Hexachlorobenzene (HCB) in the Eggs of Common Terns in Hamilton Harbour, Ontario

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Hexachlorobenzene (HCB) is a fungicide and industrial compound which has not been previously reported in tissues and eggs of North American birds. In the Netherlands, Vos et al. (1968) reported HCB contamination of raptors and raptor eggs and on the basis of experiments with Japanese Quail (Coturnix coturnix japonica) concluded that the practice of seed dressing with HCB might have noxious effects on seed eating and predatory birds. In further work Vos et al. (1971) reported tremors, mortality, liver damage, and reduced reproduction in Japanese Quail fed 80 ppm HCB for 90 days. Increased liver weight, slight liver damage and an increased fecal excretion of coproporphyrin occurred in birds fed 5 ppm for the same period.

This paper presents information on HCB and other organochlorine contamination in Common Tern (Sterna hirundo) eggs collected in 1970 from colonies on two islands in Hamilton Harbour, at the west end of Lake Ontario.

Methods and Procedures

Thirteen intact eggs were collected from the two island colonies on August 20, 1970, after the birds had left on migration. The eggs were individually wrapped in aluminium foil and stored frozen until analyzed. After thawing, the contents of each egg were homogenized in a Waring blender. An aliquot of the homogenate was weighed and dried to constant weight at 45°C in a vacuum oven. The dried material was broken up with a glass rod and to it was added anhydrous sodium sulphate. The mixture was placed in a Soxhlet apparatus and extracted with 150 mls of ether: n-hexane (1:1). After the extraction, the solvent was evaporated in a flash evaporator and the residue weighed to determine the fat content. The fat residue was dissolved in 150 mls of 5% benzene in acetone and the solution chilled to -70°C (McCully and McKinley, 1964). The mixture was filtered through a carbon-celite (2g : 10g) pad at -70°C, dried with sodium sulphate, concentrated and made up to a volume of 5 mls with hexane. Additional cleanup was effected by use of a Florisil column and the

Bulletin of Environmental Contamination & Toxicology, Vol. 7, No. 6, 1972, © by Springer-Verlag New York Inc.

cleaned-up extract was analyzed for organochlorine residues by gas liquid chromatography - electron capture (GLC - EC) techniques with parameters as described by Reynolds (1969). The separation and estimation of PCB's were carried out according to the method of Reynolds (1970). The quantitation of the PCB's was based on Aroclor 1260 as the reference standard. The DDE values may include small contributions from PCB since DDE was not separated from a minor PCB interfering component. However, the chromic acid conversion of DDE to dichlorobenzophenone (DCBP), and the TLC estimation indicated that the DDE values were not enhanced to any extent, even for those samples having a high PCB:DDE ratio. Confirmation of HCB was achieved through the use of columns of different polarity.

Results

Since some of the eggs were partially desiccated, results are here expressed on a dry weight basis. Table 1 shows the results of the analyses for hexachlorobenzene, and the more commonly found DDE, dieldrin, and PCB.

TABLE 1

Organochlorine residues (ppm dry weight) in 13 Common Tern eggs

	HCB	p,p'-DDE	dieldrin	PCB
Mean	7.67	72.3	4.93	419
Standard deviation	3.59	27.6	1.88	156
Range	14.7-1.35	147-25.3	10.1-2.47	811-97.0

Other substances found in some of the eggs were DDD, p,p'-DDT, heptachlor epoxide and mercury. Work on the colonies during 1971 has shown that eggs found at the end of the breeding season in similar conditions to these 1970 eggs were laid after the birds had been at the colony for at least two months. Thus the 1970 eggs probably reflect the level of contamination in the small fish such as alewives (*Alosa pseudoharengus*) and smelt (*Osmerus mordax*) which were located near the colonies and on which the terns had fed during May and June. Observation of the terns during feeding showed that fish were taken both in Hamilton Harbour and the extreme west end of Lake Ontario. In 1971, these terns had a very low breeding success, with a high proportion of eggs failing to hatch.

The source of HCB has not been located. The

Hamilton catchment area is not a significant grain growing district and thus the source is probably not of direct agricultural origin. The low ratio of DDE to PCB in the eggs (Risebrough et al. 1968, Keith and Gruchy in press) suggests that the industrial contribution of organochlorine substances to Hamilton Harbour, and possibly to the west end of Lake Ontario, is relatively greater than the agricultural contribution. Thus it seems likely that the source of HCB is of industrial origin and that it is located in this region.

Industrially, HCB is used as a starting material for the production of pentachlorophenol which is marketed as a wood preservative. Secondly, HCB is one of the main substances in the tarry residue which results from the production of chlorinated hydrocarbons. Thirdly, HCB is formed as a by-product in the production of chlorine gas by the electrolysis of sodium chloride using a mercury electrode (Levin and Fodiman, 1954; Bourion and Courtois 1921). Fourthly, HCB is manufactured and formulated for application to wheat seed to prevent stinking smut (bunt).

Acknowledgements

We are indebted to the Canadian Wildlife Service for the funds to analyse these eggs and to Mrs. A.M. Rick who first indicated the significance of these findings.

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