Biologic Half-Life of Endrin in Channel Catfish Tissues

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Introduction

Fish taken near agricultural areas frequently contain endrin residues exceeding 0.3 µg/g (ppm), an amount judged unsafe for human consumption by the United States Food and Drug Administration. Endrin's propensity for accumulation after application and runoff is attributable to persistence, high lipid affinity, and low aqueous solubility.

Although endrin's potential for harmful effects on fish is unquestionable (GRANT, In Press), details of its accumulation, distribution, and elimination in fish have received little attention.

ARGYLE et al. (1973) reported uptake and release rates based on whole body analysis of channel catfish, Ictalurus punctatus, that were offered diets containing 0.04-4.0 µg of endrin per gram of dry food. Endrin uptake and elimination (biologic half-life) in separate tissues, however, have not been reported for this species. Estimates of these rates were derived to help evaluate biologic consequences of endrin accumulation and to predict how rapidly the residues can be reduced to acceptable levels in catfish produced for human consumption.

Materials and Methods

Channel catfish (17 ± 3 g) were maintained in 70-liter rectangular troughs receiving heated well water (30 ± 1 C) at 0.8 liter/min. The fish were fed an endrin-contaminated diet (2.5 µg/g dry wt) at 3% body wt/day for 147 days. The basic diet was formulated from purified ingredients as described by DUPREE and SNEED (1966).

After 147 days, samples of fish were taken for residue analysis and the remaining fish were fed a contaminant-free diet. On days 0 (end of dosing period), 17, 30, and 44, samples were taken to determine elimination rates in various tissues. Samples were prepared according to procedures outlined by chemists at the U.S. Fish and Wildlife Service, Fish Pesticide Research Laboratory, Columbia, Missouri, and the extracts were analyzed with a gas chromatograph equipped with an electron capture detector.

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Elimination rates were calculated and expressed as biologic half-lives ($t_{\frac{1}{2}}$'s) according to standard "decay" equations:

1) $$\frac{N_t}{N_o} = e^{-\lambda t}$$

2) $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$ where N_t = concentration after "t" days on endrin-free food; N_o = initial concentration (t = o); λ = "decay" constant; t = time (days); and e = base of natural logarithm (ln).

Results and Discussion

After 147 days on the endrin-contaminated diet, average residue levels were 0.49 (whole body), 0.19 (liver), 1.53 (kidney), 1.09 (gastrointestinal tract, swim bladder not included), and 0.63 µg/g (remaining carcass). After 44 days on a noncontaminated diet, endrin was reduced to nondetectable levels ($<$0.01 µg/g) in the kidney and liver. The gastrointestinal tract, remaining carcass, and whole fish samples retained 0.05, 0.04, and 0.03 µg/g, respectively (Fig. 1).

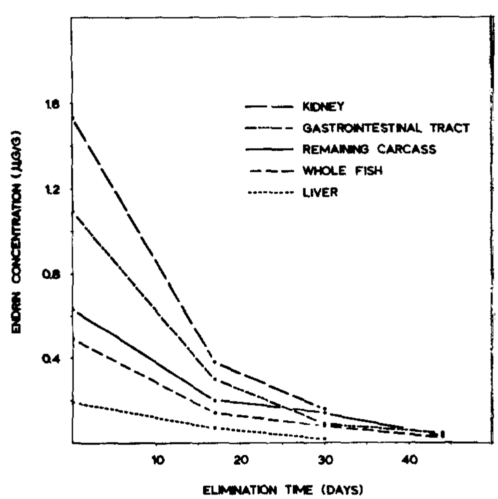

Figure 1. Endrin elimination from whole channel catfish and various tissues

Biologic half-lives of endrin in the various tissues varied between sampling intervals (Table 1). ARGYLE, et al. (1973) fed one group of channel catfish fingerlings (average weight about 2 g) a diet containing 4.0 μg endrin/g at the rate of 1% of body wt/day for 198 days. After 28 days on an endrin-free diet, whole body residues declined from 0.307 to 0.011 μg/g. This result yields a $t_{1/2}$ of 6 days, whereas my data give an average $t_{1/2}$ of 12 days for three intervals over 44 days. Fish size and feeding rate are the most significant variables that may account for the slower elimination rate observed in the present study.

TABLE 1

Endrin in channel catfish: content and biologic half-life in whole fish and various tissues [a]

Day	Whole fish		Liver		Kidney		Gastrointestinal tract		Remaining carcass	
	μg/g	$t_{1/2}$	μg/g	$t_{1/2}$	μg/g	$t_{1/2}$	μg/g	$t_{1/2}$	μg/g	$t_{1/2}$
0	0.49		0.19		1.53		1.09		0.63	
		9		12		9		9		10
17	0.14		0.07		0.38		0.30		0.20	
		16		7		10		7		26
30	0.08		0.02		0.16		0.09		0.14	
		10		-		-		17		8
44	0.03		ND [b]		ND		0.05		0.04	
Average		12		10		10		11		15

[a] $t_{1/2}$ = biologic half-life in days

[b] ND = nondetectable, (<0.01 ug/g)

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