

Food poisoning and meat microbiology:

Food poisoning is an acute illness associated with the recent consumption of food, having normally a short incubation period and symptoms with gastro-intestinal features, although in some cases there may be neurological and other signs not connected with the alimentary canal.

Types of food poisoning:

Food poisoning includes Bacterial food poisoning, Chemical contamination of food, Plant toxin contamination of food, Food allergies and Food-borne viruses.

Food allergy, or hypersensitivity to certain foodstuffs, is not uncommon. They are generally protein in nature, e.g. milk, eggs, cheese, fish, shellfish, pork, but also mushroom, tomato etc. The tendency to be sensitive to some foodstuffs may be hereditary. It is stated that some 30% of all persons are allergic to some foodstuffs.

Chemical contamination usually occurs by accidental contamination or some unforeseen chemical action between a foodstuff and its container. The metal encountered may be copper, lead, arsenic.

Inherently poisonous substances can occur in normally edible plants and animals including certain fungi, berries, fish and shellfish.

Bacterial food poisoning:

Bacterial contamination by live bacteria or bacterial toxins is much the most important and frequent type of food poisoning. In literal sense diseases such as typhoid fever, dysentery, cholera, undulant fever might be regarded as examples of food poisoning. With the exception of botulism, it is customary to restrict the term to mean acute gastroenteritis from the ingestion with the food of certain microorganisms or of bacterial toxins

resulting from the multiplication of those organisms in the food prior to its consumption.

Bacterial food poisoning, therefore, may take one of two forms: *infection with living organisms or intoxication by pre-formed bacterial poisons*. The feature which chiefly distinguishes the two types clinically is *the interval between eating the food and the development of symptoms*. Where pre-formed toxins are present the conditions are somewhat analogous to chemical poisoning and symptoms will develop very rapidly, usually within 4 hours or less. But if living organisms are ingested, some time will elapse before their multiplication in the body has proceeded sufficiently to provoke the usual reactions of diarrhea and vomiting, this period naturally depends to some extent on *the initial dose*, but is seldom less than 12hrs and may be much longer.

Organisms causing infections:

The main organisms responsible for food poisoning by infection are *Salmonella, Escherichia coli, Campylobacter and Vibrio parahemolyticus (fish and shellfish)*. Those responsible for poisoning by toxin production include *Staph. aureus, C. perfringens, C. botulinum, B. cereus (cereals) and Streptococci*. Many other bacteria occasionally cause outbreaks of food poisoning, including streptococci, Proteus, Pseudomonas, Providencia, Citrobacter, Aeromonas hydrophilia, Y. enterocolitica, Shigella flexneri and Shigella sonnei. **Viruses** are sometimes implicated, as *are toxins from fungi*, such as Aspergillus flavus (producing an aflatoxin in groundnuts and cereals). And moulds such as Fusarium graminearum.

Salmonellae:

The Salmonellae constitute a large group of organisms of which more than 2000 different serotypes have been described. They

are capable of causing disease in animals and man when taken into the body in sufficient numbers.

Salmonella food poisoning is characterized by symptoms which do not appear until at least 12 hrs have elapsed (incubation period 6-36hrs). The illness is due to the growth of the organisms within the body , tends to be prolonged and is sometimes fatal.

Salmonellae reach food in many different ways: **either directly at slaughter from animal excreta or from human excreta transferred to food by hands, utensils, equipment, flies, etc.**

Food poisoning is more likely to occur if the total number of organisms present is high, a small number may have no ill effect. If the temperatures and other conditions are suitable, there can be a great multiplication in numbers of organisms.

The following control measures have been shown to considerably reduce the Salmonella carrier rate in cattle , sheep and poultry and thereby the related incidence of cases of food poisoning:

- 1.the use on the farm of feeding stuffs free from salmonellae.
2. hygienic standards of animal husbandry, including proper control of slurry disposal and water supply and full protection from insects and rodents.
3. hygienic conditions of transport and lairagings , with the avoidance of stress at all stages from farm to slaughter.
4. proper design of slaughter lines and the adoption of efficient, hygienic methods of slaughter and carcass dressing which minimize cross-contamination.
5. suitable sewage treatment .
6. bacteriological monitoring
7. efficient refrigeration and hygienic methods of processing.
8. avoidance of consumption of raw meats , unhygienic handling in the home and the use of storage systems which contribute to the proliferation of bacteria of all types.
9. complete thawing of frozen meats and adequate cooking to ensure destruction of potential pathogens and spoilage organisms.

Campylobacter:

Campylobacteriosis is caused most often by *Campylobacter jejuni* but also *C. fetus* and *C. coli*. Poultry and cattle are the main reservoirs for human infection which is acquired by ingesting contaminated raw milk, undercooked chicken or other food contaminated in the kitchen. The incubation period is 1-10 days, usually 3-5 days. There is acute onset of fever, abdominal pain and diarrhea which may be blood stained but which usually resolves within 10 days. It may cause pseudo-appendicitis and, rarely, septicemia and arthritis.

E.coli:

It is normal inhabitant of the intestinal tract of man and animals, but some strains can cause disease. Hemorrhagic colitis or hemolytic uremic syndrome (HUS) is a newly recognized food borne disease which may lead to hemolytic anemia with renal failure. The causative agents are enterotoxin-producing strains of *E.coli*. the main source of infection are undercooked beef and raw milk and by person-to-person fecal-oral spread.

The incubation period is 1-12 days. Symptoms range from mild diarrhea to severe abdominal pain with profuse watery or bloody diarrhea with or without low-grade fever but of short duration. Hemorrhagic diarrhea may be followed by hemolysis and renal failure.

Yersinia:

Yersiniosis is usually a self-limiting enteric bacterial infection which can be food-borne. It is caused by *Y. pseudotuberculosis* and *Y. enterocolitica*. The incubation period is 3-7 days. There is an acute onset of fever followed by abdominal pain and diarrhea for 1-3 weeks. Pharyngitis is a common symptom. Symptoms similar to appendicitis also occur, occasionally followed by arthritis and erythema nodosum.

Vibrio parahymolyticus:

It is commonly found in sea creatures and sea food.

Listeria:

Listeriosis occurs mainly in pregnant women , neonates , immuno-suppressed patients and the elderly. It can cause fatal meningoencephalitis and abortion. The causative agent is *Listeria monocytogenes*. The agent is widely distributed in animals, birds , humans and soil. The organism is excreted in animal feces. Refrigeration of foods may encourage selective growth of listeria.

Preventive measures include, as for all food illnesses, the thorough cooking of all food stuffs derived from animal sources , especially poultry, heat treatment of milk, the prevention of recontamination after cooking, proper refrigeration , recognition , control and prevention of animal disease and high standards of hygiene.

Organisms causing intoxications:

The most commonly implicated organism in this respect is *Stph. aureus*, others are *Streptococci*, *Cl. Perfringens* and *Cl. botulinum*. In recent years *B. cereus* , an aerobic sporing organism found in cereals and other foods has caused food poisoning. The spores , like those of *Cl. Perfringens*, are very resistant and can survive cooking temperature to replicate and produce toxin in the food.

Staphylococci are commonly found on the skin and in the upper respiratory tract of man and animals and can easily contaminate foods of all forms. They produce toxin in the food before it is eaten and cause symptoms which develop rapidly (2-3 hrs) and usually disappear within 24hrs. these include vomiting , diarrhea, severe abdominal cramps and sometimes collapse. Though the organisms themselves are readily destroyed at

pasteurizing temperatures, the toxin appears to be heat stable and is not activated by boiling or refrigeration for long periods.

Cl. Perfringens is a common inhabitant of the intestinal tract of man and animals, and can readily gain access to food, especially meat dishes. The spores are very resistant and can survive the usual cooking temperatures **to produce toxin in the intestine after germination into vegetative forms**. The symptoms develop within 8-24 hrs afterwards in the form of nausea, abdominal pain and diarrhea due to the production of toxin within the bowel lumen. Symptoms usually continue for 12-48hrs.

Botulism:

The causal organism, Cl. Botulinum, is an obligate spore-forming anaerobe of the putrefactive type. It is saprophyte and **does not multiply in the human or animal body, so that cross-infection cannot occur**. The organism is classified into six types, A,B,C,D,E and F, the toxins of which can be differentiated from each other, antitoxin prepared from one type of organism does not inactivate the toxins of the other types.

Pathogenesis:

Botulism is caused by **a powerful exotoxin produced by the organism during its growth in food material**, the exotoxin can resist the action of the gastric and intestinal juices but is destroyed in 30 minutes at a temperature of 80 C.

Botulinus toxin is one of the most powerful poisons known. Its calculated lethal dose for an adult man is in the region of 10Ug. It is about 25 times as toxic as its closest rival, the toxin of Cl. tetani. Among the most resistant of all micro-organisms are the spores of Cl. botulinum Type A which can survive temperatures of 120 C.

Method of infection:

The organism is a natural inhabitant of the surface layers of the **soil** and thus may easily contaminate fruit, vegetables or other cultivated produce. Where meat foods are infected, soil contamination is the most likely cause. The incriminated food

has in most cases **been smoked , pickled or canned, allowed to stand and then eaten without adequate cooking.**

Meat is a favorable medium for the growth of *Cl.botulinum* , and as the spores vary in their resistance to heat and may **withstand boiling at a temperature of 100 C for up to 22hrs, they are likely to survive any ordinary sterilization.**

Symptoms:

The symptoms of botulism are produced by the action of a powerful exotoxin which possesses an affinity **for nerve tissue.** The period of incubation in man is usually under 24hrs, but may be longer, and is followed by a typical chain of symptoms which **include thirst, nerve paralysis and great muscular weakness (no diarrhea , no vomiting).**

Methods of prevention:

1. The spores of *Cl. Botulinum* are resistant to heat and can withstand boiling at 100C for 22 hrs, but are destroyed at a temperature **of 120C for 20 minutes**; the greater the **acidity** of the food the more rapid is the destruction of the spores. These factors are taken into account in modern canning procedure.
2. **pickled foods** are rendered safe if the brine used contains not less than 10% common salt.
3. **preserved foods possessing rancid or other odors should be rejected. If a housewife tastes a faulty can of food which contains botulinum toxin and spits it from her mouth there is enough toxin remaining in her mouth to cause death.**
4. the utmost care should be taken in the **manufacture of cans,** their transport, handling, storage and subsequent examination on purchase.

Factors controlling food-poisoning outbreaks:

The factors which chiefly determine the multiplication of pathogenic organisms are:

1. **Moisture:** food poisoning bacteria will grow on **the damp surfaces of meat and in foods both damp and loosely packed,** such as sausages, may penetrate and spread throughout the food.

2. *temperature range*: the majority of outbreaks occur in **summer** when the temperature favors bacterial growth.
3. *cooking*: most food poisoning bacteria grow more quickly on **protein denatured** by cooking and outbreaks often stem from reheated food. **Cooked foods should never be warmed slowly but heated thoroughly and allowed to simmer for 15 minutes.**
4. *time before consumption*: long storage and inadequate reheating are the factors most likely to increase the pathogenicity of food if the relevant bacteria are present. **The period between cooking and eating should never be longer than 1 hr unless food is stored above 60 C or in the cold.**
5. *treatment after cooking*: food should be cooled quickly and refrigerated if not eaten immediately.
6. *hygiene*: high standards of both personal and work area hygiene are essential.
7. *pests*: flies, mice, rats, etc. must be controlled.
8. *injuries*: personnel with septic lesions or excreting intestinal pathogens like salmonellae must avoid food areas.
9. *clothing*: suitable protective clothing which is easily cleaned must be provided for food personnel.
10. *medical facilities*: a well equipped medical department cannot only hygienically treat first-aid cases but also advise on health and hygiene practices.

Investigation of outbreaks of food poisoning:

The first step in the control of outbreaks of food poisoning of any communicable disease is **its rapid identification and notification to the local health authority** so that appropriate measures can be taken speedily to limit morbidity and mortality. Food poisoning outbreaks are usually recognized by the **occurrence of sickness among several individuals within a relatively short time following the consumption of one or more foods in common.** It is of great value to recognize the characteristics of **the principal food poisoning bacteria since this will assist in the diagnosis.** This applies especially to factors

such as **the incubation period** which may suggest an infection or an intoxication.

The nature of **the clinical features and an estimate of the incubation period** are useful in determining the possible type of infection. **Feces, vomits, and food samples must be collected with care for lab. examination. Any remaining of food should be withheld under refrigeration.** It is important to identify the **specific food eaten and not eaten and compare the attack rates.** The implicated food items will have the highest attack rates; most of the sick persons will have eaten the contaminated food while those not affected will be fewer in number. **Information on the preparation , storage, refrigeration, thawing, reheating, etc. of the food is important.**

Possible sources of contamination must be looked for and the **standards of general and personal hygiene assessed. Non-isolation of bacteria does not necessarily mean that heat resistant toxin is not present in the food.**