Correlation between trace element concentrations in the flesh of a benthic fish; an insight of trace element biochemical behaviour

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Abstract The correlations between 10 trace element concentrations in the flesh of the benthic fish *Mullus barbatus* have been investigated statistically. Six pairs of trace elements showed significant correlations at the 99% significance level. These correlations discussed in terms of the elements biochemical properties can give an insight on the mechanisms that govern accumulation and toxic action.

Résumé Les correlations entre les concentrations de 10 elements en traces dans le poisson benthique *Mullus barbatus* ont été étudiées statistiquement. Six paires des éléments en traces montrent des correlations significatives à un degré de signification de 99%. Ces correlations, discutées en termes de proprietés biochimiques des éléments, peuvent donner des informations sur les mécanismes qui gouvernent l'accumulation et l'action toxique.

The determination of trace elements in marine organisms has mainly two aims:

1) To monitor the concentrations of those trace elements that are potentially toxic in marine organisms in areas receiving increased quantities of trace elements due to either anthropogenic or natural sources.

2) To provide further understanding on the biogeochemical role of trace elements in the marine nvironment and thus increase our knowledge on the mechanisms of trace element pollution.

Our Laboratory's participation in the UNEP/GFCM Med II project involved among others the monitoring of 10 trace elements (Zn, Se, Sb, Rb, Hg, Fe, Co, Cs, Cr, Ag) in the flesh of *Mullus barbatus* from Saronikos gulf, Greece, over a period of 4 years. In total 42 samples were analyzed. Results have been published elsewhere (1).

It has been already reported that there is a positive correlation between Hg and Se concentrations in marine organisms and that Se probably decreases the Hg toxicity (2). Thus, it seemed interesting to investigate the correlations between the concentrations of the 10 trace elements monitored in the flesh of *Mullus barbatus*.

Correlation coefficient between 45 pairs of trace element concetrations were calculated. Six pairs of trace element concentrations were found to be correlated at the 99% significance level (Cr and Se, Hg and Zn, Hg and Se, Rb and Zn, Rb and Se, Cs and Fe) and one pair at the 99.9% level (Hg and Zn).

The most interesting correlation found is that between Hg and Zn ($r=-0.56$ significant at the 99.9% level for a total of 42 samples). According to Nieboer and Richardson, (3), Hg a class B metal can displace essential metals like Zn from functional groups and thus have a toxic action. The negative correlation found between Hg and Zn in *Mullus barbatus* may be a result of Hg displacing Zn.

Bernhard (2) has reviewed recent findings on Hg and Se association in both man and some marine organisms and has inferred to a protection mechanism against Hg poisoning. These findings are further supported by the Hg and Se correlation in *Mullus barbatus*. Selenium probably decreases Hg toxicity by forming Hg-Se binary products analogous to Hg-S products (4).

Rubidium correlates with Zn and Cs with Fe. In both cases a class A metal (Rb and Cs) which probably plays a role similar to that of the Na and K in organisms (3) correlate with essential intermediate metals (Zn and Fe).

The above discussion is not complete since the reasons why other trace element concentrations do not show any correlation are not discussed. In view of the relatively few data that we had available and the simple statistical

analysis used we think it is not prudent to continue much further the discussion. Nevertheless, this paper provides evidence that correlations between some trace element concentrations do exist and can be explained by the elements general biochemical behaviour. It is therefore very important to include as many trace elements as possible in any monitoring program since their interrelations can provide valuable insight on their marine biogeochemistry.

It is proposed that the extensive data obtained by the Med II projects be subjected to the above, as well as more sophisticated, statistical analyses. This might give us a better understanding of the mechanisms of trace element marine pollution.

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