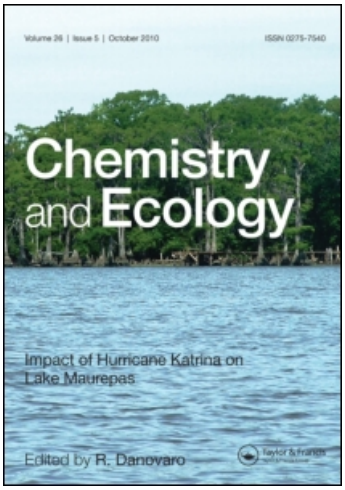

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CONCENTRATIONS OF HCHs AND DDTs IN THE TISSUES OF RIVER DOLPHINS, *PLATANISTA GANGETICA*, FROM THE RIVER GANGES, INDIA

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Concentrations of HCH and DDT organochlorine insecticide residues were measured in blubber, muscle and oil samples from three specimens of river dolphins, *Platanista gangetica*, from the River Ganges, India. Concentrations of HCH and DDT ranged from 94 to 289 ng g^{-1} and from 1324 to 9388 ng g^{-1} on wet wt. basis respectively. Comparisons are made with other aquatic mammals and other studies on river dolphins. *P. gangetica* appears to exhibit similar patterns of accumulation with age and with ß-HCH and *p-p'*-DDE being accumulated to higher levels than other HCH isomers and parent DDT and its other metabolites, respectively. These organochlorines may pose a health risk to river dolphin populations that are already showing evidence of environmental stress. Further studies are recommended.

Keywords: Organochlorine pesticides; river dolphins; India

INTRODUCTION

Marine mammals can accumulate lipophilic xenobiotics as pesticides such as HCH and DDT to very high levels in their fat tissues (Wagemann and Muir, 1984; Tanabe and Tatsukawa, 1991) but there have been few studies on freshwater mammals, except on river dolphins, *Platanista indi* (Peterle, 1982) and *Platanista gangetica*

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(Kannan *et al.*, 1993). The Ganges River dolphin, *Platanista gangetica* inhabits the Ganges, Brahmaputra, Karnaphuli and Meghana rivers and their tributaries in India, Bangaladesh, Nepal and Bhutan (Lal Mohan, 1989). Even though they are protected by nature laws, their numbers are decreasing. Modifications to the flow of these rivers by the construction of barrages for hydroelectric development (Evans, 1987) has caused fragmentation of populations and reduction in prey (Perrin and Brownell, 1989). Increased siltation and sedimentation of river beds and the use of agrochemicals (Reeves and Leatherwood, 1994) have helped put them in a precarious position.

In recent years, it has been found that about 2500 tons of pesticides end up in the Ganges River system annually (Perrin and Brownell, 1989). A part of this could enter aquatic fauna and get biomagnified in the fat rich tissues of river dolphins. HCHs (1,2,3,4,5,6-hexachlorocyclohexane isomers) and DDTs (1,1,1-trichloro-2,2′-bis (*p*-chlorobiphenyl) ethane) are the two major pesticides used in India for agricultural and vector control purposes. These two chemicals comprise nearly 90% of the total consumption of pesticides in India (Ray *et al.*, 1985). It is therefore necessary to quantify, the amount of toxic chemicals in their tissues because even a slight excess of any toxicant may have deleterious effects on this species, which is already under environmental stress. This study was carried out to assess the levels of DDTs and HCHs in river dolphins from the River Ganges, India.

MATERIALS AND METHODS

Muscle and fat tissues from one male and one female specimen accidentally caught in fishing nets at Kahlagoan in Bihar state and the oil extracted from the blubber of another female during 1992 were used (Tab. I). The muscle and fat tissues were preserved in 10% analar formalin to avoid transformation of residues until analysis.

The method described by Tanabe *et al.* (1984) was used for the quantification of pesticides. The tissues were ground with anhydrous sodium sulphate and Soxhlet extracted for 6 hours using hexane-diethyl ether mixture. The remaining extract was concentrated to 5 ml in a Kuderna–Danish concentrator. Two ml of the extract was used

TABLE I Details of the river dolphin specimens collected from Kahlagoan, Bihar, India

Specimen No.	*Sex*	*Length (cm)*	*Age* (Yr.)*	*Data of collection*
1	Male	78	< 1	May 1992
2	Female	160	> 15	Nov. 1992
3	Female	170	> 15	Nov. 1992

* Based on the observation made by Kasuya (1972).

for fat content analysis. The remaining extract was subjected to fluorisil column clean-up, eluted with 20% acetonitrile in water and transferred to hexane. The hexane extract was concentrated and cleaned up using silica gel column chromatography, sulphuric acid and hexane-washed water. Quantifications were made in Hewlett Packard 5890–Series II Gas Chromatograph, fitted with ^{63}Ni ECD and a glass column of 2 mm i.d. and 6 feet length, packed with 3% OV-25 WHP 100/120. The column temperature was 185°C held for 10 minutes, programmed at a rate of 4°C/minute to 213°C held for 6 minutes, again raised to 225°C at a rate of 2°C/minute and held for 4 minutes. Nitrogen at a flow rate of 30 ml min^{-1} was used as a carrier gas. HCH isomers and DDT metabolites were quantified as individually resolved peaks in comparison with the corresponding peak heights of standards.

RESULTS AND DISCUSSION

Kasuya (1972) stated that the length of the Gangetic dolphin at birth is about 70 cm and attains 199 cms at the age of 28 yrs. The sizes were estimated for ages of the specimens and are shown in Table I.

The levels of HCH and DDT in the tissues of river dolphins are shown in Table II. Blubber samples contained higher concentrations of both compounds than the muscle samples from the two specimens. The oil extracted from the fat of the river dolphin showed higher concentration of DDT than the blubber and muscle samples on a wet weight basis (Tab. II).

The organochlorine levels in the present specimens are similar to three species of marine mammals, *Stenella longirostris*, *Tursiops truncatus and Sousa chinensis* (levels ranging from 60 to 1100 ng g^{-1}

TABLE II Concentrations of HCHs and DDTs ($ng\,g^{-1}$) and fat content (%) in blubber, muscle and oil samples from Ganges river dolphins collected from Kahlagoan, Bihar, India

Sp. No.	*Tissues analysed*	*Total HCH* ($ng\,g^{-1}$)			*Total DDT* ($ng\,g^{-1}$)	
		Fat%	*Wet wt. basis*	*Fat wt. basis*	*Wet wt. basis*	*Fat wt. basis*
1	Blubber	42	287	863	7605	18107
	Muscle	10	110	1100	1998	19980
2	Oil	49	289	590	9388	19159
3	Blubber	37	213	576	6295	17014
	Muscle	9.6	94	980	1324	13750

and 2100 to 35000 $ng\,g^{-1}$ wet wt. for HCH and DDT respectively) collected from Bay of Bengal (Tanabe *et al.*, 1993). A study on the Indus River dolphin, *Platanista indi* (Peterle, 1982), reported 80.08 $\mu g\,g^{-1}$ of DDT on a fat weight basis, higher than those in *Platanista gangetica* from the present study (Tab. II) and from specimens collected from Patna, Bihar (Kannan *et al.*, 1993). This may indicate a higher amount of usage of DDT in the Indus area than in the Gangetic delta. Alternatively this may be due to a decrease in the levels of DDT in the bodies of higher animals in recent years after the imposition of restrictions of the use of DDT. In 1984, based on recommendations by S. N. Banarjee Committee, the Government of India banned the use of DDT in agriculture and suggested BHC as an alternative. The observed low concentrations in the present specimen may be justified by the fact that while the samples of *P. indi* analysed by Peterle (1982) were collected prior to the ban (*i.e.*, before 1984), the samples analysed by Kannan *et al.* (1993) were collected during 1988, 1991 and 1992 and the specimens of the present study were collected in 1992 (Tab. I). Such a decreasing trend of DDT is also reflected in the levels of DDTs and HCHs accumulated by people in India (Siddiqui *et al.*, 1981; Saxena *et al.*, 1983).

Among the present specimens, the smaller one (78 cm – Tab. I), which might be a newborn, contained a higher concentration of both HCH and DDT than the larger one (170 cm – Tab. I). Large quantities of lipophilic pesticides can be transferred *via* milk in aquatic mammals (Subramanian *et al.*, 1988a, b; Tanabe *et al.*, 1987) which gets accumulated in the fat of neonates. Later, when the animal grows and starts eating fish of lower fat and organochlorine content the original

amount of organochlorines accumulated gets diluted in the increasing body mass. More specimens of different ages and sizes need studying to establish whether this occurs in river dolphins.

In environmental samples and lower organisms like fish in India, HCH values generally exceed those of DDT (Ramesh *et al.*, 1989, 1990a, b; Babu Rajendran *et al.*, 1992). Table II shows however, that HCH concentrations were several times lower than those of DDT in river dolphins, showing the higher persistency and biomagnifying capacity of DDT and also the low persistency and the easily metabolisable nature of HCH in higher animals. It is well known that in the bioaccumulation process, water soluble and biodegradable chemicals such as HCH, are relatively less accumulative in the ecosystem whereas more lipophilic and less biodegradable contaminants, like DDTs and PCBs, are retained in the animal bodies for a long time (Tanoue, 1982; Tanabe and Tatsukawa, 1991) which is observed in the present specimens also.

The α-HCH predominates in commercial preparations but Figure 1 shows that in river dolphins, the ß-isomer concentration is higher due to the higher bioaccumulative nature of this isomer. The ß-isomer is more stable than α-isomer because of its low water solubility, vapour pressure and high liposolubility and resistance of microbial degradation (Takeoka *et al.*, 1991; Ramesh *et al.*, 1992).

In animal bodies, DDT is metabolized to DDE and gets accumulated in the fat. In the present samples, *p.p'*-DDE accounts for 40–63% in the total DDT concentration (Fig. 2). Ramesh *et al.* (1992) also reported that *p.p'*-DDE was the most widespread DDT

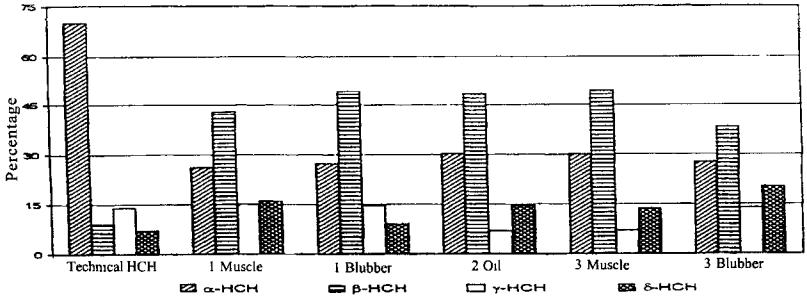

FIGURE 1 Percentage composition of HCH isomers in muscle, blubber and oil samples of Gangetic river dolphins (sample numbers as used in Tabs. I and II).

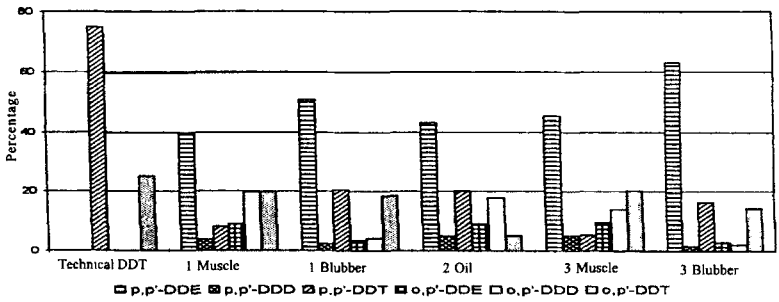

FIGURE 2 Percentage composition of DDT compounds in muscle, blubber and oil samples of Gangetic river dolphins (sample numbers as used in Tab. I and Tab. III).

metabolite in wildlife tissues, with percent composition ranging up to 60% in coastal fish and up to 90% in some higher terrestrial and aquatic life.

CONCLUSIONS

The present levels of HCHs and DDTs in Ganga River dolphins are small perhaps due to the low levels in the environment.

Even though the levels of DDT in the present specimens are only in $ng\,g^{-1}$ level, it should be remembered that river dolphins are already under environmental stress and hence synergistic effects may have a deleterious effect on the already decreasing population. Further, more detailed monitoring is therefore needed in the future.

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