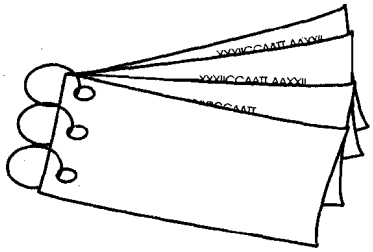
UNIT 10 INDIRECT ADDITIVES, RESIDUES AND CONTAMINANTS



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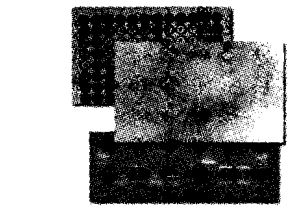
- Indirect food additives are those that become part of the food in trace amounts due to packaging, storage or other handling.
- Toxic chemicals present in soil, water and air are taken in by plants, land and marine animals. Indirect contamination of meats, milk or eggs may occur when animals consume contaminated plants.
- Human beings may be worst affected since they are at the top of the food chain and consume both contaminated plants and animals.

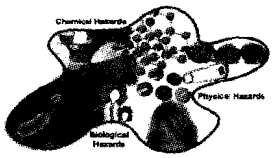
10.1 Metallic Contaminants

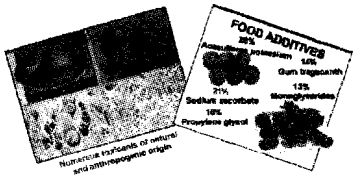
- Metals enter our bodies through the water we drink, the air we breathe and the food grown in contaminated soil.
- Metals may enter food from metallic cans in which food is packaged. Acidic conditions in the stored products may cause the surface layer of the cans to dissolve into the food products.
- Poor quality tin coating or improper tinning of vessels can result in tin and copper leaching into food cooked or stored in the vessel.
- Plants have been found to suck in heavy metal contaminants from soil, water and air. Raw sewage water and sludge used for irrigation have led to build up of heavy metals in soil.

Heavy Metals

Heavy metals can cause a lot of damage to human health. These metals are not readily excreted from our bodies and so keep getting deposited in different tissues and organs of the body. Details of various heavy metals are summarized in the following table:







Metal	Sources	Symptoms of Poisoning
1. Arsenic	Accumulation in soil and crops irrigated with arsenic-rich water; contaminated drinking water	Chronic arsenic poisoning leads to general muscular weakness, nerve damage and inflammation, burning sensation in hands and feet, loss of appetite, birth defects, liver injury. Most characteristic effects following chronic arsenic exposure seen in roughness of palms and soles of feet (hyperkeratosis) together with increased pigmentation of skin (hyperpigmentation) particularly in areas not exposed to the sun; nodular keratosis; potential cancer-causing agent for lung and skin cancers.
2. Lead	Vehicle exhausts in air and deposited on food; crops grown in contaminated soil and water, high-acid foods stored in lead-containing vessels.	Chronic poisoning associated with birth defects, mental retardation; allergies, hyperactivity, weight loss, shaky hands, muscular weakness, paralysis (beginning in forearms, acute poisoning leading to tiredness, abdominal discomfort, irritability, anaemia; children are particularly sensitive to lead (absorbing as much as 50% of ingested dose) — they are also more likely to ingest lead because they chew on painted surfaces and eat products not intended for human consumption e.g. paints, cosmetics, hair colourings even playground dirt.
3. Mercury	Industrial contaminants in water, subsequently in tissues of fish	One of the most toxic – a nerve toxin; loss of appetite, weight loss, tiredness, kidney failure; in high doses speech and hearing impairment, loss of coordination, tingling sensation in limbs easily passes through placenta harming the foetus during pregnancy.
4. Cadmium	Industrial contaminants in soil, cadmium-containing utensils, storing high- acid foods in cadmium containers; seafood like shrimps	Highly toxic; acute poisoning characterized by symptoms of nausea, vomiting, abdominal cramps, diarrhoea, shock within 15-30 minutes of ingesting metal; chronic exposure results in chronic lung disease, renal disease, fragile bones.

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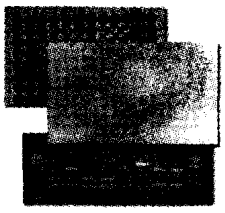
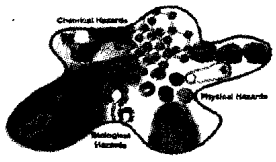
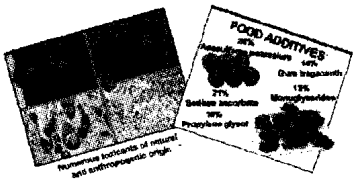
Metal	Sources	Symptoms of Poisoning
		Other symptoms include hair loss, anaemia, arthritis, learning disorders, migraines, growth impairment, osteoporosis, loss of taste and smell, poor appetite, cardiovascular disease.
5. Aluminium	Present naturally in low amounts in food; comes also from certain food additives, adulterants, food containers, cooking utensils	Linked to Alzheimer's disease characterized by gradual loss of cognitive functions of brain; role in a variety of bone diseases well recognized.
6. Tin	Organic tin from paint, plastic industries, through pesticides; inorganic tin from acidic foods stored in uncoated tin containers	Triethyl tin most dangerous; acute effects headache, stomach sickness, dizziness, severe sweating, breathlessness, urination problems; long-term effects include depression, liver damage, malfunctioning of immune system, chromosomal damage, shortage of red blood cells, brain damage causing anger, sleeping disorders, forgetfulness, headaches)
7. Antimony	Grey enamelware; storing high-acid foods in antimony-containing utensils	Symptoms within few minutes to one hour; vomiting, abdominal pain, diarrhoea.
8. Copper	Brass, copper pipes/ utensils leach metal into high acid foods; faulty back-flow prevention valves in vending machines; component of fertilizers and pesticides ending up in soil or water.	Symptoms within few minutes to few hours of ingestion, metallic taste, nausea, vomiting (green vomitus) abdominal pain; severe poisoning resulting in coma and death.
9. Nickel	Contaminated hydrogenated vegetable oil; cheap quality stainless steel releases nickel into high-acid foods	May be associated with fatigue, headaches, respiratory illness, heart conditions.

10.2 Pesticide Residues

- Pesticides used on food crops provide protection from pests such as insects, rodents, weeds, moulds, bacteria. Pesticides used on food include insecticides (to control insects); rodenticides (to control rodents); herbicides (to control weeds); fungicides (to control mould and fungus) anti-microbials (to control bacteria).
- A significant amount of pesticides used in agriculture leach into rivers (especially from farms bordering river banks) and other water bodies.
- Indiscriminate use of pesticides leads to high residue levels in food.
- Every pesticide has some safety or waiting period defined as number of days (taken after application for residues to get dissipated). The time varies from pesticide to pesticide and also from one crop to another.
- Food products become safe for consumption only after the waiting period has lapsed. If fruits and vegetables are harvested before completion of the waiting period, they are likely to have higher levels of residues hazardous to health.
- Even small quantities of pesticide residues eaten in the daily diet can lead to high levels in the body. This is particularly true if foods contain residues above "permissible levels". It has been estimated that between 50 and 70% of all vegetables grown and sold around the country were contaminated with insecticide residues, some of them well beyond permissible levels.







Health Hazards of Pesticides

The effects of chronic or long-term exposure to pesticides do not appear immediately after first exposure and may take years to produce signs and symptoms. Examples of chronic poisoning effects may include:

- insecticides to control insects;
- rodenticides to control rodents (e.g. rats, mice);
- herbicides to control weeds;
- fungicides to control mould and fungus;
- anti-microbials to control bacteria.

Acute poisoning signs that can be seen are usually vomiting, sweating, headache, weakness, dizziness or pinpoint pupils.

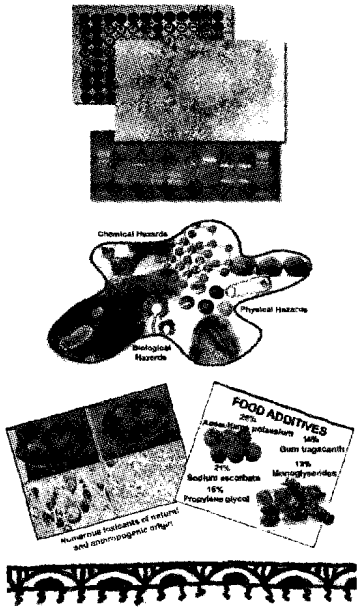
The adverse health effects of the three classes of pesticides are summarized in the following table:

Class of Pesticide	Effects of Poisoning
1. Organochlorine pesticides	Lindane consumed over a period of time affects the central nervous system, liver, kidney, pancreas, testes, nasal mucous membrane; it causes headache, dizziness, gastrointestinal disturbances, numbness, weakness of extremities, apprehension, hyperirritability, hormonal disturbances in some cases.
2. Organophosphates and carbamates	Mild-moderate exposures to organophosphate and carbamate insecticides include headache, fatigue, dizziness, loss of appetite with nausea, stomach cramps and diarrhoea, contracted pupils of the eye, excessive sweating and salivation, slowed heartbeat, inability to walk, muscle twitching, involuntary urination and bowel movement.
3. Pyrethroids	Only very large doses may cause lack of coordination, tremors, salivation, vomiting, diarrhoea and irritability to sound and touch. The kidneys promptly excrete most pyrethroid metabolites.

10.3 Veterinary Drug Residues

- The milk and flesh of animals fed antibiotics and other growth stimulating medicines and hormones becomes contaminated with the residues of these drugs. Usually these drugs remain in the body of the animal for a few days and the animal should not be milked or killed for meat during that period after the administration of the drug. Ignorance and non-compliance with safety norms can lead to these compounds entering our food.
- The different types of veterinary drugs that may end up in our food supplies are: Antibiotics, steroid hormones, ectoparasiticides, antihelminthics and antifungal agents.
- Antibiotic residues can cause allergies in people sensitive to penicillin and also cause potential build up of antibiotic-resistant organisms in humans. Antibiotic residues present in milk intended for production of cheese or formation of milk products requiring use of bacterial or yeast cultures may result in killing of these cultures. This results in economic losses to the dairy industry.
- Hormones have been used by the meat industry to promote growth or increase milk yield. Links have been suggested between hormone residues and early puberty in girls, growth promotants and breast cancer. In addition there have been serious concerns about environmental contamination particularly of drinking water from faecal and urinary excretion of hormones by millions of cattle.

- Good veterinary practices should be followed and adequate precautions should be taken in use of hormones. The veterinarian/ animal doctor should be consulted before hormones are administered; overmedication should be avoided; appropriate time gap must be given between administering the drug and milking /slaughtering the animal to avoid high residue levels in the food products.
- Residues of ectoparasiticides (applied on the bodies of cattle to control parasites like lice, fleas) can appear in milk and meat. There is concern over human and environmental safety of chemicals targeting the parasites' nervous system.
- The use of anti-helminthics to get rid of worms can cause serious ecological problems with their residues detected in soil where cattle on these drugs have grazed.
- Anti-fungal medicines also leave residues in meat and milk. They present a threat to the environment as well.



10.4 Miscellaneous Contaminants

- Contaminants can migrate from plastics to foods e.g. plasticizers, antioxidants, catalysts, suspension and emulsifying agents, stabilizers and polymerization inhibitors, pigments, fillers. Alcoholic beverages, edible fats and oils extract substances more readily than dry food such as cereals. Therefore only plastics of specified purity or food-grade plastics should be used.
- Dioxins are a group of chemicals (polychlorinated aromatic compounds) formed as a byproduct of manufacturing processes. The highly fat-soluble dioxins are persistent and accumulate in the food chain. This means that once released into the environment via air or water, they pile up in the fat tissues of animals and humans. Dioxin can enter the food supply through atmospheric deposition or pollution of soil. Some of them are known to cause cancer; they have also been linked to severe effects on the brain, reproductive and immune systems.
- Polychlorinated biphenyls or PCBs are found in animal foods such as meat, fish, eggs, milk. High levels of PCBs in the blood have been linked to reduced mental development and suppressed immune reactions. Mass poisoning caused still births or congenital defects/ health problems. Short-term memory and learning problems in adults have been reported.
- Acrylamide is a chemical that appears to be produced naturally in food as a result of baking or frying. It is also likely to be produced by grilling and roasting food. Acrylamide is used in production of polyacrylamide, an additive for water treatment. It is considered to be a probable human cancer-causing agent; it is known to have caused nerve damage and impaired fertility.

10.5 Limiting Exposure to Contaminants

- The appearance of the toxic effects of most contaminants may not be immediate. It may be delayed in view of the small quantities ingested over a period of time. The multiplicity of chemical contaminants that may be ingested at any given time further complicates matters.

- Ingestion of chemical contaminants can be greatly reduced by following good agricultural practices, minimizing use of pesticides, chemical fertilizers, following good practices of animal husbandry especially when animals need medication and ensuring safe disposal of toxic wastes from our industries.
- At the household level we can do simple things like washing thoroughly the grains, fruits and vegetables before consuming them. Removing the peels of fruits and vegetables also helps in removing contaminants adhering to the skin. Fruits and vegetables growing in the vicinity of polluting industries should be avoided.
- While consuming non-vegetarian foods, organ meats (viz. kidney, liver, brain) should be avoided as they tend to accumulate heavy metals. Fish from deep sea and lakes or free-flowing rivers are safer than those caught in water bodies close to industries releasing effluents or sewage treatment plants.

Key Terms

Anti-fungal: Substance which kills or controls fungi

Antihelminthic: Substance which removes worms from intestine

Carcinogenic: Cancer causing

Cirrhosis of liver: Condition where some cells of the liver die and are replaced by hard fibrous tissue

Cognitive: Referring to the mental processes of perception, memory, judgement and reasoning

Dissipated: Disintegrated

Ectoparasiticides: Chemicals or pesticides which are applied on the body of the animals for the control of parasites

Effluent: Fluid discharge of wastes

Fibrosis: Replacing damaged tissue by scar tissue

Hyperkeratosis: Overgrowth of the horny layer of the epidermis

Hyperpigmentation: Increased pigmentation of the skin

Immunotoxic: Toxic to the immune system

Mutagenicity: Ability to cause genetic changes

Oncogenicity: Ability to induce tumour growth

Osteoporosis: Condition where the bones become thin, porous and brittle

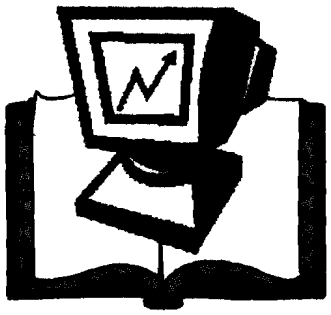
Residue: What is left over or remains

Teratogenicity: Ability to cause birth defects

Toxin: A poison

Vascular: Pertaining to the blood vessels

Veterinary: Pertaining to animals, their diseases and treatment



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