POISON CONTROL
VOLUME 6

IMPACT OF PESTICIDE RESIDUES IN FOOD AND OTHER ACTIVITIES LEADING TO PESTICIDE EXPOSURE: POTENTIAL RISK, HEALTH IMPLICATIONS AND MANAGEMENT

INTRODUCTION

Pesticides have become indispensable tools in modern agriculture, ensuring the protection of crops from pests and diseases, thus securing food production and global food security. Nevertheless, there are significant concerns about the unintended effects of pesticides on the environment and human health due to their widespread usage. Among these concerns, the presence of pesticide residues in food and water sources has emerged as a pressing issue, with potentially detrimental effects on both human and ecological systems.
In this article, we will discuss the types of pesticides, related risks, the types of exposure, which activities cause exposure, and how to possibly reduce risk of the various activities.

DEFINITION AND TYPES OF PESTICIDES

Definition of Pesticides

The Food and Agriculture Organization (FAO) has defined pesticide as any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.

Types of Pesticides

These are grouped according to the types of pests which they kill:

Grouped by Types of Pests They Kill

1. Insecticides – insects
2. Herbicides – plants
3. Rodenticides – rodents (rats & mice)
4. Bactericides – bacteria
5. Fungicides – fungi
6. Larvicides – larvae

Based on how biodegradable they are:

Pesticides can also be considered as:

- **Biodegradable:** The biodegradable kind are those which can be broken down by microbes and other living beings into harmless compounds.
- **Persistent:** While the persistent ones are those which may take months or years to break down.

Another way to classify these is to consider those that are chemical forms or are derived from a common source or production method.

The World Health Organization (WHO) has created a generally accepted pesticide classification system based on acute toxicity values. This method divides pesticides into four categories:

Class I: highly hazardous pesticides. They have high acute toxicity and constitute a serious risk to human health. Organophosphates and carbamates are examples.

Class II: moderately hazardous pesticides. They have moderate acute toxicity and constitute a substantial risk to human health. Some pyrethroids and herbicides are examples.

Class III: slightly hazardous pesticides. They have modest acute toxicity but can still be dangerous. Fungicides and insecticides are two examples.

Class IV: unlikely to present an acute hazard. Pesticides in this class have low toxicity. Some herbicides and insecticides are examples.

The classification of pesticides as highly hazardous is often based on their acute toxicity, which refers to the immediate detrimental effects that might emerge following short-term exposure. Pesticides designated very toxic can cause serious health problems even at modest levels of exposure.

Organochlorine Insecticides: Organochlorine insecticides are organic compounds that are linked to five or even more chlorine atoms (also known as chlorinated hydrocarbons). They are used in agriculture and were among the first pesticides developed. There are two types of organochlorides: DDT-type substances and chlorinated alicyclic substances, comprising bornanes, cyclohexanes, and cyclodienes. Organochlorine is also a broad category of chlorinated hydrocarbons, which also includes chlorinated compounds of hexachlorobenzene (HCB), diphenyl ethane, cyclodiene (aldrin, endrin, and dieldrin), hexachlorocyclohexane (or lindane), nonachloride, chlordane, heptachlor, and heptachlor epoxide. Such chemicals have bioaccumulated in nature as a result of their extensive use, lipophilic nature, persistence, and narrow-spectrum action.

Most of this group of pesticides have been removed from the market due to their health, environmental effects and their persistence in the environment (e.g. DDT and chlordane). However many tropical countries still use DDT to control malaria.

Organophosphate Pesticide: Most organophosphates are insecticides. They are phosphoric acid esters, which are classified as wide-spectrum insecticides because they contain diverse range of compounds. This class of compounds is differentiated by the covalent substitution of one of the four carbon-oxygen-phosphorus links of phosphate ester with the carbon-phosphate bond. Organophosphate insecticides include chlorpyrifos, diazinon, dimethoate, disulfoton, malathion, methyl parathion, and ethyl parathion.These pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Some are very poisonous (they were used in World War II as nerve agents). However, they usually are not persistent in the environment.

Carbamate Pesticides: Carbamates are broad-spectrum pesticides made from organic carbamic acid and are effective against a variety of pests. Similar to the organophosphorus pesticides, the carbamate pesticides also affect the nervous system by disrupting an enzyme that regulates the neurotransmitter. However, the enzyme effects are usually reversible.

Examples of these compounds comprise aminocarb, aldicarb, trimethacarb, carbofuran, carbaryl, propoxur, ethinenocarb, methomyl, oxamyl, pirimicarb, and fenobucarb

Pyrethroid: They are synthesized derivatives of natural pyrethrin. Compared to natural pyrethrins, they are more reliable and have prolonged residual effects. Although they are moderately poisonous to mammals, they are extremely detrimental to insects. For instance, cyclomethrin and decamethrin come under the pyrethroid category.

Sulfonylurea herbicides: Sulfonylurea herbicides are a class of pesticides used to kill weeds in crops and turfgrass. They inhibit the biosynthesis of branched-chain amino acids in plants by inhibiting the enzyme acetolactate synthase (ALS). These herbicides, such as tribenuron-methyl (TBM) and amidosulfuron, are widely used to grow cereals, strawberries, and grapes.

Biopesticides: The biopesticides are a type of pesticides obtained from natural resources such as animals, plants, bacteria, and certain minerals. They are natural substances or organisms that kill, repel, or damage pests. They are also known as biological pesticides.

Biopesticides are usually inherently less toxic than conventional pesticides.They generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects and mammals. Biopesticides often are effective in very small quantities and often decompose quickly, resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides.

For example, canola oil and baking soda have pesticidal applications and are considered biopesticides.

SOURCES AND ROUTE OF PESTICIDE EXPOSURE

Pesticide exposure is a serious concern that affects both human health and the environment. Understanding the sources and routes of pesticide exposure is crucial for minimizing risks and implementing effective safety measures. The exposure to pesticides is affected by several factors such as the readiness with which the pesticide is absorbed, the route of the exposure, dosage exposed to, nature of the pesticide itself, metabolites present, extent of bioaccumulation and persistence as well as the status of the individual that has been exposed with respect to health.

Sources of Pesticide Exposure

1. **Agricultural Practices:** Agricultural use is the primary source of pesticide exposure. Farmers, agricultural workers, and nearby residents may be exposed to pesticides through spraying, handling treated crops, or working in contaminated fields.

2. **Household Products**: Many household products, including insect sprays, rodenticides, and garden treatments, contain pesticides. Improper application or inadequate ventilation can lead to exposure in homes.

3. **Contaminated Food and Water**: Pesticide residues on fruits, vegetables, and grains are a major source of dietary exposure. Additionally, pesticides can contaminate water sources through runoff from agricultural fields and improper disposal.

4. **Occupational Exposure:** Workers in pest control, farming, landscaping, and manufacturing industries may face direct exposure to pesticides during handling, mixing, or application.

5. **Environmental Drift and Residue:** Pesticides can become airborne during application, leading to unintended exposure for nearby populations. Residual pesticides in soil and dust can persist and contribute to long-term exposure.

Routes of Pesticide Exposure:

Before pesticide can cause harm, it must be taken into the body. Pesticides can enter the body by injestion (orally through the mouth and digestive system); dermally (through the skin); by inhalation (through the nose and respiratory system) or ocular (through the eyes).

1. **Dermal (Skin Contact)**

Dermal exposure accounts for about 90% of the exposure pesticide users receive from nonfumigant pesticides. It may occur any time a pesticide is mixed, applied, or handled, and it often goes undetected. Both liquid pesticides and dry materials—dusts, wettable powders, and granules—can be absorbed through the skin.

The seriousness of dermal exposure depends upon:

- the dermal toxicity of the pesticide;
- rate of absorption through the skin;
- the size of the skin area contaminated;
- the length of time the material is in contact with the skin; and
- the amount of pesticide on the skin.

Absorption continues to take place on all of the affected skin area as long as the pesticide is in contact with the skin. The seriousness of the exposure is increased if the contaminated area is large or if the material remains on the skin for a period of time.

Rates of absorption through the skin are different for different parts of the body. Usually, absorption through the forearm is the standard against which absorption rates in other areas of the body are tested. Absorption is over 11 times faster in the lower groin area than on the forearm. Absorption through the skin in the genital area is rapid enough to approximate the effect of injecting the pesticide directly into the bloodstream.

Table 1. Parathion absorption rates through the skin on various bodily regions.

Body region	Percent relative absorption
Forearm	8.6
Palm of hands	11.8
Ball of foot	13.5
Abdomen	18.4
Scalp	32.1
Forehead	36.3
Ear canal	46.5
Genitalia	100

2. **Inhalation (Breathing in Vapors or Particles)**

Inhalation exposure results from breathing pesticide vapors, dust, or spray particles. Like dermal exposure, inhalation exposure is more serious with some pesticides than with others, particularly fumigant pesticides, which form gases. Exposures by inhalation can occur from inhaling fumes while mixing and pouring pesticides, or breathing fumes from pesticides while applying them without protective equipment. This kind of exposure is common in poorly ventilated indoor environments and near application sites.

Larger inhaled particles tend to stay on the surface of the throat and nasal passages and do not enter the lungs. Smaller particles directly enter the lungs. The number of particles needed to poison by inhalation depends upon the concentration of the chemical in the particles. Once chemicals are inhaled into the lungs, a fast route of entry is provided into the bloodstream.

3. **Ingestion (Swallowing Contaminated Food or Water)**

Consumption of pesticide residues on food or drinking contaminated water can lead to ingestion exposure. This is a significant concern for infants and young children, who may also ingest pesticides through hand-to-mouth activity. Ingested materials can be absorbed anywhere along the gastrointestinal tract; the major absorption site is in the small intestines, and once absorbed they circulate throughout the body.

4. **Ocular (Eye Contact)**

Eyes are extremely absorptive, and eye injury can occur when pesticides are accidentally splashed or sprayed on the face during mixing, spraying, or accidental rubbing of the eyes with contaminated hands.

PESTICIDES RESIDUES IN FOOD AS A GENERAL SOURCE OF PESTICIDE EXPOSURE

The use of pesticides in agriculture has further increased due to fast growing human population which is estimated to reach 8.5 billion by 2030, hence the fear of the impact of this population on food security. One of the prominent reasons for the use of chemical substances in agricultural farmlands is for the protection of crops from various pests, thereby boosting the overall agricultural yield and productivity. Consequently, exposure of the general population to pesticides occurs primarily through eating agricultural food products and drinking water contaminated with pesticide residues.

Factors affecting the amount of pesticides residue found in food include the amount and nature of the pesticide used, environmental factors such as rainfall, sunshine and wind direction and the nature of the processing the food is subjected to prior to consumption.

Pesticide residue in food has been investigated since the growing demand of food safety. The determination of pesticides residues in food has become an essential requirement for consumers, producers, and authorities responsible for food quality control.

What are residues and why do they turn up in our food?

Considering the important roles of pesticide in agricultural development, and the heavy dependence on its applications to meet the huge demand for food production by an increasing population,the presence of pesticide residues in food and water sources has emerged as a pressing issue.

Pesticides may be used in a variety of ways during the production of food. They are;

- Used by farmers to control the growth of weeds, or prevent crop damage by insects, rodents and molds.
- Used on food crops after harvest to prolong their storage life.
- Used on animal farms to control insect pests.

When a crop is treated with a pesticide, a small amount of the pesticide, or its 'metabolites' or 'degradation products', can remain in the crop until after it is harvested. This is known as **'residue'**.

Residue definition for farm animals may be required whenever a pesticide is applied directly to livestock, to animal premises or housing, or where significant residues remain in crops or commodities used in animal feed, in forage crops, or in any plant parts that could be used in animal feeds.

As defined by FAO, a pesticide residue is any specified substance in food, agricultural commodities, or animal feed resulting from the use of a pesticide. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

Residues can arise from:

- The use of legally allowed pesticides on a crop according to good agricultural practice (leave smallest and acceptable amount of residue).
- The overuse of a legally permitted pesticide, or use too close to harvest.
- The illegal use of a pesticide that is not approved for specific crop.
- The incorrect use of pesticides after harvest, to reduce pest infestation in storage or in transit.

Various factors contribute to the higher amount of these residues in food products. One major factor is the wrong dosage and poor adherence to standards with respect to the application of these pesticides. Although some pesticides such as dichlorodiphenyltrichloroethane (DDT) have been banned, most farmers still use it for agricultural activities and pest control. Occasionally, residues may also result from environmental or other 'indirect' sources (e.g residues of old pesticides).

Pesticide residues may be present in fresh or tinned fruit and vegetables, or processed food and drinks made from crops (e.g juice, bread etc.), fresh or processed animal products (if the animal have been fed with pesticide treated crop).

One of the main obstacles to the worldwide commerce of food commodities is the existence of pesticide residues.

PESTICIDE EXPOSURE AND TOXICITY

Exposure occurs when pesticides get on or into the body through the skin, lungs, mouth, or eyes as earlier mentioned. There is great risk of exposure when: opening and handling containers; mixing and loading concentrates; working around or repairing contaminated application equipment; making applications; cleaning up spills; and re-entering a recently treated area before the spray has dried.

Pesticide exposure for the general population occurs mainly through eating food and drinking water contaminated with pesticides. Reports have demonstrated that pesticide exposure contributes to over 300,000 deaths worldwide annually.

Pesticides are toxic. The health risk to people depends on the toxicity of the pesticide and the amount of exposure.

Hazard, or risk, of using pesticides is the potential for injury, or the degree of danger involved in using a pesticide under a given set of conditions. Hazard depends on the toxicity of the pesticide and the amount of exposure to the pesticide and is often illustrated with the following equation:

Hazard or Risk = Toxicity x Exposure

The toxicity of a pesticide is a measure of its capacity or ability to cause injury or illness.

How Toxicity Is Measured

All new pesticides are tested to establish the type of toxicity and the dose necessary to produce a measurable toxic reaction. In order to compare the results of toxicity tests done in different labs, there are strict testing procedures. Toxicity testing is extensive (involving many phases) and therefore expensive. Humans, obviously, cannot be used as test subjects, so toxicity testing is done with animals and plants. Since different species of animals respond differently to chemicals, a new chemical is generally tested in mice, rats, rabbits, and dogs. The results of these toxicity tests are used to predict the safety of the new chemical to humans.

Toxicity tests are based on two premises. The first premise is that information about toxicity in animals can be used to predict toxicity in humans. Over the years, scientific experience have shown that toxicity data obtained from a number of animal species can be useful in predicting human toxicity, while data obtained from a single species may be inaccurate. The second premise is that by exposing animals to large doses of a chemical for short periods of time, we can predict human toxicity from exposure to small doses for long periods of time.

Toxicity is usually divided into two types, **acute** or **chronic**, based on the number of exposures to a poison and the time it takes for toxic symptoms to develop.

Acute Toxicity

The acute toxicity of a chemical refers to its ability to do systemic damage as a result of a one-time exposure to relatively large amounts of the chemical. A pesticide with a high acute toxicity may be deadly if even a very small amount is absorbed. Acute toxicity may be measured as acute oral (through the mouth), acute dermal (through the skin) and acute inhalation (through the lungs

or respiratory system). The harmful effects may be systemic or contact in nature (or a combination of both), depending on the product, formulation, dose, and route of exposure. Acute effects occur shortly after exposure, usually within 24 hours.

Table 2: Acute toxicity measures and warnings.

Signal Word & Symbol	Toxicity Level & Class	LD_{50} Oral (mg/kg)	LD_{50} Dermal (mg/l)	LC_{50} Inhalation (mg/kg)	Toxicity Concern
DANGER-POISON/ PELIGRO Skull & Crossbones	Highly toxic, Hazard Class I	Trace to 50	Trace to 200	Trace to 0.2	a few drops to 1 teaspoon could kill
DANGER/ PELIGRO	Highly toxic, Hazard Class I				Based on corrosive or irritant properties of the product
WARNING/ AVISO	Moderately toxic, Hazard Class II	50 to 500	200 to 2,000	0.2 to 2	*1 teaspoon to 1 ounce
CAUTION	Slightly toxic, Hazard Class III	500 to 5,000	2,000 to 20,000	2 to 20	*1 ounce to 1 pint or 1 pound
CAUTION or no signal word	Hazard Class IV	Greater than 5,000	Greater than 20,000	Greater than 20	Slight to none
* could cause death, illness, or skin, eye, or respiratory damage					

The common term used for describing acute toxicity is the LD50, or lethal dose 50%.

The LD50 is the pesticide dose that is required to kill 50% of the population of test animals when administered under controlled laboratory conditions through a particular route. If the substance is swallowed the figure is an oral LD50, whereas if absorbed through the skin it is a dermal LD50. The test animals are given specific amounts of the pesticide in either one oral dose or by a single injection, and are then observed for a specified time.

The LD50 values of pesticides are expressed in milligrams of toxicant per kilogram of body weight of the test animal (mg/kg). The lower the LD50 value, the more acutely toxic the pesticide. Therefore, a pesticide with an oral LD50 of 500 mg/kg would be much less toxic than a pesticide with an LD50 of 5 mg/kg.

Another commonly used measure of acute toxicity is the LC50, or lethal concentration 50%. This is the pesticide concentration of a substance in air or water required to kill 50% of the test population. It is usually expressed in parts per million or milligrams per liter (mg/l). Lethal concentration values are used when the route of administration is by inhalation or intake via drinking water (rather than oral, dermal, etc.).

As earlier mentioned the symptoms of acute toxicity are evident shortly after exposure or can arise within 24 -48 hours. They can present as:

- respiratory tract irritation, sore throat and/or cough
- allergic sensitisation
- eye and skin irritation
- nausea, vomiting, diarrhoea
- headache, loss of consciousness

- extreme weakness, seizures and/or death

Chronic Toxicity

Chronic toxicity refers to harmful effects produced by long-term exposure to pesticides. Less is known about the chronic toxicity of pesticides than is known about their acute toxicity, not because it is of less importance, but because chronic toxicity is gradual rather than immediate and is revealed in much more complex and subtle ways.

There is no standard measure like the LD50 for chronic toxicity. The chronic toxicity of pesticides are studied and determined by the adverse effect observed.

Chronic toxicity is tested using animal feeding studies. In these studies, the pesticide under investigation is incorporated into the daily diet and fed to animals from a very young to a very old age. These, as well as the reproductive effects studies, are designed to arrive at a No-Observable-Effect-Level (NOEL); that is, a level in the total diet that causes no adverse effect in treated animals when compared to untreated animals maintained under identical conditions. This NOEL is expressed on a mg/kg of body weight/day basis.

A Reference Dose (RfD), also known as Acceptable Daily Intake (ADI), is usually established at 1/100 of the NOEL, in order to add an additional margin of safety. The RfD (ADI) is the amount of chemical that can be consumed daily for a lifetime without ill effects.

Chronic effects from pesticide exposure include genetic changes, noncancerous or cancerous tumors, reproductive effects, infertility, fetal toxicity, miscarriages, birth defects, blood disorders, nerve disorders, and hormonal or endocrine-mediated diseases.

Long term pesticide exposure has been linked to the development of Parkinson’s disease; asthma; depression and anxiety; attention deficit and hyperactivity disorder (ADHD); and cancer, including leukaemia and non-Hodgkin’s lymphoma.

The chronic toxicity of a pesticide is more difficult to determine through laboratory analysis than the acute toxicity and cannot be expressed by a single measure. If a product causes chronic effects in laboratory animals, the manufacturer is required to include chronic toxicity warning statements on the product label and also listed on the Safety Data Sheet.

Delayed Effects

Delayed effects are illnesses or injuries that do not appear immediately (within 24 hours) after exposure to a pesticide. They may be delayed for weeks, months, or even years. Whether you experience delayed effects depends on the pesticide, the extent and route of exposure(s), and how often you were exposed. The Precautionary Statements section of the label states any delayed effects that the pesticide might cause. It also tells you how to avoid exposures. Delayed effects may be caused by either an acute or a chronic exposure to a pesticide.

RECOGNIZING SYMPTOMS OF PESTICIDE POISONING

All pesticides in a given chemical group generally affect the human body in the same way. However,severity of the effects vary depending on the formulation, concentration, toxicity and route of exposure of the pesticide. It is important, therefore, to know both the type of pesticide been used and the signs and symptoms associated with poisoning from it.

The symptoms of pesticide poisoning can range from a mild skin irritation to coma or even death. Different classes or families of chemicals cause different types of symptoms. Individuals also vary in their sensitivity to different levels of these chemicals. Some people may show no reaction to an exposure that may cause severe illness in others.

The effects, or symptoms, of pesticide poisoning can be broadly defined as either topical or systemic. Topical effects generally develop at the site of pesticide contact and are a result of either the pesticide's irritant properties (either the active and/or inert ingredient) or an allergic response by the victim. Dermatitis, or inflammation of the skin, is accepted as the most commonly reported topical effect associated with pesticide exposure. Symptoms of dermatitis range from reddening of the skin to rashes and/or blisters.

Systemic effects are quite different from topical effects. They often occur away from the original point of contact as a result of the pesticide being absorbed into and distributed throughout the body. Systemic effects often include nausea, vomiting, fatigue, headache, and intestinal disorders. In advanced poisoning cases, the individual may experience changes in heart rate, difficulty breathing, convulsions, and coma, which could lead to death.

See attachement on Classes of Pesticide Chemicals and their effect on Human Body.

FIRST AID TREATMENT AND CLINICAL MANAGEMENT FOR PESTICIDE POISONING

Specific treatments for acute pesticide poisoning are often dependent on the pesticide or class of pesticide responsible for the poisoning. However, there are basic management techniques that are applicable to most acute poisonings, including skin decontamination, airway protection, gastrointestinal decontamination, and seizure treatment.

Like other toxic chemicals, pesticides can poison people in different ways: through the skin and eyes, through the mouth (by swallowing), or through the air (by breathing). Each kind of poisoning needs a different kind of treatment.

A. When pesticides get on the skin

Most pesticide poisonings are from pesticides being absorbed through the skin. This can happen when they spill while being moved, when they splash during mixing, during spraying, or when you touch crops that have just been sprayed. Pesticides can also get on your skin through your clothes, or when you wash clothes with pesticides on them.

Rashes and irritation are the first signs of poisoning through the skin. Although, skin problems may be caused by other things, such as a reaction to plants, insect bites, infections, or allergies, it can be hard to know if the problem is caused by pesticides. It is safest to treat them as if they are caused by pesticides when exposed.

Treatment

- Quickly remove any clothing the pesticides spilled onto.
- Wash the pesticides off the skin as soon as possible with soap and cool water.
- If it got into the eye, rinse the eye with clean water for 15 minutes.

If the skin is burned from pesticides:

- Rinse well with cool water.
- Do not remove anything stuck to the burn.
- Do not apply lotions, fats, or butter.
- Do not break blisters.
- Do not remove loose skin.
- Cover the area with a sterile dressing, if available.

- **If pain lasts, get medical help!** Bring the label from the pesticide containers or the names of the pesticides with you.

Pesticides can stick to your skin, hair, and clothes, even if you cannot see or smell them. Always wash with soap after using pesticides.

B. When pesticides are swallowed

Eating foods sprayed with pesticides might make you sick later.

People can swallow pesticides by eating, drinking, or smoking cigarettes in the fields while working with pesticides, or by drinking water polluted with pesticides. Children can drink or eat pesticides, especially if pesticides are stored in containers also used to hold food, or left in the open or low to the ground.

Treatment

When someone swallows pesticides:

- If the person is unconscious, lay her on her side and make sure she is breathing.
- If the person is not breathing, quickly do mouth-to-mouth breathing. Mouth-to-mouth breathing can also expose you to the pesticide, so cover your mouth with a pocket mask, a piece of cloth, or thick plastic wrap with a hole cut in the middle, before you start mouth-to-mouth breathing.
- Find the pesticide package and read the label right away. The label will tell you if you should make the person vomit up the poison or not.
- If the person can drink, give her lots of clean water.
- **Seek medical help**. If it is available, always take the pesticide label or name with you.

Do not vomit if the label says not to. Never vomit after swallowing a pesticide that contains gasoline, kerosene, xylene, or other petroleum-based liquids. This will make the problem worse. Never make the person vomit or drink if she is unconscious, confused, or shaking badly.

If you are sure vomiting is OK, give the person:

- a glass of very salty water *or*
- 2 tablespoons of pounded strong-tasting edible plant (such as celery, basil, or another local herb) followed by 1 or 2 glasses of warm water

Keep the person moving around. This can help patient vomit sooner.

After vomiting, activated or powdered charcoal can help absorb any poison still in the stomach.

Mix ½ cup of **activated charcoal** or 1 tablespoon of finely **powdered charcoal** with warm water in a large glass or jar.

Make powdered charcoal from burnt wood or even burnt bread or tortilla. This is not as good as activated charcoal, but it still works. NEVER use charcoal briquettes. They are poison!

After the person vomits, or even if she does not, you can slow the spread of the poison while getting to a doctor by giving the patient a drink of:

One raw egg white or a glass of cow's milk

Note: Drinking milk does NOT prevent pesticide poisoning. It just slows the spread of the poison.

If someone swallowed pesticides and does not have sharp stomach pain, they can take **sorbitol** or **magnesium hydroxide** (Milk of Magnesia). These medicines cause diarrhea, which can help to get poisons out of the body.

C. When pesticides are Inhaled

When pesticides are released into the air, we breathe them in through our nose and mouth. Once in the lungs, the pesticides quickly enter the blood and spread poison through the whole body.

Because some pesticides have no smell, it is often hard to know if they are in the air. The most common forms of air-borne pesticides are fumigants, aerosols, foggers, smoke bombs, pest strips, sprays, and residues from spraying. You can also inhale pesticide dust in a storage area, when it is being used in an enclosed area, such as a greenhouse, or when it is being transported to the fields.

Pesticide dust in the air can travel miles to pollute an area far from where it was used. It is easy for pesticide dust to get into houses.

If you think you have breathed in pesticides, get away from the pesticides right away! Do not wait until you feel worse.

Treatment

If you or someone else breathes in pesticides:

- Get the person away from the area where she breathed in the poison, especially if it is an enclosed area.
- Get fresh air.
- Loosen clothing to make breathing easier.
- Sit with head and shoulders raised.
- If the person is unconscious, lay her on her side and watch her to make sure there is nothing blocking her breathing.
- If the person is not breathing, quickly do mouth-to-mouth breathing.

Seek medical help. Take the pesticide label or name of the pesticide with you.

When to use atropine

Atropine is a medicine for treating poisoning from certain pesticides called **organophosphates** and **carbamates**. If the label on the pesticide container says to use atropine, or if it says the pesticide is a "cholinesterase inhibitor," use atropine as directed. If the label does not say to use atropine, do not use it.

Atropine is used only for organophosphate or carbamate poisoning.

Atropine does NOT prevent pesticide poisoning. It only delays the effects of poisoning. **Atropine should never be taken before spraying.**

IMPORTANT! Do NOT give these drugs for pesticide poisoning: Sleeping pills (sedatives), morphine, barbiturates, phenothiazines, aminophylline, or any drugs that slow or lessen breathing. They can make the person stop breathing completely.
Every farm that uses pesticides should have an emergency kit with medicines and supplies to use in case of poisoning.

Get medical advice immediately for unusual or unexplained symptoms that develop within 24 hours of a pesticide exposure. Be alert for the early symptoms of pesticide poisoning and contact (local) effects in yourself or someone else. Do not wait to call a physician until you or the person gets dangerously ill. It is better to be too cautious than to act too late.

Take the pesticide label with you to help medical personnel administer appropriate treatment and quickly. The label is important because the medical professional needs to know the pesticide ingredients to determine the proper course of treatment.

Keep in mind that symptoms commonly associated with certain pesticides are not always the result of exposure. Common illnesses (e.g., the flu, heat exhaustion or heatstroke, pneumonia, asthma, respiratory or intestinal infections, and even a hangover) can cause symptoms similar to those of many frequently used pesticides. Contact with certain plants, such as poison oak or poison ivy, may also produce skin effects like those resulting from pesticide exposure. However, it is best to take every precaution. **When symptoms appear after contact with pesticides, always seek medical attention immediately.**

PREVENTION AND CONTROL OF PESTICIDE POISONINGS

Nobody should be exposed to unsafe amounts of pesticide. Healthy, Sensible Food Practices may reduce the amount of pesticides exposure from food consumption such as;

- Washing fresh fruits and vegetables thoroughly under running water will help remove bacteria and traces of chemicals from the surface of fruits or vegetables and dirt from crevices.
- Peeling fruits and discarding outer leaves of leafy vegetables when possible helps to reduce dirt, bacteria, and pesticides.
- Triming fat from meat and skin from poultry and fish because some pesticides residues collect in fat.
- Eating variety of foods, from variety of sources will give a better mix of nutrients and reduce likelihood of exposure to a single pesticide.

People spreading pesticide on crops in the farms or gardens, or those involved in the application of pesticides in non-agriculture activities in the home such as spraying for anopheles mosquito to control malaria, such people should be adequately protected. People not directly involved in the spreading of pesticides should stay away from the area while spreading takes place, and for some time afterwards.

Food that is sold or donated (such as food aid) should equally comply with pesticide regulations, in particular with maximum residue limits. Maximum residue limits are the maximum pesticide residues limit in food considered safe to human as set by the Codex Alimentarius Commission and the joint Food and Agriculture Organization/World Health Organization meeting on pesticide residues.

People who use pesticides when growing their own food should follow instructions for use and protect themselves by wearing gloves and face masks as necessary.

CONCLUSION

Although pesticides have a positive effect on plant health in terms of insect pests and diseases control, increased productivity and improved crop storage, their malpractice impacts on food safety negatively.

On the other hand, we are facing serious consequences due to the use of pesticides in terms of environmental degradation and human health risks. The persistence of pesticide residue in food items and environmental exposure resulting from non-agricultural activities can be detrimental to human health as these can result in acute and chronic poisoning, cancer, reproductive disorders, immune dysfunction and neurological system damage.

It is important to maintain approaches like good agricultural practices for ensuring sustainability on safe food production and safe use practices for pesticides in non-agricultural activities by ensuring the most important factors which include selecting the appropriate product, and using that product according to the label directions are considered. The label directions are written to minimize the risk of problems and to define the *legal* uses for the product.

References

1. https://www.who.int/news-room/fact-sheets/detail/pesticide-residues-in-food#:~:text=Consumers%20can%20further%20limit%20their,hazards%20such%20as%20harm
2. https://npic.orst.edu/health/safeuse.html
3. https://pesticidestewardship.org/homeowner/using-pesticides-safely-and-correctly/
4. https://www.health.vic.gov.au/environmental-health/pesticide-classes-and-associated-hazards
5. https://www.pcs.agriculture.gov.ie/foodsafety/themonitoringandcontrolsprogramme/themainpesticidetypes/
6. https://iopscience.iop.org/article/10.1088/1755-1315/894/1/012025
7. https://www.pesticidereform.org/pesticides-human-health/

8. https://www.medicalnewstoday.com/articles/327414
9. https://extension.missouri.edu/publications/g1915#principles
10. https://edis.ifas.ufl.edu/publication/PI008
11. https://blogs.ifas.ufl.edu/pesticideinformation/2022/03/31/pesticide-exposure-what-are-the-routes-of-exposure/
12. https://link.springer.com/article/10.1007/s44279-024-00141-z#Sec1
13. https://www.pan-uk.org/health-effects-of-pesticides/
14. https://www.epa.gov/safepestcontrol/pesticides-and-food-healthy-sensible-food-practices
15. https://extension.psu.edu/potential-health-effects-of-pesticides
16. https://medcraveonline.com/MOJFPT/pesticide-residues-in-food-distribution-route-of-exposure-and-toxicity-in-review.html