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Organochlorine Residues in Fish from the River Nile, Egypt

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Organochlorine insecticides are ubiquitous environmental contaminants that have been found in waters (Harris and Miles 1975; Miles et al. 1978), soils (Harris et al. 1977) and in fish (Sims et al. 1977). In addition to their toxicity to biota, organochlorine pesticides were reported to persist for several years and to accumulate in aquatic organisms (Crosby 1973; Halstead, 1972).

When fish are exposed to pesticides either through contacts in water or in their food, these are taken up in varying degrees, and residues will be found in their tissues. In general, the concentration of organochlorine residues in fish depends on the level of exposure, nature of pesticide and its solubility; fish species and its ability to metabolize or excrete the compound (Holden 1973; Edwards 1973; Harris and kinoshita 1977). Consequently, fish like some other aquatic organisms could be used as indicator organism for monitoring pesticide pollution (Hill and Wright 1978) and its impact on the aquatic environment (Elzorgani et al.1979, Bjerk and Brevik 1980).

The present work, which represents, an essential part of a project of Lake Nasser and the River Nile sponsored by Michigan University deals with the identification and determination of organochlorine insecticides in Telapia fish dominante in the River Nile and its canals. Tilapia species were selected to evalute its validity as indicator organisms for monitoring the distribution of organochlorine insecticides.

MATERIALS AND METHODS

All samples were collected during August 1981 to July 1982. Six stations were selected to represent different regions in the River Nile and two canals as shown in (Fig. 1). These sites are Aswan, Assiut. Cairo, El-Mansora, Faraskur, Edfina, El-Mahmodia canal and Abo El-Gheit canal.

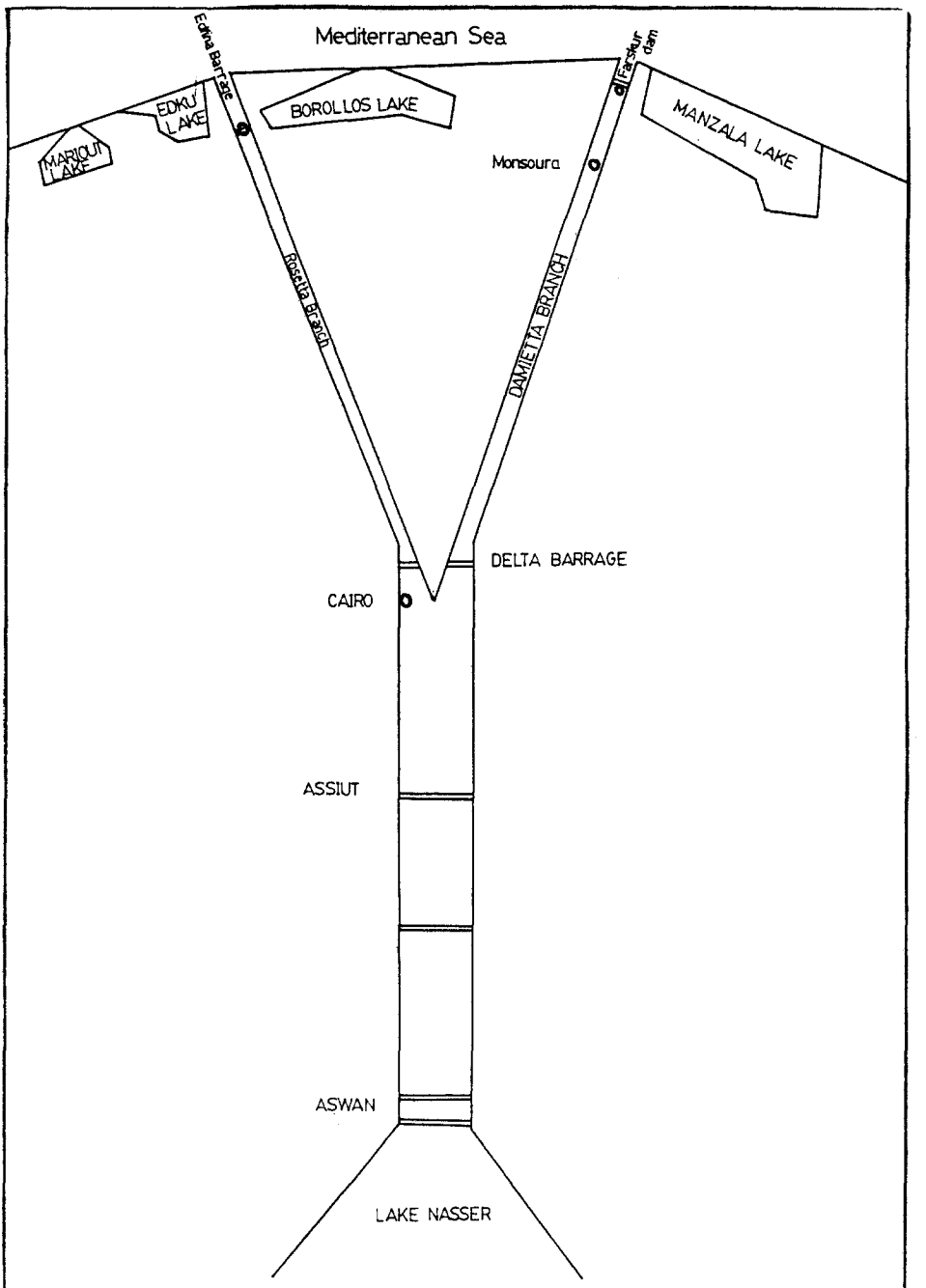

Fig. 1. SCHEMATIC MAP OF THE FISH SAMPLING LOCATIONS.

The pure pesticides references used in this study were: HCB, lindane, endrine, chlordane, aldrin, heptachlor, heptachlorepoxide, p,p̃-DDD, p,p̃-DDE, p,p̃-DDT, and o,p̃-DDT. Chemical names of the tested compounds are to be found in Analytical Reference Standards (Watts, 1981).

A known weight of muscle (50g) was chopped as fine as possible and mixed with anhydrous sodium sulphate at a ratio 4:1 of the latter salt to the sample. The sample was transferred to a glass chromatographic column for extraction of pesticides. For elution, 200 mL of 10% ethylether in petroleum ether was used at a rate of 3mL per min. The eluate was concentrated to about 5mL using a gentle stream of nitrogen gas. Details of the procedures were followed according to the US. Environmental Protection Agency (EPA) method (1974).

Residues were identified and quantified using a Varian 3700 GLC, equipped with Ni^{63} electron capture detector and a glass column (4mm I.D. and 2 meter length) packed with 3% OV-17 on 80/100 chromosorb W. The column, injector and detector temperatures were 200 ^{o}C, and 300 ^{o}C, respectively. Nitrogen was used as a carrier gas at a flow rate of 40 mL/min. All results were calculated as µg/kg on fresh weight basis. Detection limite for BHC and lindane was 0.1 µg/kg, that for DDT and its metabolites was 0.2 µg/kg. Residues of endrin, chlordane, aldrin, dieldrin, heptachlor and heptachlorepoxide were not detected in any sample.

RESULTS AND DISCUSSION

The levels of organochlorine insecticides have been monitored in Tilapia fish collected from different locations in the River Nile from Aswan to the end of Damietta and Rosetta branches. Samples of fish were also captured from El-Mahmodia canal and Abo-El-Gheit canal to compaire levels of pesticide residues in polluted and nonpolluted areas. The data represented in Table 1 are from 80 composite fish samples, most of which included 5 fish, seven compounds were identified and quantified in fish namely, lindane, BHC, endrin, p,p̃-DDE, p,p̃-DDD, p,p̃-DDT and o,p̃-DDT. Fish samples collected from El-Mahmodia canal and Abo-El-Gheit canal were found to contain higher levels of pesticides than samples collected from the River Nile. This may by due the pollution of these canals by pesticides as they are located in agricultural areas and are subjected to the application and leaching of pesticides. Results given in Table 1 reveal that the order of pesticide concentration in fish obtained from the River Nile and the two canals tends to be El-Mahmodia canal > Abo-El-Gheit canal > El-Mansoura > Assiut > Faraskour > Adfinna > Cairo > Aswan.

Table 1. Residues of Organochlorine Insecticides in Fish Collected from River Nile, ug/L

Sampling Sites	BHC		Lindan		Endrin		o,p̀-DDT		*p,p̀-DDT		Mean**
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	ug.kg
Aswan	1.6-4.2	3.0	1.9-12.2	5.5	1.2-15.9	29.7	11.1- 50.2	29.7	25.4- 42.5	35.6	103.5
Assiut	1.6-9.7	4.7	1.2-15.9	7.2	17.6-43.3	24.9	4.8-36.5	24.6	51.0-177.6	114.6	176.0
Cairo	2.0-14.6	8.5	5.0-12.5	8.9	5.0-28.3	19.6	10.6-18.6	15.6	26.9-146.3	71.0	123.6
El-Mansora	0.8- 2.5	1.4	8.0-12.7	10.7	10.3-45.3	25.3	29.8-63.8	49.2	92.1-206.2	113.0	199.9
Faraskour	0.7-3.1	1.6	3.7-15.9	8.1	11.0-35.2	21.2	22.6-62.9	44.0	27.6-98.8	69.3	144.2
Edfina	0.5-2.7	1.3	4.2-14.9	10.1	6.3-28.0	18.2	.2-27.4	23.0	9.8-101.1	75.4	128.0
El-Mahmodia canal	0.8-3.0	6.5	0.6-16.1	6.4	N.D-86.2	21.6	13.5-141.42	93.6	105.1-189.6	105.1	233.2
Abo El-Gheit canal	2.3-4.9	3.1	12.5-18.6	14.5	12.5-52.6	31.0	6.2-82.1	38.8	71.9-223.8	141.1	228.4

* p,p̀-DDT = Sum of p,p̀-DDt+p,p̀-DDE+p,p̀-DDD

** Mean values = Sum of mean values of organochlorine residues

Table 2. Mean Proportions of DDT Occurring as p,p̃-DDE, p,p̃-DDD, p,p̃-DDT (ug/L)

Locations	p,p̃-DDT		p,p̃-DDD		p,p̃-DDE		*Total
	Range	Mean	Range	Mean	Range	Mean	DDT
Aswan	6.07- 39.50	20.32	0.10- 18.18	14.12	0.2-2.19	1.13	35.57
Assiut	32.40-170.18	69.58	6.06- 77.26	41.60	1.35-9.79	3.39	114.57
Cairo	10.53-32. 82	15.32	10.18 108.57	48.67	3.50-9.79	7.00	70.99
El-Mansora	64.85-128.53	68.57	27.27- 77.65	42.80	0.2 -4.01	1.70	113.07
Faraskour	14.07-62.29	44.90	0.2 - 8.47	2.48	12.14-31.25	21.90	69.28
Adfina	8.82-54,46	33.60	8.82-121.2	39.60	0.2 - 4.19	2.20	75.40
El-Mohamodia canal	44.46-73.56	57.40	18.84-72.32	44.57	0.2 - 6.44	3.15	105.12
Abo-El-Gheit canal	30.32-181.14	96.80	16.09-62.15	35.74	1.00-18.62	8.59	141.13

Total p,p̃-DDT = Sum of p,p̃-DDT + p,p̃-DDE + p,p̃-DDD

It was observed that the concentration of p,p̃-DDT and its metabolites p,p̃-DDD and p,p̃-DDE was much higher than the other organochlorine insecticides especially in agricultural areas. In general, the sum of p,p̃-DDT and its metabolites (p,p̃-DDT + p,p̃-DDE + p,p̃-DDD) reached highest value in case of one sample obtained from Abou-El-Gheit canal (223.8 µg/kg). Residues of o,p̃-DDT were isolated from all samples with one exception in a sample collected from Adfina. El-Mahmodia canal showed highest concentration mean of o,p̃-DDT (141.42 µg.kg). The levels of p,p̃-DDT (Sum of p,p̃-DDT + p,p̃-DDE + p,p̃-DDD) in fish samples of the River Nile were less than the total DDT levels found in fish species from the Kanal River in Alaska and the St. Lucia canal in Florida (Henderson et al 1971). This variation is a function of fish species concerned and the distribution of pesticides in the aquatic environment (Bjerk and Brevik 1980).

The proportion of p,p̃-DDT and its metabolites in aquatic organisms are apparently related to the position of the organism in the food chain (Liptake 1974; Smis et al 1977; Fowler and Elder 1978). Results in Table 2 showed that the p,p̃-DDE and p,p̃-DDT were the principal components, whereas p,p̃-DDD was a minor constituent in most fish. The high levels of p,p̃-DDT indicate a recent application of that insecticide.

Endrin was the second most common residue being detected with the exception of one sample from El-Mahmodia canal. Its residues ranged from N.D. to 86 µg/kg. The mean endrin residue was highest in the Abo-El-Gheit canal.

Residues of BHC were found in all samples at low concentrations. Residue ranged from 0.5 µg/kg to 30 µg/kg. Only 4 samples were found to contain BHC in a concentration more than 10 µg/kg. Residues of BHC in the muscle of Tilapia fish are within the range found in fish from the Northwest Atlantic (Smis et al. 1977), but lower than levels reported by Henderson et al. 1971) for several fish species in the Mississippi River at Luling, Louisiana.

Lindane was found in all samples at low concentration but higher than BHC. The lowest residue was reported at El-Mahmodia canal (0.6 µg/kg), while the highest concentration was found in the Abo-El-Gheit canal.

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