Accumulation of PCBs and induction of Cytochrome P-450 and mixed function oxygenase activity in juvenile sea bass *(Dicentrarchus labrax)*

Cristina NASCI*, Laura TALLANDINI**, Valentino U. FOSSATO*, Giancarlo CAMPESAN*, Luigi PIVOTTI** and Aldo MENETTO*

*Istituto di Biologia del Mare, VENEZIA **(Italia)**
Università degli Studi, Dipartimento di Biologia, PADOVA **(Italia)

The early developing stages of marine fish are known to be more susceptible to environmental stress and pollution than mature animals; however, few data are available on the biochemical response to toxic and genotoxic chemical contaminants (1).

In this paper, we report the first results of laboratory experiments in wich specimens of *Dicentrarchus labrax*, a widely distributed fish in the Mediterranean Sea, were exposed to relatively low concentrations of PCBs in water.

About 50 juvenile sea bass, one month old and about 1 gram weight, were kept in 80 dm3 tanks in areated sea water. After seven days of acclimation, a solution of Aroclor 1254 (10 mg/cm3 ethanol) was added to give a PCB concentration of 1 µg/dm^3 (tank A) and l0 µg/dm^3 (tank B). Daily, about 5 g of fish feed were added to each tank; then half the water was renewed and a proportional solution of Aroclor 1254 added. Specimens of juvenile sea bass, in which tail was not developed probably due to irradiation during the first embrional stages, were also exposed to 10 µg/dm^3 PCB in water (tank B). Control tanks, without PCBs, were kept for the entire experimental period.

At 0, 7, 15 and 30 days of exposure, six fish from each tank were sacrificed and divided in two pools : the first one was used for PCB determination, while the second fraction was homogenised and analysed for Cytochrome P-450 content (2) and for BPH (3) and NAD (P) H reductases (4) activity in microsomal pellets. Protein concentration was measured by the method of LOWRY *et al.*, (5). The PCBs in water and fish were determined by ECD gas chromatography according to FOSSATO (6).

The results are reported in Tables I and II.

Table I

Dicentrarchus labrax; juvenile fish without tail treated with PCB Aroclor 1254; C= control, B= 10 µg/dm^3. Data, referred to wet weight, are expressed as follows : Time = days; Protein = mg pr/g; PCBs = µg/g; P-450 = nm protein/mg; BPH = fluor unit protein/mg min.; NAD (P) H ferricyanide and Cytochrome c reductase = nm reducted/mg protein min.; n. d. = not detected.

Time	Tank	Protein	PCBs	P-450	BPH	NADHferr	NADHcitC	NADPHcitC
O	C	3.47	0.02	0.111	6.79	1202	1.15	7.16
O	B	4.34	0.02	0.063	3.89	825	n.d.	7.44
7	C	3.44	0.03	0.028	3.07	1098	n.d.	n.d.
7	B	1.99	3.17	0.052	n.d.	1392	57.12	4.00
15	C	3.47	0.09	0.064	0.03	1078	n.d.	n.d.
15	B	2.62	3.69	0.143	3.53	1096	n.d.	n.d.
30	C	2.94	0.11	0.028	n.d.	866	n.d.	n.d.
30	B	2.01	12.45	0.056	7.34	1486	n.d.	n.d.

Table II

Dicentrarchus labrax; juvenile fish with tail treated with PCB Aroclor 1254; C = control, A = 1 µg/dm^3 , B = 10 µg/dm^3. Data, referred to wet weight, are expressed as follows : Time = days; Protein= mg pr/g; PCBs= µg/g; P-450= nm protein/mg; BPH = fluor. unit protein/mg min.; NAD (P) H ferricyanide and Cytochrome c reductase = nm reducted/mg protein min.; n. d. = not detected.

Time	Tank	Protein	PCBs	P-450	BPH	NADHferr	NADHcitc	NADPHcitc
O	C	1.41	0.02	0.053	n.d.	1155	n.d.	4.66
O	A	1.28	0.02	0.084	n.d.	1055	n.d.	9.09
O	B	2.75	0.02	0.084	1.99	941	n.d.	n.d.
7	C	1.09	0.03	0.080	3.86	1263	7.66	n.d.
7	A	1.59	0.33	0.088	n.d.	1574	n.d.	3.66
7	B	1.37	2.45	0.087	2.86	1049	n.d.	n.d.
15	C	1.62	0.08	0.118	4.60	1389	n.d.	n.d.
15	A	1.97	0.46	0.082	10.20	1541	n.d.	7.00
15	B	1.64	5.29	0.209	14.26	1687	2.10	10.11
30	C	1.07	0.13	0.035	n.d.	768	10.87	8.35
30	A	1.80	1.01	0.030	2.39	1333	n.d.	7.65
30	B	0.82	10.22	0.050	5.74	1151	12.56	16.53

The PCB content showed an increase with time in both treatments, reaching the highest values in animals from tank B. After 30 days of exposure to a nominal concentration of 10 µg/dm^3., the bioconcentration factor, on a wet weight basis, varies between 1,000 and 1,200, indicating an active bioaccumulation.

The pattern of enzymatic parameters is more complex and erratic. Cytochrome P-450 showed a clear increase over the control in treatment B after two weeks of exposure, but it decreased to the end of the experiment.

NADH ferricyanide reductase activity presented a slight increase in both experiments, the difference between treated fish and control becoming evident at 30 days.

NAD (P) H Cytochrome c reductases and BPH activity showed no clear responses, the values often being near the detection levels.

These preliminar results indicate an active bioaccumulation of PCBs by juvenile sea bass and give evidence of contaminant induced damage at the biochemical level for tissue PCB content of about 10 µg/g wet weight.

REFERENCES

1 PESONEN M., FORLIN L., HANSSON T. and ANDERSSON T., 1988. - *Mar. Env. Res.*, 24 : 116-117.
2 ESTABROOK R.W. and WERRINGLOER J., 1978. - *Methods in Enzymology*, 52 : 212-220.
3 NERBERT D.W. and GELBOIN H.V., 1968. - *J. Biol. Chem.*, 243 : 6242-6249.
4 LIVINGSTONE D.R., MOORE M.N., LOWE D.M., NASCI C. and FARRAR S., 1985. - *Aquat. Toxicol.*, 7 : 79-91.
5 LOWRY O.H., ROSEBROUGH N.J., FARR A.L. and RANDALL R.J., 1951. - *J. Biol. Chem.*, 193 : 265-275.
6 FOSSATO V.U., 1982. - VIes Journées Etud. Pollutions, Cannes, C.I.E.S.M. : 465-468.

Detergents in Alexandria Western Harbour

Ramzy B. NESSIM

National Institute of Oceanography and Fisheries, ALEXANDRIA **(Egypt)**

The western harbour of Alexandria is the main trade harbour of Egypt . It receives about 6 x 10 million cubic meteres daily of untreated industrial, agricultural and domestic effluents. The harbour basin is considerably contaminated by various organic and inorganic pollutants. It covers an area of about 31 km^2, comprises shallow inner and outer basins and has an average depth of 7m .

The aim of this work is to elucidate the pollution level with detergents in the very important Egyptian harbour and their relations with the hydrographical parameters such as salinity and nutrients.

Material and Methods

Water samples were collected monthly during the year 1989 from surface, 5m depth and near the bottom at eight localities representing the different regions of the harbour (Fig.1), using a plastic Ruttner sampler. Anionic surfactants were determined according to the Methylene method (APHA),1980) .

Results and Discussion

The anionic surfactants showed pronounced temporarly variations, mostly coincided with the rate of allochthonous effluents discharge into the harbour. Low values were recorded during autumn months, moderate concentrations were detected in winter and spring while the highest contents were in August (Fig. 2). COSVIC *et al.*, (1979) observed high seasonal increase of detergents during phytoplankton blooms, what is in a good agreement with the present finding. One of the consequences is that the amount of detergents is concentrated mostly in the surface water layer, sometimes doubled the bottom value.

With regard to spatial variations, relative high amounts of detergents, up to 1.21 mg/1 were estimated in the inner harbour in the vicinity of the sewers. The sheltered area in the outer harbour, st. 5, comprised the maximum value of 1.47 mg/1, these two high values were measured in the surface samples of August. At the Coal-Quay ; st. 7, the water column, on the other hand, exhibited the lowest amounts of detergents during most of the year where the values reached sometimes (<0.10 mg/1).

Based on regression analysis, a significant inverse correlation coefficient between detergents with salinity (r = -0.505, p <0.001) and a positive coefficient with silicate (r = 0.452, p< 0.001) were calculated whose indicate the allochthonous origin of detergents in the harbour (sewage). This suggestion is much confirmed from the significant positive correlations between the detergents contents and each of ammonia (r = 0.250, p<0.001) and oxidizable organic matter (r = 0.191, p < 0.001).

Statistic correlations were also calculated between detergents and different forms of phosphorus (total dissolved ; TDP, dissolved inorganic ; DIP, dissolved organic ; DOP, particulate ; PP and total phosphorus ; TP are summarized as follows :

TDP > DIP > DOP > PP > TP
r = 0.403 0.311 0.252 0.156 0.058 (p < 0.001)

These coefficients explain the relation between the concentration of methylene blue active substances in the harbour and phosphorus content particularly its dissolved forms.

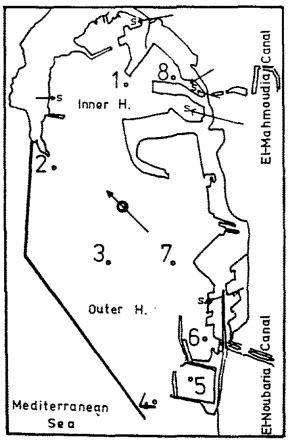

Fig. 1. Alexandria western Harbour ; Sampling Locations & Sewers (s)

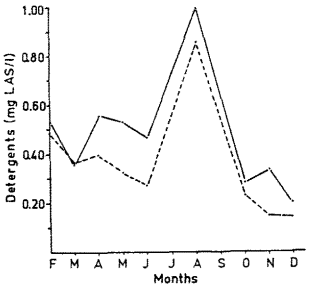

Fig. 2 Monthly averages of detergents in surface . —— . and bottom waters .-----. during the year 1989.

Compared with the mean value of anionic surfactants in El-Agami area (a reference unpolluted open water, ABOUL-KASSIM, 1990) the western harbour exhibits average being 16 folds. According to the finding of MAHMOUD and BELTAGY, 1988, in lake Borollos the present average is nearly doubled or closely similar to that obtained in abu-Qir Bay (SAID *et. al.*, 1991).

On the basis of the frequency distribution of anionic surfactants content, most of the samples (> 60%) exhibited 0.25 - 0.50 mg/1. The values > 1.00 mg/1 did not exceed 5% of the samples. This indicates that the western harbour is still far from strong pollution with anionic detergents what is in agreement with the finding of ABOUL-KASSIM, 1990 in Alexandria coastal waters .

REFERENCES

ABOUL-KASSIM T., 1990. - *Rapp. Comm. int. Mer. Medit.*, *32* : 124 .
APHA 1980. - American Public Health Association, New-York, 1193 pp.
COSVIC B., ZUTIC V., VOJVODIC V. and NOVASKOVIC T., 1979. - *Rapp. Comm. int. Mer. Medit., 25/26* , 9 : 55-60.
MAHMOUD T.H. & BELTAGY A.I., 1988. - *Rapp. Comm. int. Mer Medit.,31*, 2: 72.
SAID M A. NESSIM R.B. and EL-DEEK M.S., 1991. - Coastal transport of pollutants in Abu-Qir Bay , Alex., Egypt. Final Report submitted to IOC, 102 pp.