^{110m}Ag AND ^{51}Cr UPTAKE BY THE MOLLUSK VENUS VERRUCOSA

C. PAPADOPOULOU, C. MANOLIDIS, M. STAMOULI and J. ANDREOTIS

NRC "Demokritos", Radioanalytical Laboratory,
Aghia Paraskevi, Attikis, Athens (Greece)

Resumé: La bioaccumulation de ^{110m}Ag et ^{51}Cr dans le mollusque édible Venus verrucosa collecté par le Golfe Saronique a été étudiée dans des aquariums contenants de l'eau de mer de la region correspondante et par l'addition des isotopes en trois concentrations differents pour chaqun. Les valeurs des facteurs de concentration (K) trouvés pour ^{110m}Ag sont 16,19 et 16 pour les concentrations 7.0, 14.0 et 28.0 μCi ^{110m}Ag/ 24L, respectivement, et 64,65 et 60 pour les concentrations 20,40 et 80 μCi ^{51}Cr/20L respectivement. Les Tb $\frac{1}{2}$ ont eté trouvés de 60 jours pour l' argent et de 78 jours pour le chrome. 70.0% de ^{110m}Ag et 78.5% de ^{51}Cr de la radioactivité accumulée par l' animal est localisée dans la coquille. La distribution de la radioactivité de ^{110m}Ag et de ^{51}Cr dans les differentes parties de Venus verrucosa a eté également determinée.

The presence of silver and chromium radionuclides in the marine environment has been pointed out by several investigators (Polikarpov,1966). ^{110m}Ag (H.L 253 d) ^{108m}Ag (H.L 127 yr), and ^{51}Cr (H.L 28d) are deriving from nuclear tests, and from the discharge of the liquid radioactive waste of nuclear plants . Moreover ^{51}Cr is one of the principal corrosion products of nuclear power ships. Experimental work has demonstrated the ability of certain mollusk and crustacea species to accumulate radionuclides of silver and chromium in different concentration factors (Policarpov 1966). Also in the viccinity of nuclear power plants ^{110m}Ag has been found in mollusks and crabs. (Hunt 1980).

In an attempt to gain information on the uptake of silver and chromium radionuclides by different mollusk species, we studied the biokinetics of ^{110m}Ag and ^{51}Cr in the mollusk V. verrucosa. The study of this edible species is of importance because a high concentration of radionuclides would represent a potential hazard to the human health.

Sixty individuals of V. verrucosa (size 4-5 cm) were sampled from a farm of Salamis Island in Saronicos Gulf, in 1985. Sea water was also taken from the same area. Two uptake experiments were performed at constant temperature ($\sim$20°C) and salinity using the radioisotopes ^{110m}Ag as silver nitrate and ^{51}Cr as chromium chloride.

The results of these experiments can be summarized as follows:
^{110m}Ag. The concentration factors (K) found, were 16,19 and 16, corresponding to ^{110m}Ag concentration 7.0, 14.0 and 28.0 μCi, ^{110m}Ag/24L. respectively. The distribution pattern of ^{110m}Ag in the body of V. Verrucosa was found to be as follows: 86% Visceral mass, 5,6% mantle and gills, 3.9% muscle and 1.7% foot. 70% of the whole radioactivity was found in the shell. The radioactivity of ^{110m}Ag remaining in the shell after 60 days leaching, with 0.5 M HCl, was 15%. A 60 d biological half time (Tb $\frac{1}{2}$) for ^{110m}Ag was found.
^{51}Cr. The concentration factors (K) found, were 64,65,60 for 20,40 and 80μCi, ^{51}Cr/20L respectively. The distribution pattern of ^{51}Cr in the body of the animal was found to be as follows: 75% visceral mass, 9.6% mantle and gills, 6.7% muscle, and 1.3% foot. 78.5% of the whole body radioactivity was found in the shell. The radioactivity of ^{51}Cr, remaining in the shell after 30 days of leaching, with 0.5 HCl, was 20%. Tb $\frac{1}{2}$ for ^{51}Cr was found to be 78 days.

As it can be seen from the results mentioned above low concentration factors (K) were found for both ^{110m}Ag and ^{51}Cr in the edidle mollusk V. Verrucosa.

Viscera is a principal site of deposition of the studied radionuclides. Data presented in the litterature are in agreement with our findings concerning the high concentration of ^{110}Ag in viscera, in certain mollusk species. (Pentreath, Fowler 1978).

B I B L I O G R A P H Y

1. Hunt J. 1981 Radioactivity in surface and coastal waters of the British Isles 1980. Techn. Rep. No. 6 Aq. Env. Mon. ISSN. 0142-2499 32 p.
2. Pentreath, R.J., Fowler, S.W. 1978. Irradiation of aquatic animals by radionuclides incorporation. Techn. Rep. Ser. No. 190 IAEA, Vienna, pp. 129-171.
3. Polikarpov G.G. 1966. Radioecology of Aquatic organisms, N. Holland Publ. Co, Amsterdam Reinhold, Book Division. N.Y. 314 p.

MUTUAL INTERACTIONS BETWEEN Cd AND Fe WHILE THE TOXIC EFFECTS ON SOME MARINE FISHES

Hatice PARLAK

Ege University, Faculty of Science,
Biology Department, Bornova, Izmir (Turkey)

SUMMARY

In this investigation, the mutual interactions between Cd and Fe while the toxic effects on Chasmichtys gulosus had been studied using Cd-115 m and Fe-59 as tracers. It has been shown from the results that Fe has synergistic or additive effects on Cd accumulation and excretion.

INTRODUCTION

While the individual effects of heavy metals on marine organisms has been widely studied, a few studies exist concerning the uptake, accumulation and loss of two or more metals in combination (NEGILSKI,1981;BJERREGAARD,1982).

Cd has been known as a highly toxic metal and has received considerable attention for many years (PENTREATH,1977;THEEDE,1979;RASPOR,1980). Furthermore,it has been shown that part of the Cd is bound to soluble proteins like metallothioneis in the marine organisms (WIEDOW,1982;KÖHLER,1982).

Fe is a major components of sea water and additionaly, the industrial fluxes includes Fe as one of the pollutant. The accumulation of Fe in some marine organisms has been studied intensively (HOBDEN,1969;FRAIZIER,1975).

No information is available concerning the interactions the uptake and excretion of Cd and Fe in marine fish.

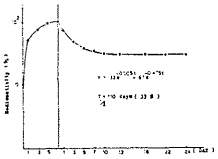
In the present study, the accumulation and excretion of Cd and Fe, their mutual inteactions is investigated in the marine fish Chasmichtys gulosus.

MATERIAL AND METHOD

In the experiments, radiactive Cd (Cd-115 m) and radioactive Fe (Fe-59) has been applied as tracers. Cd-115 m (0.007 mCi/lt) and Fe-59 (0.013 mCi/lt) has been used together with the carries as Cd (0.5 ppm) and Fe saturated sea water (0.26 ppm Fe), in single or paired combinations. Each tank includes 5 fish adopted to the laboratory condition for 15 days. Accumulation experiments has been carried on for 7 days and loss experiments for 25 days. During experiments radioactivity in fish was measured pariodically in the "Armac" 4π Scintillation counter.

RESULTS AND DISCUSSION

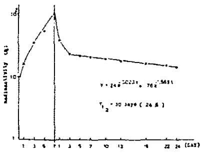
Fig.1 and Table 1 shows an uptake and excretion curve of Cd-115 m in the whole body of fish.The accumulation for 7 days is 397 cpm/gr, and biological half life was 110.6 days (33%).The excretion curve of Cd-115 m could be approximate on semi logaritmic graph and expressed as $y=33e^{-0.006t}+67e^{-0.476t}$(y=radioactivity of the fish, e=exponential function, t=days after the beginning of the excretion experiment).



DAYS		UPTAKE				LOSS								
		1	3	5	7	1	3	5	7	10	13	16	20	25
Theoric.	cpm	[illegible]	310	385	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	%	51	76	96	100	74	48	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Exp.	cpm	199	[illegible]	[illegible]	397	[illegible]	214	165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	115
	%	[illegible]	80	[illegible]	100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	29

Fig 1 and Table 1: Accumulation and excretion of Cd-115 m by Chasmichtys gulosus.

On the other hand, when Fe 59 was added to the experimental medium,the uptake of Cd-115m raised up to 1102 cpm/g (Fig 2 and Table 2). The excretion curve of the Cd-115 m in the same medium could be expressed as $y=24\,e^{-0.023t}+76\,e^{-1.568t}$ and biological half life was 30 days (24%).

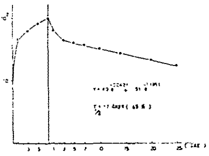


DAYS		UPTAKE				LOSS								
		1	3	5	7	1	3	5	7	10	13	16	20	24
Theoric.	cpm	191	413	641	[illegible]	[illegible]	275	[illegible]	[illegible]	[illegible]	210	[illegible]	180	[illegible]
	%	16	35	54	100	[illegible]	24	21	20	19	18	16	15	14
Exp.	cpm	[illegible]	[illegible]	[illegible]	1102	[illegible]	311	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	160	159
	%	17	35	58	100	34	[illegible]	20	23	18	18	17	15	14

Fig 2 and Table 2:Accumulation and excretion of Cd-115 m in the presence of Fe-59 by Chasmichtys gulosus.

It means that Cd accumulated rapidly also excreted considerably fast when Fe is added along with Cd to the medium.

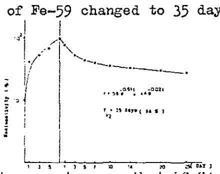
Fe-59 accumulation and excretion curve has been in Table 3 and Fig 3.The uptake for 7 days exposure was 2150 cpm/g.The excretion curve of Fe-59 could be expressed as $y=49e^{-0.042t}+51e^{-1.186t}$ and biological half life was 17 days (49%).



DAYS		UPTAKE				LOSS							
		1	3	5	7	1	3	5	7	10	17	20	25
Theoric.	cpm	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	961	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	%	59	62	82	100	63	45	[illegible]	[illegible]	32	27	21	17
Exp.	cpm	[illegible]	[illegible]	[illegible]	2150	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	%	59	61	85	100	52	54	[illegible]	[illegible]	30	[illegible]	[illegible]	17

Fig 3 and Table 3: Accumulation and excretion of Fe-59 by Chasmichtys gulosus.

When the Cd-115m added to the medium the accumulation was 1933 cpm/g and the excretion curve of Fe-59 were expressed as $y=56e^{-0.51t}+44e^{-0.02t}$.Also biological half life of Fe-59 changed to 35 days (44%),(Table4,Fig.4).



DAYS		UPTAKE				LOSS							
		1	3	5	7	1	3	5	7	10	14	20	24
Theoric.	cpm	826	1036	1337	1933	1485	1036	894	[illegible]	704	644	570	[illegible]
	%	43	54	69	100	77	54	[illegible]	40	[illegible]	[illegible]	[illegible]	27
Exp.	cpm	[illegible]	1036	[illegible]	1933	1075	977	829	771	674	[illegible]	570	510
	%	42	54	72	100	56	51	43	40	35	[illegible]	29	26

Fig 4 and Table 4: Accumulation and excretion of Fe-59 in the presence of Cd-115m by Chasmichtys gulosus.

It seems to mean that if Cd 115m has been existed in the medium the uptake and excretion of Fe-59 was depressed.

ACKNOWLEDGEMENT

I would like to express my cardial thanks to Dr.Taishi Ueda and his staff in NIRS,Div.of Marine Radioecology,JAPAN,for their helps and advices during my studies.

REFERENCES

-BJERREGAARD,P: Aquatic Toxical.2, 113-125, 1982.
-FRAIZIER,A: Rapport CEA-R 4630 (1,2,3,4) 1975.
-HOBDEN,D.J: J.Mar.Biol.Ass.U.K.49, 661-668, 1969.
-KÖHLER,K.,H.U.RISSGARD: Mar.Biol, 66, 53-58,1982.
-NEGILSKI,D.S.,M.AHSANULLAH.,M.C.MOBLEY: Mar.Biol,64, 305-309, 1981.
-PENTREATH,R.J: J.Exp.Mar.Biol.Ecol.30, 223-232,1977.
-RASPOR,B: In.Cadmium in the Environment Part I,Edit by Jerome O.Nriagu,1980.
-THEEDE,H.,N.SHOLTZ.,H.FISCHER: Mar.Ecol.Prog.Ser.1. 13-19, 1979.
-WIEDOW,M.A.,T.J.KNEIP.,S.J.GARTE; Environm.Res. 28, 164-170,1982.