

EXTRACELLULAR CARBOHYDRATES RELEASED BY P-LIMITED DIATOMS

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Abstract

A laboratory study was performed on the extracellular production of carbohydrates by the marine diatoms *Cylindrotheca closterium*, *Thalassiosira pseudonana* and *Skeletonema costatum* to investigate the role of P-limitation and growth status on abundance and chemical characteristics of the released polysaccharides. Inorganic phosphorus depletion caused an increase of total polysaccharides in all species and a reduction in the molar percentage of glucose. Maximum exopolysaccharide production was found at the transition stage between exponential and stationary growth phase.

Key-words: Diatoms, exopolysaccharides, mucilage, phosphorus

Cultures of the marine diatoms *Thalassiosira pseudonana* Hasle & Heimdal, *Skeletonema costatum* (Greville) Cleve and *Cylindrotheca closterium* (Ehrenberg) Lewin & Reimann, were isolated from the Northern Adriatic and maintained in f2 medium at 18° C, 16:8 h light:dark cycle, 112 ME m⁻² s⁻¹ irradiance. Cells were treated with an antibiotic mix [1] for 24 h. P-replete (P+; 36 μM of P-PO₄) and P-deplete treatments (P-; 6 μM of P-PO₄) were established for each species in duplicate flasks.

Cells were enumerated using a Bürker counting chamber and light microscopy. Nutrient concentrations were determined spectrophotometrically [2], extracellular carbohydrates and aldoses composition were determined colorimetrically [3] and by gas-chromatography [4], respectively.

The production of total exopolysaccharides was significantly higher under the P-depleted condition (P-) compared to the P-replete condition (P+) (Fig. 1.). Maximum carbohydrate concentrations were found in *T. pseudonana* (26.8 μmol C/10⁶ cells). The aldose signature varied according to growth status (Fig. 2A). Glucose was generally the most abundant monomer during the exponential growth phase. In the stationary growth, the percentage of glucose decreased and galactose, mannose, xylose, rhamnose and fucose increased. Changes in aldoses were most pronounced in *C. closterium* (Fig. 2B).

The diatom species investigated are commonly found in the Northern Adriatic Sea [5]. Species-specific differences in abundance and chemical characteristics of the exudates may have an important impact on the degradability of the exudates, thus influencing the dynamics of organic matter in coastal waters [6].

References

- Guerrini F., Mazzotti A., Boni L., Pistocchi R., 1998. Bacterial-algal interactions in polysaccharide production. *Aquat. Microb. Ecol.*, 15: 247-253.
- Strickland J.D.H., and Parsons T.R., 1972. A practical handbook of seawater analysis, 2nd edition. *Bull. Fish. Res. Bd. Can.*
- Myklestad S., Skanoy E., and Hestmann S., 1997. A sensitive and rapid method for analysis of dissolved mono- and polysaccharides in seawater. *Mar. Chem.*, 56: 279-286.
- Blakeney A.B., Harris P.J., Henry R.J. and Stone B.A., 1983. A simple and rapid preparation of alditol acetates for monosaccharide analysis. *Carbohydr. Res.*, 113: 291-299.
- Regione Emilia Romagna-ARPA, Struttura Oceanografica Daphne, 2002. Eutrofizzazione delle acque costiere dell'Emilia Romagna, Rapporto 2002. P. 200.
- Puddu A., Zoppini A., Fazi S., Rosati M., Amalfitano S., and Magaletti E., 2003. Bacterial uptake of DOM released from P-limited phytoplankton. *FEMS Microbiol. Ecol.* (In press).

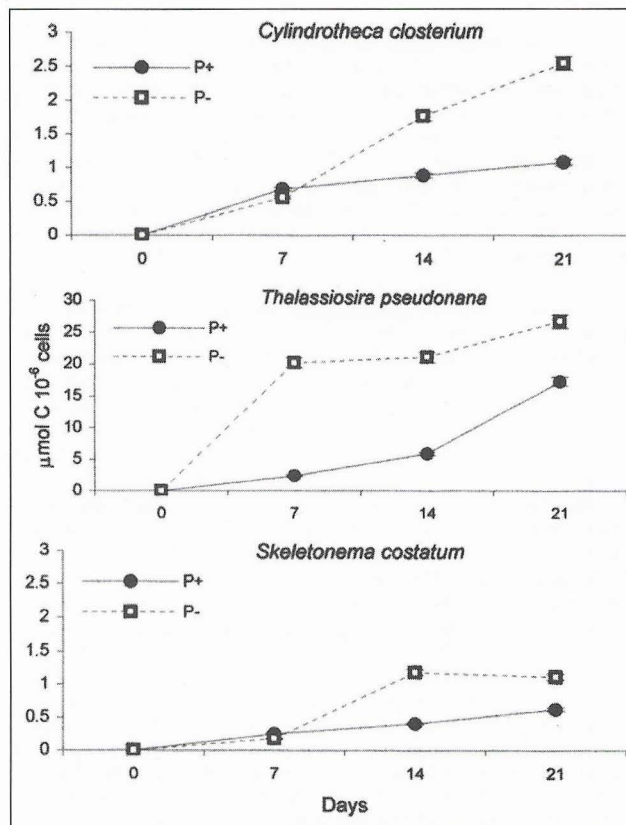


Fig. 1. Temporal variation of total extracellular carbohydrates (μmol C/10⁶ cells) in batch cultures of three diatom species. P+: P-replete; P-: P-depleted.

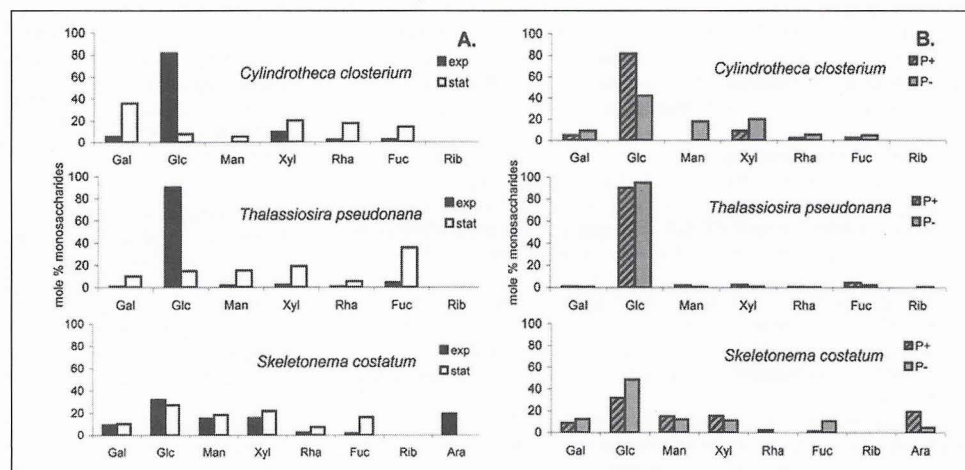


Fig. 2. Aldoses composition of dissolved extracellular carbohydrates released by three diatom species under different growth stages (A.) and nutrient conditions (B.).