CATRINA (2015), 14 (1):01-04

Chlorinated Hydrocarbons in some Fishes from Jizan Area, Southern Red Sea

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ABSTRACT

Three fish species were collected from Jizan area, Southern Red Sea, Saudi Arabia. These were Safi, Beda and Parrot. They were subjected to study the presence of chlorinated hydrocarbons in liver, muscle, gill, gut and kidney tissues of these species. Chlorinated pesticides and PCBs were examined y GC and GC-MS and quantification was achieved. The results showed the presence of these chemicals in studied species indicating minimum of 0.6 ng g dry wt to a maximum of 436 ng g dry wt. The highest level of chlorinated hydrocarbons was found in liver followed by kidney and gut tissues, while the lowest was found in muscle and gill tissues. The results revealed a certain degree of pollution which can be a risk to human and marine organisms. It is necessary to point out that this is the first attempt to measure the levels of chlorinated hydrocarbons in Red Sea fishes, therefore similar studies in Red Sea environment should be carried out in the near future in order to confirm the present results and to identify the sources of such contamination.

Key words: Fish-Red Sea-Pesticides-PCBs-Residues-Organs.

INTRODUCTION

The coastal waters of Red Sea are heavily polluted with petroleum oils, heavy metals, domestic, agricultural and industrial wastes (Dixon and Dixon, 1976; Hanna, 1983; Awad, 1985, 1988, 1989; Bakhadlag, 1988; Al-Mohanna *et al*, 1993; Al-Mohanna, 1994; 1999). The pollution problems of Red Sea coasts have recently attracted much public attention. The Red Sea almost completely landlocked with only a narrow inlet (Fig.1), thus forming a natural settling basin for discharged wastes (Randall and Ormand, 1978). The existing rapid economic and industrial development which is underway in most of Saudi Arabia cities, especially near the coasts, is associated with numerous activities that directly or indirectly affect its marine environment.

Figure (1): Map of the Red Sea showing the location of Jeddah and Jazan city.

Jizan is one of the major and fast developing Saudi cities, which is situated in the southern part of the Red Sea Coast; and is the major fishing ground in the Saudi Red Sea waters where fish catch is about 70,000 ton/year (F.A.O., 1993) Therefore, pollution monitoring programmes are necessary as fish and other marine organism in Jizan coast are harvested for human consumption. As compared to other major sites on the Eastern border of the Red Sea, Jizan area is the most poorly studied. Studies of heavy metals have shown that Jizan fishes are significantly polluted (Al-Mohanna, 1994). Polycyclic aromatic hydrocarbons in five different fish species caught from Jizan have also been studied (Al-Mohanna, 1999). In retrospective of the above view the present study was designed to analyze the concentration of canshlorinated hydrocarbons in muscles, livers, gills, gut and kidneys of three different fish species from Jizan coastal waters. These species were *Scarus strongylocephalus* Parrot), *Lutjanus johni* **(**Safi**)** and *Caranx melamphygus* **(**Beda).

MATERIALS AND METHODS

During the summer of 2012, specimens of Parrot (*Scarus strongylocephalus*), Safi (*Lutjanus Johni*), and Beda fish (*Caranx melamphygus* were collected from Jizan area (41˚ 51' N - 42˚ 30' N and16˚ 31' E - 16˚ 45' E) (Fig.1). Ten samples of each fish species were selected and handled carefully to reduce external contamination, i.e. placed individually on and wrapped in three layers of heavy gauge aluminum foil that had been prewashed with acetone followed by methylene chloride and quickly maintained at about -5 C. Within two days after the collection, samples were transferred to the laboratory. Each fish was partially thawed and dissected for the liver, kidney, gut, gills and muscle tissue. The organs were weighed after dissection. The length and weight of the fishes analyzed are given in table (1). Gas chromatography was performed on GC-17A Shimadzu, using capillary column HP-5, cross-

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Table (1): Measurements of fishes analyzed.

Fish	Length in cm	Weight in gm
Beda	10.32 ± 1.69	340.17 ± 28.42
Parrot	12.70 ± 1.45	672.33 ±60.8
Safi	8.67 ± 1.82	244.08 ± 25.28

Linked 5% Ph-Me silicones, the column dimensions were 25 m x 0.32 mm x 0.17 um. A two- phase programme was designed, initially 40-25^{0}C with 25^{0}C/min and finally 250-300^{0}C with 5^{0}C/min. Standard chlorinated aromatic hydrocarbons were injected (Aldrich Co.) and their retention time and peak area were noted. GC-MS was taken on 5000 QC-Shimadzu quadrople using splitless method, temperature programme being the same as that for GC.

RESULTS AND DISCUSSION

Jizan area has been thought of as a relatively pristine area, in terms of chlorinated hydrocarbon contamination. Results obtained in this study show otherwise. Tables (2) and (3) give the mean chlorinated pesticides and PCBs concentrations, respectively, in muscle, liver, gill, gut and kidney tissues for the three studied fish species collected from southern part of Red sea, Jizan area. Values reported was below the levels of detection (<LOD), but higher than some detectable values, that can be at reputed to the small sample mass

Table (2): Mean (± 1SD) chlorinated pesticide concentrations (ng g^{-1} dry wt) in different tissues of fishes collected from Gizan area, Red Sea.

		Muscle	Liver	Gills	Gut	Kidney
Hexachlorobenzene	Safi	2.1±1.0	32.7±28.2	3.7±1.8	5.7±3.2	10.6±8.7
	Beda	1.8±0.9	28.0±17.6	2.5±1.2	2.5±1.2	15.9±9.2
	Parrot	1.2±0.3	19.3±11.4	1.7±1.5	2.1±0.4	9.6±3.7
Lindane	Safi	0.6±0.3	4.8±3.2	0.7±0.4	5.7±3.2	1.8±1.1
	Beda	0.7±0.1	3.1±1.1	0.9±0.4	1.3±0.7	1.6±1.9
	Parrot	0.6±0.2	1.9±0.6	0.7±0.3	0.7±0.3	1.3±1.1
Heptachlor	Safi	< LOD	1.8±1.0	< LOD	0.9±0.6	< LOD
	Beda	< LOD	1.2±0.7	< LOD	< LOD	0.6±0.2
	Parrot	< LOD	0.6±0.2	0.6±0.4	< LOD	< LOD
Aldrin	Safi	1.3±0.7	1.9±1.6	1.5±0.8	1.2±0.7	1.8±1.2
	Beda	1.1±.5	1.2±06	1.5±0.4	1.1±.07	1.2±0.9
	Parrot	0.8±0.2	< LOD	0.9±0.3	0.8±0.5	0.9±0.7
Heptachlor epoxide	Safi	0.6±0.2	3.2±1.9	< LOD	0.8±0.3	< LOD
	Beda	0.6±0.1	2.7±1.3	0.8±0.2	< LOD	0.7±0.4
	Parrot	< LOD	1.9±1.1	0.8±0.1	< LOD	< LOD
O,p'-DDE	Safi	< LOD	12.3±6.3	5.2±2.3	9.2±4.6	11.3±6.2
	Beda	< LOD	7.9±2.6	2.7±0.7	3.4±1.7	6.2±2.9
	Parrot	< LOD	3.6±1.2	1.6±0.5	1.8±0.9	2.1±1.3
Alpah-chlorodane	Safi	5.9±1.7	56.7±25.1	9.2±4.3	23.1±12.3	35.4±18.7
	Beda	5.1±1.2	37.3±12.2	5.9±1.3	14.6±6.5	27.9±13.7
	Parrot	3.2±0.6	24.6±9.7	4.7±1.2	7.8±4.2	16.3±7.1
Trans-nonachlor	Safi	7.3±2.6	73.1±41.7	13.7±5.6	36.6±19.2	43.9±17.3
	Beda	6.2±2.1	49.3±23.2	9.6±3.9	32.8±12.1	41.7±12.8
	Parrot	4.5±1.7	28.9±11.8	5.3±2.6	16.2±5.7	19.4±7.2
Dieldrin	Safi	2.7±1.1	16.2±5.3	3.1±1.4	9.8±4.3	11.6±5.2
	Beda	1.9±0.8	12.5±4.3	2.8±1.2	7.6±4.7	10.3±4.9
	Parrot	0.9±0.7	6.3±1.9	1.7±1.1	2.3±0.9	5.6±1.7
P,p'-DDE	Safi	65.3±21.3	286.7±63.9	53.2±27.5	147.9±43.2	196.9±54.1
	Beda	42.7±13.6	223.9±42.7	472.15.2	131.1±36.8	153.9±56.3
	Parrot	31.3±7.9	217.6±35.1	33.9±10.7	97.6±32.5	99.7±46.8
O,p-DDD	Safi	2.9 ±0.9	36.3±12.5	3.7±1.1	21.3±10.1	24.7±9.2
	Beda	2.2±0.7	28.6±9.3	2.7±1.1	12.5±4.8	14.6±4.3
	Parrot	1.8±0.6	16.3±7.4	2.3±1.1	4.9±3.1	12.2±5.7
P,p'-DDD	Safi	19.3±9.6	537.6±162.3	21.5±11.3	386.3±95.7	423.7±106.3
	Beda	15.7±7.4	412.3±82.7	19.3±6.3	374.1±62.7	398.7±112.6
	Parrot	1.3±3.7	356.8±43.2	1.7±4.3	163.7±31.9	175.9±46.7
O,p'-DDT	Safi	3.2±1.5	14.9±5.2	3.9±1.6	9.3±2.6	11.7±4.3
	Beda	2.6±1.2	9.3±3.7	3.9±1.2	9.1±2.6	12.3±3.2
	Parrot	1.3±0.9	6.7±1.8	2.1±0.9	5.9±1.8	6.7±1.7
p.p'-DDT	Safi	36.8±12.2	57.9±18.3	37.5±11.9	39.7±15.4	45.3±19.8
	Beda	28.7±8.2	52.9±13.4	31.6±12.8	31.2±10.8	36.7±15.3
	Parrot	19.8±5.3	34.9±9.6	16.7±7.3	10.7±5.1	13.9±4.2
Mirex	Safi	0.9±0.4	5.3±1.6	0.9±0.5	2.6±0.7	4.7±1.2
	Beda	0.6±0.5	3.2±0.7	0.7.0.3	1.2±0.6	2.8±1.3
	Parrot	< LOD	3.1±0.9	< LOD	1.1±0.5	< LOD

Table (3): Mean (± 1SD) of total PCBs concentrations (ng g^{-1} dry wt) in different tissues of Safi, Beda and Parrot fish collected from Jizan area (Red Sea).

	Muscle	Liver	Gills	Gut	Kidney
Safi	115±47	436±93	103±46	267±106	273±127
Beda	97±48	412±37	75±21	251±92	236±117
Parrot	53±14	135±28	58±19	63±27	79±37

which was available for some tissue samples. Concentrations of chlorinated pesticides and PCBs were higher in Safi fish, when compared to Beda and Parrot fish (Tables 2 and 3). These differences were statistically significant (P>0.05) for most of the chlorinated hydrocarbons found at >LOD concentrations despite the high variability (SD) in the data.

There is extensive information on levels of chlorinated hydrocarbons in fish from different parts of the globe. Stegeman *et al*. (1986) reported concentrations of PCBs in rattail fish livers (e.g., total wet wt PCBs= 2730 ng g) which were higher than those measured in this study. Total PCB concentrations reported in muscle tissue of several fish species collected in the New York Bright (Gadbois & Money,1983) were also higher than those reported in the present investigation .Significant concentrations of chlorinated hydrocarbons (PCBs 4693 ng g dry wt and pesticides 2700 ng g dry wt) were detected in the tissue of tile fish collected from near Lydonia Canyon (off New Jersey) (Steimle *et al*., 1990) which was also higher than the level detected in this study (e.g., total PCBs in Safi fish = 436 ng g dry wt.).

A comparison of the tissue showed that chlorinated hydrocarbon levels were highest in the liver, followed by kidney and muscle tissues. The gut and gills results were comparable with muscle tissue levels (Tables 2 and 3). Literature on chlorinated hydrocarbon levels in separate fish tissues is sparse, but in muscle tissues, which in most cases accounts for at least 90% of the total body weight, levels were much lower than those found in whole bodies by other workers (Robinson *et al*., 1967; Huschenbeth, 1973; Wharfe and Van Den Broek, 1977).

The substantially higher concentrations of chlorinated hydrocarbon measured in Safi fish tissue compared with those measured in Beda and Parrot fish sample were unexpected. The reasons for this difference are unknown at present but several possible explanations have been considered. It is not true that the most obvious explanation, samples mishandling, is probable because of the employed procedure. A second suggested explanation is the contaminant differences are the result of differences in the size, age, sex and /or lipid content .Further sampling and analysis are necessary to confirm these results and explore further information.

The data about the contamination of fishes by chlorinated hydrocarbons is very scarce particularly in this part of the world. These compounds have been recognized as toxic and spread far and wide in the ecosystem. Their residues were recorded in abiotic and abiotic samples from unexpected places like Antarctic. The present investigation is the first attempt to determine the levels of such residues in Red Sea fishes. Three commonly used edible fishes were selected from the coastal area of Jizan. They were examined for the detection of chlorinated hydrocarbons. These were found to be present in varying amounts. Not a single sample was found to be uncontaminated. The lowest being heptachlor 0 .6 ng g dry wt and highest being PCBs 436 ng g dry wt. The results summarized in the Tables (2) and (3) indicate that these fishes can cause problem to public life and marine organisms in the sea.

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