Public Health Briefs

Contamination of the Food Chain by Polychlorinated Biphenyls from a Broken Transformer

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Abstract: In 1979, widespread distribution of chicken and egg food products and grease contaminated with polychlorinated biphenyl (PCBs) occurred across the United States and as far away as Canada and Japan. The contamination was traced to an accidental leakage of PCBs from a transformer stored in a hog slaughtering plant in Montana. Breast milk analyses showed the PCB absorption had occurred among egg consumers. The episode illustrates the need for heightened vigilance over the fate of PCBs still in use. (*Am J Public Health* 1983; 73:290–292.)

On July 6, 1979, the Food Safety and Quality Service of the US Department of Agriculture (USDA) detected an elevated concentration of polychlorinated biphenyls (PCBs) (15 ppm)* in routine testing of a fat sample from an unproductive laying hen obtained from a poultry processing plant in Provo, Utah. The origin of the contaminated hen was traced to an egg producing farm in Franklin, Idaho. Meat-meal supplements fed to the chickens contained over 1,000 ppm PCBs (FDA tolerance level in animal feeds, 2 ppm). The meat-meal had been bought from a hog processing plant in Billings, Montana, and was found to have become contaminated with PCBs from a transformer that had been accidentally punctured. About 200 gallons of the PCB transformer oil leaked down a nearby drain into an underground reservoir that received waste products from the hog processing area. The contents of the reservoir were pumped periodically into the Rendering Room, where the grease was removed from the solids (ground bone and waste meats) by heating at 240°F. The heated solids were further processed into meat-meal to be used as a protein supplement in various animal feeds. The removed grease was piped to a rail tank car to be sold for such purposes as soap and cosmetics manufacture.[1-3]

To evaluate human exposure to PCBs from the consumption of contaminated eggs, the Centers for Disease Control (CDC) and the Idaho State Health Department began a study of residents at Franklin, Idaho, and CDC and the Montana Department of Health and Environmental Sciences undertook a study of PCB exposure among workers at the hog processing plant where the contamination had occurred.

Methods

Egg Consumers

Nearly all eggs consumed by persons living in or near Franklin, Idaho were produced at the poultry farm that received the contaminated meat-meal. The chickens were sold only to distant commercial soup manufacturers.

A questionnaire designed to elicit PCB-related symptoms, details of egg consumption (including raw or cooked eggs and those eaten in salads or baked goods), and other possible sources of PCB exposure was administered on September 19 to 105 volunteers.** A blood specimen was

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*The Food and Drug Administration (FDA) tolerance level of PCBs in poultry fat is 3 ppm.

**Eighty-five of about 400 residents of Franklin and 20 residents with reportedly large egg consumption from neighboring towns; 97 White and 8 Hispanic; 62 females and 43 males; age from 14 to 77 years (mean 39.6).

collected from each participant, and breast milk samples were obtained from the eight lactating mothers.

The Bureau of Laboratories, Idaho Department of Health and Welfare, analyzed all serum and milk samples obtained in Franklin. The Toxicology Branch at CDC also analyzed about 10 per cent of the serum samples and provided quality control specimens.***

Hog Processors

PCB exposure could have occurred as a result of evaporation from the cooking vessels and from skin contact with residues in these vessels during maintenance work. Sixteen of the 17 potentially exposed men were available for study. Using a computer printout of all employees listed in order of birth date, we randomly matched 16 nonexposed employees with the exposed men by age, sex, race, and skill status. Ages ranged from 21 to 57 years. The men were asked to complete a questionnaire on their general health, sources of food and drink, past occupations, and hobbies. A physician then interviewed each of the men and examined the skin of the face and hands for chloracne; a venous blood sample was also drawn.

Environmental air samples were collected and analyzed for PCBs by the National Institute for Occupational Safety and Health (NIOSH) with standard gas chromatographic techniques.[7]

Results

Egg Consumers

Egg consumption ranged from 0 to 50 eggs per week (mean, 9.4 eggs; median, 6.5 eggs). For 98 (93 per cent) the source of the eggs was the egg ranch.‡

Although two of the 105 participants reported health complaints, the PCB levels in all 105 sera were found to be below the 5 ppb limit of detection. The split samples run at the CDC Toxicology Laboratory were also consistent with low or no exposure to PCBs.

Eight of the 105 participants were lactating women who reported that all the eggs they consumed had been from the Franklin poultry farm. They expressed samples of breast milk into a hexane-washed jar with a Teflon-lined lid under supervision of a public health nurse. The eight whole breast milk samples were found to contain PCBs (lower limit of detection—1 ppb), and the levels correlated with egg consumption (Spearman's rank correlation coefficient $r = 0.95$; $p < .01$; Figure 1); the mean PCB level was 32.4 ppb (range, 2–75 ppb; standard deviation (SD), 27.1); and the mean number of eggs consumed per week was 5.6 (range, 3–10 eggs; SD, 2.3).

PCB Concentration in Whole Breast Milk vs. Egg Consumption, Franklin, Idaho, 1979

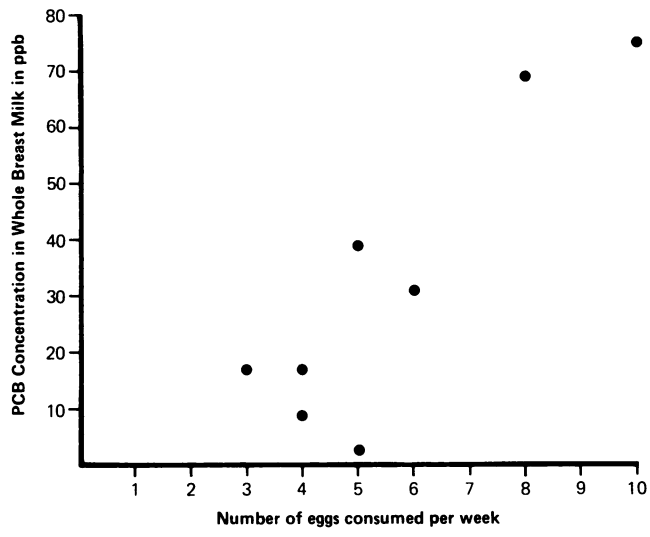

FIGURE 1—Scattergram of PCB concentration in eight whole breast milk specimens and the egg consumption of the lactating women (Spearman's rank correlation coeffficient $r = 0.95$; $p < .01$).

Hog Processors

No symptoms among the workers at the hog processing plant could be related to occupational exposure to PCBs. There was no evidence of chloracne. The mean serum PCB level in the potentially exposed group was 6.4 ppb (SD, 2.3), and, in the controls, 7.5 ppb (SD, 6.8). The highest level, 30 ppb, was found in one control, but no explanation for this was apparent from his occupational or dietary history.

The air samples taken at the plant all contained less than the minimum detectable concentration of 0.5 $\mu g/m^3$ of PCB vapor. (The NIOSH recommended standard is 1 $\mu g/m^3$.)[8]

Discussion

PCBs are semisynthetic, chlorinated, petroleum-derivative oils. Their manufacture in the United States was phased out from 1976–1979 and then banned by the Environmental Protection Agency (EPA). Because of their dielectric properties and high stability, PCBs were used as coolants and insulators in most transformers and capacitors manufactured in this country before 1972. The typical useful lifespan of transformers is at least 10 years. Therefore, many thousands of transformers, each containing up to several hundred liters of PCBs, are still in use.

PCBs and their highly toxic contaminants, the chlorinated dibenzofurans, are persistent biosphere pollutants. Long-term health hazards of residual amounts of these substances in human tissues are as yet unknown, but they should be regarded as potential human carcinogens.[9]

The PCB levels found in the whole breast milk samples showed a statistically significant correlation with eating

***All samples in both laboratories were analyzed by standard gas chromatographic techniques[4,5] with Aroclor 1260 as the analytical standard. The CDC laboratory quantified PCB residues by using Webb and McCall factors.[6]

‡One participant ate 50 eggs per week as part of an "egg and grapefruit" reducing diet. Four people ate more than 24 eggs per week.

eggs, but were *not elevated* when compared with a national survey[10] in which the average PCB level among the 309 positive whole milk samples was 93 ppb. Although the laboratory methods were virtually the same as those used here, the limit of detection in that survey was 50 ppb; the number of women surveyed was 1,038. Our findings suggest that incidents of low level contamination of food with PCBs may be detected in epidemiologic studies of breast milk, at least in a population judged to have low background levels of PCBs according to serum measurements. A similar observation was made regarding accidental food contamination in Michigan by polybrominated biphenyls, chemicals closely related to PCBs.[11]

Although no adverse health effects attributable to PCB exposure were discovered or would be expected at the levels of exposure found here, the FDA investigation indicated a startlingly wide distribution of PCBs in the food chain from this single source. Product recalls resulted in many disruptions in the food-processing industry; estimated losses were over $3.5 million.[2] Had the episode gone undetected, human contamination would have spread throughout the United States and to other countries.

Since 1969, several other incidents involving accidental PCB contamination of foodstuffs (mostly cattle and chicken feeds) have been recorded, but none was as complex or as far ranging as the one described here.[2] Ten weeks elapsed between the detection of PCBs in the original sample of chicken fat and the discovery of the source of the contamination; under ideal conditions the interval would have been reduced to four weeks.[2] With current limitations of analytical techniques and resources, meat and poultry monitoring programs are not designed to ensure that a localized chemical accident, like the one described here, will be discovered within any specified time, assuming it is detected at all.[1] To reduce the likelihood of such incidents in the United States, the EPA has promulgated new regulations to limit and ultimately to prohibit the use of PCB-containing equipment which poses an exposure risk to food or feed.[12] Health workers must be alert to the continuing hazard to occupational and public health posed by PCBs still in industrial and home use or being stored awaiting disposal. The ease with which PCB contamination spread over a wide geographic area in this incident demonstrates the need for heightened vigilance among industrial and regulatory bodies concerned with all phases of food production.

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Sixteenth Annual Conference of APLIC

APLIC—International, the worldwide Association for Population/Family Planning Libraries and Information Centers has scheduled its sixteenth annual conference titled "APLIC is Alive and Well and Visiting Pittsburgh," to be held April 12–14, 1983 at the Pittsburgh Hilton in Pittsburgh, Pennsylvania.

The conference will feature on overview of several major demographic surveys and a migration course structured especially for information managers.

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