

CHOLINESTERASE

Cholinesterase is one of many important enzymes needed for the proper functioning of the nervous systems of humans, other vertebrates, and insects. Certain chemical classes of pesticides, such as organophosphates and carbamates work against undesirable insects by interfering with, or inhibiting cholinesterase. While the effects of cholinesterase inhibiting products are intended for insect pests, these chemicals can also be poisonous or toxic to humans in some situations.

Human exposure to cholinesterase inhibiting chemicals can result from inhalation, ingestion, or eye or skin contact during the manufacture, mixing, or applications of these pesticides. To understand why these compounds can be poisonous or toxic to humans, a basic understanding of some human physiology must be considered. Electrical switching centers, called synapses, are found throughout the nervous systems of humans, other vertebrates, and insects. Muscles, glands, and nerve fibers, called neurons, are stimulated or inhibited by the constant firing of signals across these synapses. Stimulating signals are usually carried by a chemical called acetylcholine. Stimulating signals are discontinued by a specific type of cholinesterase enzyme, acetylcholinesterase, which breaks down the acetylcholine. These important chemical reactions are usually going on all the time at a very fast rate, with acetylcholine causing stimulation and acetylcholinesterase ending the signal. If cholinesterase-affecting pesticides are present in the synapses, this situation is thrown out of balance. The presence of cholinesterase inhibiting chemicals prevents the breakdown of acetylcholine. Acetylcholine can then build up, causing a “jam” in the nervous system. Thus, when a person receives too great an exposure to cholinesterase inhibiting compounds, the body is unable to break down the acetylcholine. Electrical impulses can fire away continuously unless the number of messages being sent through the synapse is limited by the action of cholinesterase. Repeated and unchecked firing of electrical signals can cause uncontrolled, rapid twitching of some muscles, paralyzed breathing, convulsions, and in extreme cases, death.

In an effort to provide a safe and healthy work environment, APHIS has an established cholinesterase monitoring program to protect employees from pesticide poisoning. The program is currently administered by Federal Occupational Health (FOH), an agency within the Department of Health and Human Services. APHIS will monitor blood cholinesterase levels in employees exposed to organophosphate and carbamate program pesticides and/or other cholinesterase inhibitors. This includes supervisors and/or observers of pesticide applications who may be exposed to the drift and may be unaware of their contamination.

All APHIS employees whose responsibilities include exposure to organophosphate or carbamate pesticides are required to have their baseline cholinesterase levels determined before assuming their duties. This requirement includes both new employees and employees transferred from other duties which excluded pesticide exposure. To initiate entrance into the cholinesterase monitoring program, the employee and supervisor must

complete an APHIS Form 29. Once completed, the form is forwarded to the FOH medical adviser; the medical adviser will determine what test(s) will be done and how often the test(s) will be repeated. This is based on the pesticide exposure, amount of exposure, and frequency of exposure.

After inadvertent exposure to organophosphate or carbamate insecticides, depression of cholinesterase activity can last from hours to days to at most a few weeks. The purpose of follow up testing is to make sure that there is not inadvertent exposure to these pesticides while APHIS employees are performing their routine work duties. Performing blood testing when there has not been activity around these pesticides, or substances which may have been treated with these agents, will give a false sense of security, since no potential for exposure has occurred. Timing of any follow up testing is critical, and should only occur when there has been significant activity around these pesticides or their residue.

Overexposure to organophosphate and carbamate pesticides can result in cholinesterase inhibition. The more cholinesterase levels decrease, the more likely symptoms of poisoning from cholinesterase inhibiting pesticides are to appear. Signs and symptoms of cholinesterase inhibition include the following:

Mild Poisoning: headache, fatigue, dizziness, weakness, nausea, sweating, tearing, and runny nose.

Moderate Poisoning: in addition to the above signs and symptoms, tremor, muscular incoordination, drooling, blurring of vision, difficulty breathing, abdominal cramps, vomiting, diarrhea, twitching of muscles, mental confusion, profound weakness, and rapid pulse rate.

Severe Poisoning: in addition to the above signs and symptoms, loss of reflexes, inability to breathe, slow pulse rate, uncontrollable muscular twitching, incontinence, constriction of pupils, convulsions, unconsciousness, and severe secretion from the respiratory tract.

If someone experiences any of these symptoms, especially a combination of four or more of these symptoms during pesticide handling or through other sources of exposure, they should immediately remove themselves from possible further exposure. Work should not be started again until first aid or medical attention is given and the work area has been decontaminated. Work practices, possible sources of exposure, and protective precautions should also be carefully examined. The victim of poisoning should be transported to the nearest hospital at the first sign(s) of poisoning.