

### ***Food contamination:***

Refers to the presence in food of harmful substances which can cause consumer illness, can occur at every step on the way from raw material to consumer.

***Food contaminants:*** are substances that are included unintentionally in foods. Raw material of plant origin can be contaminated with environmental pollutants, such as heavy metals, pesticide residues, industrial chemicals, and products from fossil fuels. In animal products also, residues of veterinary drugs and growth promoting substances may be present. While during processing, food can be contaminated with processing aids, such as filtering and cleaning agents, and with metals coming from the equipment.

### ***Types of Contamination:***

There are three ways which food can be contaminated:

- Physical : Metal, broken glass, wood splinters, bandages, insects, hair and fingernail.
- Chemical : cleaning agents, metal leaching (copper, lead, cadmium), pesticides, paints, petroleum products, too much food additive.
- Microbiological: Bacteria, fungi, viruses, parasites.

### **Physical contamination**

This can occur in a variety of ways at different stages of food processing and production. Some examples are: soil from the ground when harvesting; a bolt from a processing plant when packaging; a hair from a cook in the kitchen. Care must be taken at each stage to prevent physical contamination.

### **Chemical contamination:**

This can occur in a variety of ways at different stages of food processing and production. Some examples are: chemicals from the farm; a cleaning product used in the processing plant when packaging; fly spray used in the kitchen when preparing food. Care must be taken at each stage of food production to prevent chemical contamination.

### **Microbiological contamination:**

As soon as food is harvested, slaughtered or manufactured into a product it starts to change. This is caused by two main processes:

- Autolysis – self destruction, caused by enzymes present in the food.
- Microbial spoilage – caused by the growth of bacteria, yeasts and molds.

Autolysis and microbial changes are sometimes desirable (and are not referred to as spoilage), for example enzymes cause fruit to ripen.

Enzymes are chemicals that are found in food, these chemicals have important uses in food. They can cause food to deteriorate in three main ways:

- **Ripening** – this will continue until the food becomes inedible, e.g. banana ripening.
- **Browning** – enzymes can react with air causing the skin of certain foods, e.g. potatoes and apples discolouring.
- **Oxidation** – loss of certain nutrients, such as vitamins A, C and thiamine from food, e.g. over boiling of green vegetables.

### ***Food-borne illness:***

*Infection or intoxication caused by transfer of microbial or chemical contaminants from food or drinking water to a human*

#### ***How do you know if you have food-borne illness?***

It is hard to tell if a food is unsafe, because you can't see, smell or taste the bacteria. Very IMPORTANT CONCEPT! Usually food-borne bacteria take 1 to 3 days to cause illness. You could become sick as soon as 20 minutes or as long as 6 weeks after eating some food with dangerous bacteria. It depends on a variety of factors, dose amount, immune-status, and type of bacteria in the food. Sometimes food-borne illness is confused with other types of illness. If you get food-borne illness, you might be sick to your stomach, vomit; or have diarrhea; or symptoms could be flu-like with a fever, headache, and body aches. Many food-borne illnesses are a result of fecal-oral contamination. If you are vomiting or have diarrhea it is best NOT to prepare food for others as the pathogen may aerosolize after an incident and contaminate you unknowingly. Food-borne illness can be dangerous, but is often easy to prevent.

## ***Types of microbial food-borne diseases:***

Food-borne diseases in humans result from:

### ***- Food infection:***

Illness occurs as a result of the consumption of food and water contaminated with enteropathogenic bacteria or viruses. It is necessary that the cells of enteropathogenic bacteria and viruses remain alive in the food or water during consumption. The viable cells, even if present in small numbers, have the potential to establish and multiply in the digestive tract to cause the illness (e.g. Salmonellosis, hepatitis A).

### ***- Food intoxication:***

Illness occurs as a consequence of ingestion of a preformed bacterial or mold toxin (mycotoxin) due to its growth in a food. A toxin has to be present in the contaminated food in an active form. Once the microorganisms have grown and produced toxin in a food there is no need of viable cells during the consumption of the food for illness to occur. e.g Staphylococcal food poisoning.

### ***Food borne infections vs intoxication***

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| <ul style="list-style-type: none"><li>• <b>Infections-</b><br/>Bacterial/Viral/parasite</li><li>• Invade and or multiply in lining of intestine</li><li>• <b>Incubation period</b>-hours to days</li><li>• <b>s/s-</b><br/>diarrhoea,nausea,vomitting, abdominal cramps, fever</li><li>• <b>Transmission</b>-spreads from person to person</li><li>• <b>Factors</b>-inadequate cooking, cross contamination, poor personal hygiene, bare hand contact</li></ul> | <ul style="list-style-type: none"><li>• <b>Intoxications</b>-toxins (natural/preformed bacterial/chemical)</li><li>• No invasion or multiplication</li><li>• <b>Incubation period</b>-minutes to hours</li><li>• <b>s/s-</b><br/>vomitting,nausea,diarrhea,weakness,resp.failure,numbness,sensory/motor dysfunction</li><li>• Not communicable</li><li>• <b>Factors</b>-inadequate cooking , improper handling temperatures</li></ul> |
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## ***Some important food-borne pathogens:***

1. Bacteria : *Staphylococcus aureus*, *Listeria monocytogenes*, *Salmonella* , *Escherichia coli* O157:H7, *Clostridium perfringens*, *Clostridium botulinum*, *Campylobacter jejuni* ,*Bacillus cereus*, *Brucella*

2. Viruses : Hepatitis, rotavirus, Norwalk-type viruses.

3. Protozoa : *Cryptosporidium*, *Cyclospora*, *Entamoeba*, *Giardia*, *Toxoplasma gondii*

4. Molds: *Aspergillus*, *Penicillium*, *Alternaria*

5. Yeast: *Candida*, *Cryptococcus*.

The Center for Disease Control (CDC) reports that the most commonly accounted Food-borne infections are those caused by the bacteria *Campylobacter*, *Salmonella*, *Listeria monocytogenes*, and *Escherichia coli* O157:H7; and by a group of viruses called Norwalk-type viruses.

### ***Salmonellosis:***

An infectious disease, infection caused by a bacterium called *Salmonella*. People of all ages can catch *Salmonella*. Infants and young children are at a greater risk due to their underdeveloped immune systems. Most commonly spread by unwashed hands, cross-contamination, and infected animals.

*Salmonella* are now established as one of the most important causes of food-borne illness worldwide. *Salmonella* are members of the Enterobacteriaceae. They are Gram negative, non-spore forming rods which are facultative anaerobic and are generally motile with peritrichous flagella (except *S. gallinarum* & *S. pullorum*). Growth has been recorded from temperatures just above 5 °C up to 47 °C with an optimum at 37 °C. *Salmonella* are heat sensitive and are readily destroyed by pasteurization temperatures, and sensitive to low pH (4.5 or below) and do not multiply at a  $a_w$  0.94, especially in combination with a pH at 5.5 and below. The cells survive under frozen and dried states for a long time. They are capable of multiplying in many foods without affecting the acceptance qualities. *Salmonella* are natural inhabitants of the gastrointestinal tracts of domesticated and wild animals, birds, and insects. In animals and birds, they can cause Salmonellosis and then persist in a carrier state. Humans can also be carriers following an infection and shed the pathogens through feces for a long time. They have also been isolated from soil, water, and sewage contaminated with fecal matters. There are specific serotypes that are capable of producing food-borne illness including *S. enteritidis* (egg & egg products), *S. newport* (milk & dairy cows), and *S. typhimurium* (cattle).

*Salmonella* are the cause of two diseases called :

**\*\*Enteric fever (typhoid)**, resulting from bacterial invasion of the bloodstream.

**\*\*Acute gastroenteritis**, resulting from a food-borne infection/intoxication.

### **Pathogenesis:**

Following ingestion, the pathogen colonizes in the small and large intestines and most of the pathological lesions are reported to be found in the large intestine rather than in the small intestine. The organism adheres to the mucosal cells using fimbriae or other adhesion factors and then actively invades mucosal cells. Bacteria can also enter through M cells in Peyer's Patch, a localized lymphoid tissue in the small intestine. *Salmonella* multiplies inside epithelial cells and macrophages and eventually lyses the cells. As a result, inflammation and severe edema occur in the site of infection and lead to mucosal damage. The inflammatory cells such as neutrophils, activated macrophages, and so forth release prostaglandins that increase the cyclic adenosine monophosphate (cAMP) which inhibits the uptake of sodium ion and release of chloride ion. Electrolyte imbalance facilitates fluid loss resulting in diarrhea. Then **cytotoxic factor** produced by *Salmonella* is also thought to be responsible for inflammation and tissue damage resulting in the loss of fluid and electrolytes. Production of the **enterotoxin** is directly related to the growth rate of the pathogens.

### **Symptoms:**

Infection usually causes a self-limiting enterocolitis with symptoms resolving within days. People infected with *Salmonella* develop diarrhea, acute onset of fever, abdominal cramps, nausea and sometimes vomiting 12 to 72 hours after infection.

Dehydration is the principal clinical concern. Illness lasts 4 to 7 days and people recover without treatment. The elderly, infants and those immunocompromised are most likely to have a severe illness. The infection may spread from the intestines to the blood stream and the associated dehydration can become severe and life-threatening.

### **Transmission**

Transmission from one host to another is primarily through the air, Infection acquired from contaminated food. *Salmonella* live in the intestinal tracts of humans and other animals, including birds, *Salmonella* are usually transmitted to humans by eating foods contaminated with animal faeces. Contaminated foods are often of animal origin, such as beef, poultry, milk, or egg, but any food including vegetables may become contaminated. The disease has a greater chance of spreading in overcrowded condition, Vertical transmission (transmission of the bacteria to and egg) can occur.

### **Control and Prevention:**

- Proper hygiene is the best way to prevent outbreaks of *Salmonella*.
- There is no vaccine to prevent Salmonellosis.
- Cross-contamination of food should be avoided.
- *Salmonella* can survive several weeks in a dry environment and several months in water.
- Destroy the bacteria when further cooking. Avoid uncooked food (People should not eat raw or undercooked eggs, poultry or meat).
- Prevention and detection is better than cure.
- Be particularly careful with food prepared for infants, the elderly and the immunocompromised.
- Mother's milk is the safest food for young infants.

### **Treatment :**

Usually resolve in five to seven days and many times require no treatment unless the patient becomes severely dehydrated or the infection spreads from the intestines. Treatment with antibiotics is not usually necessary. But if the infection spreads from the intestines or otherwise persists, the infection can be treated with Ampicillin, Gentamicin, Trimethoprim , Sulfamethoxazole , Amoxicillin. The length of treatment varies depending on the extent of a patient's illness and can range from 14 days for enteric fever to six weeks for bacteraemia.