Pigment transfer from phytoplankton to copepods in nutrient-enriched mesocosms

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Introduction

The Baltic Sea is one of the most polluted waterbodies on earth. With increased nitrogen (fourfold) and phosphorus (eightfold), silicate levels have decreased over the last decades (Wulff et al. 1990) and the microalgal community has changed (Leppäkoski & Mihnea 1996, Schulz 1998). The M74 syndrome is a reproductive disease in the Baltic salmon that has been a problem since 1974. Many speculations about the causes have been presented but no definite answers have yet been found. Two natural compounds have shown to be connected to M74 (Pettersson & Lignell 1998). These are the carotenoid astaxanthin and the vitamin thiamine (Vitamin Bl). Astaxanthin is produced from B-carotene (originating from algae) in certain species of crustaceans.

Current studies on the M74 syndrome deal with higher trophic levels of the Baltic salmon only (Hansson et al. 1990, Rudstam et al. 1992, Arrhenius & Hansson 1993, Flinkman et al. 1992, Karlsson et al. 1999). We are investigating the dynamics of silicate, astaxanthin and thiamine in lower trophic levels of the Baltic salmon food. Our hypotheses are that large-scale eutrophication lowers the quality of microalgae as food for zooplankton, which ultimately affects the reproduction, growth and survival of fish. We think that decreasing levels of antioxidants (e.g. astaxanthin) and/or vitamins (e.g. thiamine) in the lower part of the food web are of paramount importance.

In this frame we study the transfer of micro-algal pigments to pelagic copepods and which.of them is the best precursor for astaxanthin, the red pigment in e.g. crustaceans and salmon.

Materials and Methods

In the summer of 1999 two mesocosm experiments (enclosures of 2 m^3) were performed in the Trondheim fjord (Norway) as a reference. By adding different amounts of nutrients to natural pre-filtered seawater (<200 μm mesh size), different phytoplankton blooms were created. There were two treatments: an N-P treatment where daily N and P were added and an N-P-Si treatment where also Si was added (in Redfield ratios). Trace-metal elements and vitamins were never limited. The bags were stirred thrice a day and bicarbonate was added daily.

When the blooms were established (defined as Chl a content >20 mg m^{-3}), starved copepods were added and followed during 6 days. Algal samples were collected on GF/F filters and copepods on GF/C filters.

Carotenoids of algae and copepods were analysed by HPLC (High Performance Liquid Chromatography, Jeffrey et al. 1997).

Results of the algae analyses

After five days chromophytes and dinoflagellates dominated the phytoplankton in the N-P treatment. In the Si-N-P- treatment diatoms took over. The biomass in the latter treatment was higher but exact figures are not available yet.

Major and taxonomically significant pigments of algal classes were found back in the HPLC analyses. In the N-P treatment fucoxanthin decreased, diadinoxanthin and peridinin increased. In the Si-N-P treatment the opposite pattern was observed.

Preliminary results from **copepod** analyses

None of the two treatments seemed to contribute to the production of canthaxanthin in copepods. The levels decreased in both treatments during the first 12 hours and stabilised afterwards. Astaxanthin levels however were higher in the N-P treatment than in the N-P-Si treatment. They dropped slightly during the first day but recovered afterwards. In the N-P-Si treatment they continued to decrease.
Probably chromophytes and dinoflagellates were more accessible as food to copepods. The diatom blooms that were established consisted mainly of large chain forming species like *Skeletonema* sp. and *Thalassiosira* sp. that are uneatable for copepods.

In Progress

The analyses of our data are incomplete and we need to study the results much more thorowly in order to draw conclusions about the difference in food quality of the algae as a precursor for astaxanthin in copepods.
Thiamine levels in these samples will be analysed next year.

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Acknowledgements