THE PARTICULATE ß-DIMETHYLSULPHONIOPROPIONATE (DMSP) LEVELS IN RELATION TO PHYTOPLANKTON SPECIES DURING A SPRING BLOOM IN TOULON BAY (FRANCE)

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Abstract

This work investigated the origin of particulate DMSP in a Mediterranean ecosystem perturbed by anthropogenic inputs (Toulon bay, France). We studied the contribution of phytoplankton species to DMSP levels. Dinoflagellates were always predominant in comparison to Bacillariophyceae and peaked in March-April. The intracellular concentrations of DMSP revealed that Dinoflagellates contained about five times more DMSP than Bacillariophyceae. *Alexandrium minutum* produced up to 56% of the DMSP pool. We suggest that the production of the nitrogenous toxin by *Alexandrium minutum* may explains its high levels of DMSP synthesis.

Keywords : DMSP; Alexandrium minutum; eutrophication; coastal ecosystem; mediterranean sea

Dimethylsulphide (DMS) is the most abundant form of volatile sulphur in the ocean and is produced by the enzymatic cleavage of ß-dimethylsulphoniopropionate (DMSP), which is abundant in phytoplankton (1). It is accepted that DMSP is an osmolyte and a cryoprotectant for marine algae (2).

We have studied particulate DMSP in Toulon Bay for the size class 5-90 µm to show the contribution of phytoplankton species to DMSP levels in this perturbed and eutrophic littoral marine ecosystem. Protein concentrations were used to determine the biomass. To compare the phytoplankton activity with DMSP synthesis, the DMSP/protein ratio was calculated.

The temporal evolution showed three peaks (March, June and September, Fig. 1). The March peak corresponded to the highest total level of DMSP synthesis (0.58 nanomoles DMSP.µg-1). The 5–90 µm size class was principally composed of algal cells belonging to the Dinoflagellates or to the Bacillariophyceae. Dinoflagellate biomass and abundance peaked in March-April, whereas Bacillariophyceae biomass and abundance peaked in October-November. No relationship ($p > 0.1$, Spearman test) was found between Bacillariophyceae biomass and the DMSP concentration, whereas a significant correlation was observed between Dinoflagellate biomass and DMSP concentration ($r = 0.699$; $p = 0.011$). We have separated Bacillariophyceae and Dinoflagellates out of seawater to determine their respective contributions to DMSP production. Comparison of the intracellular concentrations of DMSP in the two samples revealed that Dinoflagellates contained about five times more DMSP than Bacillariophyceae (Table 1). These results highlight the importance of Dinoflagellates and the minor contribution of Bacillariophyceae in DMSP production. We had also identify the species implicated in DMSP synthesis. The peaks of biomass were consistent with peak of DMSP above all for *Alexandrium minutum* (Fig. 1). Five monospecific samples were prepared and analysed for DMSP contents. The intracellular content per unit of biovolume was highest in *A. minutum* (Table 1).

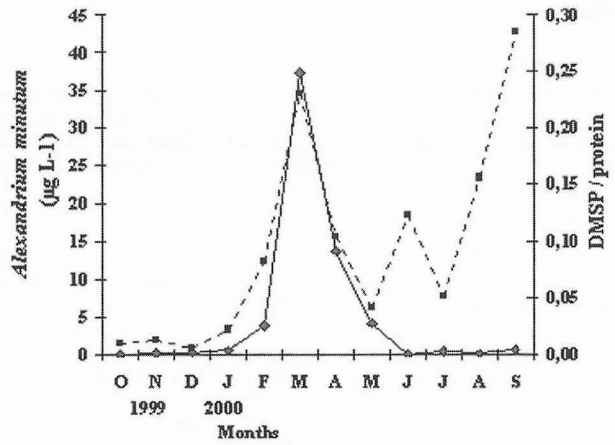

Fig. 1. Relationships between the DMSP / protein ratio (black square) and the *Alexandrium minutum* biomass (grey diamond).

Our results suggest that the semi-enclosed configuration of Toulon Bay and its exposure to high levels of human activity could lead to stronger productivity involving high concentrations of DMSP. This hypothesis is in accordance with (3). In addition, it is generally accepted that Prymnesiophytes and Dinoflagellates produce more DMSP than Bacillariophyceae. (4) measured similar values in Dinoflagellates (355 to 972 mM). *A. minutum* produce toxins such as PSP (paralytic shellfish poison) and DSP (diarrheic shellfish poison) (5) and grows better in nitrogen-rich ecosystems. This specific nitrogen requirement could be due to the production of nitrogenous precursor of the PSP, called saxitoxin (STX) (6). In the osmoregulation in algal cells, two compounds could be produced (DMSP or Glycine betaine, GBT). The production of GBT require high nitrogen levels. In Toulon Bay, high DMSP levels have been found in *A. minutum* suggesting the preferential synthesis of DMSP rather than GBT. This suggests that the nitrogen requirement of *A. minutum* was not totally fulfilled in spite of the high nitrate levels.

Table 1. Intracellular concentrations of DMSP in phytoplanktonic algae.

Dinoflagellates	**124 +/- 5.7 mM**
Bacillariophyceae	**25.1 +/- 1.1 mM**
Alexandrium minutum	**3387.6 +/- 121.9 mM**

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