Effects of pollution on the physiology of *Callianassa tyrrhena* (Crustacea : Decapoda) from Saronikos gulf

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This study concerns the effect of pollution on the physiology of the decapod crustacean *Callianassa tyrrhena*, which is a widely distributed callianassid along the european coast of the Mediterranean and is present in coastal polluted and non polluted areas of the Saronikos gulf (gulf of Athens). This species forms dense populations on sand flats and its influence on redox potential and nutrient cycling of the sediment has been documented by OTT*et al.* (1976). Its ecology and biology in greek seas has been the subject of some recent studies (THESSALOU-LEGAKI, 1988, 1990).

The physiological condition of the organisms was examined by means of a dual approach : metabolic (respiration rate) and enzymatic, in order to obtain a pluridimentional view of the effects of pollution at the physiological level.

Two sampling areas were chosen : Elefsis bay (eutrophic, one of the most polluted areas in the eastern Mediterranean) and Vouliagmeni bay and Fleves Islands (oligotrophic, non polluted area). Animals were collected from the shore of both areas during spring and summer 1991, using a hand-operated pump.

In each sample, males, ovigerous and non-ovigerous females were immediately selected and the individuals were placed separately. Animals were then divided into two groups. The first one was preserved in a freezer (-25°C) and transported by air to Marseille (France) in a dry ice container for the enzymatic tests. The API-ZYM system (Bio-Merieux, France) was used as a semiquantitative micromethod to test the enzymatic activity of 19 hydrolases from digestive gland extracts. Oxygen consumption both on individual (total respiration rate) and per biomass unit (weight-specific respiration rate) basis was measured from the second group using a dissolved oxygen meter (YSI model 51B) according to OMORI and IKEDA (1984). Dry weight of the individuals was determined only in a few cases directly (for 72h at 70°C) while for the majority of the specimens it was calculated from length-weight relationships that already existed (THESSALOU-LEGAKI, 1988). The statistical treatment of the results was mainly based on a multifactor analysis of variance taking into account the relationships between the respiration rate and the season, the locality, the sex (males, ovigerous and non ovigerous females) and the dry weight.

From the biochemical point of view, the results showed a large individual variability according to the physiological state of each specimen. Figure 1 gives the comparative mean enzymatic activities observed by the API-ZYM technique in males and non ovigerous females from the two areas. A statistically significant increase was observed in the total respiration rate with increase of the dry weight, whereas the weight-specific respiration rate decreased significantly with increasing individual dry weight ($P<0.001$). A seasonal variation was also observed ($P\approx0.01$): the mean total respiration rate was 70.5±5.2µl in spring and 55.5±3.7µl $O_2.ind^{-1}.hr^{-1}$ in summer. No statistically significant variation was found in the total respiration rate regarding sex, locality as well all the interactions of the factors concerned. A significant geographical variation was observed for the weight-specific respiration rate ($P=0.05$): 0.12+0.01µl $O_2.mg\ DW^{-1}\ hr^{-1}$ for specimens from Elefsis bay, and 0.20±0.02µl O2.mg $DW^{-1}.hr^{-1}$ for those from Vouliagrneni.

The results obtained both by enzymatic tests and respiration experiments, show that *C. tyrrhena* exhibits different physiological behavior according to sampling areas. As hydrolases are acting mainly on substrates provided by the environment, the differences observed for most of them may be attributed to the trophic conditions of the sampling areas. Therefore, they appear to be an ecophysiological response to the environmental conditions. Out of the 19 enzymes tested, only 3 exhibit a higher activity in Elefsis than in Vouliagmeni specimens.

The general tendency is, therefore, an "inhibitory" effect of the pollution on enzymatic activities. Such observations are in agreement with several literature data (AMIARD *et al.*, 1982; RIVIERE et KERAMBRUN, 1983) and may be related to the benthic way of life, which is more directly affected by pollution.

As far as respiration metabolism is concerned, season and locality significantly affect total and weight-specific respiration rate respectively : the total respiration rate of the individuals collected in summer is about 1.3 times lower than those collected in spring while the animals of the non polluted area (Vouliagmeni) have a two times higher weight-specific respiration rate than those of the polluted eutrophic area (Elefsis bay).

The low rates of respiration of *C. tyrrhena* obtained from the present study are in good agreement with the literature data concerning thalassinids from coastal or intertidal sediments, the respiration rates of which are among the lowest observed for decapods. This is interpreted as an adaptation allowing them to maintain aerobic respiration even in almost anoxic conditions. The decrease in the activity of digestive enzymes agrees with this interpretation and suggests that the whole metabolism is involved in the adaptation to pollution.

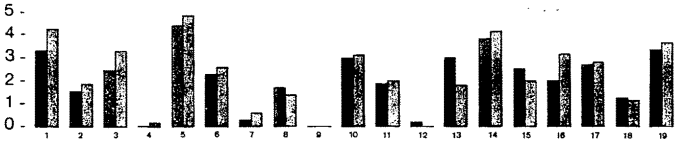

Figure 1. *Callianassa tyrrhena*. Comparative enzymatic activities mean obtained from API- ZYM (arbitrary units from 0 to 5). Dark : Elefsis bay samples; Light: Fleves islands samples.
1, acid phosphatase; 2, esterase (C4); 3, esterase lipase (C8); 4, lipase (C14); 5, leucine arylamidase ; 6, valine arylamidase; 7, cystine arylamidase; 8, trypsine; 9, α-chymotrypsine; 10, acid phosphatase; 11, phosphoamidase; 12, α-galactosidase; 13, β-galactosidase; 14, β-glucuronidase; 15, α-glucosidase; 16, β-glucosidase; 17, N-acetyl-β-glucosaminidase; 18, α-mannosidase; 19, α-fucosidase

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