



ChemicalWatch Factsheet

A Beyond Pesticides Factsheet

Lindane

Introduction

Lindane, in the organochlorine family like DDT, has been controversial for decades because of its cancer-causing and neurotoxic properties. Historically, lindane was used in a number of insecticidal capacities on crops and as a seed treatment, as well as on humans for lice and scabies. Despite its toxicity, lindane is still registered for use in the United States as a prescription only treatment for head lice and scabies.

Many agricultural uses were phased out over the past two decades, and the last agricultural uses were cancelled by the U.S. Environmental Protection Agency (EPA) in 2006. The only remaining use, for treating head lice and scabies, is regulated by the U.S. Food and Drug Administration (FDA). Over the last ten years, prescriptions for lindane have significantly declined from over a million per year to fewer than half a million per year (Humphreys, 2008).

Despite the limited and declining use, the FDA found lindane to be the 18th most commonly found pesticide residue in food samples tested (FDA, 2003a).

Lindane Bans

In September 2000, over concerns regarding the levels of lindane in wastewater treatment facilities, California Governor Gray Davis signed a bill that prohibited the use or sale of any lindane containing products for treatment of human head lice or scabies. Since this ban, which was enforced starting January 1, 2002, lindane levels in wastewater treatment facilities

chemicalWATCH Stats:

CAS Registry Number: 58-89-9

Chemical Class: Organochlorine

Use: Lice and scabies shampoo (only remaining uses)

Toxicity rating: Toxic

Signal Words: Warning

Health Effects: cancer, endocrine disruption, reproductive effects, neurotoxicity, kidney/liver damage

Environmental Effects: groundwater contamination, toxicity to birds, fish, and bees, bioaccumulation

have decreased to almost undetectable levels in California (Humphreys et al., 2008).

Lindane has been banned in over 50 countries globally and is under consideration for addition to the Stockholm Convention on Persistent Organic Pollutants (POPs) because of its persistence, bioaccumulation, toxicity and transport (CEC, 2006).

Routes of Exposure

Exposure to lindane is a concern, especially considering its inclusion in creams and shampoos for lice and scabies. Lindane is efficiently absorbed across the skin, with a documented 9.3% dermal absorption rate. It is absorbed even more efficiently across abraded skin, which is of high concern considering the severe dermatitis associated with scabies. Absorption across the skin as well as in the gut is enhanced by the presence of fat and fat solvents. Although lindane is not highly volatile, pesticide-laden aerosol or dust particles trapped in respiratory mucous and subsequently swallowed may lead to significant absorption in the gut (Reigart, 1999).

Following absorption, lindane is partially dechlorinated and oxidized, promptly yielding a series of conjugated chlorophenols and other oxidation products in the urine. Excretion of lindane occurs within a few days, primarily through the feces. While exposure to most organochlorines results in significant storage of the unchanged parent compound in fat tissue, the rapid metabolic breakdown of lindane reduces the likelihood that it will be detected in body fat, blood or milk

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Health Effects

The EPA classifies lindane as moderately toxic, or a class II chemical, and it bears the signal word "warning." The chief toxic action is on the nervous system where lindane, like other organochlorines, interferes with the flux of cations across nerve cell membranes. Adverse health effects include: apprehension, agitation, mental/motor impairment, excitation vomiting, stomach upset, abdominal pain, central nervous system depression, convulsions, muscle weakness and spasm, loss of balance, grinding of the teeth, hyper-irritability, violent seizures, increased respiratory rate and/or failure, dermatitis, immunotoxicity, and fetotoxicity.

Lindane is more acutely toxic than DDT and may modify brain function for days and even weeks after a single exposure (Gosselin, 1983). Data from animal tests indicate that lindane may affect the liver, kidney, pancreas, testes, and nasal mucous membrane (Dalsenter, 1997; Sircar, 1989; ETN, 1996, US EPA, 1985; US EPA, 1998). Lindane is an endocrine disruptor and was found to be slightly estrogenic to female rats and mice, and caused the testes of male rats to become atrophied (PAN, 1998; ETN, 1996). Lindane has been shown to induce drug-metabolizing enzymes in the liver (Gosselin, 1983). This tends to accelerate excretion of the pesticides themselves, but may also stimulate biotransformation of critical natural substances, such as steroid hormones and therapeutic drugs (Reigart, 1999).

Diet and age can affect sensitivity to lindane's toxic action. Children are more sensitive; doses of 1.6 and 45 grams are capable of

producing seizures in young children and adults, respectively. For this reason, the FDA has required a new label on lindane containing products stating that they should not be used on people under 110 lbs (FDA 2003b). A low protein diet may render an individual more susceptible as well. Rats on low protein diets were twice as susceptible to the acute toxic effects of lindane compared with animals on a normal diet (Gosselin, 1983).

There is a great deal of anecdotal evidence in medical literature linking chronic lindane exposure to rare blood disorders including aplastic anemia (West, 1967; PAN, 1998). Pulmonary edema has been reported after intentional lindane ingestion (US EPA, 1998), but the exact role of aspiration in producing these changes is not clear. The development of myoglobin in the urine, acute kidney failure, and muscle weakness in the limbs after ingestion of 15-20 ml of lindane suggests that it may be a direct muscle toxin (Gosselin, 1983).

A laboratory study found that a single topical application of 1% lindane on weanling rabbits caused convulsions. Gosselin et al. report six human cases of alleged neurotoxicity associated with the use of this type of product. At least five of these were judged the result of accidental ingestion or inappropriate application. "Some children exhibited seizures after total body applications or after applications that were left on longer than the recommended 24 hours."

Carcinogenicity

The International Agency for Research on Cancer (IARC) has

concluded that lindane is a possible human carcinogen (class 2B), and EPA has classified it similarly as a class B2/C possible human carcinogen based on liver and lung tumors in mice (US EPA, 2000). The State of California has listed lindane as known carcinogen since 1989 (CalEPA, 2008).

Lindane is linked to breast cancer (Wolff, 1985; Schafer, 2000). There is a significant body of evidence that suggests that where lindane is used extensively, and particularly in areas where cattle were treated, the incidence of breast cancer is elevated (PAN, 1998). The presence of lindane in human and cow milk has been reported in countries throughout the world (Moses, 1993; Schafer, 2000).

Ecological Effects

Lindane is moderately toxic to bird species and can be stored in the fat of birds. Residues can also find their way into egg yolks at measurable concentrations for 32 days after dosing. Lindane is highly toxic to fish and aquatic invertebrate species. Lindane is also highly toxic to bees and certain beneficial parasites and predacious insects (ETN, 1996; US EPA, 1994).

Plants may pick up residues from not only direct application, but through water and vapor phases. Persistence is seen when plants are rich in lipid content, and crops like cauliflower and spinach will build up less residue than crops like carrots (ETN, 1996).

Environmental Fate

Lindane is highly persistent in most soils, with a field half-life of approximately 15 months. It may be mobile in soils and may pose

a risk of groundwater contamination. Lindane is very stable in both fresh and salt water and is resistant to photodegradation (ETN, 1996). EPA's Office of Water established the maximum contaminant level for lindane in drinking water at 0.2 parts per billion (US EPA,

1998). From 1987 to 1993, according to EPA's Toxics Release Inventory, lindane releases to land and water totaled 1,115 pounds (US EPA, 1998). Lindane has been found in 239 sites listed on EPA's National Priorities List (ATSDR, 1995).

The Centers for Disease Control and Prevention, and the World Health Organization, among others, cite widespread insect resistance to lindane in the U.S. and other parts of the world (NPA, 2000; Downs, 1999; Brainerd, 1998).

Lindane *ChemicalWATCH* Fact Sheet References

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