

FOOD BORNE DISEASES

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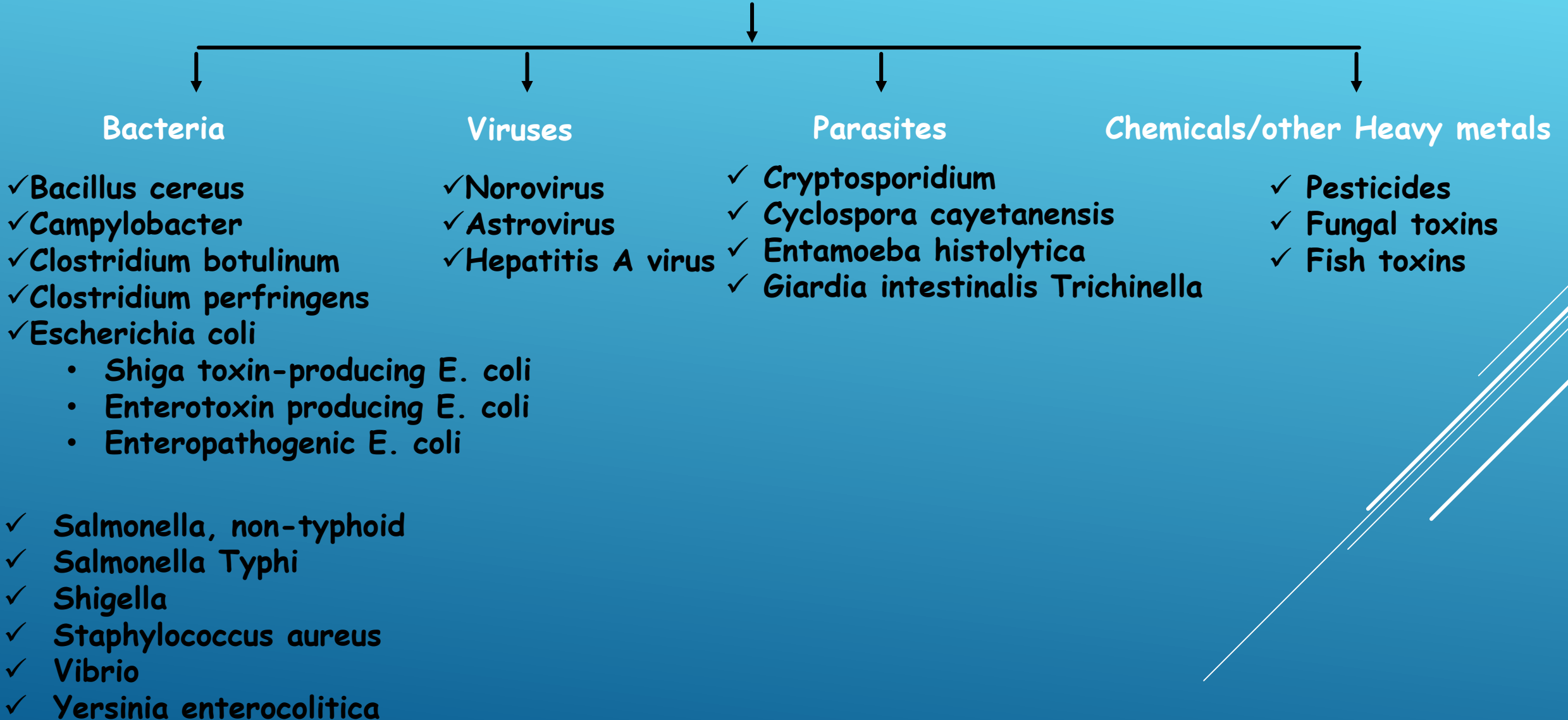


Foodborne diseases

- ▶ Foodborne diseases encompass a wide spectrum of illnesses and are a growing public health problem worldwide. They are the result of ingestion of foodstuffs contaminated with microorganisms or chemicals. The contamination of food may occur at any stage in the process from food production to consumption (“farm to fork”) and can result from environmental contamination, including pollution of water, soil or air.
- ▶ The most common clinical presentation of foodborne disease takes the form of gastrointestinal symptoms; however, such diseases can also have neurological, gynaecological, immunological and other symptoms. Multiorgan failure and even cancer may result from the ingestion of contaminated foodstuffs, thus representing a considerable burden of disability as well as mortality.

Common Foodborne Disease

Causative Agents



Foodborne illness

Foodborne illness occurs when a pathogen is ingested with food and establishes itself (and usually multiplies) in the human host, or when a toxigenic pathogen establishes itself in a food product and produces a toxin, which is then ingested by the human host.

Foodborne illness is generally classified into:

- (a) foodborne infection
- (b) foodborne intoxication.

What is a foodborne infection?

A foodborne infection is an inflammation of the stomach and bowels. The infection can happen when you eat or drink something that is contaminated by a bacteria, virus or parasite.

Often the inflammation leads to

- ✓ diarrhoea,
- ✓ nausea,
- ✓ vomiting,
- ✓ abdominal pain,
- ✓ abdominal cramps and sometimes fever.

A foodborne infection can last between one and three days.

Foodborne intoxication

Foodborne intoxication is caused by consumption of food containing toxins. Toxins cause foodborne diseases such as gastrointestinal and systemic disorders.

Food Intoxication

- ▶ **Food intoxication** is a *bacterial foodborne illness that occurs when microorganisms grow in food and produce a toxin there. The toxin causes the illness when the food is eaten.*
- ▶ A few examples of toxin-producing bacteria are:
 - ▶ Clostridium Perfringens
 - ▶ Staphylococcus Aureus
 - ▶ Clostridium Botulinum



Staphylococcus aureus: Foodborne Intoxication

Description

Staphylococcal foodborne intoxication is a gastrointestinal illness, caused by consumption of food contaminated with toxins produced by *Staphylococcus aureus*.

Symptoms

Symptoms occur suddenly, sometimes in as little as 30 minutes after eating contaminated food.

They include severe nausea, cramps, vomiting and often diarrhea. In most cases the illness is short-lived usually lasting not longer than one to two days.

Causative Agent

Staphylococcus aureus is a common bacterium found colonising the skin and nasal passageways. *S. aureus* has the capacity to produce a range of enterotoxins (toxins that act within the intestine) that damage the mucosal endothelium making the mucosae more permeable to ions and water leading to vomiting and diarrhoea. Enterotoxins are stable at 100°C. Staphylococci replicate in food.

Staphylococcal Food Poisoning

- Caused when consuming food in which S.aureus has multiplied and formed endotoxin
- Symptoms:
 - Nausea
 - Vomiting
 - Severe abdominal cramp
 - Diarrhoea
 - Sweating
 - Headache,etc.



Causes

Staphylococcal food intoxication is caused by eating contaminated food. The most common way for food to become contaminated with the bacteria is through contact with food workers who carry the bacteria or through contaminated milk or cheeses. The *staphylococcal* bacteria are resistant to heat and cannot be destroyed by cooking. Common foods that can become contaminated are pastries, custards, salad dressings, sandwiches, sliced meat and meat products.

Treatment

The toxin is not affected by antibiotics, thus antibiotics are not useful. Plenty of rest, plenty of fluids and medications to calm the stomach are recommended. Those most at risk for severe illness such as young children, the elderly and individuals with a weakened immune system may require intravenous therapy and care in the hospital.

Prevention

Staphylococcal food intoxication can be prevented by practicing safe handling and proper storage of food, frequent hand washing with soap and water, keeping kitchens and food serving areas clean and sanitized, and educating food handlers in strict food hygiene.

Clostridium botulinum

Clostridium botulinum are anaerobic, Gram-positive, spore-forming bacilli that are found in soils and aquatic sediments. Strains of *C. botulinum* are classified into seven types, designated A to G, according to the antigenic properties of the botulinum toxin they produce.


Human botulism is caused by types A, B, E and, rarely, type F. Some strains of *Clostridium* *baratii* and *Clostridium butyricum* can also produce botulinum neurotoxin and have been implicated in human disease.



The spores of *C. botulinum* are highly resistant. Under appropriate conditions, they germinate to release vegetative organisms that produce neurotoxin. Following absorption and hematogenous dissemination, botulinum toxin exerts its effects at the presynaptic terminals of cholinergic nerve junctions by blocking neurotransmitter release.

Botulism

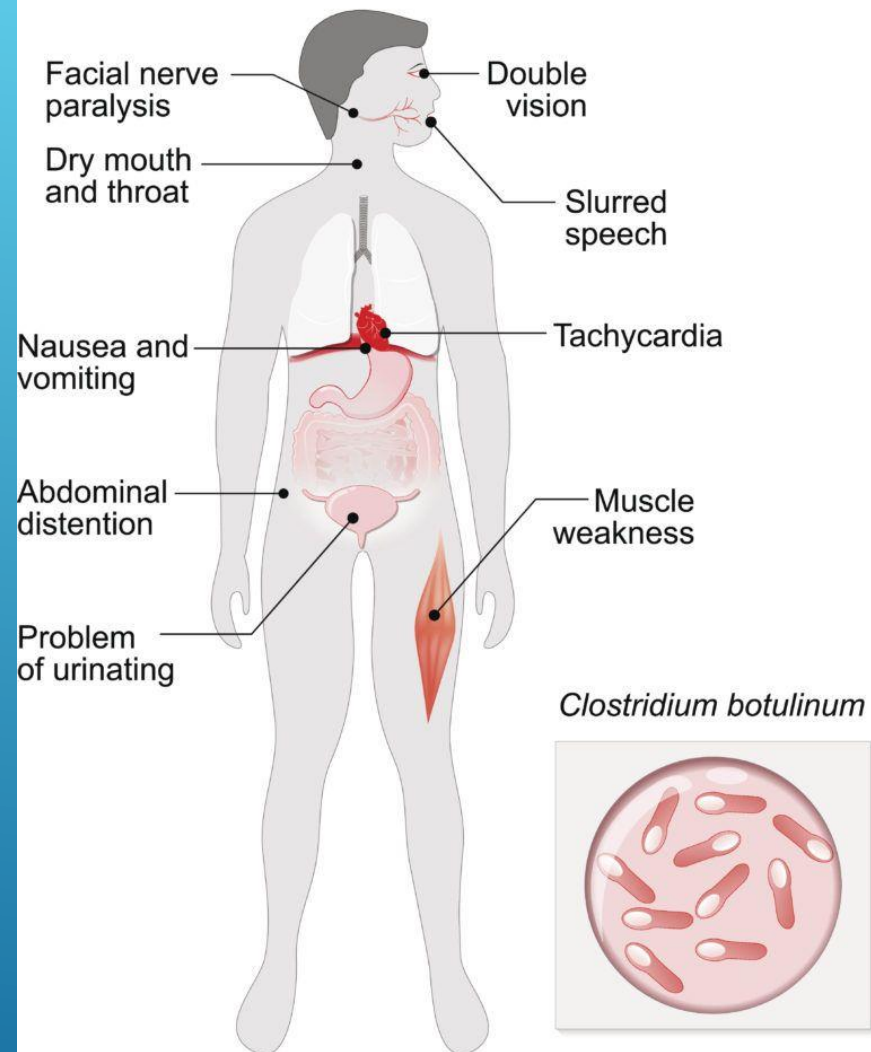
Botulism is a life-threatening disease caused by the ingestion of a potent neurotoxin produced during growth of the *C. botulinum* bacteria. This neurotoxin is among the most toxic substances known; even microscopic amounts can cause illness or death. In the past, botulism was linked primarily to home-canned foods. In recent decades, however, botulism illnesses have been linked to foods such as unrefrigerated homemade salsa, baked potatoes sealed in aluminum foil, honey (the primary cause of botulism in infants), garlic in oil, and traditionally prepared salted or fermented fish.

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The Disease
Botulism is a paralyzing disease affecting the body's nervous system that is caused by the ingestion of one of the potent neurotoxins produced by *C. botulinum* bacterium. This neurotoxin is among the most toxic substances known; even microscopic amounts can cause illness.

BOTULISM

SIGNS AND SYMPTOMS



How is the Toxin Produced in Food?

C. botulinum spores are often found on the surfaces of fruits and vegetables and in seafood. The organism grows best under low-oxygen conditions and produces spores and toxins. The toxin is most commonly formed when food is improperly processed (canned) at home. *C. botulinum* cannot grow below a pH of 4.6, so acidic foods, such as most fruits, tomatoes, and pickles, can be safely processed in a water bath canner. However, foods with a higher pH (most vegetables and meats) must be processed under pressure. Therefore, a pressure cooker should be used. The pressure cooker will reach high enough temperatures to destroy the *C. botulinum* spores.

Symptoms

Symptoms of botulism usually appear within 12 to 36 hours after eating food containing the neurotoxin, although there have been documented cases that ranged from 4 hours to 8 days. The earlier the symptoms appear, the more serious the disease. Treatment requires quick medical attention and an antitoxin.

How Does the Illness Occur?

Once in the body, the toxin binds to nerve endings that join muscles. This prevents the nerves from signaling the muscles to contract. The first symptoms of botulism are nausea, vomiting, weakness, and vertigo (dizziness). These are followed by neurological symptoms: visual impairments (blurred or double vision), loss of normal throat and mouth functions (difficulty speaking and swallowing; dry mouth, throat, and tongue; and sore throat), general fatigue, lack of muscle coordination, and difficulty in breathing. Gastrointestinal symptoms may include abdominal pain, diarrhea, or constipation. Death is usually caused by respiratory failure and airway obstructions. When the diaphragm and chest muscles become fully involved, breathing is affected and results in death from asphyxia.

If botulism is caught in the early stages, the injection of an antitoxin can lessen the severity of the disease by neutralizing any toxin that has not yet bound to nerve endings. However, due to the risk of serious side effects, the antitoxin cannot always be used. A human-derived antitoxin is used to treat cases of infant botulism and is available from the California Department of Public Health.

Infant botulism

Infant botulism may affect infants under 12 months of age, but most commonly those under 2 months of age. It occurs when infants eat food, such as honey, that contains spores of *C. botulinum* that germinate, colonize, and produce neurotoxin in the infant's intestinal tract.

For this reason, the U.S. Food and Drug Administration, the Center for Disease Control and Prevention, and the American Academy of Pediatrics recommend that honey not be given to children under 1 year of age. Also, fruits and vegetables should be washed before being fed to infants.

SYMPTOMS OF INFANT BOTULISM



- Constipation
- Drooling
- Vomiting
- Floppy Movements
- Weak Cry

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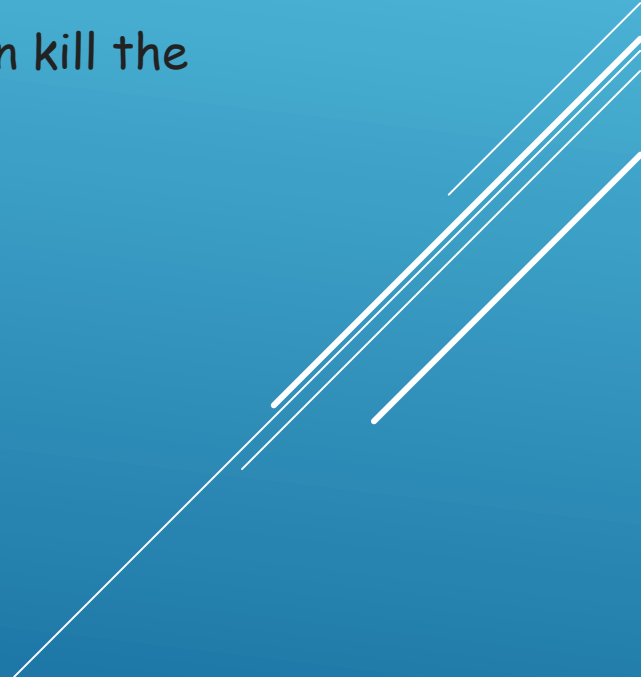
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What is the Best Way to Prevent Botulism?

The control of foodborne botulism is based almost entirely on thermal destruction (heating) of the spores or inhibiting spore germination into bacteria and allowing cells to grow and produce toxins in foods. To prevent foodborne botulism:

- Use approved heat processes for commercially and home-canned foods (i.e., pressure-can low-acid foods such as corn or green beans, meat, or poultry).
- Discard all swollen, gassy, or spoiled canned foods. Double bag the cans or jars with plastic bags that are tightly closed. Then place the bags in a trash receptacle for non-recyclable trash outside the home. Keep it out of the reach of humans and pets.
- Do not taste or eat foods from containers that are leaking, have bulges or are swollen, look damaged or cracked, or seem abnormal in appearance. Do not use products that spurt liquid or foam when the container is opened.
- Boil home-processed, low-acid canned foods for 10 minutes prior to serving. For higher altitudes, add 1 minute for each 1,000 feet of elevation.

What is the Best Way to Prevent Botulism?

- Refrigerate all leftovers and cooked foods within 2 hours after cooking (1 hour if the temperature is above 90 °F).
 - One of the most common causes of foodborne botulism is improperly home-canned food, especially low-acid foods such as vegetables and meats. Only a pressure cooker/canner allows water to reach 240 to 250 °F, a temperature that can kill the spores.
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Mycotoxins

Mycotoxins are secondary metabolites synthesized by a variety of fungal species such as *Aspergillus*, *Penicillium*, *Fusarium*, and *Alternaria*. These secondary metabolites are toxic and have a significant impact if they enter the production and food chain.

fungal metabolites which when ingested, inhaled, or absorbed through the skin can cause disease or death in humans and domestic animals, including birds.

Some mycotoxins cause primarily acute and highly reversible effects, others cause irreversible organ damage, and still others cause both acute and chronic effects, depending upon exposure levels, time course, and other circumstances.

Most mycotoxins are chemically and thermally stable during food processing, including cooking, boiling, baking, frying, roasting, and pasteurization. Mycotoxins can also come to the human plate via animal products such as meat, eggs, milk as the result of the animal eating contaminated feed

MOULD	MYCOTOXIN
Aspergillus	Aflatoxin
	Ochratoxin
Penicillium	Ochratoxin
Fusarium	DON (Deoxynivalenol)
	ZON (Zearalenone)
	T-2 Toxin
	Fumonisin

Mycotoxin	Producing fungi	Mode of action	Physiological consequences
Aflatoxin B1	<i>Aspergillus flavus</i> <i>A. parasiticus</i> <i>A. nomius</i>	Covalent binding of activated AFB1 to cellular proteins DNA and RNA Stimulation of lipid peroxidation Apoptosis	Protein adduct formation leads to cytotoxicity DNA-adduct formation leads to mutation & cancer lipid peroxidation, apoptosis and gene expression changes
Ochratoxin A	<i>Aspergillus Ochraceus</i> <i>Penicillium aurantiogriseum</i> <i>P. verrucosum</i> <i>P. viridicatum</i> <i>P. cyclopium</i>	Inhibition of protein synthesis Decreased mitochondrial respiration Stimulation of lipid peroxidation Apoptosis	ATP depletion Decreased gluconeogenesis lipid peroxidation, apoptosis and gene expression changes
Fumonisin B1	<i>Fusarium moniliforme</i> <i>F. proliferatum</i> <i>F. verticillioide</i>	Inhibition of sphinganine N-acyl-transferase Stimulation of lipid peroxidation Apoptosis	Disruption of sphingolipid metabolism lipid peroxidation, apoptosis and gene expression changes
T-2 toxin, DON	<i>Fusarium poae</i> <i>F. acuminatum</i> <i>F. sporotrichioides</i> <i>F. graminearum</i>	Inhibition of protein synthesis Stimulation of lipid peroxidation Apoptosis	Inhibition of cell proliferation Inhibition of protein synthesis lipid peroxidation, apoptosis and gene expression changes
Zearalenone	<i>Fusarium culmorum</i> <i>F. sporotrichioides</i> <i>F. graminearum</i>	Oestrogen-like properties	Competition for oestrogen receptors Imitation of oestrogen effects lipid peroxidation, apoptosis and gene expression changes

FOOD SAFETY AND REGULATION

Mycotoxins can enter the food chain in the field, during storage, or at later points. Mycotoxin problems are exacerbated whenever shipping, handling, and storage practices are conducive to mould growth. The end result is that mycotoxins are commonly found in foods.

Moulds and mycotoxin contamination in animal food and feed can be easily attained by keeping moisture under control, maintenance of temperature unfavourable to their growth and cleaning of equipment's.

Prevention of mycotoxin

- Proper drying and storage of grains and other affected foods.
- Quality control of potentially hazardous foods by use of appropriate analytical tests.
- Use of fungicides as seed dressings to protect stored cereals and other foods like pulses and potatoes against fungal invasion.

For detail study on mycotoxin, reference

Mycotoxins: The Hidden Danger in Foods

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