ORGANOCHLORINE PESTICIDE RESIDUES IN BIRD EGGS*

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(Accepted for publication 8 September 1988)

ABSTRACT

Organochlorine (OC) pesticide are known to persist in the environment and to affect reproduction of birds. To assess the distribution of these contaminants locally, seventy-eight bird eggs were analyzed for OC pesticides residues. Ten each of local chicken, improved chicken, duck and quail eggs and 38 wild wading bird eggs were sampled. The domestic bird eggs were obtained from a Bogor market place while the wild bird eggs were collected from Pulau Seribu. Each egg was separately extracted with organic solvents, the extract cleaned up by column chromatography and pesticide residues estimated by gas chromatography. Residues of lindane, aldrin, endrin and metabolites of DDT were commonly found. The level of total DDT metabolites was higher than the concentration of other OC pesticides. Some striking differences in OC residues were noted. Lindane was particularly high in quail eggs. Local chicken eggs were very high in DDT but very low in lindane compared to the other birds. Wild bird eggs showed high levels of DDT but low levels in lindane. Improved chicken eggs were high in DDT but low in lindane. Duck eggs were high in DDT but very low in aldrin compared to the other birds. More eggs should be analyzed to determine whether the differences observed are real or simply due to small sample size. Although the OC residue levels observed here are below the World Health Organization recommended limits, our observation indicate that widespread environmental contamination has already occurred in Indonesia.

ABSTRAK

Pencemaran lingkungan yang disebabkan oleh pestisida golongan organokhlorin adalah sangat persisten dan dapat menyebabkan gangguan reproduksi pada burung yang tinggal di lingkungan tersebut. Untuk mengetahui sejauh mana pencemaran pestisida telah berakibat buruk pada burung-burung dan unggas lain, maka telah diambil 78 butir telur yang terdiri dari telur-telur ayam kampung, ayam negeri, itik dan burung puyuh untuk dianalisa adanya residu pestisida golongan organokhlorin. Telur burung liar berasal dari Pulau Seribu, sedangkan telur yang lain dibeli dari Pasar Bogor. Telur diekstraksi dengan pelarut organik dan dimurnikan dengan khromatografi kolom, sedangkan residu pestisida dideteksi dengan khromatografi gas. Residu pestisida yang terdeteksi pada umumnya adalah lindan, aldrin, endrin dan beberapa macam metabolit dikhloro difenil trikhloretan (DDT). Kadar total metabolit DDT ternyata lebih tinggi dibandingkan dengan kadar insektisida organokhlorin yang lain. Beberapa perbedaan yang sangat menonjol terlihat pada residu yang terdeteksi tersebut. Lindan didapatkan berkadar tinggi pada telur puyuh. Telur ayam kampung dan ayam negeri pada umumnya mengandung DDT sangat tinggi dan lindan sangat rendah dibandingkan dengan pada telur-telur burung yang lain. Pada telur burung liar, kadar DDT cukup tinggi, tetapi kadar lindannya rendah. Telur itik mengandung DDT dengan konsentrasi cukup tinggi, tetapi mengandung aldrin sangat rendah dibandingkan dengan pada telur burung-burung lain. Penelitian lebih lanjut perlu dilakukan dengan mengambil sampel lebih banyak untuk mengetahui apakah perbedaan-perbedaan itu nyata atau tidak. Meskipun residu pestisida golongan organokhlorin yang terdeteksi dalam sampel tersebut masih berada di bawah batas-batas kadar yang disarankan oleh WHO, namun penelitian ini menunjukkan bahwa pencemaran lingkungan akibat pemakaian pestisida golongan organokhlorin telah terjadi di Indonesia.

INTRODUCTION

Using pesticides is an integral part of modern agriculture. Environment pollution may be a side-effect of pesticide or other chemical usage. Hill and Hoffman (1984) reported that birds may be used as a model to study environmental pollution as well wildwife toxicity. The environmental pollution can be detected in many kinds of sample, such as soil, water, tissue and also eggs (Latimer and Siegel, 1977; Meler *et al.*, 1983; Blus, 1984). A chronic effect of the organochlorine (OC) pesticide in birds is reproductive failure (Bogan and Newton, 1983). DDE in the shell gland of the duct inhibits the Ca-ATP-ase which acts as calcium pump responsible for active transport of this cation from the blood to the developing shell. The shell thinning leads to reproductive failure because the shell is mechanically incapable of surviving incubation (Brown, 1977). Blus (1984) reported that the egg shell tickness has a negative correlation with pesticide residue in brown pelican birds.

The aim of this study was to determine whether the environment was contaminated by pesticides or not and also to estimate the level of pesticide residues in bird eggs.

* Presented in part at Konferensi Toksikologi Indonesia I, Bandung, 18 – 31 Juli 1986

MATERIALS AND METHODS

To assess the distribution of these contaminants locally, seventy eight bird eggs were analyzed for OC pesticide residues. Ten each of local chicken, improved chicken, duck and quail eggs and 38 wild wading bird eggs were sampled. The domestic bird eggs were obtained from a Bogor market-place while the wild bird eggs were taken from nest sites in Pulau Seribu.

Acetone (100 ml) was added to each egg and the mixture was shaken overnight. The mixture was filtered and the filtrate extracted with 2 x 50 ml hexane. The extract was washed with 100 ml distilled water. The hexane layer was dried using anhydrous sodium sulphate and evaporated to approximately 10 ml using a rotavapor (Buchi Rotavapor R.E. 120). This extract was added to a chromatography column (1.5 cm inside diameter) packed with 10 cm activated Florisil (80 – 100 mesh) and topped with 2 cm of dry anhydrous sodium sulphate. This column was then eluted with 100 ml 6% diethyl ether in hexane followed by 100 ml 15% diethyl ether in hexane. The two eluants were separately evaporated to dryness using the rotavapor. Each fraction was diluted with hexane and chlorpyrifos was added as international standard (AOAC, 1975). The pesticide residues were measured by electron capture gas chromatography (Varian model 3700 GC; column OV 210 MIXED OV 17; column temperature 180°C; detector temperature 250°C; injector temperature 230°C; nitrogen flow 35 ml/min; sensitivity 10^{-11}). The results were compared with the maximum limits for pesticide residues recommended by WHO (Anon., 1978).

Table 1. Pesticide residues in bird eggs (ppb)

Species	Lindane	Endrin	Aldrin	Total DDT and metabolities
Quail	6.69 ±6.43	4.54 ±4.25	ND	35.28 ±39.99
Local chicken	0.49 ±0.43	0.3 ±0.06	1.66 ±0.2	55.42 ±43.93
Improved chicken	0.63 ±0.38	1.17 ±0.8	1.06 ±2.13	10.9 ± 9.6
Duck	0.66 ±0.24	1.77 ±1.22	0.30 ±0.10	33.18 ±23.18
Wild bird	2.68 ±2.65	4.01 ±7.22	10.84 ±17.22	75.94 ±96.44

Note: ppb = parts per billion
ND = not detected (< 0.0025 ppb)

Table 2. Maximum limit residue (ppm) (Anon., 1978)

Species	Lindane	Endrin	Aldrin	DDT
Eggs	0.1	0.1	0.1	0.5

RESULTS AND DISCUSSION

The results are given in Table 1 and the WHO maximum limits for pesticide residues are given in Table 2.

Recovery of the OC pesticides were 85 – 95%. All levels of pesticide residues were considered low according to WHO guide (Anon., 1978). The total of DDT and metabolites was higher than the level of other pesticides especially in wild bird, local chicken, quail and duck eggs. It is suggested that DDT was a major contaminant in the environment, as was also reported by Sumatra (1982). The quail eggs contained higher level of lindane than other eggs. It was suspected that the quail cages may have been made of wood which has been treated with lindane. Generally improved chicken eggs had a lower levels of all pesticide residues than other species, possibly because the intensive rearing reduced the birds access to pesticide contaminants normally available to free ranging birds.

Although the OC residue levels observed here are below WHO recommended limits, our observations indicate that widespread environmental contamination has already occurred in Indonesia.

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