POLYCHLORINATED BIPHENYLS IN FOOD *

by

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I welcome the opportunity here today to discuss the following aspects of one of our common problems, the problem of polychlorinated biphenyls in food: the analytical findings in FDA's surveillance and enforcement programs; the toxicology of PCB's; FDA's action levels for PCB's in various foods; and other FDA activities with respect to PCB's.

Since November 1969, the FDA has analyzed all raw agricultural commodities sampled in the pesticide program for PCB's. More than 15,000 samples have been collected and analyzed for PCB's in this program. As of June 1971, a total of about 480 samples of raw agricultural commodities has been reported to contain PCB's. See tables 1 and 2. PCB's were encountered most frequently in fish in approximately 300 of the 480 samples.

The FDA total diet studies for 60 market baskets representing a total of 720 composite samples during FY-70 and FY-71 show 22 composite samples to contain PCB residues ranging from a trace to 0.36 p.p.m. Seventeen of these samples represented the meat, fish, and poultry composite. Other positive findings were in the dairy and the grain and cereal composites. Table 4 (last three items) shows the amount of PCB's in individual items of the total diet and indicates the source in three cases to be the packaging material.

We have also analyzed a number of other paperboard packaging materials and the food packaged in such materials. See tables 3 and 4.

You will note in examining these tables of PCB data that no PCB's have been found in fresh fruits or vegetables. This is indeed significant because thousands of samples have been analyzed. However, PCB's have been found in a feed by-product from potato processing plants (source of the PCB's could not be identified).

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During the past year, there has been a series of accidents related to fishmeal and other animal feeds, which have resulted in the contamination of food. As of August 30, 1971, 166 samples of eggs had been analyzed as a part of the follow-up investigation of the Wilmington East Coast Terminal fish meal accident. Fifty-five of these contained PCB's in excess of the action level of 0.5 p.p.m. Seizures aggregating about 75,000 eggs have been made. The FDA also seized one shipment of the fish meal and five shipments of a catfish and trout chow manufactured from the contaminated meal. It was then agreed the responsible firms would recall the fishmeal and the fish feed.

The U.S.D.A. has examined the poultry involved in that incident and our two agencies have coordinated their efforts to protect the consumer. The U.S.D.A. has also had a number of other poultry incidents of a similar nature to contend with; and FDA has investigated several other feed contamination accidents.

Toxicology of PCB's

What is the toxicological significance of PCB's? I would like to briefly summarize data derived from animal experiments and from human intoxications.

While the oral LD^{50} in mammals varies from about 2 to 10 gms/kg, substantially smaller doses adversely affect egg production in chickens. Chick embryo studies indicate that lethal effects decrease with increases in the chlorine content of the PCB's, and that a variety of birth defects can result from PCB's tested in this sensitive system. However, the chick embryo studies are not directly relevant to man.

Rats experience growth depression and increase in liver size when dosed with 1,000 p.p.m. in the diet; however, induction of certain enzymes has been noted at levels as low as 25 p.p.m. in the diet. Generally, enzyme induction increases with increases in chlorine content of PCB. Pathologically, monkeys given 1.4 to 16 mg/day PCB's in their diet showed liver cell enlargement, fatty degeneration, and an increase in the smooth endoplasmic reticulum of the liver cells indicating fibrotic changes. Alteration of liver metabolism, changes in hexabarbital sleeping time and other enzymatic related detoxification steps were noted, largely related to induction of hepatic hydroxylating enzymes.

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At levels around 100 p.p.m. in the diet, adverse reproductive effects with decreased litter size and survival have been noted in rats with increases noted in liver and thyroid weights. Obviously PCB's affect metabolism by inducing certain enzyme systems and undoubtedly inhibiting others. It is likely that such changes adversely affect the metabolism of hormones and pesticides, not to mention the relatively unexplored area of interactions with therapeutic drugs.

We know that PCB residues have been found in human fat and milk at levels of 60 p.p.b. However, little is known about the metabolism of the PCB's themselves in animals and humans.

Human intoxication with Kanachlor 400, a PCB manufactured in Japan with 48% chlorine, with unknown chemical characteristics as to the purity, was noted when a heat exchanger leaked into rice oil which was consumed by Japanese families in 1968. About 600 people were eventually affected. Exposure levels to the oil were calculated to approximate 15 gm/day. The oil itself was apparently contaminated at levels estimated to range from 200 to 2,300 p.p.m. PCB's, but the origin of the lower figure is not given in the particular Japanese publication and is currently under FDA investigation. The higher figure is derived from the known organic chlorine content of rice oil related to the known organic chlorine content of Kanachlor 400.

The clinical problems associated with the Japanese incident included chloracne, impaired vision, systemic gastro-intestinal symptoms with jaundice, edema, and abdominal pain. Birth abnormalities were noted in that a few babies were born with decreased birth weights and skin discoloration (cola-colored babies) which later regressed. Nothing is known as to whether or not these children have experienced permanent liver damage or alterations in liver function or metabolic detoxification of hormones, etc. Nothing was described in relation to thyroid function which you will remember was noted apparently to be affected in animals. Transplacental transmission of PCB's were noted by the presence of residues in fetal tissue.

To summarize what is presently known, the no-effect level in test mammals may approximate 10 p.p.m. in the diet. Based on this animal data with allowance for a 1,500 gm human dietary food intake, the ADI would permit a 100-fold margin of safety if set at 150 micrograms PCB's per day.

From the observations available to us concerning the Japanese incident, the lowest reported figures estimate a minimal positive effect level at 3 mg per day even though the average doses to these

Japanese may have been higher. Using a tenfold safety margin, we could roughly estimate that 300 micrograms/day would be without overt effect although possibly subtle changes in liver function may still occur.

Thus animal and human data both point to 150 to 300 micrograms/day as being in the range of consideration for establishing an acceptable daily intake for the period of time that we as a society are forced to tolerate the presence of these chemicals in our food supply, but I would like to emphasize that we know very little about the potential metabolic consequences of long-term PCB exposures even at these low levels.

In further consideration of low-level exposures, we can predict that since 2 gms was reported to be the total dose necessary to cause an effect in the Japanese, then 200 mg would be an estimated total safe ingestion over an extended period of time. I emphasize that I am now talking total accumulated exposure and not a daily exposure.

Our previous lowest estimate of a safe dose was 150 micrograms/day based on animal data or 300 micrograms/day based on human data. With a total allowable ingestion of 200 mg we could estimate a safe period of intake of 44 months based on the 150 micrograms/day animal exposure data or 22 months at the 300 micrograms/day level based on human data. If we can assume new regulatory approaches will bring the problem under better control within 6 months, this would permit 1.1 mg/day of PCB in the dietary intake during this period.

At a level of 5 p.p.m. this allows total intake of 200 grams food.

At a level of 4 p.p.m. this allows total intake of 250 grams food.

At a level of 3 p.p.m. this allows total intake of 330 grams food.

At a level of 2 p.p.m. this allows total intake of 500 grams food.

At a level of 1 p.p.m. this allows total intake of 1 kilogram food.

FDA Action Levels for PCB's

Until the long-range feeding studies of Monsanto have been completed and fully evaluated, the FDA is unwilling because of toxicologic uncertainties for man to establish formal guideline levels for PCB's in food. However, since residues of PCB's are occurring at significant levels in some foods, and since the FDA is charged with the responsibility of protecting the public health against such poisonous substances in

the food supply, the agency has had to act on the best information and toxicologic data available, recognizing that such information and toxicologic data are not wholly adequate. Thus, we have advised the states and the U. S. Department of Agriculture on a case by case basis with respect to action levels we believe should be used to remove PCB contaminated food from the market place.

The basis for the FDA action levels for PCB's in foods is the toxicology data discussed above although these data were not all available at the time the first action levels were set.

Action Levels

1969, late fall --- milk, 0.2 p.p.m.

1970, February --- fish, 5 p.p.m.

1971, February --- poultry, 5 p.p.m.

1971, August --- eggs, 0.5 p.p.m.

1971 --- animal feed, no action level set.

It should be emphasized that these action levels are subject to review in the light of new toxicologic data and in any event may be considered safe only for short-term or occasional exposure at this time.

Earlier I referred to FDA seizures of shell eggs and fish meal because of PCB's over the action levels, but FDA has not seized any milk or fish because of PCB's. However, state agencies have taken action in some cases.

Other PCB Related Activities

1. Earlier this month we began a nationwide survey of selected food categories to determine the extent of food contamination by PCB containing paperboard. Each District is collecting three samples of each of 15 categories of food such as crackers, infant cereals, dried fruit, frozen fruit juices, etc. The food and its package will both be analyzed for PCB's. When that survey is completed about November 1, 1971, a nationwide survey of milk for fluid milk use and for manufacturing use will be instituted. Following the milk survey, we plan a nationwide survey of shell eggs.

2. Conference of Monsanto Chemical Company on September 8, 1971, with FDA, Office of Science and Technology and Council on Environmental Quality: Uses reviewed and some considered essential, such as use in transformers and capacitors; toxicity studies to be completed in a few weeks; migration from packaging materials believed to occur in vapor phase.

3. Conference --- FDA with American Paper Institute, September 3, 1971: carbonless carbon paper from 1966 - June 1, 1971, contained 3% PCB; paperboard now being produced should not exceed 15 p.p.m. PCB; and API to study migration problem.

4. September 5, 1971 (Press release).

"Six Federal agencies today agreed to establish an inter-departmental task force to coordinate a government-wide investigation into PCB contamination of food and other products.

"The task force will be coordinated through the Office of Science and Technology and the Council on Environmental Quality. Other members are: the Environmental Protection Agency, the Food and Drug Administration, the National Institute of Environmental Health Sciences, and the U.S. Department of Agriculture.

"The PCB Task Force will have two objectives:

-- To insure maximum, effective coordination of government response against specific and preventable PCB contamination as such problems may arise;

-- To develop a long-range strategy for coordinating scientific resources to better define the PCB problems and its possible implications for human health.

"Based on current scientific knowledge, the government sees no imminent threat to the safety of the food supply or to the public health from this broadly used family of industrial chemicals. Enforcement activities by FDA, the USDA, and other agencies of government are adequate to protect the public health from the occasional accident which can result in short-term but controllable human exposure to PCB's in the food supply. Still unknown, however, and more difficult to assess on the basis of current information, is the size and significance of long-term, low-level human exposure to PCB's.

"The PCB Task Force is intended to expedite the search for answers and solutions by bringing together the combined resources and authorities of cooperating government agencies."

5. Conference --- FDA with Food Manufacturers, September 14, 1971: GMA members are currently testing paper packaging for PCB's. Question of defining food packaging grade paper must be resolved. Paper from virgin pulp reported to contain 3-4 p.p.m. PCB (apparent or real?).

6. HR 10085 - a bill to ban interstate commerce in PCB's. Introduced in the House on July 26, 1971. FDA has been requested to comment on the bill.

7. Commissioner's response to our critics on FDA's method of dealing with PCB's: "This Agency cannot and will not act on the basis of emotionalism. We will not declare national health alerts when in the best opinion of science no such alert is justified. We reject scare headlines in favor of good science."

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