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PCB Residues in a Lactating Beef Cow and Calf

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Several beef heifers and steers located in North Dakota were exposed to waste oil by licking the liquid leaking from a container placed in the pasture several years previously. The source of this container was not substantiated. A problem was not suspected until several animals exhibited signs of posterior paresis typical of triaryl phosphate intoxication. Chemical analysis of liquid from the container revealed that the waste oil consisted of 60% polychlorinated biphenyl (PCB as Aroclor 1248) and 40% triaryl phosphate (as tricresyl phosphate).

A heifer in the third trimester of pregnancy which had a violative level of PCB in a tailhead fat biopsy but no detectable tricresyl phosphate, was purchased in order to monitor PCB levels in her fat, milk fat, and the calf's fat. Two months after purchase the heifer delivered a full term calf which died of respiratory failure 10 minutes after delivery. Tissues were collected from the calf for PCB analysis. A newborn beef type calf from a known PCB-free dam was purchased as a replacement for the dead calf and was accepted by the heifer. Tailhead fat biopsies were subsequently collected from this calf to monitor any accumulation of PCB from the heifer's milk.

MATERIALS AND METHODS

Animal care and sample collection. The cattle were housed in a concrete stall with access to a dirt lot. Feed consisted of alfalfa cubes and a commerical pelleted grain mixture. Tissue samples were wrapped in aluminum foil and were frozen at -20 C prior to analysis. Milk samples were collected in clean glass jars and were refrigerated.

Extraction. Milk: Fat extracted from the milk (HORWITZ 1975) was used for analysis. 1.0 g of the fat was dissolved in 10 mL of the elution solvent, cyclohexane and methylene chloride (85+15). All solvents used were distilled in glass.

Nonfatty Tissue: Representative 10 g subsamples of tissues were ground by mortar and pestle with sea sand and granular sodium sulfate, extracted 3 times with acetonitrile and partitioned into petroleum ether (HORWITZ 1975). The petroleum ether was evaporated to dryness on a rotary evaporator and the residue was dissolved in

10.0 mL of the elution solvent.

Fat Biopsies: The entire biopsies were rendered in 125 mL flasks by heating in an oven at 120 C until the fat melted. Depending on the amount present in the original biopsies, up to 1.0 g of the rendered fat was weighed into a 15 mL graduated tube and dissolved in 10.0 mL of elution solvent (ROSS et al. 1981).

Cleanup. After the sample extracts were dissolved in the elution solvent, 5.0 mL of that solution was injected onto a Model 1002 Gel Permeation Chromatograph (ABC Laboratories, Columbia, MO), utilizing 50 g of BioBeads SX-3,200/400 mesh in a 2.5 cm x 30 cm glass column. The elution solvent was pumped through the column at a constant volume of 5.0 mL/minute.

The 0-115 mL fraction was discarded and the 116-240 mL fraction containing the PCB was collected. The eluate was evaporated to dryness on a rotary evaporator and the residue was redissolved in 10.0 mL of petroleum ether (STALLING et al. 1982).

Detection and Quantification. The detection of PCB was done on a Model 5840 Hewlett-Packard Gas Chromatograph using a ^{63}Ni electron capture detector and a 3 mm x 2.5 m glass column packed with 3% OV-101 on 80/100 mesh Chromosorb G-HP and operated isothermally at 200 or 220 C. Quantification was performed by peak area summation of all PCB peaks compared to an authentic Aroclor 1260 standard (99%) obtained from EPA (Research Triangle Park, NC). Sample volumes were adjusted to allow injections to fall within the working range of the detector.

RESULTS

The date of the original fat biopsy of the pregnant heifer was designated as Day 1. On Day 60 she delivered a full term calf which died of respiratory failure 10 minutes after delivery. Results of PCB analyses of the calf's tissues are shown in Table 1.

TABLE 1. PCB levels in tissue samples of original calf in ppm as Aroclor 1260.

TISSUE	LEVEL
Fat	14
Brain	0.1
Liver	0.4
Kidney	0.3

A newborn substitute calf was accepted by the heifer as replacement for her dead calf. Due to lack of sufficient subcutaneous fat, a biopsy sample was not obtained from this calf before it was placed with the heifer. However, since the dam of this calf contained no detectable level of PCB in her milk fat, it was as-

sumed that the calf was also PCB-free at this time. A satisfactory tailhead biopsy was collected from this calf on Day 171 (110 nursing days). The calf was weaned on Day 326 when it was approximately 9 months old. Results of PCB analysis of the fat biopsies and milk samples are shown in Figure 1.

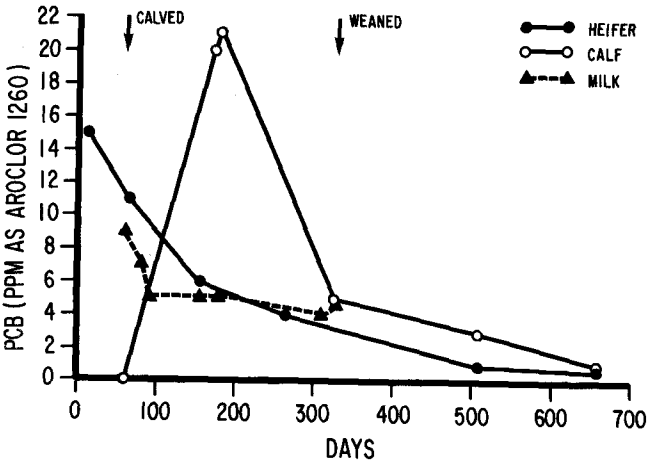

Figure 1. PCB residues in the heifer's fat, substitute calf's fat and milk fat.
[a]Initial PCB level in substitute calf's fat assumed to be 0 since natural dam's milk fat was PCB-free.

The concentration of PCB in the fat samples of the heifer ranged from 15 ppm to 0.8 ppm over a period of 669 days. Levels of PCB in the milk fat ranged from 9 ppm to 4 ppm over the 265 day period the calf nursed. In general, a level of 4-5 ppm PCB was maintained during most of this period. On Day 326, the milk fat and cattle fat samples all contained 5 ppm PCB. PCB levels in the calf's fat reached a recorded high of 21 ppm and dropped to 1 ppm, approximately equal to that of the heifer, by the end of the study.

DISCUSSION

Fat and milk residues in dairy and beef cows fed controlled amounts of PCB have been previously monitored (FRIES et al. 1973, PERRY et al. 1981). This study demonstrated the in utero accumulation of PCB as well as postpartum accumulation in the nursing calf via excretion of PCB in the milk fat.

This laboratory previously reported the accumulation of PCB in fat and tissues of beef cattle accidently exposed to Aroclor 1260 via

an insecticide backrub solution (ROSS et al. 1981, OSHEIM et al. 1982). Another source of exposure of cattle to PCB has been through contaminated silage stored in silos coated with PCB-containing sealants (WILLETT & HESS 1975, CHRISTMAS et al. 1977, WILLETT 1980).

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