# The Effect of Atmospheric Levels of Pesticides on Pesticide Residues in Rabbit Adipose Tissue and Blood Sera

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Only a limited amount of data is available on atmospheric levels of pesticides. The two most extensive studies are those of Tabor (1965) and Stanley, et al. (1971). In both studies air pesticide levels were sampled in several locations across the United States. Both of these workers concluded that if all the pesticides in the air breathed by an adult at the various locations were retained in the body, the highest level measured would only approximate the intake from total diet. They also concluded that the more typical levels measured (10 to 30 ng/$m^3$) would represent only a fraction of the dietary intake. Stanley, et al. (1971) concluded that the levels of pesticides found in the ambient air were usually far below levels that might add to the total human intake of pesticides. However, Edmundson (1972) thinks that the amount of DDT absorbed by persons, from dust consumption and inhalation, to be considerable for those who live in heavily contaminated environments.

Although speculations have been made on the effect of atmospheric levels of pesticides on intake and thus body residues, no data is available. As a result, this experiment was designed to quantitate atmospheric pesticide levels and determine the pesticide uptake into adipose tissue and blood sera in rabbits placed in an area of heavy pesticide usage.

## MATERIALS AND METHODS

Animals. Forty, five month old white rabbits (20 male, 20 female) were obtained from Ra-Donna Farms, a local rabbit farm. Twenty rabbits (10 male, 10 female) were housed in open cages under an aluminum roof allowing for free air movement at Stoneville, Mississippi, an area of high pesticide use. The remaining rabbits were housed in cages inside a small animal building at Mississippi State, an area of low pesticide usage. A commercial rabbit chow was fed. To avoid variations in the diet, all of the feed was purchased at one time

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from one source. The animals received feed and water ad libitum. During the course of the experiment, one male rabbit at Stoneville died from unknown causes. The rabbits were placed on experiment July 1, 1972 and were sacrificed October 4, 1972. Blood samples were collected by cardiac puncture and adipose tissue was collected from the abdominal cavity upon sacrifice.

Weekly air samples were taken in Stoneville during the test period. A MISCO Model 88 air pesticide sampler was used utilizing ethylene glycol as the trapping agent. The timer was set so that the sampler would run 4.29 minutes every hour for seven days. This gave a total collecting time of twelve hours per week. Previous work had shown that atmospheric levels of DDT around Mississippi State were in the range of 2-8 $ng/m^3$ (Arthur, 1975). Since the pesticide levels at Mississippi State were so low, air samples were not taken during the test period.

Analysis. The adipose tissue and blood sera samples were analyzed by the procedures as described by Thompson (1972). Identification and quantification of the pesticides were accomplished on a Micro Tek MT-220 Gas chromatograph. Two columns with different resolution characteristics were utilized on every sample. Instrument parameters were as follows:

Columns: (A) Borosilicate glass, 6' x $\frac{1}{4}$", packed with 1.5% OV-17, 1.95% QF-1 on 80/100 mesh Gas Chrom Q

(B) Borosilicate glass, 6' x $\frac{1}{4}$", packed with 4% SE-30, 6% QF-1 on 80/100 mesh Gas Chrom Q

Detector: Electron Capture, having a 130 mc tritium ionizing source.

Temperatures: Injector 230°C
Column 200°C
Detector 215°C

Carrier Gas: Prepurified nitrogen flowing at 90 ml/min (Column A) and 60 ml/min (Column B)

## RESULTS AND DISCUSSION

Pesticide residue values for rabbit adipose tissue from both locations are shown in Table I. There were no significant differences between the male and female rabbits from either location so the data were combined. As can be seen, the adipose tissue residues were higher

in the rabbits from the high pesticide use area. The greatest differences were found in DDT and DDT metabolite residues. p,p'-DDT showed a 20-fold difference, p,p'-DDE showed a 5-fold difference, and p,p'-DDD showed a 7-fold difference in rabbits housed in the high pesticide use area. These differences are reflected in a 10-fold difference in total DDT (DDT + metabolites) residues between the two groups. Also, 2-fold differences were seen in dieldrin and heptachlor epoxide levels. All differences were significant ($p<0.001$) when compared using the Student $t$ test.

TABLE I

Rabbit Adipose Tissue Residues

| Residue | p,p' DDE | p,p' DDD | p,p' DDT | Total DDT | Dieldrin | Heptachlor Epoxide |
|---|---|---|---|---|---|---|
| Stoneville | 0.273[a,b,c] ±0.017 | 0.036 ±0.005 | 0.652 ±0.045 | 0.944 ±0.058 | 0.022 ±0.002 | 0.039 ±0.002 |
| Mississippi State | 0.049 ±0.012 | 0.005 ±0.002 | 0.030 ±0.003 | 0.084 ±0.016 | 0.009 ±0.001 | 0.016 ±0.001 |

a Values are means ± SE, reported as ppm in adipose tissue.
b Mean of 19 animals for Stoneville and 20 animals for Mississippi State.
c All differences are significant at $P<0.001$.

No pesticide residues were detected in the blood sera of the rabbits housed at Mississippi State. Only six of the rabbits housed at Stoneville had detectable blood sera amounts of DDT and these were all less than one ppb. Neither dieldrin or heptachlor epoxide were detected in any of the blood sera samples.

Table II shows the average air pesticide levels for Stoneville during the test period, the estimated daily respiratory intake of these pesticides for rabbits, and the calculated daily dietary intake. The estimated daily respiratory intake was calculated using the respiratory volume and rate for rabbits of 800 ml/min (Guyton, 1947) and assuming all pesticides that were inhaled were retained in the body. The dietary intake was calculated by using the average daily intake of 142 gm of feed containing 0.006 ppm total DDT and 0.002 ppm dieldrin by analysis.

TABLE II

Average Air Pesticide Levels in Stoneville and Respiratory and Dietary Intake by Rabbits.

| Residue | Total DDT | Dieldrin | Heptachlor Epoxide |
|---|---|---|---|
| Air | 649.60 $ng/m^3$ | 4.59 $ng/m^3$ | 1.86 $ng/m^3$ |
| Respiratory Intake | 0.748 µg/day | 0.005 µg/day | 0.002 µg/day |
| Dietary Intake | 0.852 µg/day | 0.284 µg/day | ------ |

As can be seen, the calculated dietary intake was slightly greater for total DDT than the estimated respiratory intake and the calculated dieldrin dietary intake was 57 times greater than the estimated respiratory intake. Heptachlor epoxide residues were not detected in the feed.

Although, the estimated daily respiratory intake for DDT only approximates the estimated daily dietary intake it did cause significant residues of DDT to be present in the adipose tissue of the rabbits. Since all rabbits were fed the same diet the increase in residue levels found in the Stoneville animals came from atmospheric pesticides. The only other source could be from pesticides in the drinking water. This is doubtful as the total DDT levels in the drinking water at Stoneville have been found to average 2.5 ppt (Arthur, 1975).

These results suggest that exposure of animals to air in the Mississippi Delta can lead to a significant build up of pesticide residues. It would appear from these data that respiratory exposure may approach and even surpass dietary intake in importance in terms of levels of total DDT in adipose tissue in certain areas of Mississippi, and perhaps certain areas of the United States.

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