Preliminary data on ^{60}Co uptake by the Black Sea Molluscs Mytilus galloprovincialis Lam. and Mya arenaria L. under laboratory conditions

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ABSTRACT

Preliminary experimentally-derived concentration factors (CFs) for ^{60}Co in two common Black Sea bivalve molluscs collected along the Romanian shore are given.

RESUME

Ce travail présente des facteurs de concentration (FC) préliminaires du ^{60}Co déterminés en conditions expérimentales chez deux Mollusques Bivalves communs du littoral Roumain de la mer Noire.

Quantitatively, Mytilus galloprovincialis and Mya arenaria are among the most wide spread bivalve molluscs of the Romanian coast. Former radioecological approaches initiated on these biota (BOLOGA, 1984,1985) have confirmed their stature as bioindicators for certain radionuclides (e.g. POLIKARPOV,1966; DAHLGAARD,1981; GOMEZ et al., 1986). These researches have continued under laboratory conditions (IAEA,1975) by the determination of CFs for ^{60}Co, which is a vital microelement and also an important activation product, with a long half-life (5.25 y) and belonging to the upper medium radiotoxicity group.

MATERIALS AND METHOD

Adult specimens of mussel and soft clam were collected at Constantza and Mamaia between June and August 1987. The experimental procedure was previously described (BOLOGA,1984). For each species (shell, soft part, byssus and syphon) two uptake experiments were performed in 3o l aquaria, with 4o unfed animals per experiment, by adding 111 kBq l^{-1} aequous solution of $^{60}CoCl_2$. The experiments lasted between 1o-25 days. ^{60}Co activity was monitored during uptake and measured simultaneously in water and three animals per sampling point, every 2 to 3 d, with a mono-gamma counter IFIN-L8, coupled to a well-type NaI(Tl) scintillation crystal; counting efficiency was about 2%. The radioactive water was not changed during the experiments.

RESULTS, DISCUSSION, CONCLUSION

Table 1. Concentration factors (in relation to fresh weight) of ^{60}Co in mussel and soft clam

Species	shell	soft part	byssus	syphon
M. galloprovincialis	6-17 1o-18	15-32 1o-5o	251-723 253-754	- -
M. arenaria	3- 6 2- 6	5-17 3-12	- -	13-4o 1o-31

The highest CFs in mussel were found during the first experiment after 8 d in all samples and during the second one after 16, 25 and 1o d, respectively. In soft clam these CFs were reached during the first experiment after 6 d, and in the second after 1o d in all components.

It seems that due to the short duration of these preliminary experiments in 1987, equilibrium concentrations have not been achieved for the soft part of mussel and for all components of soft clam.

As to other reference data, the results obtained as yet on the mussel from the Black Sea agree with those on Mytilisepta virgatus from the Pacific Ocean with the following CFs: shell - 11, soft part - 13 and byssus - 658 (NISHIWAKI et al.,1981); with regard to the soft clam results are lower as compared to the rare data on the same species from the Pacific (HARRISON,1973).

The low CFs so far obtained in the mentioned bivalves point out the necessity of further work in order to establish if these species would make suitable bioindicators for ^{60}Co contamination in the Black Sea.

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Polonium-210 in marine Fish

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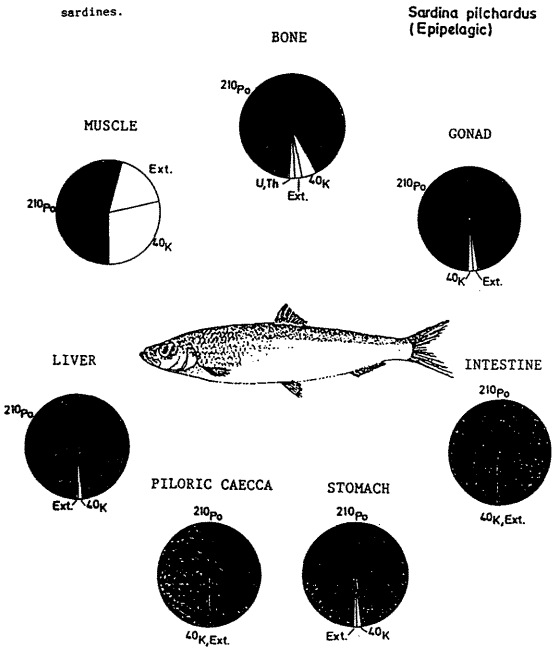
Po-210 is concentrated by marine organisms and concentration factors repported are typically about 10^4 for zooplankton, 10^2-10^3 for fish muscle and reach 10^5 for fish liver.

Po-210 activity concentration levels in marine fish were found to be independent of water depth in ocean, and high concentrations are displayed by epipelagic teleosts as well as by deep sea teleosts. Epipelagic teleosts, as sardine and maeckerel, which food heavily relies on zooplanktonic crustaceans, display the highest ^{210}Po concentration found in fish muscle (2-21 Bq.Kg^{-1} wet wt), while large predators as the blue-marlin and the oilfish display lower concentrations (0.4-0.7 Bq.Kg^{-1}). Varying ^{210}Po concentration were also measured in muscle of mesopelagic and bathypelagic fish. In all oceanic and neritic domains studied, ^{210}Po concentrations found in fish are explainable by food-chain transfer.

A similar pattern of ^{210}Po distribution in fish tissues was found in teleosts and elasmobranchs from all depths, but a clear cut exists between these two fish groups.

Fig 1. Relative contribution of internal (^{210}Po, ^{40}K, U, Th) and external radiation sources (Ext) to the absorbed dose rate in the tissues of the Atlantic sardines.



Absorbed radiation doses in fish come from internally accumulated nuclides and external radiation sources. External sources, as cosmic radiation, dissolved ^{40}K in sea water and natural nuclides in bottom sediments, give, however, lower contribution than internal ^{210}Po. Due to the variable ^{210}Po concentration in fish tissues also the contribution of this nuclide to the absorbed radiation dose varies accordingly. Considering for instance the common sardine, the ^{210}Po contribution for the absorbed dose rate is always the most important in every tissue (Fig.1). Dose equivalent rates due to ^{210}Po alone can be so high as $3x10^2$ mSv.y^{-1} in sardine liver and $5x10^3$ mSv.y^{-1} in intestinal walls.

In epipelagic teleosts the external radiation sources contribute with about 1/3 for the total absorbed dose rate in fish muscle. The remaining 2/3 contribution from the internal sources is mainly shared between ^{210}Po and ^{40}K, while man-made radionuclides, as ^{137}Cs and $^{239+240}$Pu, contribute with 0.5% or less to the absorbed dose.

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