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Uptake, accumulation and distribution of trace metals and  
radioisotopes by marine organisms in the Izmir area, (part  
of a coordinated programme on the fate and significance of  
foreign substances in the agricultural environment)

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Title of the Project : A Study of the Accumulation and  
Distribution of Trace Metals and  
Radioisotopes in Marine Organisms  
(particularly in Tapes decussatus  
L.) in Izmir Bay and its Vicinity.

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STUDY OF THE ACCUMULATION AND DISTRIBUTION OF TRACE METALS AND  
RADIOISOTOPES IN MARINE ORGANISMS (PARTICULARLY IN  
TAPES DECUSSATUS L.) IN IZMIR BAY AND VICINITY

ABSTRACT

Tapes decussatus claims an economical importance as an important product from Izmir bay. The concentrations of trace metals (Cu, Mn, Zn, Fe, Pb, Co, Cr, Hg, Cd) in this organism have been determined in respect to different localities with polluted and non-polluted waters. The measurement of these trace elements bears a paramount importance for the public health. Izmir bay is exercising greater magnitude of pollution which has exerted a deteriorous effect upon the aquatic organisms. Keeping these facts in mind seasonal as well as locality wise fluctuation of trace elements and accumulation of  $^{65}\text{Zn}$  and  $^{115}\text{Cd}$  in the organs and tissues of T. decussatus were determined: Comparison of the concentration of trace elements in natural condition as well as in laboratory conditions was carried out using radioisotopes.

It has been found out that concentration of trace elements in T. decussatus varied according to tissues and organs of the body, size of the animal, locality of sampling and season of the year. Accumulation of the concentration of radioactive  $^{65}\text{Zn}$  and  $^{115}\text{Cd}$  was also observed varying according to tissues and organs of the animal and was found to be slow. Pathway of the trace elements was also observed using radioisotopes ( $^{65}\text{Zn}$  and  $^{115}\text{Cd}$ ). Effect of toxicity of stable elements on the uptake and loss was also determined. Toxic effects of different concentrations upon the uptake and loss of  $^{65}\text{Zn}$  and  $^{115}\text{Cd}$  was also studied.

INTRODUCTION

Hygeinic problems are gaining considerable importance throughout the world. Unfortunately the increasing urbanization and industrialization along the coasts have created an alarming situations in regards to hygeinic conditions throughout the world. Similar conditions prevail in the countries bordering along Medi-terranean, Aegean sea, Marmara sea and Black sea. In spite of the combined efforts of organizations for the conservation of nature no fruitful results have been achieved. At present the wastes from these countries directly fall into the sea (SCHREIBER, TASSIPELATI

and MEZZADRI, 1971, FRIGILOS, 1974)). These wastes effect the shape and morphologic features of the aquatic organisms (CRISAFI, 1974) and influence the population density. This leads to the pronounced effect upon the productivity and ecosystem (MUNDA, 1974).

Wastes entering the sea undergo changes and are recirculated again between biota, water and sediments (RICE, BARTIST and MEZAORI, 1970). But this process takes place in limited concentrations. The contribution of the trace elements and non ability of breaking up influences the ecosystem. This also greatly effect the hygienic conditions of the people through food chain (U.I., 1972, BAEZ and YUCERAN, 1973, UYSAL, 1973, 1975).

A large number of investigations have been carried out in regards to the general determination of trace elements being contributed into the sea water. But the work dealing with the relationship of trace elements with the organisms is sparse (KOSTA, 1973). This problem has increased manifold in the countric bordering Mediterranean Aegean and Black sea, and has demanted greater consideration. These water bodies are linked with oceans through narrow passages. Therefore the industrial wastes are hardly broken up and cannot introduced into the oceans (UYSAL, 1975). Therefore SCHREIBER et al (1971) has also stressed upon the necessity of studying the relationship of trace elements and organisms in the localities such as Bosphorus , Dardenelles, Gibraltar and Suez.

Present work deals with the concentrations of trace metals such as copper, manganese, zinc, iron, lead, cobalt, chromium mercury, cadmium and uptake and loss of some radioisotopes by marine organisms (particularly *T.decussatus*) in different localities in Izmir bay.

#### MATERIALS AND METHODS

Animals were collected by hand from intertidal zone from Izmir Bay. Before being used they were well cleaned with running sea water and kept at the constant room temperature (13°C), in the polythene buckets for six days in filtered sea water, having a low trace metals content. Their water was changed with clean, filtered and aerated sea water everyday. The filtered sea water for use in experiments was collected from the surface of the outer part of Izmir Bay, well away from land. Polythene containers were used for this purpose. The water was filtered through Millipore (0.45 u pore size) membrane filters. In the experiments the same stock of sea water was used.

Ten experimental animals were dissected after six days. Stainless steel scalpel and scissors were used. All samples were dried in pyrex flasks at 105 °C for a night. Their dry and wet weights were measured before they were finally dissolved. All samples were first dissolved in 10 cc redistilled nitric acid. The flasks closed with silica bulb stoppers and allowed to stand overnight at room temperature. On the following day the flasks were then transferred to a hotplate. The bulb stopper was removed and the solution was slowly to dryness. After evaporation from redistilled nitric acid 10 cc redistilled hydrochloric acid was added. After finally evaporation the samples were diluted with 0.1 normal redistilled hydrochloric acid according to their wet weight previously measured. The diluted samples finally were measured by using a Technor AA 5 Atomic Absorption Spectrophotometer. For the determination of mercury concentration in animals, special wet digestion apparatus, cold vapor technique and Varian Techtron Model 64/As/Se/Hg analysis kit was used.

#### LOCATION AND DESCRIPTION OF AREA

The bay of Izmir is located on the western coast of Turkey (Fig.1). As it will be seen from the map localities of Deniz Bostanli and Tuzla area situated in the north side of Izmir Bay and claim the same environmental conditions by having a muddy substratum. Çakalburnu fishery is situated in the south side of the bay which has a substratum of mud mixed with pebbles. Deniz Bostanli is heavily polluted, Çakalburnu fishery is little and Tuzla has very clear water. So these three localities of the Izmir Bay are distinguished according to their grade of pollution. Tuzla is situated in salt production the decrease in size of the animals results increase in the mean amount of the trace metals, such as manganese, zinc, lead and cobalt (and with some exceptions). On the other hand the increase in size of these results in an increase in the amount of some elements, but do not show an increase with size in some elements in some localities of Izmir Bay. Iron mostly increased with size. Amount of iron was seen to decrease with size in Tuzla. This is a reverse relation. This remains to be explained. The zinc concentrations has the same relation in Çakalburnu Fishery.

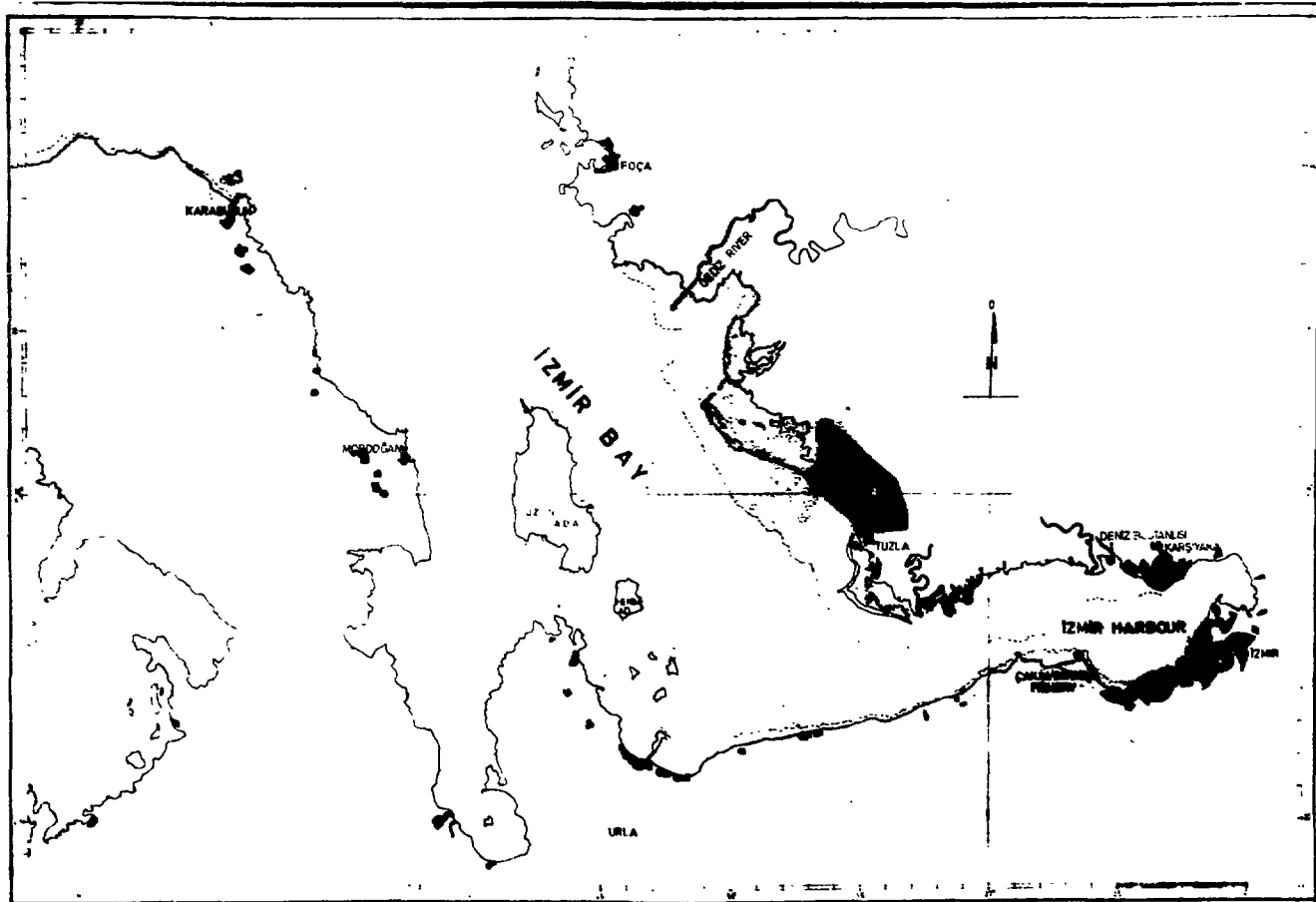


Fig. 1, Location of Stations for sampling *Tapes decussatus* in Izmir Bay.



The present work demands a check up of some analytical works in order to make sure the variation in the amount of trace metals in tissues and in the organs of animals in different localities of the Izmir Bay. These results for one year are taken, from analytical work, which is still in progress according to our contract regulations. After checking up some uptake laboratory experiments and analytical work, we will be able to compare all our results and we will give more informations concerning this process in our untouched area. But according to the present results, we can say that these animals live and feed in sediments through absorption and adsorption. The animals take the metals directly from solution in sea water or through food chains by digestion and through special areas as gills by absorption or adsorption (BRYAN, 1971).

#### RESULTS AND DISCUSSION

As mentioned in the previous progress reports similar seasonal variation and periodic work of trace elements has been carried out on the same organism, *T.decussatus*, from the three localities in Izmir bay (Fig.1). Trace elements were determined through different assemblage of the same equipments. Best methods and processes were selected for each element. As mentioned in our previous reports the values were obtained according to the concentrations in

- (a) organs and tissues (b) size of animal (c) localities
- (d) season of the year

Concentration of Cd was not included in the report before. It was found out that Cd was higher in *T.decussatus* in comparison with other elements. The study of Cd is still in progress. In general different elements showed the tendency of accumulation in specific tissues or organs. Results given in the Table 1 show that concentration of trace elements was higher in digestive glands, mantle siphon, gills and polp. Uptake of trace elements occurred through the contact with the environment and through the digestive gland.

Table 1. The distribution of trace elements in the tissues and organs of *T. decussatus* in Çakalburnu fishery (Izmir bay).

Tissues and organs	ug/g Dry weight Basis.								
	Cu	Mn	Zn	Fe	Cd	Co	Cr	Pb	Hg
Blood	5.56	4.03	136.90	45.03	12.63	7.42	5.39	12.25	0.56
Foot and Digestive system	7.07	4.86	69.26	229.87	1.27	1.85	2.21	4.57	1.32
Mantle and siphon	10.40	15.47	70.30	194.78	1.22	1.17	2.20	9.08	2.02
Muscles	1.74	5.92	59.18	79.89	4.19	4.61	2.79	10.62	3.04
Gills and palpes	7.80	12.85	133.21	645.12	6.28	5.04	4.09	14.75	3.09
Digestive glands	3.19	6.38	177.65	624.45	3.93	1.76	5.32	9.79	4.04
Soft body	9.82	3.40	94.17	198.95	5.98	6.19	3.63	2.65	2.47

This data provided as information about the pathway of trace elements and also about the variation in accumulation of trace elements according to polluted and non polluted localities.

Concentration of trace elements in the animal in natural conditions was already observed and in order to certify the accuracy of data similar observations were carried out in the laboratory to study the experimental uptake and loss using some radioisotopes. Results are given in Table 2.

Table 2. Accumulation of  $^{65}\text{Zn}$  and  $^{115}\text{Cd}$  in the organs and tissues in the experimental animal (count per minute/g) after 140 hours in the uptake experiment.

Tissues and organs	Blood	Mantle and siphon	Foot and Dig.Syst.	Gills and Palps	Muscles	Dig.Gland/Shell
$^{65}\text{Zn}$ -CPM/g	253	263	137	478	207	478 516
$^{115}\text{Cd}$ -CPM/g	16	14	57	223	418	52 14

During the uptake experiments the animals, kept in the fixed radioactive conditions, were dissected after 140 hours and organs and tissues were dissolved in  $\text{HNO}_3$ . The results given in Table 2 show that higher concentration of trace elements in respective organs in the natural conditions was similarly found higher in the same organs in the laboratory conditions.

Besides, the speed of radioactive uptake increases very slowly after a definite level and also the loss occurs slowly after a definite level.

Apart from this, it was observed that in the uptake experiments the animals of the same size and number were kept in fixed radioactivity and also in different normal element concentrations (0, 30, 300, 1000, 3000 FPM/l Cu, Hg, Pb, Cd). Through this experiment the effect of different concentration of these elements upon radioactive uptake of Cu, Hg, Pb, Cd. Also the toxic effect of these elements upon the organism was studied. As a result Hg, Cu, Cd, Pb, showed the toxic effect in order of magnitude.

## R E F E R E N C E S

- BAEZ, P.A., and R. MULLMAN, 1973 : Transport and fate of Mercury in the Aquatic Environment. Instituto Nacional de Energia Nuclear, Mexico. (Presented at the Joint FAO/IAEA Co-ordinated Research Meeting on Isotopic Tracer Aided Studies on the Origin and Fate of Foreign chemical Residues, in the Agricultural Environment, Vienna, 5-9. November 1973).
- CRISAFI, P., 1974 : Some Responses of Planktonic Organisms to Environmental Pollution. Rev. Intern. Oceanogr. Med. Tome XXXIV.
- FRANTZOS, N., 1974 : Chemical and Physical Parameters from a large scale outfall in the Upper Saronikos Gulf, 1972. Rev. Intern. Oceanogr. Med. Tome XXXIV.
- KOSTA, L., 1973 : Behaviour of Trace Elements in Living organisms. (Working paper IAEA, Vienna 5-9 November, 1973).
- MUNDA, I., 1974 : Changes and Succession in the Benthic Algal Associations of Slightly Polluted Habitats. Rev. Intern. Oceanogr. Med. Tome XXXIV.
- RICE, T.R., J.P. BAPTIST, F.A., F.A. CROSS and T.W. DUKE, 1972 : Potential Hazards from Radioactive Pollution of the Estuary. Marine Pollution and Sea Life. Published by arrangement with the Food and Agriculture organization of the United Nations by Fishing News (Books) LTD.
- SCHREIBER, B.; L. TASSIPELATI, and M.G. MEZZADRI, 1971 : Radioecology Research in Toronto Gulf. Part. I: Radiometric Measurements on sea water, plankton, Benthic organisms and sediments. Rev. Intern. Oceanogr. Med. Tome XXI.
- UL, J., 1971 : Mercury Pollution of Sea and Fresh water its Accumulation into water Biomass. Rev. Intern. Oceanogr. Med. Tome XXII-XXIII.
- UYSAI, H., 1973 : A study of the accumulation and regulation of trace metals and their radionuclides by the estuarine bivalves *Cardium edule* and *Scrobicularia plana* (Da Costa). (In Press).
- UYSAI, H., 1975 : A report on the Natural gross beta Radioactivity and Heavy Metals of Zooplankton and Their Environments in Izmir. Bay. (Presented to International Conference on heavy metals in the Environments).

