Nowhere to Hide

Persistent Toxic Chemicals in the U.S. Food Supply

March 2001

Pesticide Action Network North America
Commonweal

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Founded in 1982, Pesticide Action Network is an international coalition of more than 400 citizens groups in more than 60 countries working to oppose the misuse of pesticides and to promote sustainable and ecologically sound pest management.

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Commonweal

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A Note to Readers

This report documents that persistent toxic chemicals are pervasive in the U.S. food supply. In the final analysis, however, the report is not about U.S. food production or processing.

Today's farmers and food processing companies, after all, are not to blame for the contamination documented in this report. Most of the persistent organic pollutants or "POPs" targeted for global elimination under the recently negotiated international POPs treaty were banned in the United States years ago. Nevertheless, these POPs continue to make their way into the food supply from sources outside of U.S. agriculture. In a very real sense, therefore, today's farmers, food processing companies and the consumers they service are largely victims of previous and continuing global production and use of these POPs.

The new global POPs treaty offers an unprecedented opportunity to eliminate production and use of some of the most dangerous persistent toxic chemicals ever produced. The fact that the treaty is scheduled to be signed in May 2001 in Stockholm, Sweden is cause for celebration indeed. However, the "Stockholm Convention" will come into effect only after 50 countries have ratified it. So unless and until the treaty is ratified and effectively implemented, these dangerous chemicals will continue to be produced, released into the environment, and make their way into the diets of consumers here and abroad.

We urge leaders in U.S. agriculture and the food industry to join us in pressing the Bush Administration to play a leadership role in supporting the rapid ratification and implementation of a strong POPs treaty that is designed to protect the health of present and future generations.

Monica Moore
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EXECUTIVE SUMMARY

A class of toxic chemicals known as persistent organic pollutants (POPs) are among the most dangerous compounds ever produced. They include industrial chemicals, byproducts of manufacturing processes and waste incineration, and pesticides that have been linked to devastating human health consequences.

Despite their hazards, POPs continue to be produced, used and stored in many countries. Because they are long-lasting and travel long distances in global air and water currents, even POPs already banned in the United States, such as DDT and PCBs, still make their way into the U.S. food supply.

This report is being released following the international community's successful negotiation of a global treaty in December 2000 to eliminate the worldwide production and use of 12 of the worst persistent toxic chemicals, including DDT, PCBs, dieldrin and dioxins. The United Nations-sponsored accord reflects worldwide recognition that stopping further POP contamination of any country's food supply and environment can only be accomplished through effective global cooperation.

The purpose of the report is to construct the most comprehensive picture possible of the prevalence of persistent toxic chemicals in the U.S. commercial food supply, given available federal government and university data. The compounds examined in the report are the 12 chemicals to be eliminated under the global POPs treaty.

Findings of POPs in food products are presented for a stereotypical U.S. Thanksgiving/Christmas holiday meal as well as for hypothetical daily diets in four geographic regions of the country: the Southeast, the Northeast, the Midwest and the West. Menus for breakfast, lunch, snack and dinner are included in the daily diets for each region. The POP contaminants and residue levels found in each food item are listed. Data on POPs levels in food items are drawn primarily from the year 2000 version of the Food and Drug Administration's annual *Total Diet Study* and the latest annual pesticide residue data on fruits and vegetables from the U.S. Department of Agriculture's Pesticide Data Program.

Persistent Toxic Chemicals Pervade the U.S. Food Supply

The evaluation of POPs residue data produced startling results, including the following:

- Virtually all food products are contaminated with POPs that have been banned in the United States—baked goods, fruit, vegetables, meat, poultry and dairy products.
- It is not unusual for daily diets to contain food items contaminated with three to seven POPs.
- A hypothetical holiday dinner menu of 11 food items can deliver 38 "hits" of POPs exposure (where a hit is one persistent toxic chemical on one food item).
- Hypothetical *daily* meal plans, for four U.S. regions, can each deliver between 63 and 70 exposures to POPs per day. By region, the number of exposures found were as follows:
  - Northeast: 64 exposures per day
  - Midwest: 63 exposures per day
  - Southeast: 70 exposures per day
  - West: 66 exposures per day

The top 10 POPs-contaminated food items, in alphabetical order, are butter, cantaloupe, cucumbers/pickles, meatloaf, peanuts, popcorn, radishes, spinach, summer squash and winter squash.

While POPs residue levels in individual food items are small, when viewed in the context of daily amounts of food consumption, the contamination found is at or near levels of concern according to health-based standards set by the Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry (ATSDR) and the EPA.

The two most pervasive POPs in food are dieldrin and DDE. Dieldrin is a highly persistent and toxic organochlorine pesticide banned since the late 1970s. DDE is a breakdown product of DDT, which has been banned since 1972. Exposure to these chemicals has been associated with breast cancer, other types of cancer, immune system suppression, nervous system disorders, reproductive damage and disruption of hormonal systems.

Low Level POPs Exposure Associated with Serious Health Effects

- Developing fetuses and children are especially vulnerable to problems caused by exposure to POPs. Recent scientific studies show that exposure to miniscule levels of POPs at crucial times in fetal and infant development can disrupt or damage reproductive, neurological and immune systems.
- Exposure to low levels of POPs has likely contributed to disturbing public health trends, including increased incidence of breast cancer, learning disabilities and other neurodevelopmental problems, as well as reproductive problems.
- The Food and Drug Administration's "action levels" for determining whether contaminated foods should be removed from the U.S. food market do not protect American food consumers from the health threats of POPs. In some cases, consumption of a single food item contaminated at levels allowed by FDA would expose the consumer to more than 50 times the daily exposure levels considered "safe" by other agencies.

Recommendations

This study shows the ubiquitous presence of persistent toxic chemicals in the U.S. food supply, despite the fact that most of the POPs pesticides that have been used for food production have been banned in this country for years.

From a health protection standpoint, the evidence presented strongly indicates that American consumers would be served best by implementing the precautionary principle to prevent additional accumulation of POPs in our air, water and soil. Given the serious health risks associated with even extremely small levels of exposure to POPs, preventing further contamination of food must be a national priority.

The recently negotiated POPs treaty includes references to the precautionary approach, and offers a vehicle for preventing further accumulation of persistent toxic chemicals in U.S. food supplies. Effective implementation of the treaty, including the early addition of POPs chemicals not included in the initial targeted list,will give future generations everywhere the chance to experience life free from fear of harm from persistent toxic chemicals. Rapid ratification and implementation of the treaty should be an urgent priority for the current U.S. Administration.

INTRODUCTION: Persistent Toxic Chemicals, the Food Supply and the Global Pops Treaty

A class of toxic chemicals known as persistent organic pollutants (POPs) are among the most dangerous compounds ever produced. This ubiquitous class of chemicals includes many pesticides, industrial chemicals and byproducts of certain manufacturing processes and waste incineration. The characteristics that make these chemicals unique also make them an urgent global environmental health problem:

- POPs persist in the environment;
- POPs build up in body fat and concentrate at higher levels (bioaccumulate) as they make their way up the food chain;
- POPs travel in global air and water currents; and
- POPs are linked with serious health effects in humans and other living organisms.

In just a few decades, POPs have spread throughout the environment to threaten human health and to damage land and water ecosystems all over the world. All living organisms on Earth now carry measurable levels of POPs in their tissues. POPs have been found in sea mammals at levels high enough to qualify their bodies as hazardous waste under U.S. law (Cummins, JE 1988). Nor are humans immune to contamination. Evidence of POPs contamination in human blood and breast milk has been documented worldwide (CHEJ 2000, Solomon 2000).

There is strong evidence that exposure to even miniscule amounts of POPs at critical periods of development—particularly in the womb—can cause irreversible damage. The effects of such exposures may take years to develop, sometimes appearing first in the offspring of exposed parents. Some of the human health effects now linked to POPs exposure include cancer, learning disorders, impaired immune function, reproductive problems (e.g., low sperm counts, endometriosis) and diabetes (Orris et al. 2000, Colburn et al. 1996).

Despite their hazards, these chemicals continue to be produced, used and stored in many countries. Even where national bans or other controls exist, these restrictions are often poorly enforced—and in any case, they cannot protect citizens from exposure to POPs that have migrated from other regions where the chemicals are still in use.

Because they are persistent and continue to be produced and released into the global environment, even POPs already banned in the United States, such as DDT and PCBs, make their way into the U.S. food supply. Once in the air, the water and the soil, these chemicals resist breaking down. Some have half-lives measured in decades, and they remain in water and soil as well as plants and animals that ultimately, in one form or another, provide food for humans. POPs that were once particles in the sediment of a riverbed, in soil or in grasses find their way into the fatty tissue and milk of livestock or into the vegetables that pull POPs from the soil in the same way they take in nutrients.

It is no surprise, therefore, that POPs are pervasive in store-bought food as well as in fish and wildlife consumed after being caught in the wild. This presence of POPs in the food supply creates a compelling and urgent need for action to prevent further release and buildup of these dangerous chemicals.

The Global POPs Treaty

Recognizing that the health risks from POPs can neither be managed by individual countries' regulators nor contained by national borders, the United Nations Environment Programme sponsored an international agreement to phase out production, use and release of POPs. Twelve POPs have been identified as initial phaseout targets under the new treaty. This list includes nine organochlorine pesticides and three industrial chemicals/ byproducts (see box). The global POPs treaty is a promising vehicle for addressing POPs accumulation in the U.S. food supply.

The nine pesticides on this initial list have been banned or severely restricted in the United States since the 1970s and 1980s. Most industrialized countries and many developing countries also have banned or restricted the use of these pesticides. It is important to note that while other POPs pesticides are present in the U.S. food supply, the focus of this report is limited to the initial list of chemicals targeted under the POPs treaty. The treaty includes provisions for adding additional POPs chemicals in the future.

Twelve POPs Targeted for Global Ban

Pesticides	***Industrial Toxins and Byproducts***
Aldrin	PCBs
Chlordane	Furans
Endrin	Dioxins
DDT	
Dieldrin	
Heptachlor	
Hexachlorobenzene	
Mirex	
Toxaphene	

Polychlorinated biphenyls (PCBs) also have been banned in most industrialized countries since the late 1970s. Large quantities, however, remain in storage in many countries, including the United States. PCBs also are still permitted in some closed electrical systems and can be found in old transformers, fluorescent lighting fixtures and other appliances. Used primarily as coolants and lubricants in electrical transformers and other equipment, this group of chlorinated industrial chemicals is highly toxic to both wildlife and humans (Orris et al. 2000). PCBs are stable and persistent, and there is evidence that they have been transported thousands of kilometers in the atmosphere (Environment Canada 1995). PCBs are the chemicals that most frequently cause government warnings (advisories) against consumption of fish and wildlife in the United States (U.S. EPA 1999).

Dioxins and furans are byproducts of chlorine-based industrial processes and incineration. Primary sources include the bleaching of paper products, manufacture of chlorinated chemicals, and the burning of hospital, hazardous and municipal waste. Dioxins are known to be toxic at extremely low levels. The EPA has called one form of dioxin the most potent synthetic carcinogen ever found (IARC 1997, CHEJ 2000). Like many POPs, dioxin is also a known endocrine disruptor, mimicking hormones such as estrogen to cause permanent hormonal and metabolic changes in humans and other animals. A recent report documented dioxins in the Arctic environment and linked them to key emissions sources in the United States (Commoner 2000).

While some POPs have been banned or restricted, they continue to circulate in the global environment at levels of concern. This is due both to the persistence of these chemicals and continued use in some countries. Dioxins continue to be released as byproducts of production and waste disposal processes worldwide, adding to the chemical burden of populations around the globe. Rapid ratification and effective implementation of the international treaty is urgently needed to protect present and future generations from POPs-related harm.

How POPs Enter the Food Supply

Worldwide, humans are exposed to persistent toxic chemicals mainly through our food supply. In the United States, POPs enter the human diet in several ways.

Waterways. When released into rivers, lakes and oceans, POPs collect in sediments. Away from light and oxygen, these pesticides degrade slowly and are ingested with sediments by small invertebrates at the bottom of the food chain. Once inside the organism, POPs accumulate in fatty tissues. Fish that eat pesticide-contaminated invertebrates accumulate more of the chemical with each shrimp or insect they ingest. A large, mature fish is likely to contain much higher pesticide residues because it has eaten more contaminated food over time than a younger fish. The highest concentrations of these persistent, bioaccumulating chemicals are found in those animals at the top of the food chain—humans, predatory birds, seals and other predatory animals (see below for a discussion of POPs-related fish advisories issued in the United States).

Deposition on Land. POPs are deposited on U.S. soil through a well-documented process of transport by air currents and storm systems—sometimes over great distances—and deposition through contact with solid surfaces or through precipitation. For example, dioxin released from an incinerator could be deposited in either a nearby or distant pasture where grazing cattle consume the chemical. The ingested dioxin then contaminates the milk and fatty tissue of the meat consumed by humans. It also can become incorporated in the fatty tissue of nursing calves, including those destined for veal production. By the time the dioxin makes its way into the bodies of consumers, it will have bioaccumulated to much higher levels than originally deposited on the grass (see Appendix A).

Banned Pesticides in Soils. Persistent soil residues of POPs pesticides that have been banned for decades provide another primary source of POPs in the food supply. DDT and its breakdown products, as well as dieldrin and other organochlorine chemicals, continue to be taken up by crops grown in soil contaminated by heavy pesticide use in the 1960s and 1970s. These soil-borne POPs residues also are taken up in pastures and crops used as feed for livestock and make their way to consumers through livestock food products.

Pesticides Used to Produce Imported Foods. POPs pesticide residues also are found in produce imported from countries where the pesticides are still in use or were recently banned (Groth, et al., 2000). There is no clear evidence, however, that imported produce has more POPs residues than fruits and vegetables grown in the United States. In the case of winter squash, for example, dieldrin was found in 35 percent of the domestically produced samples, and found in only 4.2 percent of the samples from Mexico. Moreover, the residue levels were significantly higher in the U.S. squash. In the case of carrots, in contrast, DDT was found in 75 percent of Canadian samples taken, but only found in 6.4 percent of the U.S.-grown carrots tested. While the data on imported POPs residues collected through USDA's pesticide data program is not comprehensive, the samples collected clearly illustrate that contamination levels depend on a range of variables. U.S. consumers cannot assume that domestically produced fruits and vegetables are less contaminated with POPs than imported produce (USDA 1998, Groth et al. 2000).

Overview of the Analysis: *Scope, Methods and Data Sources*

This report was designed to paint the most accurate picture possible of the prevalence of POPs in the U.S. commercial food supply given available federal government and university data. The chemicals examined in the report are the 12 organochlorine compounds targeted under the recently negotiated POPs treaty.

Findings of POPs in food products are presented for a typical U.S. winter holiday meal as well as for hypothetical daily diets in four geographic regions of the United States. Menus for breakfast, lunch, snack and dinner are included in the daily diets for each region, and the persistent toxic chemicals found in each menu item are listed.

Recent scientific findings regarding the potential public health implications of regular exposure to even small amounts of POPs are reviewed and discussed. In addition, to put the levels of POPs in food in perspective, health-based exposure thresholds established by the Environmental Protection Agency and the Agency for Toxic Substances and Disease Registry are compared to intake levels of certain POPs through food consumption (ATSDR 2000). These comparisons are made for the estimated food consumption of both an average adult (154 pounds) and a young child (44 pounds).

The Food and Drug Administration's "action levels" for POPs in food products were also reviewed (FDA 1998). Action levels are used by FDA to determine whether inspected food should be sold to consumers. The level of public health protection provided by this standard was evaluated by calculating the estimated consumption of a particular POP chemical (DDT) if food contamination was at the FDA action level, and then comparing this intake with the health-based thresholds established by EPA and ATSDR.

Data on POPs levels in food items are drawn primarily from the latest reported findings of FDA's *Total Diet Study*, which reports annually on samples taken from a random, off-the-shelf "market-basket" of fresh and processed foods consumed in the United States (FDA 2000). The FDA POPs residue data was supplemented by more comprehensive annual pesticide residue data on fruits and vegetables from the U.S. Department of Agriculture's Pesticide Data Program (Groth et al. 2000). Given the random nature of sampling, some foods contaminated by POPs do not show up in these databases. In addition, information on PCB-contaminated foods, such as fish, which represent a recognized health risk, are not included in the FDA/dioxin analysis (see fish advisory discussion below).

For dioxin residues in food, prior EPA and university research was used, as neither the FDA nor the USDA test regularly for the presence of dioxins and furans (U.S. EPA 1994, Schecter et al. 1994). Data on PCB residues in commercially sold food products were not available for this report. However, evidence of POPs contamination of wild fish obtained from a 1999 U.S. Environmental Protection Agency database on fish advisories is presented (U.S. EPA 1999).

The food samples tested by the federal government are not attributable to any particular location. To simulate the impact of POPs in each geographic region, it was assumed that FDA findings on POPs in food are representative of all regions in the country. This assumption should not bias the regional findings dramatically, given the extent of the integration of national and international food markets, which result in a tendency toward the homogenization of the food supply.

FINDINGS: Persistent Toxic Chemicals Pervade the U.S. Food Supply

Overview of Findings

Evaluation of POPs residue data from several government and university sources produced startling results. Residues of five or more persistent toxic chemicals per food product are not unusual. The most commonly found POPs are dieldrin and DDE. Dieldrin is a highly persistent and very toxic organochlorine pesticide banned since the late 1970s. DDE is a breakdown product of DDT, which has been banned since 1972.

Residues are found in virtually all food categories—baked goods, fruit, vegetables, meat, poultry and dairy products are all contaminated with POPs that have been banned in the United States. A typical holiday dinner menu of 11 food items can deliver 38 "hits" of POPs exposure, while hypothetical daily meal plans developed for four U.S. regions can each deliver between 63 and 79 POPs exposures per day. By region, the number of exposures found were as follows:

- Northeast: 64 exposures per day
- Midwest: 63 exposures per day
- Southeast: 70 exposures per day
- West: 66 exposures per day

According to FDA's *Total Diet Study*, POPs residues usually occur at less than 100 parts per billion (i.e., 100 pounds of DDT per billion pounds of food). Scientific data indicate, however, that even these low levels of exposure are cause for concern. Moreover, the daily dietary exposure determined from the data on POPs in food products is at or near the safety thresholds established by various federal agencies (see Appendix B, and full discussion of the health effects of low-level exposure below).

For example, both the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) and the EPA have set the level of concern for exposure to the pesticide dieldrin at 0.05 micrograms per kilogram of body weight per day—a total of 3.5 micrograms of dieldrin per day for a 154 pound (70 kg) adult. This amount of dieldrin represents 0.000000005% of an average adult's body weight, similar to a drop of water in an Olympic-size swimming pool (50 meters x 25 meters x 2 meters).

In the case of dioxin, even smaller levels of exposure are cause for concern. Agency standards for "safe" daily intake of dioxin range from EPA's 0.70 picograms a day for a 154 pound adult[1] to the World Health Organization's 70–280 picograms a day—one picogram is one trillionth of a gram.

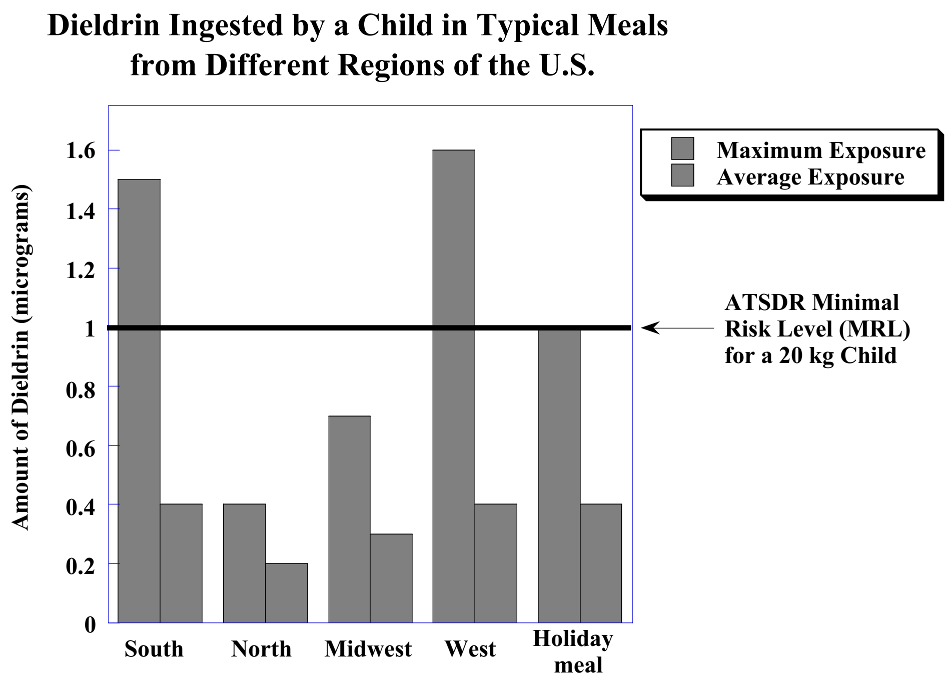
According to FDA's food residue data, the average daily exposure to dieldrin through food consumption approaches the health-based "safety" thresholds established by ATSDR and EPA for adults, and it can exceed the standards for children (see Figure 1). This illustrates that POPs residues are occurring in food at or near levels understood by federal agencies to be cause for concern.

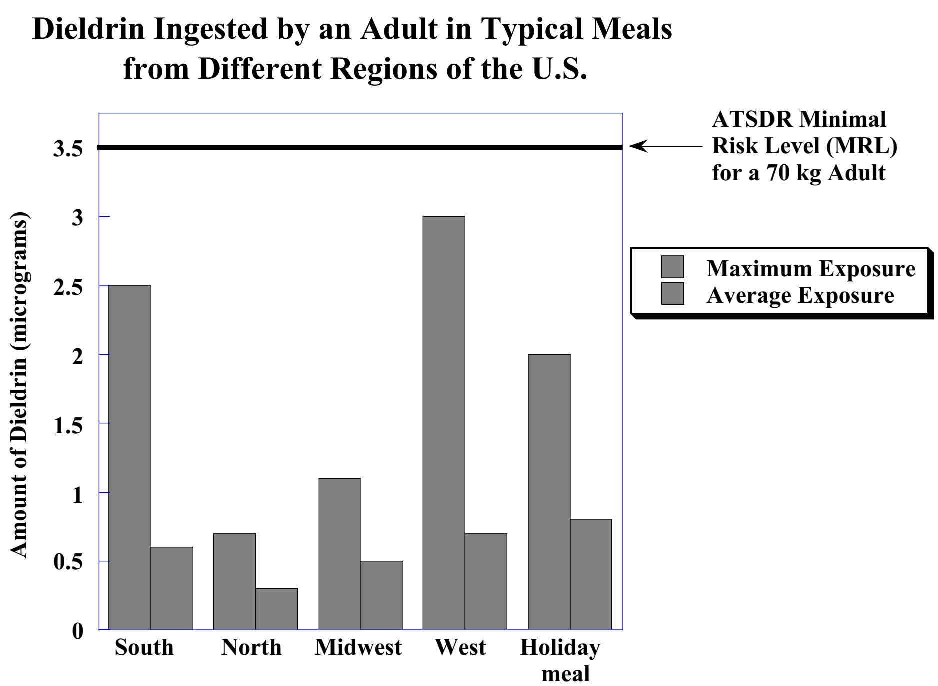
The threat from POPs in food is greater than implied by the bar chart in Figure 1, since dieldrin is only one of the chemicals consumers are exposed to through their daily diet. As the tables for regional and holiday meal plans show, Americans are exposed to an array of persistent toxic chemicals every day through the foods they eat. Health-based thresholds are established for individual chemicals, while actual diets may include PCB residues in a fish filet, dieldrin in a serving of zucchini, and dioxin in an ice cream cone. Bit by bit, these combinations of chemicals, which in many instances cause the same or similar types of negative health effects, accumulate in daily diets at levels much higher than implied by the bar charts.

When it comes to protecting children from POPs, "safe" levels of exposure are even lower. The Food Quality Protection Act of 1996 recognized that

1. The EPA's reference dose (RfD) assumes a lifetime of exposure at the level indicated.

Figure 1. Comparison of Dieldrin in Regional Daily Diets and Federal Health-Based Risk Thresholds





children are not simply small adults. Following recommendations of an influential National Academy of Sciences study, the law requires EPA to take into consideration the factors that make children uniquely vulnerable to the risks posed by pesticides in the food supply. Children eat disproportionately more of certain foods on a pound-for-pound body weight basis than does an average-weight adult male. For heavily consumed foods, their smaller size means children have a proportionately greater exposure to POPs from those food products. In addition, young children's bodies are engaged in a multitude of developmental processes that are uniquely susceptible to harm from POPs. Proportionately larger exposures and unique susceptibilities combine to make developing children much more vulnerable to POPs than adults.

Top 10 Foods Most Contaminated with Persistent Toxic Chemicals

The foods listed in the table below are the 10 foods in FDA's *1999 Total Diet Study* found to be most contaminated with residues from POP pesticides and dioxin. The table lists the persistent toxic chemicals found in each of these food products. (Levels of contamination of each food item can be found in Appendix C).

The food products included in the top 10 list are distinguished by their containing residues of at least three, and as many as seven, different POPs at levels higher than those found in other foods. The food items containing three or four POPs have high levels of at least one particularly toxic chemical (e.g., dioxin in meatloaf, chlordane in popcorn). The list reflects contamination from POP pesticides for which FDA has tested and for dioxins, which have been examined by other researchers. Data on the presence of PCBs and furans were not available for this study.

The top 10 POP-contaminated foods, in alphabetical order, are butter, cantaloupe, cucumbers/pickles, meatloaf, peanuts, popcorn, radishes, spinach, summer squash and winter squash.

Table 1: Top 10 Foods Most Contaminated with Persistent Toxic Chemicals

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Heptachlor*	*Hexachlorobenzene*	*Toxaphene*
Butter	X	X	X	X	X		X	X	
Cantaloupe		X		X	X		X		X
Cucumbers/ Pickles	X	X		X		X	X		X
Meatloaf		X		X	X		X	X	
Peanuts		X		X				X	X
Popcorn	X			X					X
Radishes	X	X	X	X		X	X		X
Spinach		X	X	X			X		X
Summer squash	X	X		X		X		X	X
Winter squash	X	X		X		X		X	X

Sources:

1. U.S. Food and Drug Administration. Total Diet Study, September 2000.

2. Schechter A., et al., 1994. "Congener-specific levels of dioxins and dibenzofurans in U.S. food and estimated daily dioxin toxic equivalent intake." Environmental Health Perspectives 102: 962–966.

3. U.S. EPA. 1994. Estimating Exposure to Dioxin-Like Compounds, Volume II: Properties, Sources, Occurrence and Background Exposures, U.S. EPA Office of Research and Development, EPA/600/6-88/005Cb, External Review Draft.

POPs Residues Contaminate Holiday Dinner and Daily Diets

Data from FDA's "marketbasket" diet study and other sources documented above are presented in the tables below to indicate the POPs residues found in a typical winter holiday dinner and in hypothetical daily diets for four regions of the United States. The holiday dinner menu and regional daily diets were created to illustrate the range and combination of POPs-contaminated foods that U.S. consumers might eat. Information on dioxin contamination is included where data are available (see Appendix D for full listing of contamination levels).

* * * * * * * *

Holiday Dinner Menu

Roasted turkey with celery stuffing and giblet gravy
Baked winter squash
Green beans
Boiled potatoes with butter
Dill pickles
Pumpkin pie

* * * * * * * *

POPs Contaminants in Holiday Dinner Menu

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Hepta-chlor*	*Hexachloro-benzene*	*Toxaphene*
Butter	X	X		X	X		X	X	
Celery		X	X	X					
Gravy		X		X			X		
Green beans		X		X					
Ice cream		X		X	X			X	
Onion				X					
Dill pickles	X	X	X	X			X		
Boiled potatoes		X		X					
Winter squash	X	X		X			X	X	X
Pumpkin pie	X	X		X					
Roasted turkey		X		X	X				

Southeastern Daily Meal Plan

Breakfast: *Fried eggs, pork sausage; biscuit with butter; peaches; coffee/half & half*
Lunch: *Ham-and-cheese sandwich; potato chips; grapes; milk*
Dinner: *Fried chicken; corn bread; collards; summer squash; ice cream*
Snacks: *Popcorn; watermelon*

POPs Contaminants in Southeastern Daily Meal Plan

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Hepta-chlor*	*Hexachloro-benzene*	*Toxaphene*
Butter	X	X		X	X		X	X	
Cheese, swiss		X		X			X	X	
Fried chicken		X		X	X				
Collards	X	X	X	X					X
Cornbread		X		X			X		
Eggs, fried		X		X	X				
Grapes		X		X					
Half & half		X		X	X		X	X	
Ham			X		X			X	
Ice cream		X		X	X			X	
Mayonnaise		X		X					
Whole milk		X		X	X		X		
Peaches		X		X					
Popcorn	X			X					X
Pork sausage		X	X	X	X		X	X	
Potato chips	X	X	X	X			X		
Summer squash	X	X	X	X		X	X	X	X
Watermelon								X	
Yellow mustard			X						

Northeastern Daily Meal Plan

Breakfast: *Bagel with lox and cream cheese, coffee*
Lunch: *Clam chowder, tuna sandwich, French fries with ketchup*
Dinner: *Beef chuck roast; brown beans; baked potato with butter; boiled carrots; sugar cookies*
Snacks: *Peanut butter on celery; raisins*

POPs Contaminants in Northeastern Daily Meal Plan

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Hepta-chlor*	*Hexachloro-benzene*	*Toxaphene*
Bagel							X		
Chuck roast		X		X	X		X	X	
Butter	X	X		X	X		X	X	
Cantaloupe		X		X		X	X		X
Carrots		X	X	X					
Celery		X	X	X					
Clam chowder		X		X					
Coleslaw		X	X	X					
Cream cheese		X		X	X		X	X	
French fries	X	X	X	X					
Ketchup	X	X							
Lox (Salmon)		X	X	X			X	X	
Mayonnaise		X		X					
Milk (2%)		X		X	X				
Mustard			X						
Peanut butter		X		X				X	X
Potato, baked		X	X	X					
Raisins		X	X						
Sugar cookies		X	X						
Tuna, in oil		X		X				X	

Midwestern Daily Meal Plan

Breakfast: *Scrambled eggs; hash brown potatoes; bacon; sweet cherries; coffee/half & half*
Lunch: *Grilled-cheese sandwich; pickles; cottage cheese/peaches; chocolate chip cookies; milk*
Dinner: *Meatloaf; baked potato/sour cream; green beans/mushroom sauce; fruit cocktail; pumpkin pie*
Snacks: *Potato chips; grapes*

POPs Contaminants in Midwestern Daily Meal Plan

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Hepta-chlor*	*Hexachloro-benzene*	*Toxaphene*
Bacon		X	X	X	X			X	
Cheese, american		X		X	X		X	X	
Cherries, sweet		X							
Cookies, choc. chip			X						
Cottage cheese		X		X	X				
Half & half		X		X	X		X	X	
Scrambled eggs		X		X	X				
Grapes		X		X					
Green beans		X		X					
Hash browns (from boiled potatoes)		X		X					
Meatloaf		X		X	X		X	X	
Whole milk		X		X	X		X		
Mushroom sauce		X		X					
Peaches		X		X					
Sweet pickles	X	X		X			X		X
Baked potato		X	X	X					
Potato chips	X	X	X	X			X		
Pumpkin pie	X	X		X					
Sour cream		X		X	X		X	X	

Western Daily Meal Plan

Breakfast: *Yogurt/granola; cantaloupe slice; blueberry muffin; coffee/2% milk*
Lunch: *Spinach salad w/radish, bell pepper, cucumber, French dressing; quesadilla; strawberries; skim milk*
Dinner: *Baked salmon; rice; stir fried vegetables (carrot, summer squash, potatoes); fruit sherbet*
Snacks: *Trail mix with peanuts; apple*

POPs Contaminants in Western Menu

	Chlordane	*DDE*	*DDT*	*Dieldrin*	*Dioxin*	*Endrin*	*Hepta-chlor*	*Hexachloro-benzene*	*Toxaphene*
Apples		X							
Blueberry muffin		X							
Cantaloupe		X		X		X	X		X
Carrots		X	X	X					
Cheddar cheese		X		X	X		X	X	
Cucumber	X	X		X		X	X		X
French dressing				X					
Granola		X							
Green pepper		X							
Milk, 2%		X		X	X				
Skim milk		X							
Peanuts		X		X				X	X
Potatoes		X		X					
Radish	X	X	X	X		X	X		X
Salmon		X	X	X			X	X	
Sherbet		X		X					
Spinach		X	X	X			X		X
Strawberries		X		X					X
Summer squash	X	X	X	X		X	X	X	X
Yogurt		X			X				

FDA Action Levels Do Not Protect Public Health

FDA is responsible for taking action to protect consumers from food contamination. When the residue level of a toxic chemical in a food product tested by FDA is at or higher than FDA "action levels," FDA must remove the food from the market. These action levels, however, are substantially higher than the health-based standards. Thus, while our analysis shows that POPs residues are found at levels at or above health-based standards, contamination is well below the level that would trigger FDA action. (Several federal agencies have established health-based standards for "safe" levels of exposure to POPs chemicals—see Appendix B).

Suppose, for example, fish was contaminated by DDT residues equal to the amount allowed by FDA's action level for the banned chemical. Because FDA's action level for DDT is significantly higher than health-based standards set by EPA and ATSDR, consumption of a single serving of fish would expose a consumer to almost 50 times the daily exposure considered "safe" by those health-based standards.

Table 2: Daily DDT Intake Per Person if Food is Contaminated with DDT Allowed by FDA Action Levels

Food Item	*Amount of Food Ingested (g)*	*FDA Action Level (ug/g)[a]*	*Total Amount of Pesticide Ingested (ug)*
Eggs	125	0.50	62.5
Melon	125	0.10	12.5
Milk	250	1.25	312
Toast (grains)	250	0.50	125
Carrots	125	3.00	375
Cucumbers	125	0.10	12.5
Tomatoes	125	0.05	6.2
Spinach	125	0.50	62.5
Radishes	62.5	0.20	12.5
Fish	372	5.00	1860
Eggplant	125	0.10	12.5
Legume	250	0.20	50
Potatoes	250	1.00	250
Total			3,154
ATSDR MRL[b] (adult)			35
ATSDR MRL[c] (child)			10

[a] Micrograms of pesticide residue allowed per gram of food.

[b] Agency for Toxic Substances and Disease Registry, Minimal Risk Level for a 70 kg adult.

[c] Agency for Toxic Substances and Disease Registry, Minimal Risk Level for a 20 kg child.

If a glass of milk contained an amount of DDT equal to the level allowed by FDA's action level, it would contain nearly 10 times as much DDT as the daily exposure level considered safe by EPA and ATSDR.

As illustrated in Table 2, eating a full day's diet of items contaminated with DDT at levels allowed by FDA would bring an adult's exposure to about 90 times the safe level established by ATSDR's health-based standards (Minimal Risk Levels or "MRLs"). A child's exposure to amounts of DDT allowed by FDA's action levels would be more than 300 times the health-based standard. While it is unlikely that an entire day's diet would consist of all items contaminated at FDA's action levels, the table illustrates the dramatic extent to which FDA's action levels fall short of other federal agency standards of public health protection.

PCBs in Food

No data on PCBs in commercially sold food is available from federal agencies. However, data on PCB contamination of fish in the nation's rivers and lakes suggests that PCBs, like the other POPs being considered for the global treaty, contaminate the commercial food supply. The most recent (1999) data from EPA's fish and wildlife advisories database indicate that PCBs are the dominant cause of government warnings against consumption of fish caught in the wild (see box below for data from selected states). Some of the most dramatic statistics derived from the database include the following:

- Of 13,237 fish advisories in force as of early 1999, 3,855 (29%) were caused by POPs in fish;
- Of the 3,855 POPs advisories, 3,101 (80%) were caused by PCB contamination of fish; and,
- Of the 3,101 PCB advisories, 2,551 (82%) occurred in the nine states bordering the Great Lakes.

POPs, Especially PCBs, are Pervasive in Fish

The U.S. Environmental Protection Agency has compiled data about fish advisories issued throughout the country. The 1999 database shows widespread chemical contamination of U.S. lakes and rivers and widespread contamination of fish by POPs, especially PCBs. The EPA database includes the following POP and PCB contamination:

State	POPs-Related Advisories		Advsories Involving PCBs	
	(Number)	(Percent)	(Number)	(Percent)
California	69	64%	32	46%
Illinois	61	95%	53	87%
Indiana	944	58%	944	100%
Massachusetts	133	46%	69	52%
Michigan	523	73%	443	85%
New York	309	86%	185	60%
Ohio	109	74%	98	90%
Pennsylvania	98	99%	85	87%
Wisconsin	484	28%	477	99%

Source: U.S. EPA, Office of Water, 1999. *Listing of Fish and Wildlife Advisories.*

Persistent Toxic Chemicals Are Linked to a Variety of Health Problems

The chemicals targeted by the global POPs treaty are associated with a long list of serious health problems, including cancer, neurological damage, birth defects, sterility and immune system defects (see Table 3 below).

In the timeframe of widespread use of persistent toxic chemicals, various disease registries and surveillance efforts show increased incidence of breast cancer, learning disabilities and reproductive system damage. No one can say with certainty the extent to which exposure to POPs is responsible for these trends; we are exposed to a variety of pesticides and other chemicals in our daily lives that certainly contribute to these diseases. Nevertheless, the scientific studies used to compile Table 3, as well as many of those cited throughout this report, indicate that exposure to POPs is linked to numerous chronic illnesses and developmental disorders.

Various U.S. and international agencies have established maximum POPs exposure levels, above which they have determined there is significant cause for concern about increased risk of both cancer and non-cancer effects. While there are some differences in the thresholds established by different health and environmental agencies, the levels of exposure triggering concern about potential health damage are generally extremely low (see Appendix B). Unfortunately our food supply is contaminated with levels of these chemicals that result in exposures at or above the health-based standards.

For four decades, scientists and health professionals have warned us about the health effects of POPs on people and animals. That is the reason most of the POPs being considered in the global treaty have been banned in the United States and in a number of other countries for many years.

Breast Cancer on the Rise. An estimated 2,044,000 women are living with breast cancer in the United States today (National Cancer Institute 2000). Of those, about 40,000 will die of the disease this year (American Cancer Society 2000). In the year 2000, the incidence of newly diagnosed cases of invasive breast cancer is predicted to increase by four percent (American Cancer Society 2000). For ductal carcinoma in situ, or DCIS (a condition of abnormal cells in the milk ducts that is thought to be pre-cancerous), incidence rates rose 214 percent for women under age 50 between 1983–1997, and 329 percent for women older than age 50 (National Cancer Institute 2000).

While there is a popular conception that breast cancer is largely linked to genetic factors, environmental factors actually play a significant role (Lichtenstein 2000). Several studies have specifically linked exposure to POPs pesticides to increased risk of breast cancer. PCBs and hexachlorobenzene, for example, have been linked to increased risk of breast cancer malignancy (Liljegren et al. 1998). Dieldrin exposure also has been linked with significantly elevated breast cancer risk (Davis et al. 1997, Hoyer et al. 1998).

Learning Disabilities and Autism. Nearly 12 million American children, or 17 percent of all children in the U.S under age 18, suffer from learning, developmental or behavioral disabilities (Census Bureau). Scientific research points to environmental toxicants, including some persistent toxic chemicals, as significant contributors to neurodevelopmental problems (Schettler et al. 2000). Developmental neurotoxicants are chemicals that cause harm to the developing brain of a fetus, and they include POPs like dioxins and PCBs (Schettler et al. 2000). Reduced intellectual performance has been measured in both children and monkeys exposed to PCBs in utero (Jacobson and Jacobson 1996, Rice 1999).

In addition, the prevalence of autism has doubled in the past 30 years. California alone has seen a 210 percent increase in the number of children receiving services for autism (National Environmental Trust 2000). Autism incidence likely arises from a combination of genetic defects and exposure to toxic chemicals, according to the California Birth Defects Monitoring Program, which is run jointly by the state of California and the March of Dimes.

Table 3. Health Effects of POPs Covered by Global Treaty[a]

Chemical Contaminant	Health Effects Associated with Chemical	
Aldrin, Dieldrin, Endrin	• Probable human carcinogen (aldrin, dieldrin) • Immune system suppression • Nervous system disorders • Reproductive damage • Liver damage	• Birth defects: abnormal bone formation in animals (endrin) • Kidney damage • Suspected endocrine disruption • Developmental toxin (endrin)
Chlordane and Heptachlor	• Probable human carcinogen • Immune system suppression • Blood disorders • Liver damage	• Central nervous system disorders • Suspected endocrine disruption • Developmental disorders (heptachlor)
DDT, DDE	• Probable human carcinogen • Reproductive failure in wildlife • Liver damage • Central nervous system disorders	• Known endocrine disruption • Developmental disorders • Shortened lactation in nursing women
Dioxins and Furans	• Dioxin is a known human carcinogen[b]; Furans are possible carcinogens • Altered immune function • Central nervous system disorders • Chloracne and other skin disorders • Disrupts liver and kidney function	• Reproductive effects: altered sex ratio, reduced fertility • Endometriosis • Known endocrine disruption • Developmental disorders, including birth defects
Hexachlorobenzene	• Probable human carcinogen • Disrupts hormone function • Damages liver, thyroid, kidneys, blood and immune system	• Suspected endocrine disruption • Developmental toxin
Mirex	• Possible carcinogen in humans • Suppresses immune system • Suspected endocrine disruption •	• Damages liver, stomach, kidneys, thyroid, nervous and reproductive systems
Toxaphene	• Probable carcinogen in humans • Reproductive/developmental effects • Suspected endocrine disruption	• Damages lungs, kidneys, and nervous and immune systems
PCBs	• Probable human carcinogen • Chloracne and other skin disorders; Liver damage • Developmental disorders	• Neurodevelopmental effects: reduced IQ and short term memory; spatial effects; hyperactivity • Endocrine disruption

a. *Sources:* Agency for Toxic Substances and Disease Registry Toxicity Profiles, IARC 1997, Orris et al. 2000.
b. IARC cancer rating is cited for dioxin; all other cancer ratings are from the U.S. EPA's Integrated Risk Information System or U.S. EPA Office of Pesticide Programs *List of Chemicals Evaluated for Carcinogenic Potential,* August 26, 1999.

Endocrine Disruption: Small Amounts of POPs, Serious Health Impacts. In the past decade, disturbing evidence has emerged that serious damage can be caused by exposure to extraordinarily low levels of POPs. The reason for this lies in the ability of POPs to mimic human and animal hormones, including the male and female sex hormones responsible for the proper development of the fetus. These chemicals all are capable of crossing the placenta during gestation, and as a result, mixed messages are sent to the developing fetus. These hormonal messages are critically important to the developmental process, in which specialized organs and integrated reproductive, immune and neurological systems are formed. Any disruption can cause permanent damage to these developing systems.

The timing of chemical exposure to the developing fetus or infant is crucial. Because hormones are active at very low concentrations, even a tiny dose of an endocrine disruptor can have a profound effect if exposure occurs during critical times in the development of the fetus or infant. Because the development of different organ systems, the immune system and the nervous system occurs at different times during gestation and infancy, the vulnerability of various systems depends strongly on the timing of the dose.

Humans are not the only victims of endocrine disruption caused by POPs. The rapid decline in bird populations in the 1960s and 1970s caused by the POPs pesticide DDT was due to endocrine-disrupting effects. Exposure of developing animals to these chemicals, in utero or in eggs, has been associated with feminization or demasculinization of male offspring or masculinization of female offspring. In fish, endocrine disruptors interrupt normal development and cause male fish to have female characteristics. These outward symptoms of developmental disruption are accompanied by reduced fertility and even sterility in adults, as well as lower hatch rates and viability of offspring (Goodbred et al. 1996). Disruption of the balance of endocrine hormones during development of young fish also can cause defects of the skeletal system, resulting in deformities and stunted growth (Ewing 1999).

Fertility Problems: Endometriosis and Lower Sperm Counts. POPs also might be affecting our ability to conceive children. Recent studies demonstrate a correlation between exposure to POPs and the incidence of a variety of reproductive effects, including infertility (MacLusky et al. 1998, Edmunds et al. 2000, Grey et al. 1999, Ulrich et al. 2000). Some fertility problems are likely due to the endocrine-disrupting ability of these chemicals and include effects such as endometriosis in women and lowered sperm counts in men (Guo 2000).

Mounting evidence links exposure to POPs and other chemicals to increased incidence of endometriosis in women. Endometriosis is a disease in which the endometrial tissue normally found in the uterus migrates to other parts of the body. Infertility is a very common result as the disease progresses, affecting 30 percent to 40 percent of women with the disease (Susag 1998; see also www.endometriosisassn.org).

Endometriosis incidence has skyrocketed in recent years, and now affects at least 5.5 million American women—about 15 percent of women of reproductive age. The percentage of women with endometriosis reporting symptoms before age 15 has jumped from 15 percent to 38 percent in the past 15 years. From 1965–1984 alone, hysterectomies for 15- to 24-year-old women due to endometriosis increased 250 percent, and 186 percent for 25- to 34-year-old women. One laboratory animal study directly correlated the incidence of endometriosis with dioxin exposure, with the severity of the disease dependent upon the dioxin administered (Susag 1998; see also www.endometriosisassn.org).

Male fertility statistics also show troubling trends. In particular, male sperm density has significantly declined since the early years of the chemical age. Between 1938 and 1990, sperm density declined in the United States at a rate of 1.5 percent per year, while in Europe the numbers are 3 percent per year (Swan 2000).

POPs Have Cumulative Effects. Many POPs exhibit similar modes of action on the human body, resulting in additive or even synergistic effects. In other words, the health effects resulting from exposure to multiple chemicals can be substantially greater than those resulting from exposure to a single chemical. The effects are especially pronounced on a developing fetus or infant (Vonier et al. 1996). The fact that additive and/or synergistic effects are common for POPs makes a strong case for banning the use of the entire class of chemicals, not just a few of the worst offenders.

CONCLUSION AND RECOMMENDATIONS

This study shows the ubiquitous presence of persistent toxic chemicals in the U.S. food supply despite the fact that most of these pesticides have been banned for use in this country for many years. Highly toxic persistent toxic chemicals are found in food as a result of their use abroad and their release by domestic manufacturing processes and waste incineration, as well as residues of historical use in this country. As long as POPs continue to be produced and used anywhere, they will continue to contaminate the U.S. food supply and threaten the health of American consumers.

There is little that can be done to immediately reduce the level of persistent toxic chemical levels in food. In some cases, heavy concentrations in soil and water can be cleaned up, and cropping choices can be made to avoid cultivation of certain crops in POPs-contaminated agricultural lands. Given enough years, even these persistent chemicals will break down into harmless compounds. A combination of the passage of time, prevention of additional POPs accumulations, and clean up of POPs in our soil and waterways can lay the groundwork for a virtually POPs-free world for future generations of Americans.

From a health-protection standpoint, the evidence strongly indicates that American consumers would be served best by a implementaton of the precautionary principle to prevent additional accumulation of POPs in our air, water and soil. Given the serious health risks associated with even extremely small levels of exposure to POPs, prevention of further food contamination must be made a national health policy priority.

The global POPs treaty offers the most promising vehicle for preventing further accumulation of persistent toxic chemicals in food and giving future generations the chance they deserve to experience life free from harm from persistent toxic chemicals. Early and effective implementation of the treaty should be an urgent priority for the current U.S. Administration.

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Online Resources

On POPs Health Effects

www.cancer.org/statistics/index.html
www.census.gov U.S. Census Bureau:
www.cfe.cornell.edu/bcerf/ bibliography/ general/ bib.endocrineDisruption.cfm.
www.epa.gov/ncea/pdfs/dioxin/factsheets/ dioxin_short.pdf
www.igc.org/psr/ihw.htm
www.ourstolenfuture.org
www.pesticideinfo.org
www.psr.org/trireport.html
www.safekidsinfo.org
www.seer.ims.nci.nih.gov/Publications/ CSR1973_1997.

On POPs Treaty, Policy

www.chej.org
www.ipen.org
www.panna.org
www.stoppops.org.
www.worldwildlife.org/toxics/