Adam Mickiewicz University
Faculty of Biology

Influence of the collected biomass treatment on its efficiency as fertilizer in plants crops

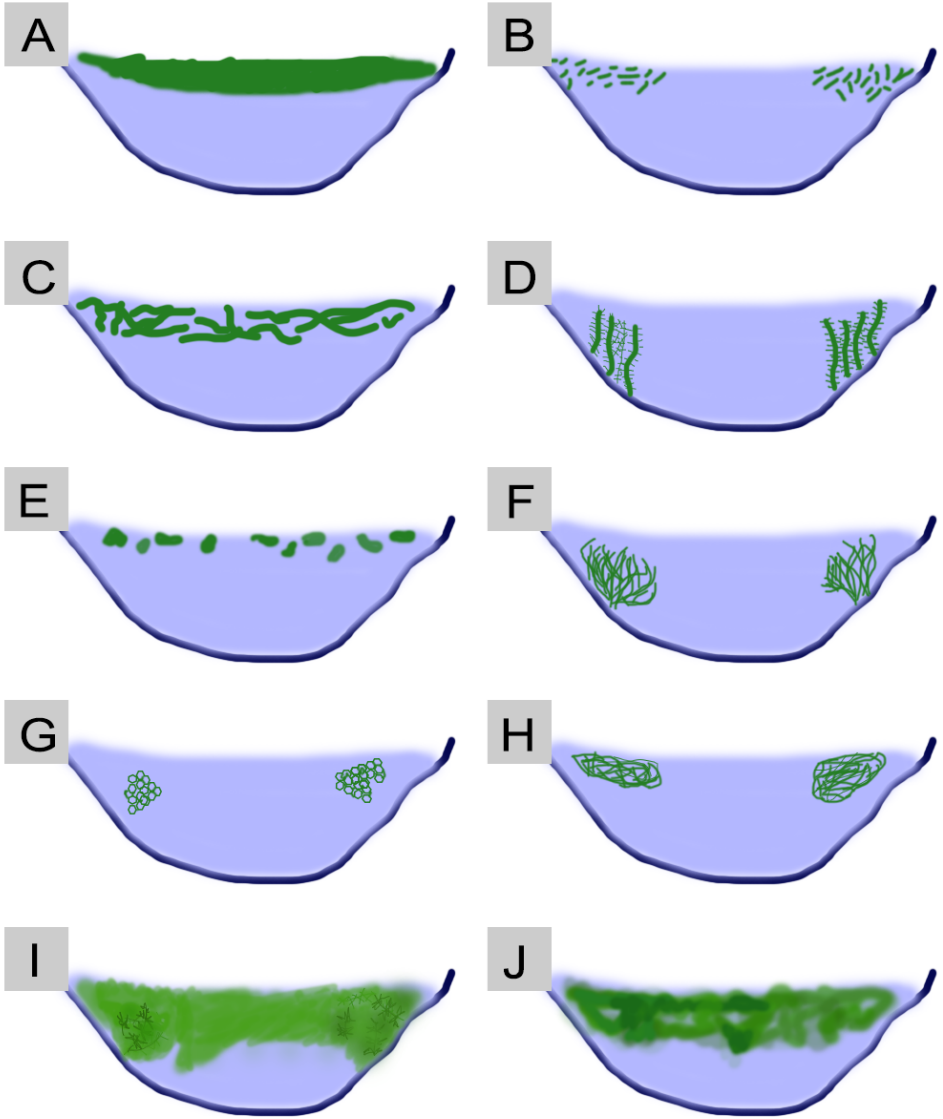
Beata Messyasz

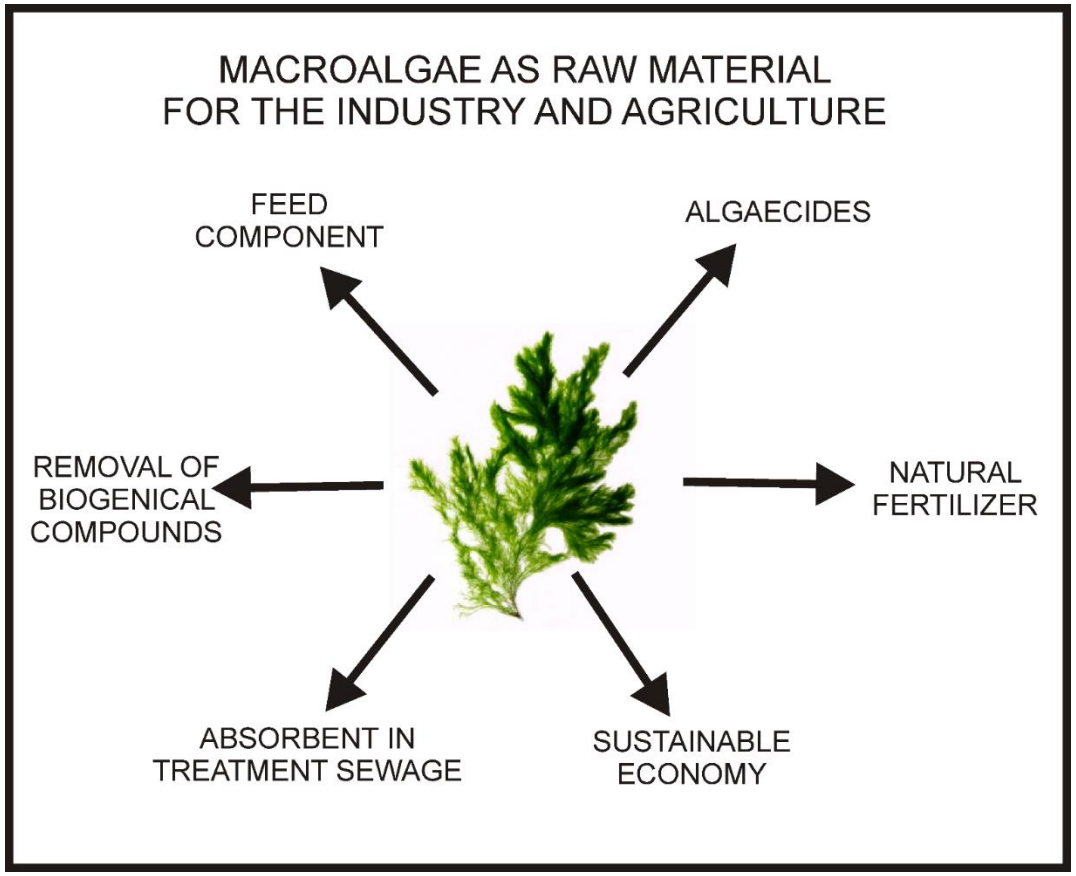
Department of Hydrobiology, Institute of Environmental Biology, Poznań

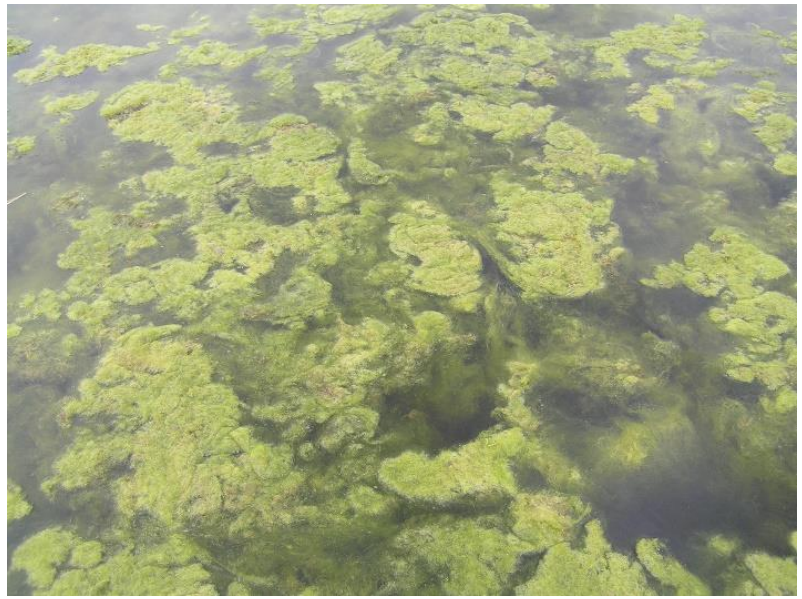
messyasz@amu.edu.pl

Karpacz, 22.11.2021

Macroalgae – characteristics of the mat structure







Collecting biomass ⇨ **Drying biomass** ⇨ **Grinding biomass**

Further analyzes in laboratory

Essential and beneficial elements for plants

Elements necessary
for the growth and development of plants

Macronutrients:
N, P, K, Ca, Mg, S

Micronutrients:
Fe, Mn, Cu, B, Zn, Mo, Cl, Ni, Si

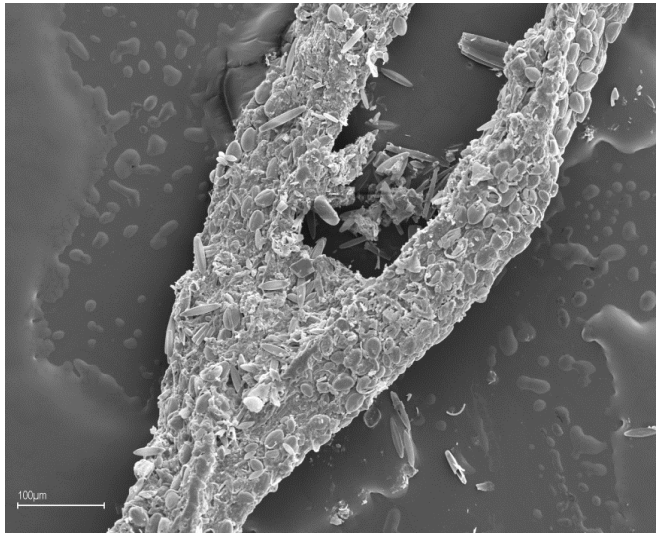
Elements beneficial
for the growth and development of plants

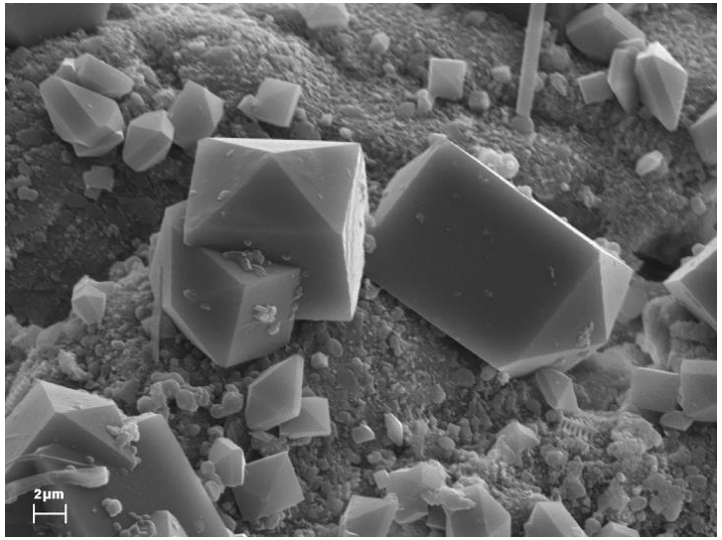
Na, Al, Co, Se, Ti, V, La, Cr

Macroalgae – adition to natural fertilizers

Chemical components	MANURE* [%]	ALGAE [%]
water	ca. 77	ca. 80
Organic substances	20-27	20-30
Nitrogen	0,4-0,7	0,3-0,7
Phosphate	0,2-0,9	0,3-0,8
Magnezium	0,1-0,3	0,2
Potassium	0,5-0,7	0,2-0,6
Sodium	0,1	0,1
Calcium	0,4-0,8	0,5-1,0
Silicon	0	0,3-1,0
pH	7,5	7,9

*Maćkowiak i Żebrowski 2000





Macroalgae have a high content of bioactive compounds

(1) Wet biomass - increase in moisture content of dried manure; immediate availability of all bioactive substances; longer storage = homogeneity of the material (humidity, penetration of layers)

(2) Dry biomass – extracts (easy to store, can be used in doses during spraying)

Key benefits of macroalgae as bio-fertelizers

- Ultra-fast nutritional effect - quick and easy absorption of macronutrients
- Very high concentration of nutrients - up to 55% more nutrients compared to standard chelates
- High performance
- Biodegradability
- Excellent solubility and miscibility with agrochemicals

Adam Mickiewicz University
Faculty of Chemistry

Differences in the content of important chemical components of macroalgal biomass depending on the time of their uptake

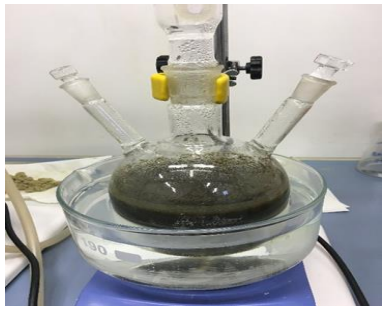
Radosław Pankiewicz

Department Environmental Physicochemistry, Faculty of Chemistry, Poznań

pankiewicz@amu.edu.pl

Karpacz, 22.11.2021

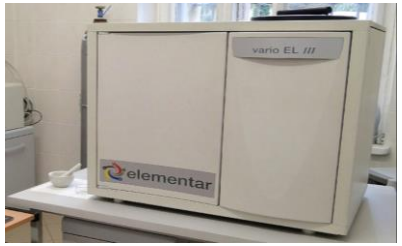
Isolation and analysis of the chemical composition of macroalgal thalli



- **Extraction**

Purification using a Flash chromatograph

FT-IR analysis



Elemental Analysis

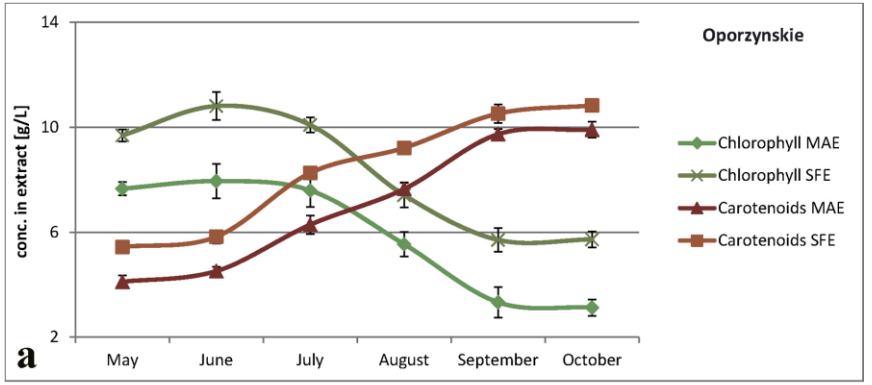
NMR analysis

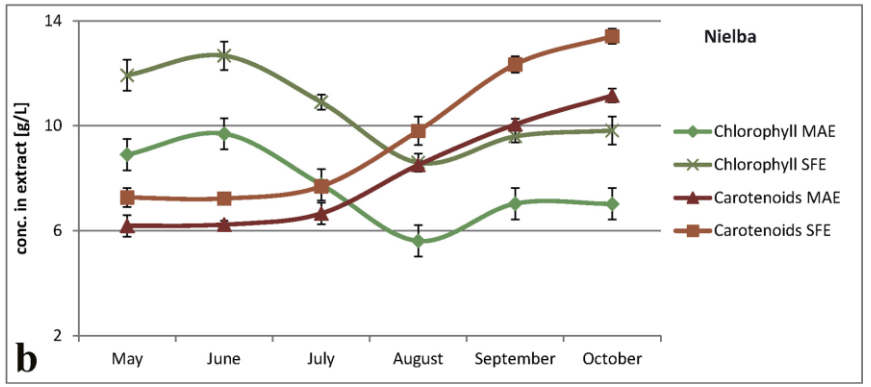
HPLC analysis

Total pigments contentin algae extracts

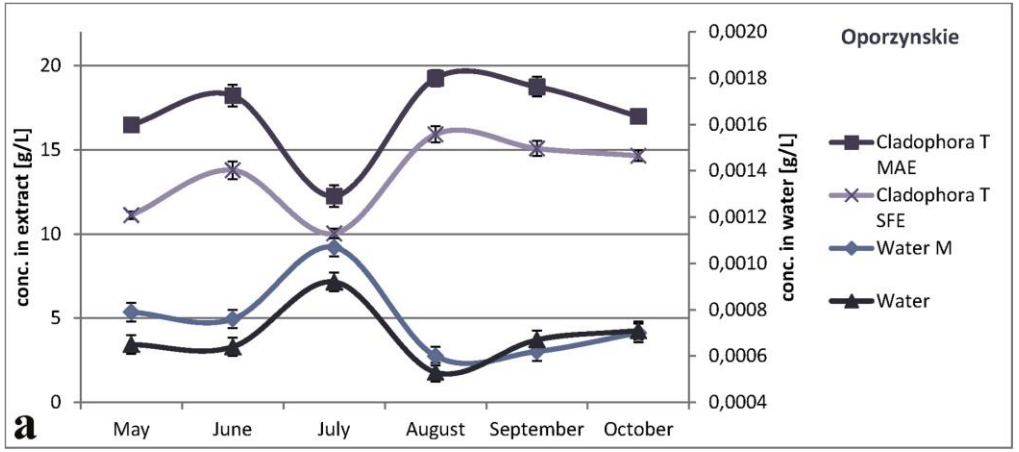
river Nielba

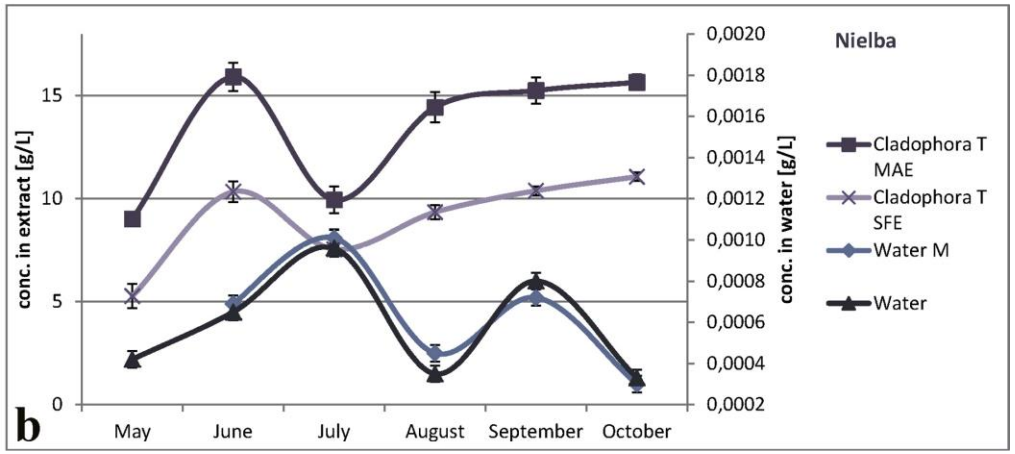
lake Oporzyńskie





Total pigments (chlorophylls and carotenoids) content in algae extracts determined in the period May-Oct: A Lake Oporzynskie, B Nielba River.





Total phenols content in algae extracts (Cladophora T MAE and Cladophora T SFE), water from the mat (Water M) and water from outside the mat (Water) in the period May- Oct

A Lake Oporzynskie, B Nielba River.

Adam Mickiewicz University
Faculty of Biology

Freshwater macroalgae as a new raw material for high value products

Bogusława Łęska

Department Environmental Physicochemistry, Faculty of Chemistry, Poznań

bogunial@amu.edu.pl

Karpacz, 22.11.2021

Fatty acids analysis

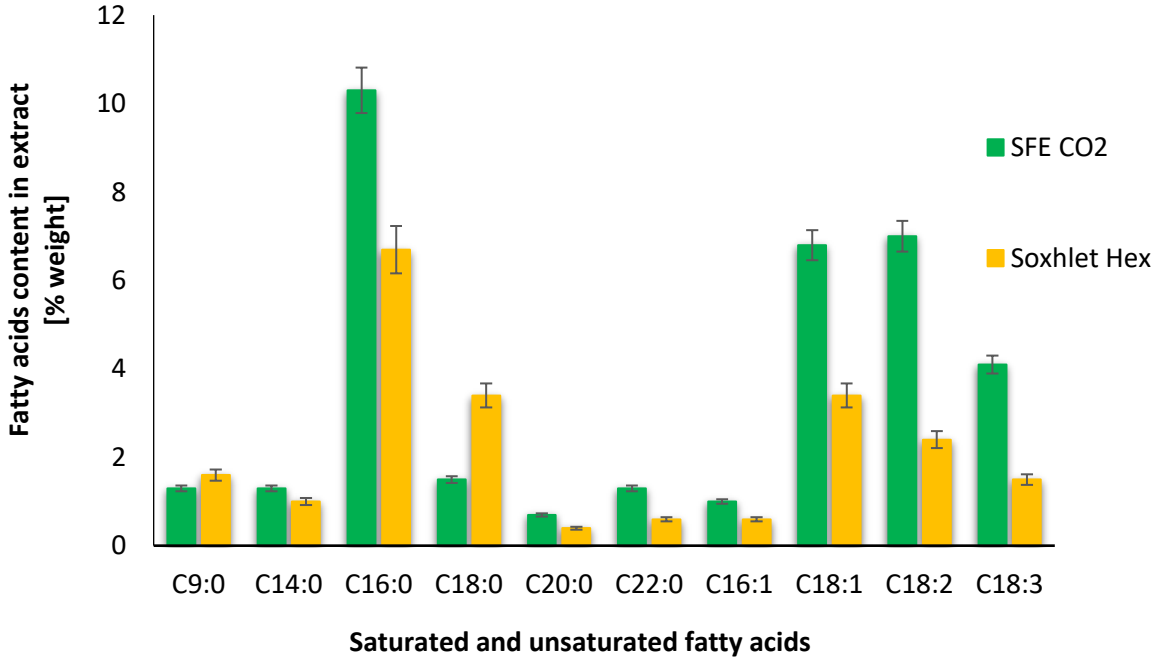
- Soxhlet extraction with hexane

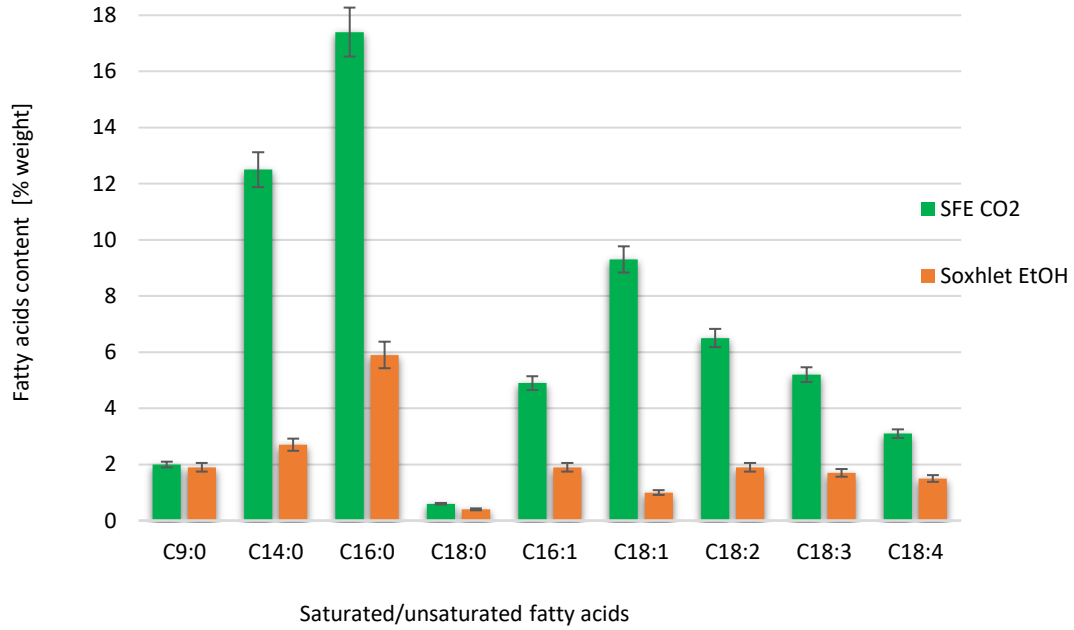
- Supercritical fluid extraction with SC-CO_2

- Gas chromatography (GC) analysis

Important group of biologically active compounds occuring in the freshwater *Cladophora glomerata* - saturated and unsaturated fatty acids included in the group of lipids or lipophilic substance; - aliphatic lipophilic monocarboxylic acids containing respectively saturated bonds (saturated fatty acids) or at least one double bond in the carbon chain (unsaturated fatty acids).

The saturated fatty acid: palmitic acid (C16: 0), and also there others: miristic (C14:0), pentadecanoic (C15: 0), stearic (C18: 0) and arachidic (C20: 0); - unsaturated acids: tetradecatrienoic (C14:3), tetradecatetraenoic (C14:4), 9-hexadecaenoic (C16:1), hexadecadienoic (C16:2), 6,10,14-hexadecatrienoic (C16:3), heptadecatrienoic (C17:3), linoleic (C18:2), eicosahexaenoic (C20:6).





Fatty acids have many important functions in cosmetics; in particular unsaturated fatty acids (ssential fatty acids (EFAs) - characterized by good effects on the skin.

Carotenoids analysis

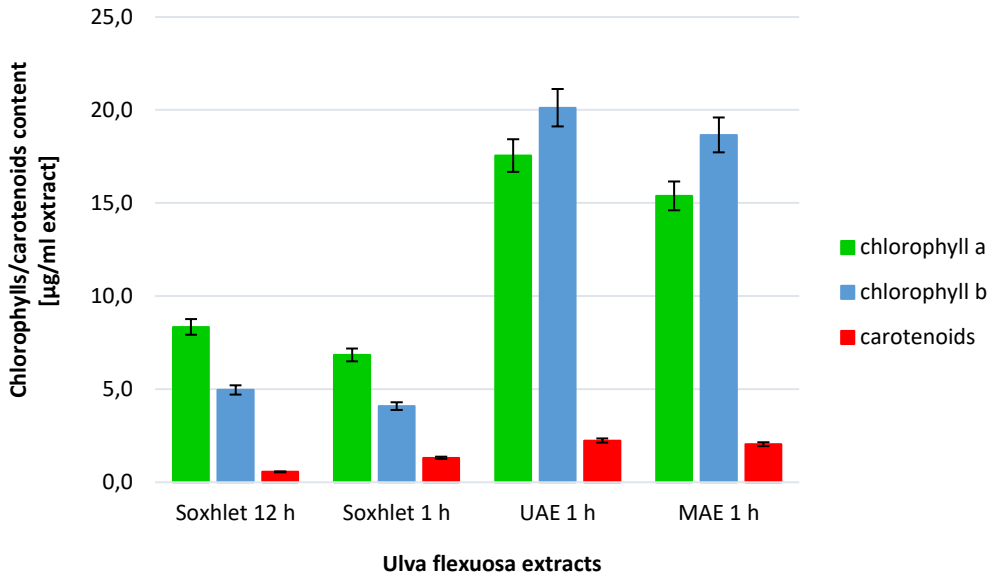
- Supercritical fluid extraction with SC-CO_2 and ethanol

- Ultraviolet and visible (*UV-Vis*) absorption spectroscopy analysis

- HPLC-DAD-MS analysis - High-performance liquid chromatography-diode array detection/electrospray ionization mass spectrometry

Analysis of bioactive compounds

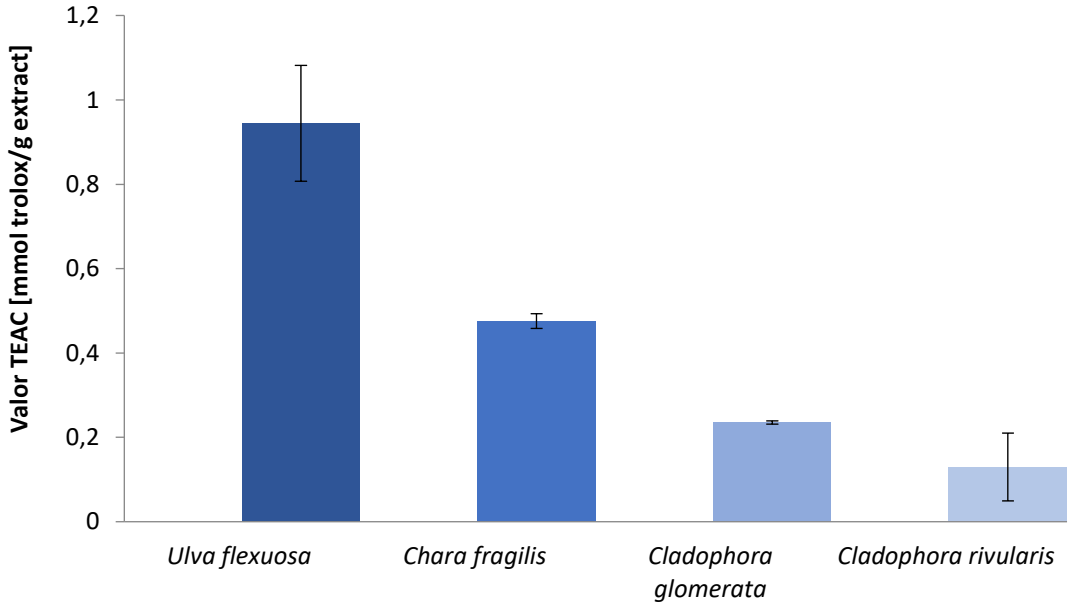
- Soxhlet extraction
- UEA – ultrasound assisted extraction
- MAE – microwave assisted extraction



Chlorophylls and carotenoids content in Ulva flexuosa extracts

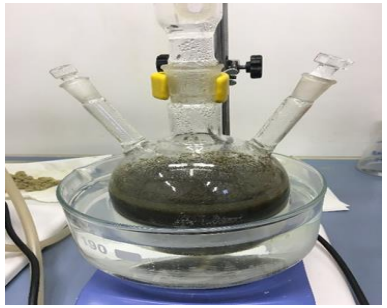
Trolox equivalent antioxidant capacity (TEAC) measures the antioxidant capacity of a given substance, as compared to the standard, Trolox (**analog of vitamin E**). Most commonly, antioxidant capacity is measured using the ABTS Decolorization Assay. Other antioxidant capacity assays which use Trolox as a standard include the diphenylpicrylhydrazyl (DPPH), oxygen radical absorbance capacity (ORAC) and ferric reducing ability of plasma (FRAP) assays.

The TEAC assay is often used to measure the antioxidant capacity of foods, beverages and nutritional supplements

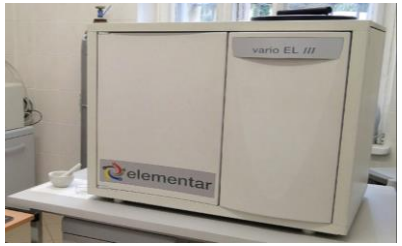


Results of TEAC assay for freshwater algae extracts

Polysaccharides analysis



- Hot water extraction combined with enzymatic hydrolysis



- Elemental analysis

- FT-IR analysis (Fourier Transform Infrared Spectroscopy)

- ^{1}H NMR analysis (nuclear magnetic resonance)

Bioactivity of ulvans

- antimicrobial activity

  antiviral

  immunostimulatory

  anticoagulant

  antihyperlipidemic

  antiproliferative

  anti-cancer (breast, liver, colon)

- Antioxidant activity

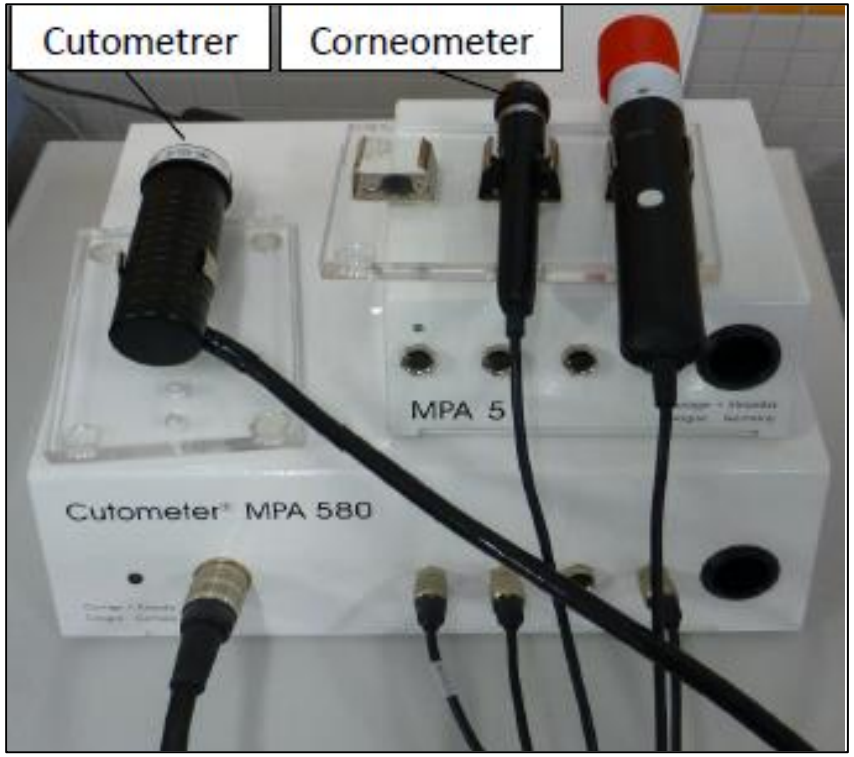
  Moisturizing properties

  Ability to regenerate skin tissues

  Natural surfactants

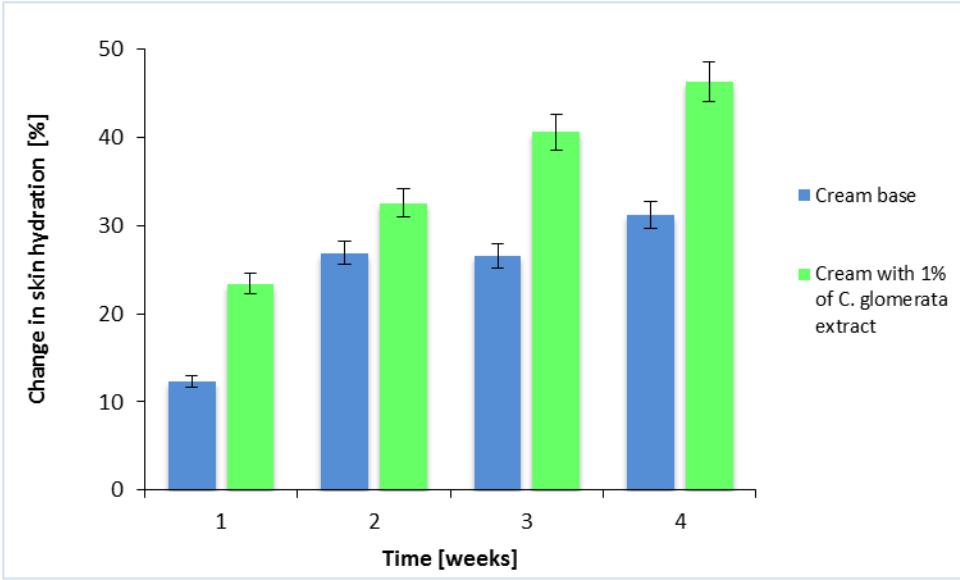
  Stabilizers of cosmetic emulsions

Studies *in vivo* - application study

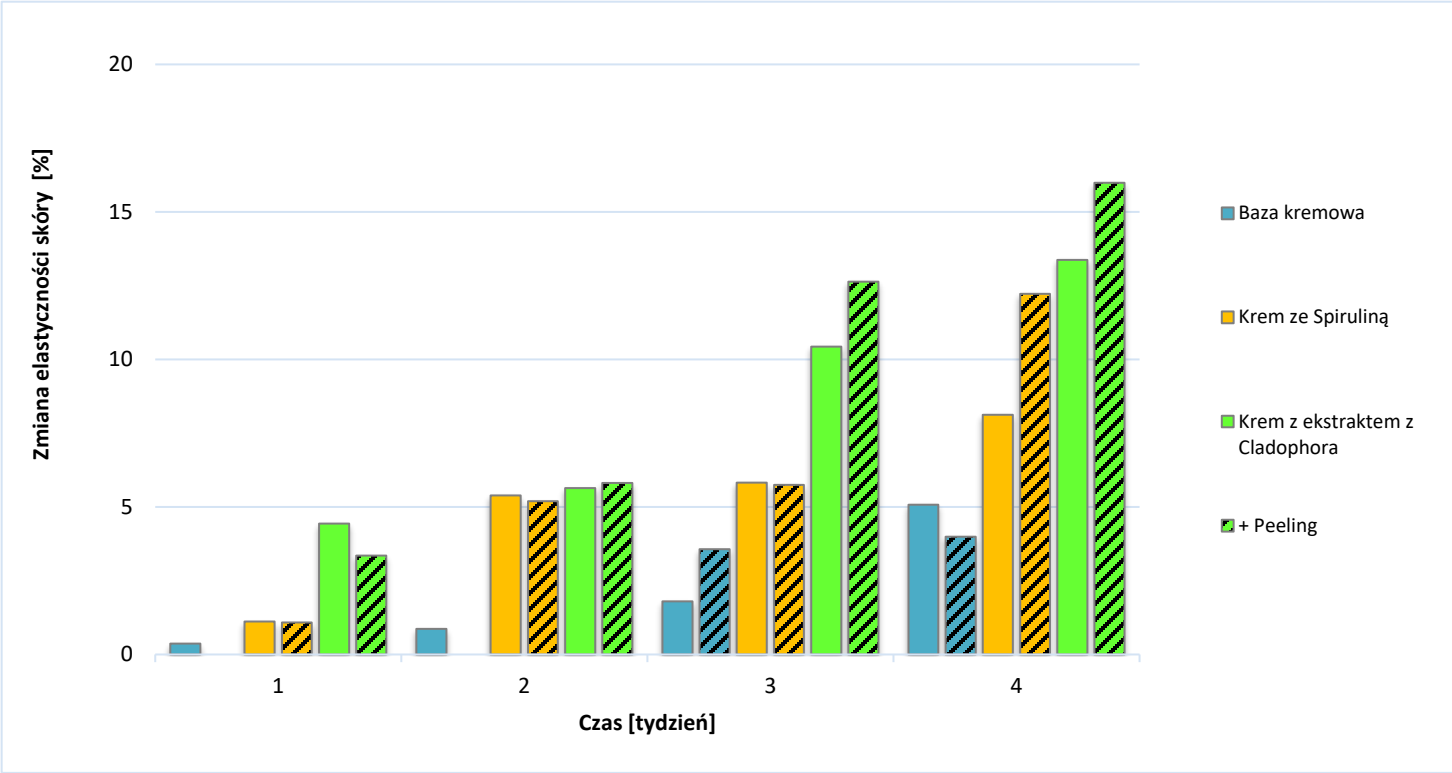


Courage + Khazaka Electronic GmbH apparatus

- **Cream with 1% of *C. glomerata* extract obtained by SFE**
- **Skin hydration**
- **Skin elasticity**



Percentage change in skin hydration after 4 weeks of creams application



Percentage change in skin elasticity after 4 weeks of creams application (age +40)

- **Freshwater green macroalga *C. glomerata* was found as a source of various bioactive compounds:**
  - **Fatty acids;**
  - **Carotenoids;**
  - **Phenolic compounds;**
  - **Sulfated polysaccharides**
- **Extracts from the alga possess antioxidant properties**
- **Extracts added to cosmetics increased skin hydration and elasticity**
- **Biomass of *C. glomerata* may be used as a new cosmetic raw material**

Adam Mickiewicz University
Faculty of Biology

CO_2 pathways in the shallow aquatic ecosystem: relationship between algae and bacteria

Ewa Szczuka[1] Beata Messyasz[2]

[1]Department of Microbiology, Institute of Experimental Biology, Poznań
[2]Department of Hydrobiology, Institute of Environmental Biology, Poznań

ewasz@amu.edu.pl

Karpacz, 22.11.2021

Inorganic/organic CO_2 pathways

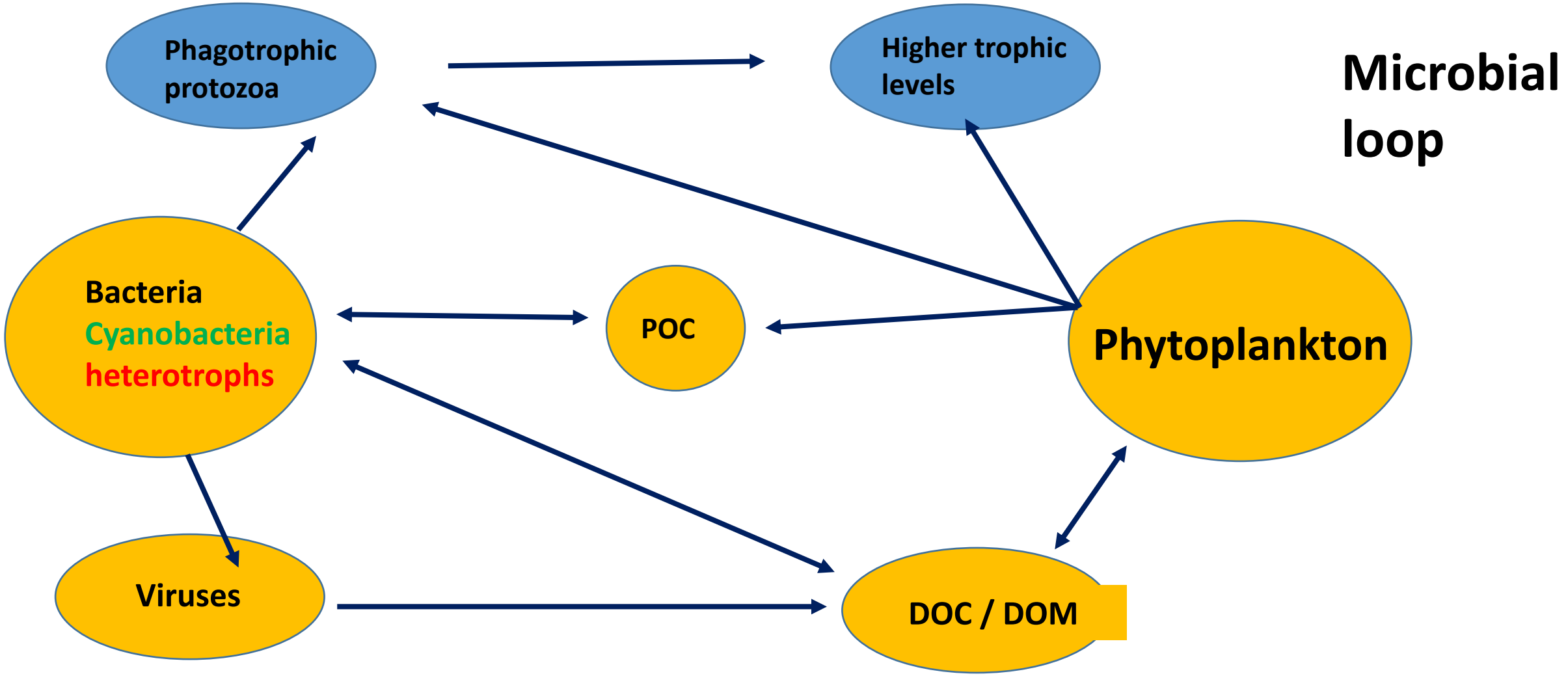
(1) Algae not „living alone” in water bodies and have to interact.

(2) Bacteria have the highest respiratory potential for organic matter oxidation, thereby releasing CO2, PO4, NH4, and other nutrients that are required for phytoplankton metabolism.

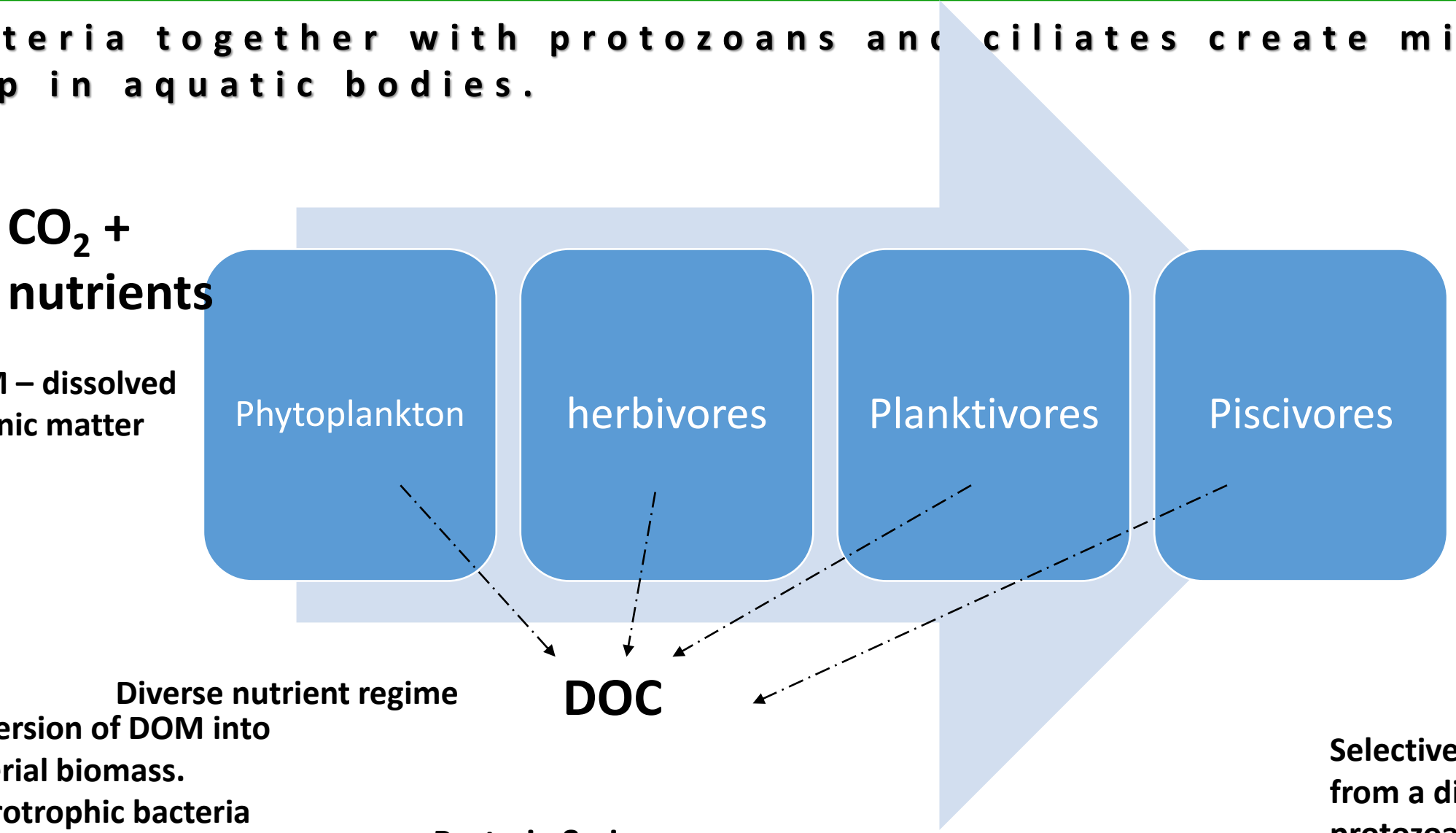
(3) In soft water lakes, particularly, a paralel effect invoking inorganic carbon may be discerned, where those algal species that utilize sources different than CO2 (e.g. bicarbonate) and are tolerant of pH levels (>8.5) elevated by increased CO2 demand (e.g. most cyanobacteria, some dinoflagellates and chlorophytes), are preferentially selected over „intolerant species” of oligotrophic lakes (chrysophytes, desmids)

(4) As eutrophication advances and biological production increases, so the greater is the sedimentation of biogenic material to the lake bottom which becomes totally anoxic.

Only free CO_2 can enter photosynthetic pathways



Bacteria together with protozoans and ciliates create microbial loop in aquatic bodies.



Algae Service for Life

THANK YOU
FOR YOUR ATTENTION