Physiological responses of the copepod *Acartia Clausi* to Phenol

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Many authors have used marine zooplankton in acute or chronic toxicity tests. In particular there is a large literature concerning toxicity tests with copepods (see WELLS, 1984 for a review). Their sensitivity to toxic compounds is important because they are the main component of the zooplankton. A number of studies have addressed the question of how high concentrations of toxic substances affect juvenile stages (SULLIVAN and RITACCO, 1985). However, in the aquatic environment, pollutants occur at lower concentrations than those generally used for toxicity tests. For this reason, some authors observed response to sublethal toxicant doses, such as growth and mortality rates, and used these data to interprete chronic bioassays (ALLAN and DANIELS, 1982).

In our study, we chose the neritic calanoid copepod *Acartia clausi*, typical in Mediterranean coastal waters, for a toxicity test. The aim of this work was to control if reproductive rates, mortality and feeding activity were modified by exposing *A. clausi* females to phenol pollutant with respect to control populations. This compound was chosen because it is an ubiquitous environmental contaminant typical of many industrial wastes. Phenol is remarkably important as it is part of the production cycle of many chemical industries, in particular the oil industry. Many studies on acute toxicity have been conducted on fish, but only a few authors have analyzed phenol chronic toxicity on marine zooplankton and, in particular, on copepods (BUTTINO *et al.*, 1991).

We present here preliminary results of reproductive rates, feeding activity (expressed as fecal pellets production) and mortality rates of *A. clausi* females exposed to 500 µg/l phenol concentration.

Eighty adult females were collected in the Mar Grande in Taranto. Forty females were sorted individually in 60 ml crystallizers with 20 ml sea water filtered through a 45 µm mesh net and 30 ml of a mixture of food cells *Prorocentrum minimum* and *Phaeodactylum tricornutum* and forty females were taken in the same conditions but with phenol solution added to a final concentration of 500 µg/l.

Comparison among fiducial intervals (P=0.05) shows that there are not significant differences in reproductive rates between phenol-exposed females and control ones, until the eighth day (Fig.1A). Mean fecal pellet production showed lower values for phenol-exposed females only on the ninth and tenth day (Fig.1B). There were no differences between spawning and non-spawning females. *Acartia clausi* showed a great resistance to phenol as reported by KUYPER and HANSTVEIT in an *in situ* study (1984).

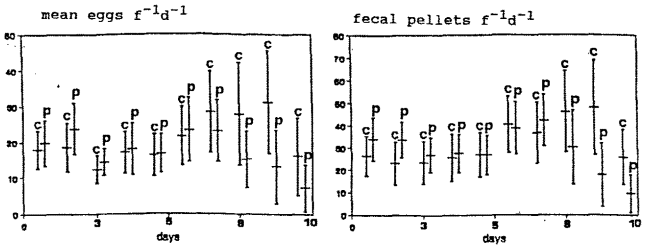

Fig.1 : Confidence intervals (95%) for phenol-exposed females (p) and control ones (c). A: Mean egg production rates; B: Mean fecal pellets production.

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Temporal variations of polyunsaturated fatty acids in particulate matter from a Ligurian Sea zone

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Particulate organic matter (POM) is a very important food source in both pelagic and benthic food chains. As previously reported (HUNTLEY *et al.*, 1987; LIBOREL HOUDE & ROMAN, 1987), the food quality greatly affects growth, reproduction and survival of zooplanktonic grazers and, after all, the whole marine food web (CARLI *et al.*, 1989; 1991); therefore, the evaluation of POM biochemical composition is extremely interesting because of its role in the marine environment.

Here we report results concerning the polyunsaturated fatty acid (PUFA) composition of POM during spring phytoplankton blooms, in a coastal zone of the Ligurian Sea.

Samplings were carried out in a station located within the Gulf of Spotorno-SV (sea bed -50m); some researches carried out in this area showed lack of eutrophic phenomena (COTTA, 1992). On the whole, 32 samplings were collected during 1990 (26/2-19/7) and 16 during 1991 (14/2-13/6). To value the chlorophyll a concentration and the POM lipidic content were collected respectively 5 and 7 litres of sea water by an hand pump, to a depth of -10m. Sea water samples were filtered first with a 200 µm net, then with Whatman GF/C filters.

The chlorophyll a values were determined by spectrophotometric methods (STRICKLAND & PARSONS, 1968); lipid extraction was performed using a chloroform-methanol mixture (FOLCH *et al.*, 1957). After methylation (METCALFE & SCHMITS, 1961), the fatty acid composition was determined using a gas chromatograph (PERKIN-ELMER, SIGMA 3), equipped with a capillary column Supelcowax 10. The column temperature was maintained at 220°C.

During the two sampling periods changes of chlorophyll a concentrations were similar, ranging between 0.06 µg/l and 0.65 µg/l in 1990 and between 0.13 µg/l and 0.75 µg/l in 1991. During the first year, a phytoplankton bloom was recorded in April-May, while during the second year, two phytoplankton blooms occurred in March and May respectively (fig. 1).

During the examined periods the PUFA total percentages were low, accounting for 4.14% of total fatty acids in 1990 (minimum 1.8%; maximum 8.1%) and 6.46% in 1991 (minimum 2.9%; maximum 14.8%) on the average. By examining the PUFA percentage trend during the sampling periods (fig. 2 a-b), it can be noted that the maximum was recorded before the bloom start; a decrease followed subsequently. During the blooms, the PUFA percentages increased; maximum values followed the chlorophyll a peak.

The most abundant PUFA was C18:2 in both years; as for total fatty acids, C18:2 percentages (fig 2 a-b) reached maximum values in the pre-bloom period. The C18:2 percentage variations were not univocal during the various phytoplankton blooms. Among the other PUFA, C18:3, C18:4 and C20:5, generally found at low percentages, increased during the blooms; on the contrary, C22:6 percentage variations were not univocal during the various phytoplankton blooms.

As regards the lipid fraction, the nutritional value of POM greatly depends on its PUFA content. These fatty acids can be synthesized "ex novo" only by autotrophic organisms and are essential nutritional factors for animals (SARGENT & WHITTLE, 1981)

The PUFA percentage of the POM examined during this research was rather low in comparison with available data (KATTNER *et al.*, 1983; CLAUSTRE *et al.*, 1989; MAYZAUD *et al.*, 1989); it suggests that the analysed particulate matter be mainly composed by detritus, since PUFA decompose more rapidly than saturated fatty acids; perhaps this is due to the proximity of the sampling station to the coast line.

As regards the C18:2 prevalence over other PUFA, it can be noted (SARGENT *et al.*, 1987) that this fatty acid is a mayor constituent in blue-green algae, whereas is not abundant in Diatoms and Dinoflagellates; therefore it can be assumed a prevalence of blue-green algae within the phytoplanktonic biotic community in the examined area.

Variations of PUFA percentage showed that in the "pre-bloom" period the POM lipidic fraction had similar or greater qualitative value, altough occurring in lower amounts than during the blooms. The PUFA abundance of POM in the "pre-bloom" periods would exert an important role for consumers, representing a component of high nutritional value.

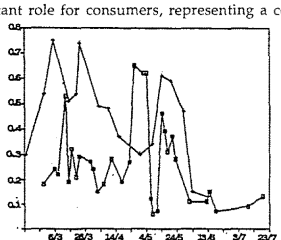

Fig. 1. Chlorophyll a concentrations (µg/l) recorded in the Gulf of Spotorno (SV). 5.3 - 19.7.1990 (□); 14.2 - 13.6.1991 (+).

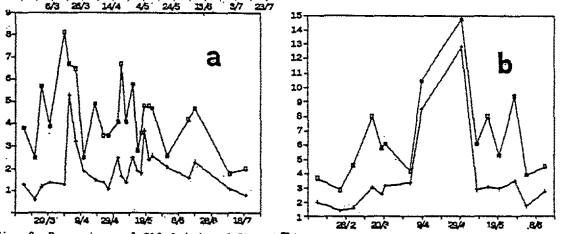

Fig. 2. Percentage of C18:2 (+) and PUFA (□) on total fatty acids of the POM in the Gulf of Spotorno (SV). a: 5.3 - 19.7.1990. b: 14.2 - 13.6.1991.

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