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The Filtration Rate in the Mediterranean Mussel *Mytilus galloprovincialis* as a parameter to assess the toxicity of Zinc and Copper acting together

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The effects of two heavy metals, copper and zinc, acting together on the filtration rate of the Mediterranean blue mussel Mytilus galloprovincialis was studied, providing data on the synergism or antagonism between these two trace metals. This study also tried to evaluate a fairly simple and rapid procedure for screening and monitoring pollutants and effluent.

The animals were obtained in early December 1988 from a mussel farm located near the Salamis Island (Saronikos Gulf, Greece) and were kept at a depth of about 1 m. for a period of 4 weeks with mortality less than 0.8%. All experiments were conducted in a constant temperature room with 18±2 ° C. The nominal concentrations, in the 21 experimental aquaria, that were used to study the effects on the filtration rate, made up from a stock solution, were the following: Conc.1: 0.025 ppm Cu + 0.25 ppm Zn; Conc. 2: 0.05 ppm Cu + 0.5 ppm Zn; Conc. 3: 0.1 ppm Cu + 1 ppm Zn; Conc. 4: 0.2 ppm Cu + 2 ppm Zn; Conc. 5: 0.3 ppm Cu + 3 ppm Zn; Control. Measurements of the above solutions showed very small variation from the actual values.

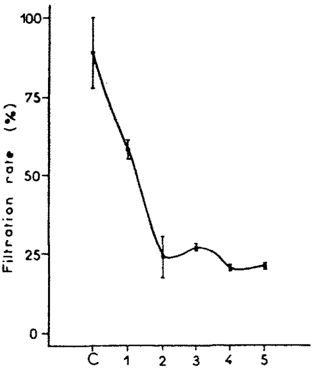

Fig 1. Effect of Cu and Zn on the filtration rate as percentage of the controls after 20 min. Vertical lines represent 95 % confidence limits.

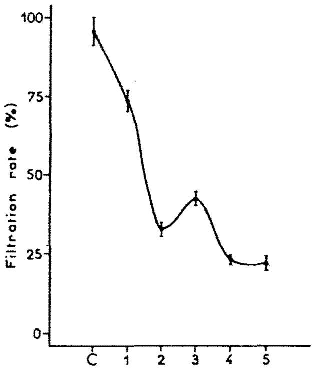

Fig 2. Effect of Cu and Zn on the filtration rate as a percentage of the controls after 40 min. Vertical lines represent 95 % confidence limits.

Following the procedure described by Abel & Papathanassiou (1984), samples of about 20 ml of water were removed after 20 and 40 min and measured, using a Perkin-Elmer/Hitachi Spectrophotometer. The formula described by Coughan (1969) was then used to determine the filtration rate. Three replicates were made for each combination of the concentrations including the controls. For the first period (0-20 min) there was a significant difference between groups (F=10.008, p = 0.0006) namely between the controls and the lowest concentrations and all other concentrations (Fig 1). Significant differences were also observed for the second period (20-40 min) (F=7.187, p = 0.0025) (Fig 2). The sensitivity from these experiments resembles to a large extent the filtration rate of the control samples of Mytilus edulis described by Abel (1976) and relatively lower than that described by Abel & Papathanassiou (1984); they took their samples from the local fish market (commercial supply) while in this experiment the animals were collected from a relatively undisturbed site offshore from the Salamis Island. Another factor which could also affect the filtration rate is the season in which the experiments are carried out. Abel & Papathanassiou (1984) experimented during the summer months, at the peak of the spawning season, while the present experiments were conducted during the winter months, preceding spawning, when lower metabolic activity is involved. Similar experiments in bivalves showed that when heavy metals are applied individually, the filtration rate is generally lowered (Cappuzo & Sasner, 1977; Watling & Watling, 1982; Howell et al, 1984; Mathew & Menon, 1984).

The concentration 1 is not significantly different from the controls, which suggests that the filtration rate is not affected under this environmental regime. The higher filtration rate reported for animals exposed at concentration 3, is unknown and must be related to the different physiological state of the animals, suggesting that the elevated activity observed at the low concentrations may alone be due to the increased metabolic rate to compensate the metal stress (Mathew & Menon, 1984). The decrease of the filtration rate that was observed for low concentrations suggest that at this level there is a reduction in the filtration rate due to the presence of heavy metals. The combination of concentrations of the two metals in the present study suggest that copper and zinc have certainly synergist effects but no additive ones. Finally there are advantages and disadvantages in using M. galloprovincialis as a test organism in the Mediterranean region. Among these are such extraneous factors as the organism's size and age, its habitat and seasonal variations. Some lack of precision in the results may be resolved if a lot of specimens are used. There are also the added effects caused by the possible metal-metal interactions and the time period during which the experiment should be conducted.

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