A REPORT FROM

The State Hygienic Laboratory

MEDICAL LABORATORIES BUILDING

THE UNIVERSITY OF IOWA

IOWA CITY, IOWA 52240

PESTICIDES IN THE EDIBLE PORTION OF FISH FROM IOWA WATERS

#70-33

Report of a study conducted by the State Hygienic Laboratory in Cooperation with the Iowa State Conservation Commission.

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Lauren G Johnson, Senior Chemist
R L Morris PhD, Associate Director

INTRODUCTION

Surveys of rivers in and bordering Iowa have shown the presence of measurable amounts of chlorinated hydrocarbon insecticides for a number of years [1,2,3].

Fish living in these waters will act as biological concentrators, extracting pesticides from their food and the water and storing these pesticides in their tissues. Because of this, the concentration of these toxic chemicals in the fish may be much greater than that actually measured in the water. Actual concentrations in the fish will depend on such factors as type of diet and the fat content of the fish tissues as well as concentration in the aquatic environment so that a considerable variation of pesticide content should be expected from different species taken from the same waters.

Because large numbers of fish taken from Iowa waters each year are eaten by humans, the State Conservation Commission and the State Hygienic Laboratory undertook a joint study to determine the level of pesticides in edible portions of fish taken from some Iowa waters.

In 1966 a similar study was done but the analytical methods used at that time did not allow a determination of the actual levels of chlorinated hydrocarbon insecticides in the fish. At that time it was reported to the State Conservation Commission that there were no insecticides present at concentrations of 1 part per million or greater.

Because of increasing use of pesticides and reports from other areas of fish containing residues much greater than 1 part per million we have analyzed samples of the edible portion of fish collected in the fall of 1969 by the State Conservation Commission and determined the amounts of pesticides actually present in these samples.

RESULTS AND CONCLUSIONS

The identification of the fish used in this study are listed in Table I. This table shows that a variety of species from several locations in the state were analyzed. The data on pesticide concentrations found are listed in Table II. Table III lists the fish that were analyzed in the 1966 study and shows that no pesticides were found at concentrations of 1 part per million or greater.

The results in this report are in agreement with the findings of 1966 that no individual pesticides are present at 1ppm or greater concentration.

When the actual amounts found for all residues are added together for each sample, only two of the sixteen samples have a total residue concentration of 1ppm or greater and these two are only slightly over 1ppm.

Those samples from the Mississippi River contain a group of unidentified compounds which interfere with the analysis of the insecticides. They must be removed by an additional clean up step which separates them from the insecticides before chromatographic analysis. Based on their liquid and gas chromatographic behavior they appear to be poly-chlorinated biphenyls as described by Reynolds(5).

Fish from the Coralville Reservoir and Lake MacBride show a greater variety and larger amounts of insecticides than the other samples. These are both fed by the Iowa River and the presence of these pesticides is undoubtedly due to the high agricultural and residential use of the areas drained by this river. The high dieldrin content of these fish is a result of the use of aldrin for corn insect control. The majority of the aldrin is converted to its epoxide, dieldrin, but in those samples having the highest dieldrin content some aldrin still remains.

The relatively low levels of DDT residues (DDT + DDE + DDD) found in these samples are probably a reflection of the fact that DDT is no longer used in significant amounts in Iowa agriculture.

The US Food and Drug Administration found DDT residues ranging up to 19ppm(6) in samples of coho salmon caught in Lake Michigan. Because these fish were being shipped in interstate commerce for human consumption the Department of Health, Education and Welfare set an interim tolerance of 5ppm for residues of DDT in fish(7).

METHODS OF ANALYSIS

Samples from the edible portion of the fish collected were wrapped in aluminum foil, frozen and delivered to the State Hygienic Laboratory by the State Conservation Commission.

Twenty grams of each sample was ground to a fine consistency with dry ice and then analyzed according to the methods of the US Foof and Drug Administration's Pesticide Analytical Manual[4]. An additional clean up step was necessary on those samples from the Mississippi River to remove interfering compounds.

The identification and quantitation of the individual insecticides was done on an F&M Model 400 gas chromatograph equipped with an electron capture detector. Both a non-polar OV-1 column and a polar mixed QF-1:OV-1 column were used to confirm the analysis.

There is a zero tolerance for other pesticides in fish, however because the sensitivity of the methods used in residue analysis has greatly increased in recent years the Food and Drug Administration has set administrative guide lines of a 0.3ppm for residues of most of the other common chlorinated hydrocarbon insecticides in fish flesh. Thus 0.3ppm is the actionable limit for dieldrin and fish containing more than this could not be shipped in interstate commerce. Three of the samples from the Iowa River (Coralville Reservoir - Lake MacBride) did exceed this 0.3ppm limit for dieldrin.

The analysis of water from the Iowa River showed higher than usual content of dieldrin during most of 1969. This was undoubtedly due to the high amount of surface run-off into the Iowa River during the early summer months.

Several Iowa rivers showed higher than usual pesticide content during 1969 and while these concentrations were well below the maximum permissible limits for public water supplies suggested by the National Technical Advisory Committee to the Secretary of the Interior they did result in elevated levels of dieldrin in some species of fish. Further analysis of fish from these rivers will be necessary to fully assess the problem.

T A B L E I

SAMPLE NO.	SPECIES	AREA CAUGHT	DATE CAUGHT	LENGTH-INCHES
1	Big Mouth Buffalo	Coralville Res.	Nov 7 1969	18.0
2	Black Crappie	"	"	9.2
3	Carp	"	"	20.4
4	Carp Sucker	"	"	14.4
5	Large Mouth Bass	"	"	14.6
6	Big Mouth Buffalo	Lake MacBride	"	22.2
7	Blue Gill	"	"	9.6
8	Carp	"	"	22.0
9	Large Mouth Bass	"	"	10.6
10	Big Mouth Buffalo	Mississippi R. Pool II	Nov 3 1969	18.5
11	Carp	"	"	17.5
12	Northern Pike	"	"	27
13	Walleye	"	"	22.5
14	Walleye	"	"	25
15	Walleye	Spirit Lake	Dec 1 1969	12.5
16	Walleye	"	Dec 15 1969	17.3

T A B L E II

Pesticides in Fish Flesh
Concentration in Parts per Billion

SAMPLE	DDT	DDE	DDD	DIELDRIN	HEPTACHLOR EPOXIDE	CHLORDANE	ALDRIN
1	39	95	22	840	42	103	110
2	3	6		12			
3	12	33	4	214		35	7
4	21	48	11	313		51	52
5	5	9		35			
6	24	56	15	721	29	62	100
7	2	4		14			
8	14	31	9	135		21	
9	3	4		18			
10	14	39	17	28			
11	16	30	10	15			
12	34	80	38	33	10		
13	23	59	17	20			
14	24	58	33	41			
15	7	13		7			
16	7	14		5			

1 Part Per Million is 1000 Parts Per Billion

REFERENCES

1) R L Morris, L G Johnson and W Patton, State Hygienic Laboratory Report #70-10.

2) M L Schafer, J T Peeler, W S Gardner and J E Campbell, Environmental Science and Technology 3(12), 1261, 1969.

3) A W Breidenbach, C G Gunnerson, F K Kawahara, J J Lichtenberg and R S Green, Public Health Reports 82(2), 139, 1967.

4) US Department of Health, Education and Welfare, Food and Drug Administration, Pesticide Analytical Manual, Volume 1, Revised January 1968.

5) L M Reynolds, Bull. Env. Contam. Tox. 4, 126, 1969.

6) Chemical and Engineering News, page 33, April 14, 1969.

7) Chemical and Engineering News, page 17, April 28, 1969.