# ⁂Chlorinated Pesticide Residues in Meat and Fat from Animals Raised in Iran

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## ABSTRACT

Meat and fat samples (310) from carcasses of cattle, sheep, goats and camels from different regions of Iran were analyzed to determine concentrations of chlorinated pesticide residues. DDT, DDE, TDE, lindane, dieldrin and endrin were detected in the adipose tissues and meat of all species. Incidence as well as concentration of most pesticide residues were lowest in the camel and highest in the sheep. External fat samples were satisfactory for pesticide monitoring. The concentration of DDT did not exceed the World Health Organization (WHO) maximum limit for meat and fat.

## INTRODUCTION

Over the years, vast quantities of chlorinated pesticide have been used in Iran for crop protection and control of disease-transmitting insects. Because of the persistence of many of these pesticides and their products, they may be found in many foods and feeds.

Since meat is an important source of pesticide residue in the human diet, this paper reports the results of analyses for meat and fat of animal carcasses generally consumed by man. The samples were collected from October 1975 through August 1978 from the Tehran region and 4 provinces of Iran. The concentration of DDT and its metabolites (DDE and TDE) and of dieldrin, lindane and endrin were determined.

## MATERIALS AND METHODS

Fresh adipose tissue and meat samples from external and internal carcass sites were excised from cattle, sheep, goats and camels within 48 h postmortem. The samples were placed in glass jars flushed with nitrogen and stored at -10 C prior to analysis. The excised fat samples were melted and a 2-g portion taken for analysis. The meat was ground and 35 g mixed with 70 g of anhydrous sodium sulfate. This mixture was extracted in a Soxhlet apparatus with petroleum ether (bp 50-60 C) for at least 6 h. The solvent was evaporated using a Kuderna-Danish evaporator. Pesticide residues were detected and determined according to AOAC (1) methods: ca. 2 g of fat was dissolved in petroleum ether, partitioned with acetonitrile and back-extracted into petroleum ether. This mixture was evaporated using a Kuderna-Danish evaporator to ca. 5 ml, transferred to Florisil column with anhydrous sodium sulfate and eluted successively with 200 ml each of 6% and 15% diethyl ether in petroleum ether. The 6% elution contained lindane, DDT, DDE and TDE whereas the 15% elution contained dieldrin and endrin.

Five µl each of 6% and 15% elutions of diethyl ether in petroleum ether were injected into a Varian 1400 gas chromatograph equipped with $^{63}$ Ni electron capture detector and a glass column of 1518 x 3.2 mn od packed with 5% DC-200 on chromosorb W (60/80 mesh). For further confirmation of peaks obtained, a second gas chromatograph (Perkin Elmer 910) with a $^{3}$H electron capture detector and a glass column of the same size packed with 10% OV-1 on Varaport 30 were used.

The operating conditions for both gas chromatographs were 230, 180 and 240 C for injector, columns and detectors, respectively; nitrogen flow rates were 40 and 60 ml/min in the first and second gas chromatographs, respectively. The recovery rates of DDE, DDT, dieldrin and lindane were 85, 81, 83 and 80%, respectively. The results were not corrected for recoveries and are tabulated in Tables I-VI.

## RESULTS AND DISCUSSION

This study demonstrates that both meat and fat contain

TABLE I

Chlorinated Pesticide Residues in 107 Samples of Fat from Various Sites in the Carcasses of Sheep Showing Ranges and Means in Parts per Billion (ppb)

| Tissue sample | Organochlorine pesticide | | | | | |
|---|---|---|---|---|---|---|
| | DDE | TDE | DDT | Lindane | Aldrin/dieldrin | Endrin |
| Loin | 4–270<br>30±20 | 15–360<br>25±10 | 6–130<br>21±20 | 6–270<br>21±10 | 4–140<br>70±210 | 1–5<br>3±2 |
| Round | 10–170<br>52±10 | 12–38<br>34±10 | 5–72<br>29±20 | 15–370<br>220±10 | 6–20<br>14±20 | 1–109<br>17±10 |
| Tail (Donbe) | 1–265<br>69±6 | 1–314<br>50±22 | 1–288<br>56±15 | 1–165<br>49±18 | 1–850<br>8±5 | 1–440<br>7±10 |
| Perirenal | 14–190<br>48±20 | 5–44<br>21±18 | 22–148<br>38±10 | 32–390<br>140±80 | 5–32<br>12±10 | 1–8<br>3±4 |
| Heart | 10–85<br>59±10 | 8–68<br>39±10 | 5–10<br>72±20 | 85–450<br>160±50 | 2–37<br>19±0 | 1–12<br>1±9 |
| Caudal | 57–570<br>95±110 | 17–140<br>47±28 | 23–30<br>28±0 | 189–1,290<br>790±250 | 11–33<br>12±18 | ND[a] |

[a]Not detected.

TABLE II

Chlorinated Pesticide Residues in 107 Samples of Fat from Various Sites in the Carcasses of Cattle Showing Ranges and Means in Parts per Billion (ppb)

| Tissue sample | Organochlorine pesticide | | | | | |
|---|---|---|---|---|---|---|
| | DDE | TDE | DDT | Lindane | Aldrin/dieldrin | Endrin |
| Loin | 3-92 | 4-32 | 1-59 | 1-28 | 1-7 | 1-7 |
| | 29±30 | 20±10 | 18±20 | 9±10 | 5±3 | 2±3 |
| Round | 17-120 | 5-99 | 12-210 | 6-660 | 1-25 | 1-3 |
| | 52±20 | 29±7 | 32±40 | 87±30 | 8±6 | 1±1 |
| Back[a] | 4-109 | 10-100 | 6-126 | 2-186 | 4-134 | 1-18 |
| | 48±20 | 68±20 | 40±17 | 46±90 | 22±89 | 11±9 |
| Perirenal | 4-370 | 2-190 | 6-120 | 40-270 | 1-160 | 1-27 |
| | 51±22 | 48±26 | 26±36 | 86±36 | 8±8 | 7±8 |
| Heart | 7-133 | 5-212 | 8-180 | 58-310 | 1-222 | 3-7 |
| | 65±33 | 38±20 | 26±90 | 160±20 | 16±60 | 3±2 |
| Caudal | 5-950 | 3-185 | 4-90 | 2-350 | 1-32 | 3-37 |
| | 39±25 | 39±22 | 34±17 | 79±80 | 11±10 | 13±12 |

[a]Full fillet and sirloin.

residues of DDT and its metabolites (DDE and TDE), lindane, dieldrin and endrin in varying concentrations, reflecting the intake of pesticides by the animals. The persistence of DDT and its metabolites in the environment mean that much of the material used for control of insect-borne disease and elimination of agricultural pests still contaminates soil, water and air (2). Though their widespread use in this country was restricted in 1974, foods and feeds still contain detectable levels of these contaminants. In our study, the percentages of adipose samples contaminated by DDE, TDE, DDT, lindane, dieldrin and endrin in cattle were 100, 94.8, 84.1, 94.8, 61.5 and 17.0, respectively, whereas these of sheep were 93.8, 83.6, 87.7, 97.9, 83.6 and 20.4, respectively; percentages for camels were 58.3, 66.6, 58.3, 66.6, 41.7, and zero, respectively. Endrin was absent in many samples from goats. The low concentration of DDT compounds in camel fat and meat resulted

TABLE III

Chlorinated Pesticide Residues in 21 Samples of Fat from Various Sites in the Carcasses of Camel Showing Means in ppb

| Tissue sample | Organochlorine pesticide[a] | | | | |
|---|---|---|---|---|---|
| | DDE | TDE | DDT | Lindane | Aldrin/dieldrin |
| Loin | 14 | 2 | 6 | 14 | 1 |
| Round | 1 | 2 | 1 | 18 | ND[b] |
| Hump | 12 | 7 | ND | 14 | 2 |
| Perirenal | 2 | 2 | ND | 20 | 2 |
| Heart | 4 | 11 | 6 | 9 | ND |
| Brisket | 3 | 2 | ND | ND | 2 |
| Back[c] | 2 | 2 | 1 | 19 | 1 |

[a]Endrin not detected in any sample.
[b]Not detected.
[c]Full fillet.

TABLE IV

Chlorinated Pesticide Residues in 21 Samples of Fat from Two Sites in the Carcasses of Goats Showing Means in ppb

| Tissue sample | Organochlorine pesticide | | | | | |
|---|---|---|---|---|---|---|
| | DDE | TDE | DDT | Lindane | Aldrin/dieldrin | Endrin |
| Round | 12 | 19 | 12 | 18 | 13 | ND[a] |
| Perirenal | 48 | 38 | 105 | 48 | 17 | ND |

[a]ND = Not detected.

TABLE V

Chlorinated Pesticide Residues in Fat from Various Sites of Meat Animals Irrespective of Species Showing Means in ppb

| Tissue sample | Organochlorine pesticide | | | | | |
|---|---|---|---|---|---|---|
| | DDE | TDE | DDT | Lindane | Aldrin/dieldrin | Endrin |
| Loin | 24 | 15 | 15 | 15 | 4 | 2 |
| Round | 29 | 16 | 18 | 15 | 4 | 2 |
| Perirenal | 37 | 27 | 42 | 73 | 10 | 5 |
| Heart | 42 | 27 | 35 | 109 | 11 | 11 |
| Caudal[a] | 67 | 43 | 31 | 79 | 11 | 6 |
| Back[b] | 25 | 35 | 20 | 32 | 11 | 5 |

[a]From cattle and sheep.
[b]From camels and cattle (full fillet and sirloin).

TABLE VI

Chlorinated Pesticide Residues in 54 Samples of Meat from Two Sites of Four Species of Meat Animals Showing Ranges and Means in ppb

| Pesticide residue | Cattle | | Goat | | Sheep | | Calf | |
|---|---|---|---|---|---|---|---|---|
| | Round | Brisket | Round | Shank | Round | Shank | Round | Brisket |
| DDE | ND[a]–7 (3) | ND–6 (3) | ND–3 (2) | ND–5 (2) | ND–6 (3) | ND–5 (3) | ND–5 (3) | ND–9 (6) |
| TDE | ND–17 (5) | ND–19 (4) | ND–3 (2) | ND–8 (5) | ND–49 (7) | ND–9 (5) | ND–19 (3) | ND–10 (8) |
| DDT | ND–7 (5) | ND–14 (4) | ND–10 (6) | ND–13 (6) | ND–14 (7) | ND–13 (3) | ND–8 (5) | ND–16 (5) |
| Lindane | ND–10 (4) | ND–13 (7) | ND–15 (10) | ND–2 (2) | ND–3 (2) | ND–6 (2) | ND–3 (2) | ND–3 (2) |
| Endrin | ND | ND | ND | ND | ND | ND | ND | ND |

[a]Not detected.

from its feeding on dessert bushes and thorns which contain little, if any, of these pesticide residues.

Endrin was undetected in camel and goat samples and its mean concentrations in sheep and cattle adipose tissue were low. The results show that the concentrations of all pesticides are lowest in the camel and highest in the sheep. The concentrations of pesticides in the meat were ca. 7-10% that in fat. Lisk (3) has reported that the solubility of DDT in fat is affected by the degree of saturation, but the more nonlipid extractable tissue residues are located in the internal adipose tissue. External fat samples showed the least variation.

The mean concentrations of pesticide residues in the fat of various organs irerespective of the animal is reflected in Table V. The metabolic degradation of DDT to compounds other than DDE also would explain the greater concentrationof DDE (4). The concentrations of DDT compounds in various samples analyzed were much lower than the maximum limits established by the World Health Organization (WHO) (5), which is 5 ppm on a fat basis. Our findings confirm our previous study which demonstrated low contamination of butter with chlorinated pesticide residues (6).

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