A SURVEY OF HEAVY METALS IN MUSSELS (MONACO, 1989 - 1996)

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The pollution by heavy metals of the marine environment in Monaco was estimated by analysing mussels which naturally grow on the open-sea side of the main dam of the new harbour of Fontvieille (1). Sampling took place ten times between November 1989 and May 1996.

Soft tissues of mussels were removed from the animals on the day of sampling and were kept frozen at - 30°C until the analysis. Then, they were wet-ashed by nitric acid and hydrogen peroxide. Solutions of tissues were analysed by atomic absorption spectrometry using the graphite furnace technique and Zeeman background correction for Cu, Cd and Pb. Mercury was determined by the cold-vapour technique using stannous chloride as a reducing agent. The quality of results was checked by participating in IAEA/MEDPOL intercomparisons.

The analysed mussels always had a minimum size of 2.0 cm. For each sampling, the collected mussels were divided in three groups according to their size (small, medium and big size). Animals belonging to the same group of size were pooled and their soft tissues constituted a subsample for subsequent analysis. This procedure was applied in order to determine the effect of the size of mussels on their heavy metal concentrations. It was not possible, however, to keep constant the size limits for each sampling since the population of mussels on the dam naturally grew during the survey period. Collected samples of this population were essentially constituted of small size (2-3 cm) mussels in 1989 and of big size (till 6 cm) mussels in 1996.

For each sampling, the highest concentration of copper was found in small size mussels while the smallest concentration was found in big size mussels. In the case of cadmium, the effect of the animal size on the concentration was not systematic. The smallest concentrations of lead were found in the group of big size mussels and, like copper, lead concentration has a general tendency to decrease when the size of the analysed animals increases. Mercury concentrations present two peaks (in November 1991 and February 1994) and an effect of the animal size on the concentration is only visible for these peaks (the mercury concentration tends to decrease when the animal size increases). Similar effects of the influence of the size of mussels on their heavy metal concentrations were reported by other authors (2,3).

A significant correlation between metal concentrations was only found for copper and lead ($r = 0.638$, $p < 0.001$). An inverse relationship between metal concentration and animal size is significant in the case of copper ($r = - 0.697$, $p < 0.001$) and lead ($r = - 0.800$, $p < 0.001$).

An inverse relationship between metal concentration and sampling date is also significant in the case of lead ($r = - 0.473$, $p < 0.01$). At first sight, this could indicate a decrease of the lead concentration in the surrounding sea water during the survey period. This decrease could result, for instance, from a decrease of lead concentration in gasoline (the traffic is very important in this area and can be a major source of pollution of the coastal sea water by lead).

A significant correlation, however, was also found between the average size of the mussel samples which were analysed and the sampling date ($r = 0.620$, $p < 0.001$). This is due to the above-mentioned fact that samples of collected mussels originate from a naturally growing population, the mussels collected at the end of the survey period being generally bigger than mussels collected at the beginning of this period.

As already mentioned, metal concentrations (and in particular lead concentrations) exhibit a general tendency to decrease when the animal size increases. We attribute, therefore, the inverse relationship between lead concentration and sampling date to the fact that the average size of the analysed animals increased with time, resulting in an apparent general decrease of lead concentration in mussels. If such a decrease of lead concentration in mussels really exists, it is probably very small and it is masked by the effect of the animal size on metal concentration in mussels.

Concentrations of copper, cadmium, lead and mercury in mussels collected in Monaco are of the same order of magnitude as those which were reported for other places in this area of the Mediterranean sea (4).

This work underlines the fact that the effect of the animal size should be taken into account when applying the mussel watch technique to the estimation of the state of pollution of sea water by heavy metals.

References

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