

Distribution of Polychlorinated Dioxins and Furans in Beef

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Human exposure to polychlorinated dioxins and furans has been proposed to be predominantly from dietary components with beef being possibly the largest contributor.¹ Information on dioxin levels in the U.S. beef supply has been limited. Recently, the results of a study by the U.S. Department of Agriculture, Food Inspection Service and the U.S. Environmental Protection Agency were reported.^{2,3} Dioxin levels in food samples collected at supermarkets and at fast food restaurants have also been determined.^{4,5,6} These studies were done on either the entire food sample or on back fat. We report here the distribution of some chlorinated dioxins and furans in back fat, perirenal fat, rib eye, liver and serum from animals fed a mixture of dioxins, furans and PCBs.

The experiment was conducted at the Carrington Research Extension Center, Carrington, North Dakota with four control and four experimental steer calves (220-262 kg). The animals were offspring from cows that had spent their entire lifetime at the Research Center and had completed at least two previous lactations. All animals had consumed feed that had been entirely produced at the Center. Analyses of the corn and alfalfa hay used in the experiment showed non detect levels for nearly all congeners. The experimental animals were fed the mixture shown in Table 1 for 120 days. Serum and feces samples were collected at the beginning of the experiment and at 30 day intervals. Tissue samples were taken at slaughter and were stored at -80°C.

Analyses of serum samples indicated that the animals used in the experiment had levels of dioxins and furans that were below the limits of detection for nearly all congeners at the beginning of the experiment (Fig. 1). Animal exposure to the higher chlorinated congeners was similar for both the experimental and control groups. The most likely source of these congeners has been determined to be some pentachlorophenol-treated wood in the facility that was used for the feeding experiment.⁷ Serum levels of most of the congeners fed have reached plateaus during the feeding period; thus, relative levels in the matrixes analyzed should have stabilized.

Figures 2 and 3 show distribution of the dosed congeners on weight and on lipid adjusted bases, respectively. On a weight basis back fat and perirenal fat have the highest levels of the lower chlorinated congeners while liver has the highest levels of the higher chlorinated congeners. On a lipid adjusted basis the tetra isomers are evenly distributed (within a factor of two) among the tissues analyzed, whereas the higher chlorinated isomers are found predominantly in the liver. Back fat and perirenal fat appear to be equally suitable tissues for monitoring levels of the lower chlorinated congeners with perirenal fat being the more suitable for lean animals where back fat is

often scarce or non existent. Liver appears to be the most sensitive measure for levels of the higher chlorinated congeners although levels in back fat and perirenal fat also appear to be adequate.

References:

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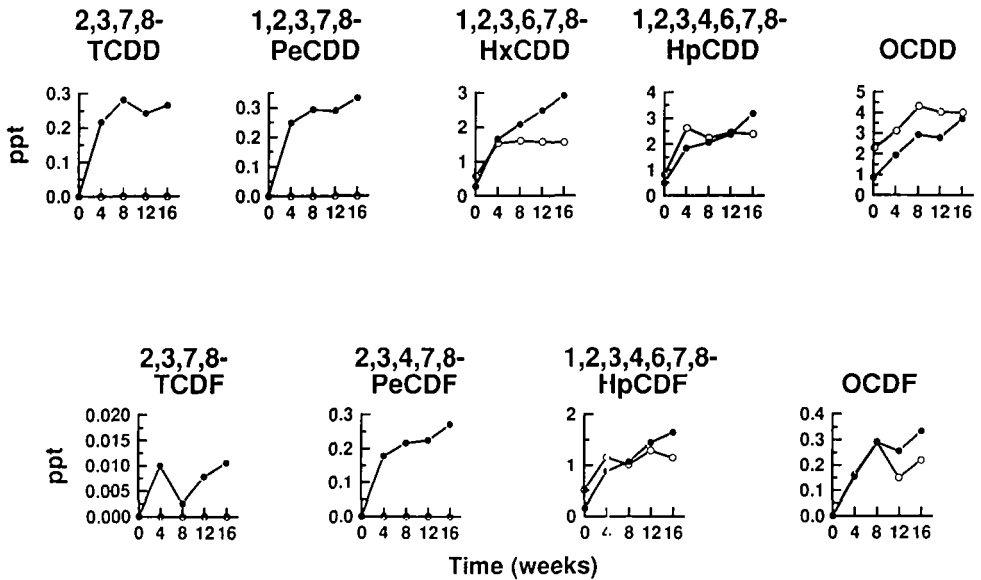
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Table I. Dose components and levels of the feeding study

Dioxin	Toxicity Equivalency Factor	Daily Dose Per Animal (ng)	Total Dose Per Animal (µg)	Dose equivalent to forage level (estimate) (ppt)*
1,2,7,8-TCDD	0	750	90	250
1,3,7,8-TCDD	0	750	90	250
1,4,7,8-TCDD	0	750	90	250
2,3,7,8-TCDD	1	83.3	10	28
1,2,3,7,8,-PeCDD	0.5	83.3	10	28
1,2,3,6,7,8-HxCDD	0.1	150	18	50
1,2,3,4,6,7,8-HpCDD	0.01	750	90	250
OCDD	0.001	750	90	250
p,p'-DDE	?	750	90	250
2,3,7,8-TCDF	0.1	150	18	50
2,3,4,7,8-PeCDF	0.5	83.3	10	28
1,2,3,4,6,7,8-HpCDF	0.1	150	18	50
OCDF	0.001	750	90	250
3,3',4,4',5'-PCB (#126)	0.1	150	18	50
2,3',4,4',5'-PCB (#118)	0.0001	750	90	250
2,3,3',4,4',5,5'-PCB (#189)	0.0001	750	90	250

* Dioxin levels that would be required for an animal to consume the levels fed (based on estimated forage consumption).

Figure 1. Average Serum Concentrations of Dosed Congeners



- Dosed Animals
- Control Animals

Non-detect values taken as zero

Figure 2. Tissue Distribution (ppt) of Dosed Congeners - Weight Basis

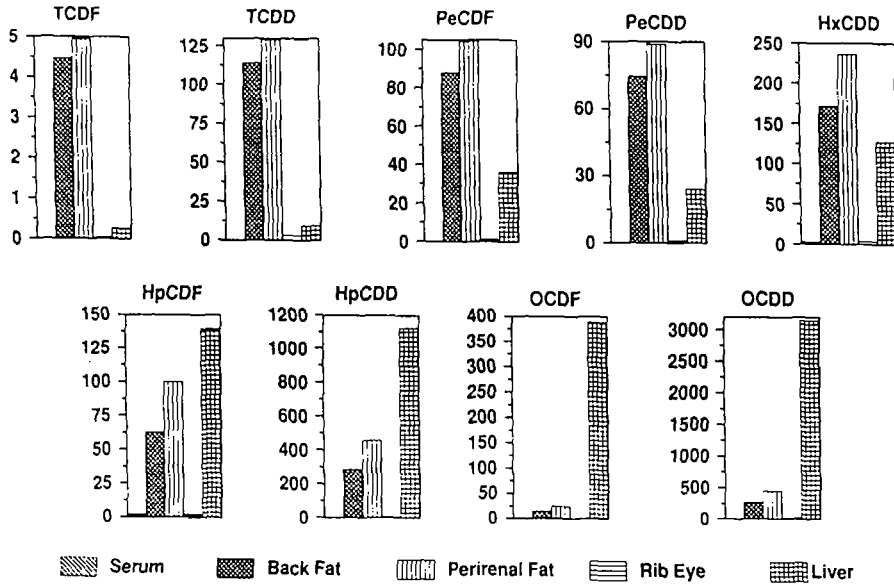


Figure 3. Tissue Distribution (ppt) of Dosed Congeners - Lipid Adjusted Basis

