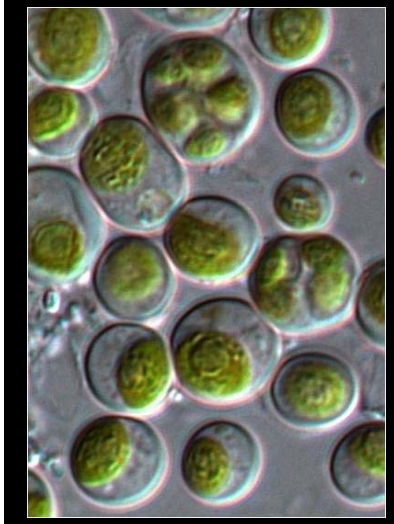
Other interesting strains in ASIB



ASIB-BS-735 *Watanabea sp.*

ASIB-BS-782 *Symbiochloris sp.*

ASIB-BS-807 *Microglena cf. media*



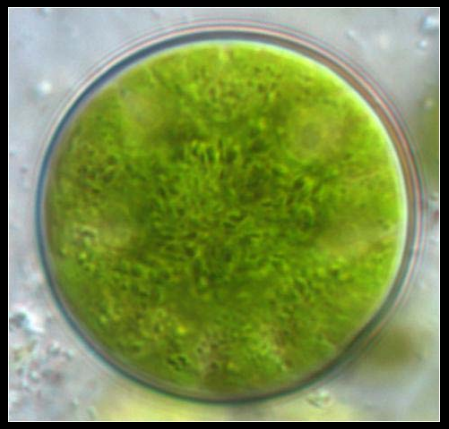
ASIB-BS-778 *Pseudo-chlorella signiensis*

ASIB-IB-329 *Rhopalocystis cucumis*

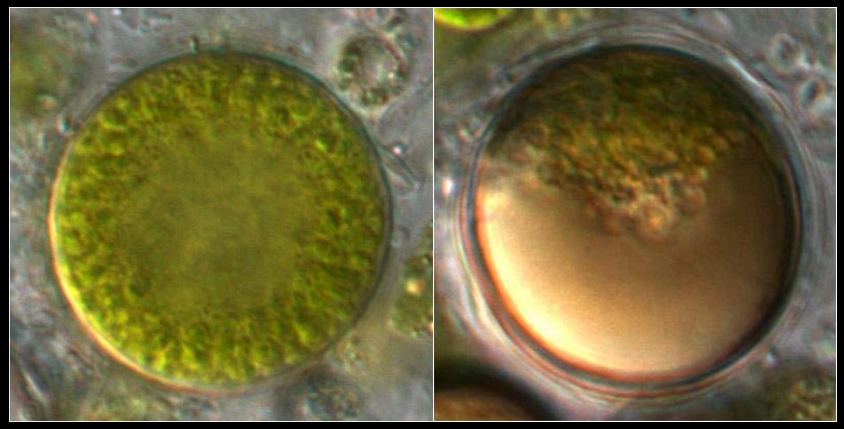
ASIB-IB-266 cf. *Chlorochytrium sp.*

ASIB-IB-164 *Chloroidium angusto-ellipsoideum*

Other interesting strains in ASIB



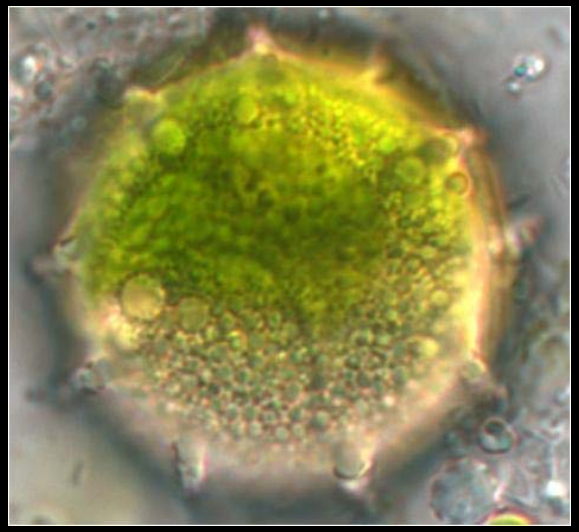
ASIB-IB-495 *Actinochloris sphaerica*



ASIB-BS-590 *Dictyochloris sp.*

ASIB-IB-275 *Chlorokybus atmophyticus*

ASIB-IB-494 *Pleurastro-sarcina sp.*



ASIB-T-77 *Trochisciopsis tetraspora*

ASIB-BS-524 *Myrmecia bisecta*

ASIB

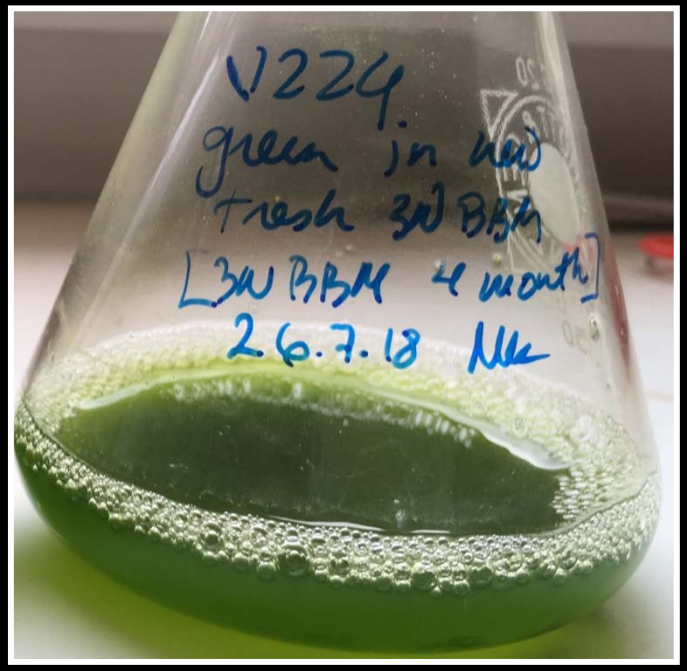
Backup isolates,
no media change
for 7 years

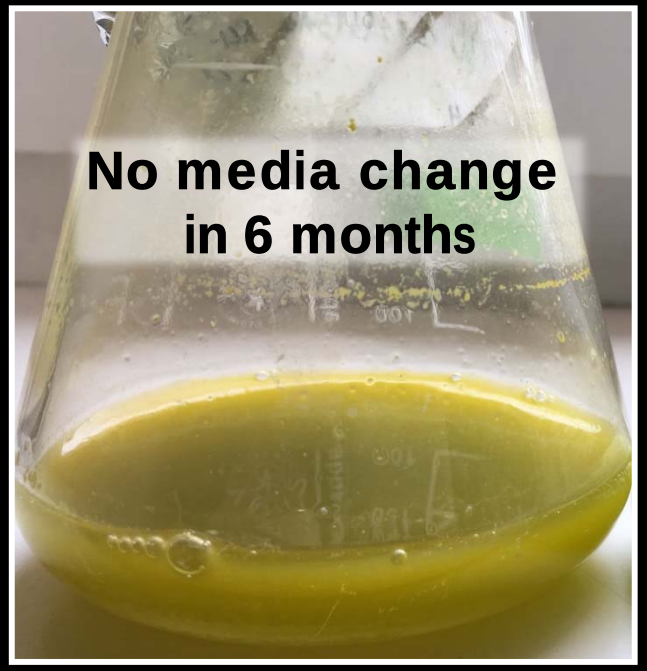
media change
Feb 2019

Nutrient deprivation induces resource recycling

Photosynthetically Active

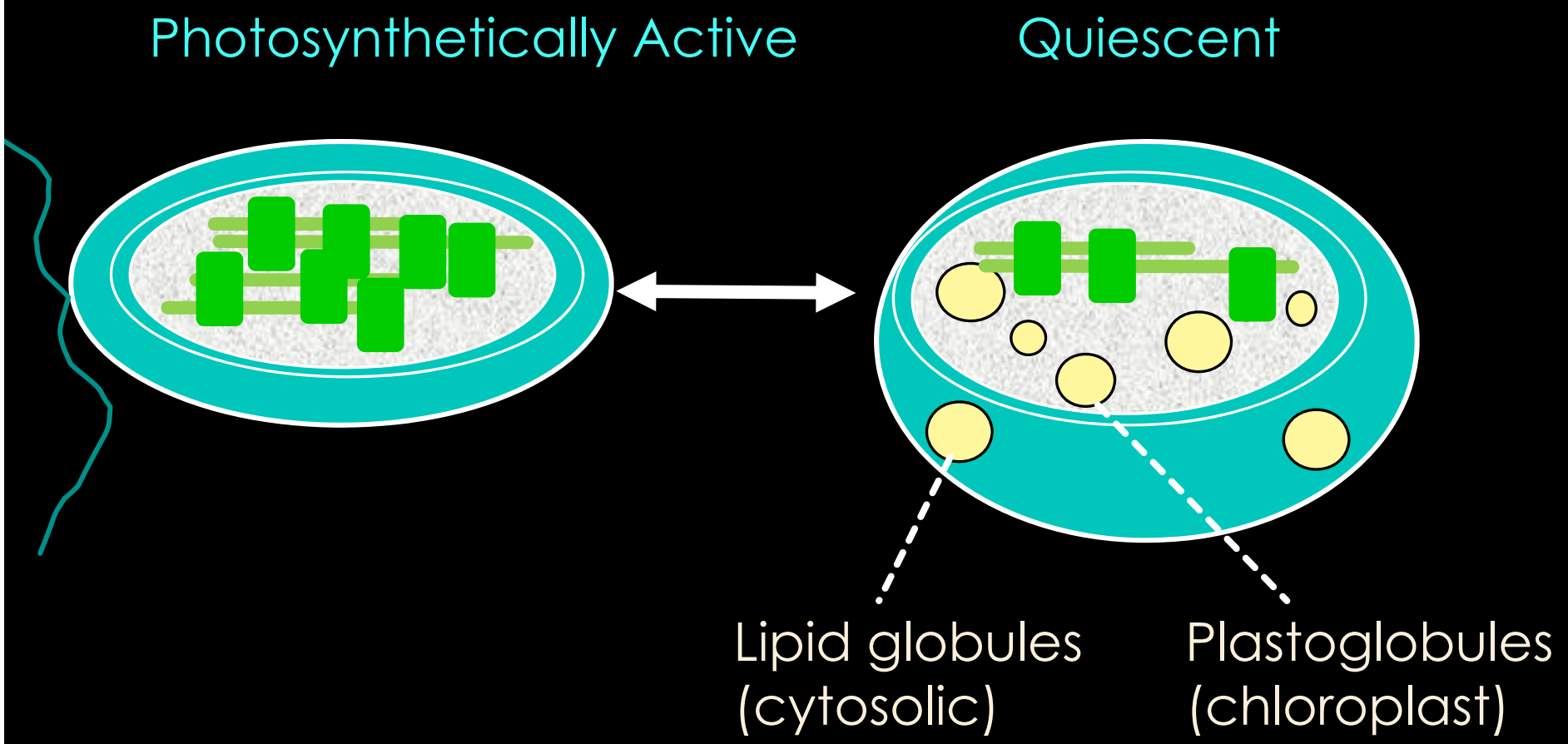
Quiescent





⇧ β-carotene

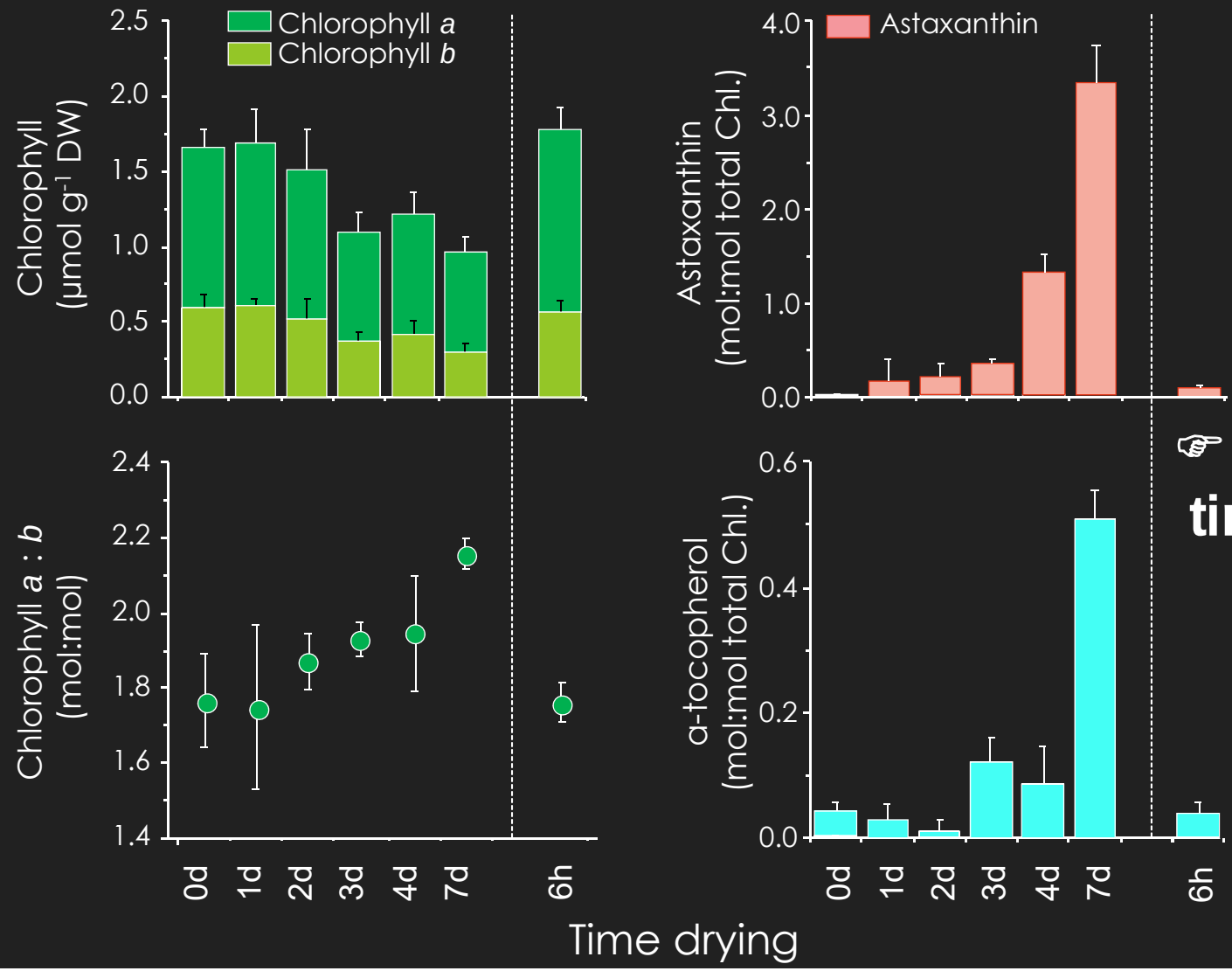
Nutrient deprivation induces resource recycling



Stress induces resource recycling in *Haematococcus pluvialis*

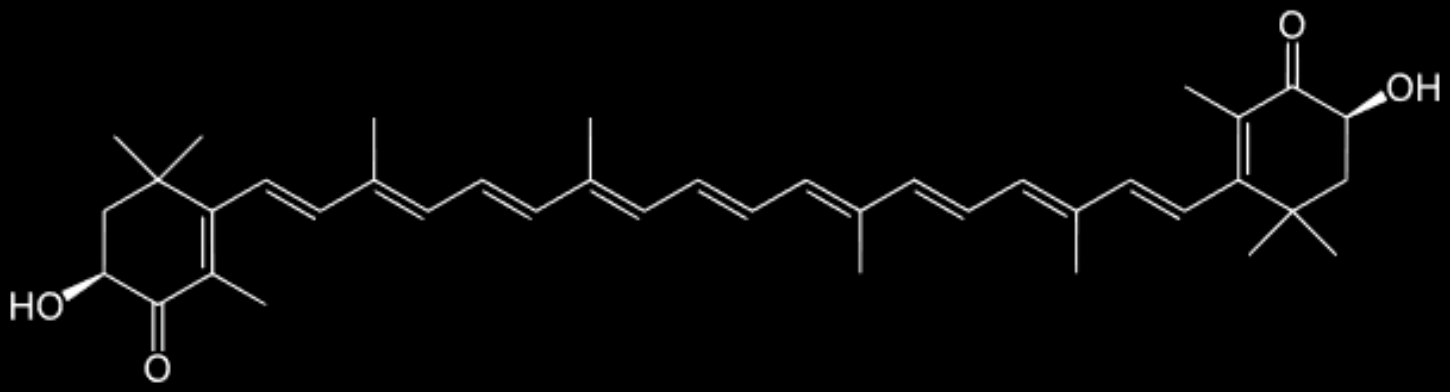
- Photosynthetic components broken down
- Lipid globules & astaxanthin synthesised

Desiccation-induced resource recycling in *Haematococcus pluvialis*



☞ **acclimation time required**

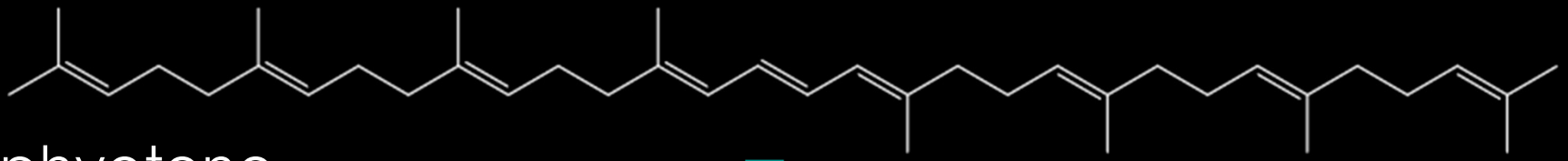
Function of non-photosynthetic carotenoids? e.g. astaxanthin



Powerful lipid-phase antioxidants

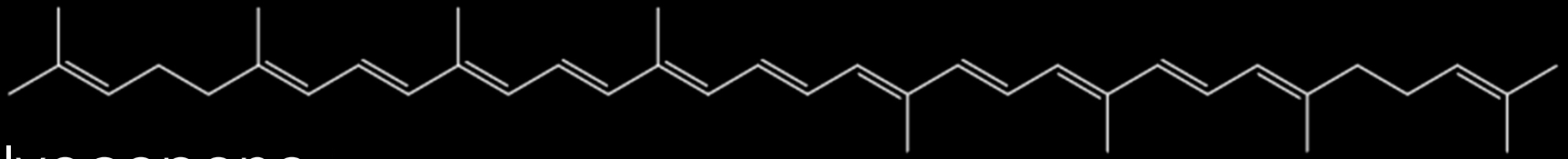
prevent lipid peroxidation

Carotenoids in algae - synthesis



phyotene

various Phytoene desaturases — *desaturation*

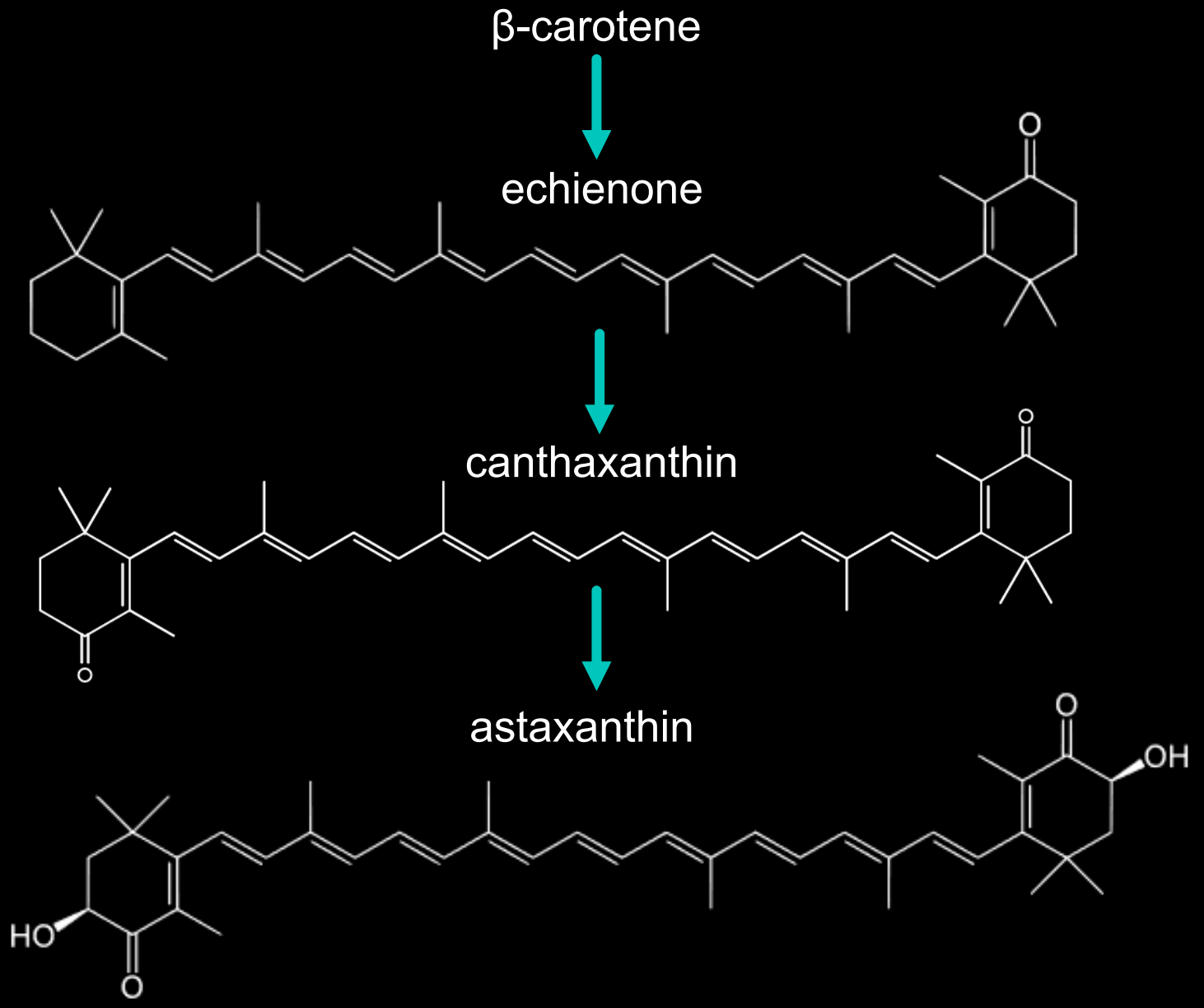


lyocopene

Lycopene cyclase — *cylazation*

carotene

Carotenoids in algae - synthesis



Photosynthetic carotenoids in algae

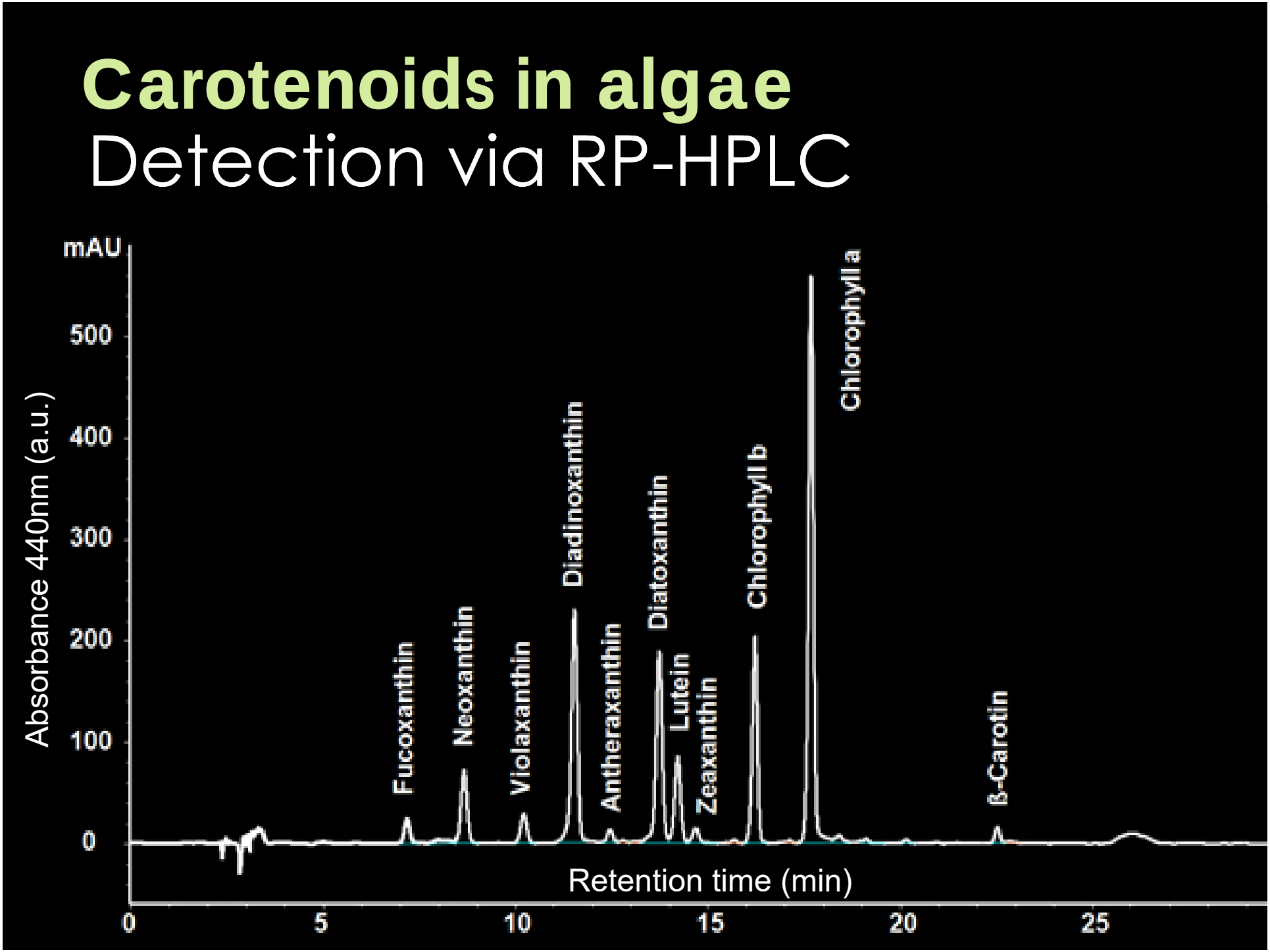
Division / Class	Carotene		Xanthophyll								
	β-caroten	α-carotene	Zeaxanthin	Violaxanthin	Neoxanthin	Diatoxanthin	Diadinoxanthin	Fucoxanthin	Lutein	Loroxanthin	Siphonaxanthin
Cyanophyta											
Glaucophyta											
Rhodophyta											
Unicellular type											
Macrophytic type											
Cryptophyta											
Heterokontophyta											
Chrysophyceae											
Raphidophyceae											
Bacillariophyceae											
Phaeophyceae											
Xanthophyceae											
Haptophyta											
Dinophyta											
Euglenophyta											
Chlorarachniophyta											
Chlorophyta											
Prasinophyceae											
Chlorophyceae											
Ulvophyceae											
Trebouxiophyceae											
Charophyceae											
Land Plants											

Taxonomic distribution of photosynthetic carotenoids

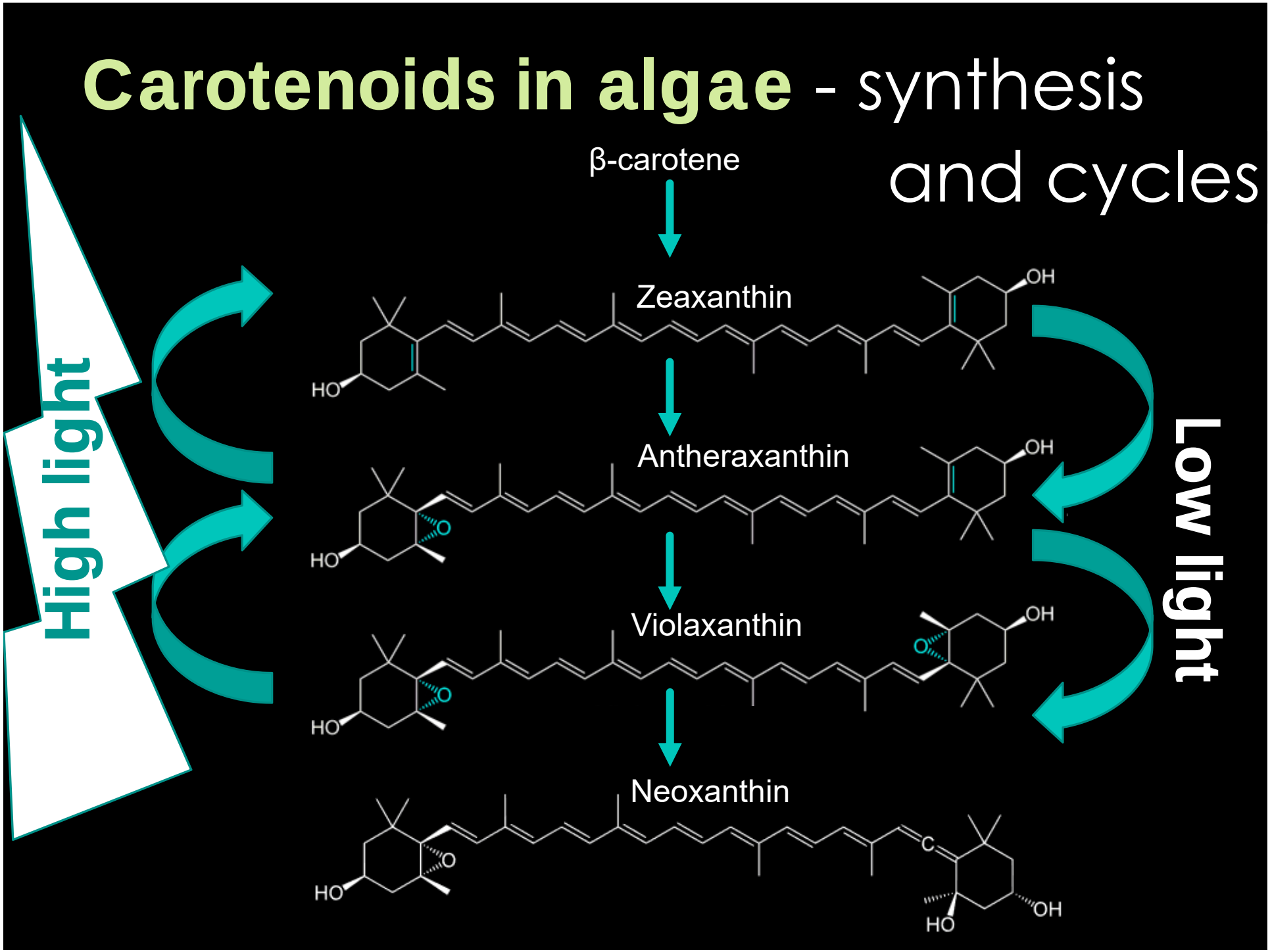
High abundance
Low abundance

Adapted from Takaichi (2011) Marine Drugs

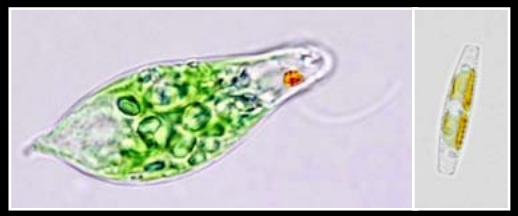
Carotenoids in algae
Detection via RP-HPLC



Carotenoids in algae - synthesis and cycles

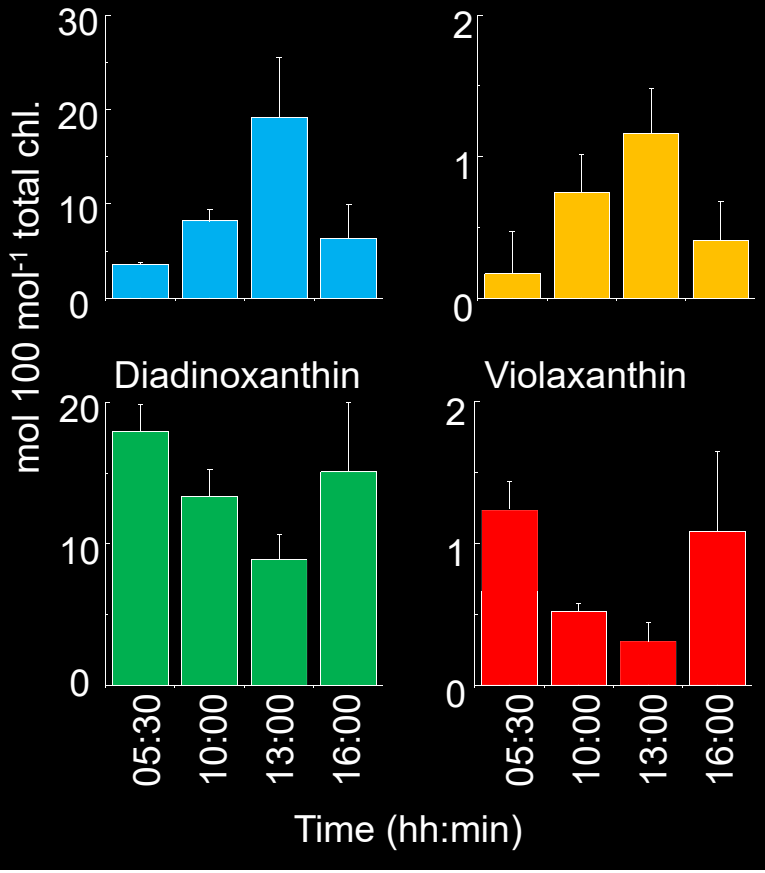


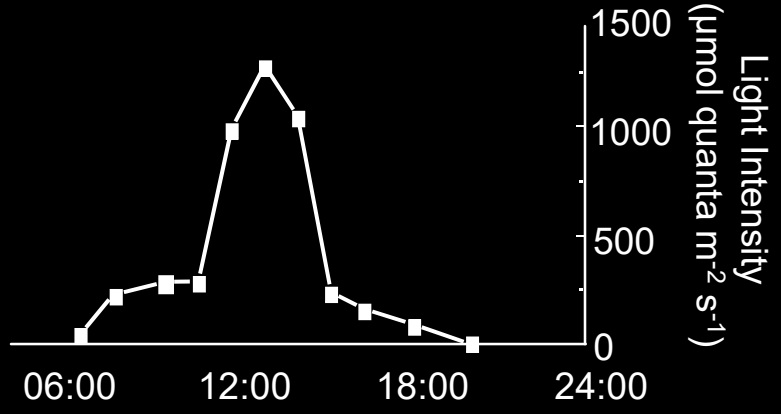
Carotenoids in algae – diurnal xanthophyll (de-)epoxidation cycles

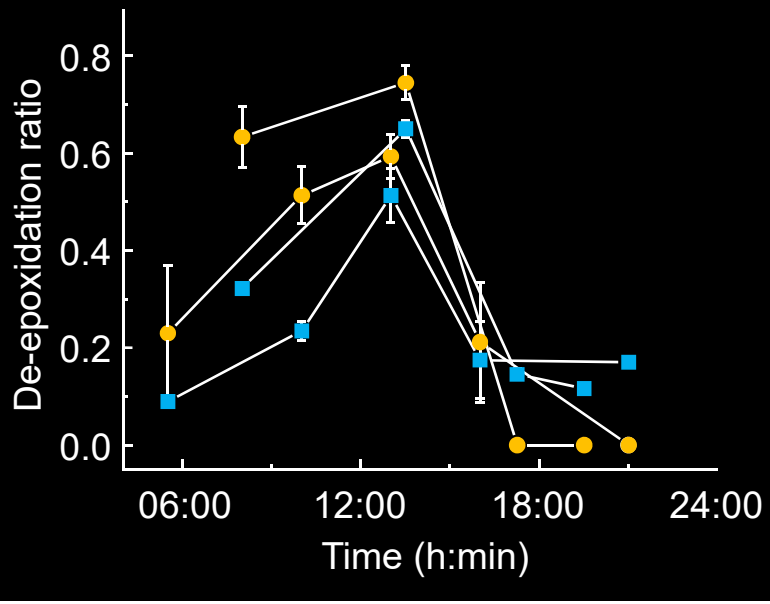


Diatoxanthin

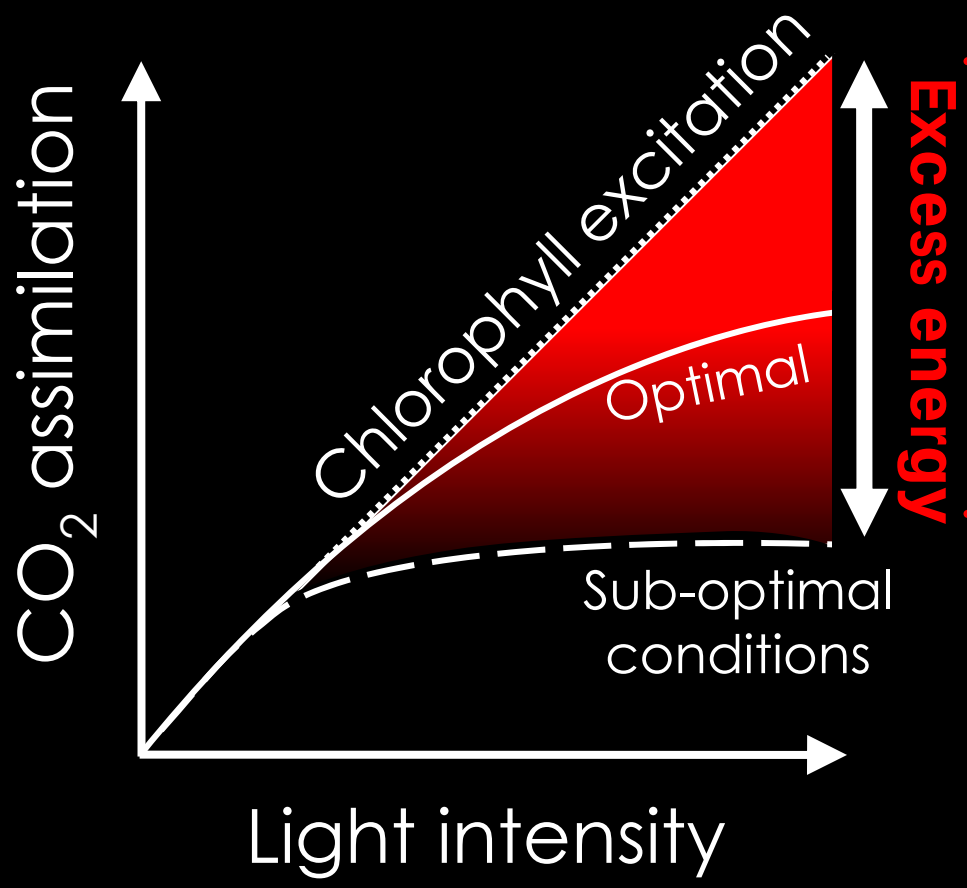
Zeaxanthin







Function of de-epoxidised xanthophylls? e.g. zeaxanthin



Reactive oxygen species (ROS)

- Excess light energy released as heat to prevent ROS production and photo-inhibition
- Antioxidants

Acknowledgements

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