



Breast Cancer and Environmental Risk Factors

March 1998
FACT SHEET #12

Q & A's from the Cornell University Program on Breast Cancer
and Environmental Risk Factors in New York State

Pesticides and Breast Cancer Risk, An Evaluation of Heptachlor

What is heptachlor?

Heptachlor is a mixture of synthetic chemicals widely used as an insecticide in the United States (U.S.). Heptachlor and its partial breakdown product heptachlor epoxide, are resistant to being broken down in the environment and can still be found in some soils. Some of the common trade names of heptachlor sold in the U.S. were Fennotox, Cupincida, Velsicol 104 and Biarbinex. These products were mixtures and included chlordane, another persistent insecticide that is no longer in use. Similarly, the chlordane used to treat buildings for termites contained 10-20% heptachlor (see BCERF fact sheet *Pesticides and Breast Cancer Risk, An Evaluation of Chlordane*).

What is the history of heptachlor's use?

Heptachlor was used extensively from the 1950s through the mid-1970s in agriculture to protect corn, grain seeds, sorghum, pineapple and other fruit crops from insect pests, and to control insects in the soil. During this time, it was also applied to the foundations of homes and buildings to protect them from termite damage, and used to prevent fire ants from building nests in power transformers. Heptachlor was used in the manufacture of termite-resistant plywood. Most commercial, agricultural and domestic use of heptachlor in the U.S. was phased out between 1974 and 1988. All use of heptachlor products was banned by the U.S. Environmental Protection Agency (EPA) in 1988, with one exception: commercial use of heptachlor is permitted for fire ant control in power transformers.

Why was heptachlor use banned?

Laboratory mice that were fed high levels of heptachlor over long periods of time developed liver cancer. These results in animals raised concerns about heptachlor's ability to also cause cancer in humans. Heptachlor and heptachlor epoxide have the ability to stay in the environment and build up in

animal and fish fat. There was a concern that people may be exposed to these chemicals by eating contaminated food, including fish, shellfish, dairy, meat and poultry products. Its use was subsequently banned due to these concerns.

How do our federal agencies regulate heptachlor to protect the consumer?

All sales and use of heptachlor was prohibited in the U.S. by the EPA in 1988, with the one exception mentioned above. The Occupational Safety and Health Administration (OSHA) regulates heptachlor levels in the workplace. The EPA limits the amount of heptachlor that can be released from any industrial source into waste waters. The EPA also sets the maximum level of heptachlor allowed in drinking water. This "maximum contaminant level" for heptachlor has been set at no more than 0.4 micrograms of heptachlor per liter of drinking water (one microgram is one-millionth of a gram, one liter is approximately one quart). However, heptachlor and heptachlor epoxide do not dissolve easily in water and drinking water is not considered to be a major route of exposure to humans. The Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA) monitor the levels of heptachlor and its breakdown products in domestic and imported foods.

Who might have been exposed to heptachlor and heptachlor epoxide in the past?

People most likely to have been exposed to these chemicals in the past are:

- People who were exposed to chlordane, since chlordane products contained 10-20% heptachlor
- Insecticide applicators who used heptachlor
- People who treated their own homes with heptachlor
- People who lived in homes treated with heptachlor
- Farmers and agricultural workers who treated fields with heptachlor, or worked with treated soil



- People who were involved in the manufacture of heptachlor
- People who handled or laundered heptachlor-contaminated clothing
- People who ate food contaminated with heptachlor or heptachlor epoxide

In a particularly notable example, the feeding of heptachlor-contaminated pineapple leaves to dairy cows in Hawaii resulted in unusually high amounts of heptachlor epoxide to appear in cow's milk sold on the island of Oahu in the early 1980s. Higher levels of heptachlor epoxide were also found in the breast milk of women who lived on Oahu during this time. Further studies are needed to determine if exposure to heptachlor in the women, infants and children of Oahu caused any health problems.

How can we be exposed to heptachlor and heptachlor epoxide today?

The main potential for exposure to heptachlor and heptachlor epoxide today is through eating contaminated food, especially fish, dairy, meat and poultry products. Since heptachlor and heptachlor epoxide can remain in the soil for as long as 15 years, people may be exposed by handling contaminated soil found near the foundations of heptachlor-treated buildings and homes. Contaminated soil near heptachlor-treated foundations and near hazardous waste storage sites that contain heptachlor could release heptachlor epoxide into the air. People living in homes treated with heptachlor may be exposed to air contaminated with heptachlor. Because chlordane products contained heptachlor, those who live in chlordane-treated houses may also be exposed to heptachlor epoxide.

Does heptachlor cause cancer in animals?

Heptachlor caused an increase in the incidence of liver cancer in mice and thyroid cancer in rats when it was fed to these laboratory animals at high levels over long periods of time. Diethylnitrosamine (DEN) is a known cancer-causing substance (carcinogen). Male mice that were given DEN in drinking water and then given heptachlor were twice as likely to develop liver tumors than those given the carcinogen alone. This suggests that heptachlor can act with other carcinogens to "promote" the development of liver tumors in male mice.

Does heptachlor cause cancer in humans?

Slightly higher numbers of deaths from bladder cancer were observed among men who had been employed at a

heptachlor manufacturing plant. Among men who had been working as pesticide applicators for more than 20 years, no increase was observed in the number of deaths from bladder cancer, however, there was an increase in the number of deaths from lung cancer. The workers were exposed to other chemicals as well as to heptachlor. It is difficult to determine if heptachlor, other chemicals, or other factors such as tobacco use caused the observed increase in cancer deaths. Other studies on men who were occupationally exposed to heptachlor have not observed an increase in the incidence of these cancer types. Unfortunately, similar studies on cancer death rates of women who have been occupationally-exposed to heptachlor have not been done.

Does heptachlor cause breast cancer?

In studies conducted so far, heptachlor and heptachlor epoxide have not been directly linked with breast cancer in either animals or humans. Heptachlor epoxide is known to build up and stay in the breast fat of exposed women. Only a few studies have compared the levels of heptachlor or heptachlor epoxide in the breast fat of women with and without breast cancer. The results of these studies have not been consistent. Two out of the three studies found no statistically significant differences in heptachlor epoxide levels in women with or without breast cancer. The one study that found higher levels of heptachlor epoxide in the breast fat of women with breast cancer is of limited value because of the very small number of women studied (14) and the lack of information on other factors that may have affected the breast cancer risk of these women.

It is difficult to make any meaningful conclusions from the few, small studies that have been conducted to date. Larger, more carefully designed studies are needed to further investigate whether higher body levels of heptachlor and its breakdown products are associated with an increased risk of developing breast cancer. One study involving a larger group of women is in progress. A follow-up study of the women and children that were exposed to heptachlor in Hawaii has been recommended to assess their risk for breast cancer.

How can heptachlor affect breast cancer risk?

A woman's lifetime exposure to estrogen has been linked to increased breast cancer risk. Estrogen is a female hormone that helps control the reproductive cycle and breast growth. There is a concern that chemicals that "disrupt" the way the body makes or breaks down estrogen may also increase breast cancer risk. Estrogen can be broken down by several routes. One route yields a very weak form of estrogen that is



excreted from the body. Other routes produce forms of estrogen that may be cancer promoting. Heptachlor itself does not act like estrogen. However, heptachlor does affect the way the body breaks down estrogen in the liver. Scientists have not yet determined if heptachlor causes breakdown of estrogen into the more cancer-promoting form or the less harmful form.

Cells use many different ways to monitor and control their growth. As a consequence, there are many different ways by which a chemical like heptachlor may be able to disrupt cell growth control and promote cancer. While growing in the body, or in a laboratory on a plastic dish, cells need to communicate with neighboring cells to regulate their growth. Heptachlor has been shown to disrupt this cell-to-cell communication in human breast cells grown in the laboratory. By disrupting this growth regulation mechanism, heptachlor could affect cancer growth.

Is heptachlor present in breast milk?

Since heptachlor epoxide can build up and be stored in breast fat, human milk can carry this chemical from a mother to a breast-fed infant. Heptachlor epoxide has been detected in human milk samples in the U.S. A nation-wide study from the 1980s reported that the highest levels of heptachlor epoxide were detected in breast milk samples from women living in the Southeast, while comparatively lower levels were found in women residing in the Northeast and Northwest regions of the U.S. At the levels of heptachlor epoxide contamination that have been found in breast milk samples in the U.S., researchers have concluded that the beneficial effects of breast feeding an infant far outweigh the estimated risk for cancer.

Conclusions

There is not enough evidence to show that heptachlor directly causes breast cancer in either laboratory animals or humans. In humans, a large scale study is currently re-addressing this question. However, there is limited evidence that heptachlor has the potential to affect breast cancer risk. There is evidence from studies in animals that heptachlor can “promote” liver tumors, and affect the way the body processes estrogen in the liver. There is also evidence that heptachlor can disrupt important cell-to-cell communication pathways. More research is needed to determine if heptachlor affects breast cancer risk through any of these mechanisms.

Where is more research needed?

- Larger case-control studies should be done to see if build up of heptachlor or its breakdown products in body tissues of

women is associated with higher incidences of breast cancer. A study is now in progress to address this research need (see following section).

- There is some evidence that heptachlor can act with carcinogens as a liver tumor “promoter” in male mice. Animal studies are needed to test if heptachlor can also act as a “promoter” with carcinogens known to cause breast cancer.
- Women with known exposures to heptachlor should be followed to determine effects of this pesticide on general health and on breast cancer rates. This includes evaluating the women and children known to be exposed to heptachlor in Hawaii, women agricultural workers exposed to heptachlor, and women employed in heptachlor manufacturing plants. Women who laundered clothing contaminated with heptachlor that was worn by spouses exposed to heptachlor (agricultural workers, manufacturing, pesticide applicators) should also be monitored.
- Animal studies should test whether heptachlor causes estrogen breakdown into the cancer-promoting forms of estrogen.
- The immune system of the body plays an important role in its defense against cancer. Animal studies are needed to determine if heptachlor can damage the immune system and affect the body’s defense against breast cancer.

Is more research being done?

A large ongoing study based in California is studying the blood levels of heptachlor-epoxide and breast cancer incidences in African-American women. This study is being sponsored by The National Institutes of Health (NIH).

How can I minimize exposure to heptachlor that may still be in the environment?

- Avoid digging in the soil, or planting close to foundations of homes that were treated with heptachlor or mixtures containing heptachlor.
- Monitor children so they do not play with soil around foundations that may have been treated with heptachlor or chlordane, or near hazardous waste sites.
- Avoid the soil near hazardous waste storage sites that may contain heptachlor, heptachlor epoxide or chlordane.
- If unsure about heptachlor contamination, check with your local fish and game or health authorities before eating sport fish caught from local streams and rivers.
- If you still have containers with heptachlor in your home or garage, contact your regional environmental authorities on how to handle and dispose of these chemicals properly.



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An extensive bibliography on *Heptachlor and Breast Cancer Risk* is available on the BCERF web site (<http://www.cfe.cornell.edu/bcerf/>)

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