# UNIT 11 BACTERIAL FOOD INFECTIONS

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## 11.0 OBJECTIVES

After reading this unit, you will be able to:

- describe major bacteria causes food born infections
- explain the mode of transmission of the food borne infection, symptoms and preventive measures.

## 11.1 INTRODUCTION

Food infection occurs when a pathogen enters the gastrointestinal tract and multiplies. Microorganisms can penetrate into the intestinal mucosa and grow there, or they can pass through other systemic organs. Infections are characterized by a delay in the appearance of gastrointestinal disturbance while the pathogen increases in numbers or affects invaded tissue. There is also usually a fever, one of the body's general responses to an infective organism.

Foodborne infections remain a major public health problem. The Council for Agricultural Science and Technology estimated in its 1994 report, *Foodborne Pathogens: Risks and Consequences*, that as many as 9,000 deaths and 6.5 to 33 million illnesses in the United States each year are food-related.

### 11.1.1 Zoonotic Diseases

The World Health Organization defines Zoonoses (Zoonosis, sing.) as "Those diseases and infections which are naturally transmitted between vertebrate animals and man".

Mode of transmission: Feces, urine, saliva, blood, milk, via aerosol, oral, contact with bedding or animals, etc.

Approximately 150 zoonotic diseases are known to exist. Wildlife serves as a reservoir for many diseases common to domestic animals and humans. Persons working with wildlife should be alert to the potential for disease transmission from animals. Generally, disease is more easily prevented than treated. Many zoonotic diseases are so common in nature, so rare in humans, or so mild in their symptoms, that wild animals pose a minimal health risk to people.

Zoonotic diseases include:

- Those which can be transmitted directly from animals to humans (e.g. rabies).
- Diseases that can be acquired indirectly by humans through ingestion, inhalation or contact with infected animal products, soil, water, or other environmental surfaces which have been contaminated with animal waste or a dead animal (e.g. salmonellosis, leptospirosis, anthrax). *Campylobacter* infection is mainly found in chicken meat. Listeriosis and *E.coli* gastroenteritis are two other common infections caused by zoonotic agents. All these will be discussed one by one.
- A disease which has an animal reservoir, but requires a mosquito or other arthropod to transmit the disease to humans (e.g. St. Louis encephalitis, Rocky Mountain spotted fever).

## 11.2 SALMONELLOSIS

Salmonellosis is the most reported zoonotic disease in European countries. Salmonellosis (*Salmonella* gastroenteritis) results from the ingestion of foods that contain significant numbers of viable cells of the members of the genus *Salmonella*. It is the most frequently occurring food borne infection.

*Salmonella* are small gram negative, motile, non-spore forming rods that ferment glucose, usually with gas, but usually do not ferment lactose or sucrose. They are widely distributed in nature, with humans and animals being their primary reservoir. Generally large number of salmonellae typically $10^6$ to $10^9$ bacterium must be ingested to cause illness.

**Occurrence:** The initial source of the bacteria is the intestinal tract of animals such as birds, reptiles, farm animals, humans and occasionally insects. As intestinal form, the organisms are excreted in feces from which they maybe transmitted by insects and other living creatures to a large number of places, polluted water and contaminated food. The organism may get transferred from actual infected cases of the disease or from carriers. A carrier is defined as a person or an animal that repeatedly sheds bacteria, usually through feces, without showing any signs or symptoms of the disease. Infected rodents, rats and mice may contaminate unprotected foods with their feces and thus spread *Salmonella* bacteria. Flies may play an important role in the spread of *Salmonella*, especially from contaminated fecal matter to foods. Humans acquire the bacteria from contaminated food such as beef products, poultry, eggs, egg products or water.

**Symptoms:** The susceptibility of humans varies with the species and strains of the organism and the total number of bacteria ingested. A longer incubation period usually distinguishes salmonellosis from staphylococcus poisoning: usually 12-36 hours for the former and about 2-4 hours for the latter. The

principle symptoms of a salmonella gastroenteritis infection are nausea, vomiting, abdominal pain and diarrhoea that usually appear suddenly. This may be preceded by a headache and chills. Other evidences of the disease are watery, greenish-fowl-smelling stools, prostration, muscular weakness, faintness, usually a moderate fever, restlessness, twitching and drowsiness. The mortality is less than 1%. Intesibility may vary from slight discomfort and diarrhoea to death in 2 to 6 days. About 0.2 to 5.0% of the patients may become carriers of the *Salmonella* organism. During the acute phase of the disease, as many as one billion salmonellae can be found per gram of feces.

**Associated foods:** Raw meats, poultry, eggs, milk and dairy products, fish, shrimp, coconut, sauces and salad dressings, cake mixes, cocoa, peanut butter and chocolate.

**Conditions Necessary for Outbreak**

The food must contain or become contaminated with the *Salmonella* bacteria.

These bacteria must be there in considerable numbers i.e., food should be a good culture media, temperature favourable and enough time allowed for appreciable growth.

The viable organism must be ingested.

**Prevention of Outbreak:** The control of food borne salmonella infection requires the following:

1. Preventing food contamination by human carriers, especially food handlers.
2. Avoiding the use of animal products from domestic livestock that are grossly infected with salmonellae.
3. Avoiding the use of food ingredients that contain salmonellae.
4. Processing all foods susceptible to *Salmonella* contamination at time-temperature schedules sufficient to destroy the organism. Heating foods so that all portions reach 66ºC for 12-15 minutes will assure destruction of even most resistant *Salmonella* types.
5. Refrigerating all foods susceptible to *Salmonella* contamination and avoiding prolonged holding of these foods at room temperature.

## 11.3 ENTEROPATHOGENIC *ESCHERICHIA COLI*

*Escherichia coli* is generally regarded as part of the normal flora of the human intestinal tract and that of many animals. Serotypes of *E. coli* which have been implicated in human diarrhoeal diseases or food poisoning outbreaks and have been designated enteropathogenic *E. coli* (EEC). They grow over a wide range of temperatures, 20-40ºC with a minimum growth temperature at 10ºC and an optimum at 37ºC. Heating at 65ºC for 15-20 minutes is lethal. The pH range for growth is 4.2-8.50, with an optimum in the range of pH 7.2-7.5. *E. coli* will grow in the presence of 5.0% salt at 37ºC but 10% is inhibitory.

**Symptoms:** The *E. coli* gastroenteritis syndrome is caused by the ingestion of $10^6$-$10^{10}$ viable cells/g that must colonize the small intestine and produce enterotoxin. The syndrome is characterized primarily by non-bloody, watery diarrhoea without inflammatory exudates in stools. Incubation time of disease

is around 2 days after eating the contaminated food and may last for 8 days. Common symptoms included are cramps, chills, vomiting, aches and headache.

**Associated Foods:** *E. coli* is the etiologic agent of food poisoning involves variety of foods such as cream pie, mashed potatoes, cream puffs and creamed fish. Other *E. coli* food poisoning outbreaks have been attributed to the consumption of milk, cheese, ice cream, meats, fish and macaroni. *E. coli* is relatively sensitive to destruction by drying or freezing but some survivors may exist for extended periods.

"Enteropathogenic" strains colonize in the small intestine and cause acute gastroenteritis in newborns and in infants up to two years of age. "Enteroinvasive" strains invade the epithelial cells of large intestine and cause diarrhoea in older children and adults. "Enterotoxigenic" (enterotoxin producing) strains produce one or both of two different toxins:a heat stable toxin (ST) and a heat labile toxin (LT). Both toxins cause diarrhoea in adults and infants. Enterotoxigenic strains of *E. coli* are often associated with Travellers' diarrhoea, a common disease contracted by tourists when visiting developing countries. Diagnosis of travellers' disease is based on the past travel history and symptoms. Laboratory diagnosis is by isolation of the bacteria from feces. Treatment is with fluid and electrolytes. Other strains of *E. coli* which are usually harmless in their normal habitat (the intestine) can cause disease when they gain access to other sites or tissues. These diseases include urinary tract infections, septic infections, bacteremia, meningitis, pulmonary infections, abscesses, skin and wound infections.

**Prevention and Control:** Involves avoiding contaminated food and water that have high coliform counts, avoiding unpasteurized juices, washing fresh fruits and vegetables thoroughly before eating raw, using adequate cooking procedures for destruction and prompt refrigeration. Most people recover from *E. coli* infection within 5-10 days without treatment. Antibiotics and antidiarrhoeal drugs are usually not helpful.

## 11.4 *BACILLUS CEREUS* GASTROENTERITIS

*Bacillus cereus* is not a common cause of food poisoning. It is a Gram positive, aerobic, spore forming rod shaped bacteria normally present in soil, dust and water. The bacterium has a minimum growth temperature around 4-5ºC, with maximum around 48-50ºC. Optimum pH range for growth is 4.9 to 9.3.

**Symptoms:** Extremely large numbers ($10^8$ per gram) of viable cells of *B.cereus* must be ingested to develop signs and symptoms of the syndrome. The bacterial cells produce intoxication characterized by acute abdominal pain, flatulence and watery diarrhoea. Headache and dizziness are common, dehydration and prostration may occur but nausea, vomiting, fever and chills are rare. The illness appears within 6-15 hours after consumption of food and the symptoms usually last less than 24 hours.

**Associated Foods:** Vehicle foods consist of cereal dishes that contain corn and corn starch, mashed potatoes, vegetables, minced meat, liver sausage, milk, cooked meat. Food mixtures such as sauces, puddings, soups, pastries and salads have frequently been incriminated in outbreaks.

## 11.5 CHOLERA

Cholera is caused by the gram negative, *V. cholerae*, which is acquired by ingesting food or water contaminated by fecal material from patients or carriers (shellfish and plankton may be the natural reservoir).

**Symptoms:** Once the bacteria enter the body, the incubation period is from several hours to three or more days. An infective dose of around one million organisms should be ingested to cause illness. The bacteria adhere to the small intestine wall, where they secrete the cholera enterotoxin, choleragen. As a result, there is hyper secretion of water and chloride ions, while inhibiting absorption of sodium ions. The patient experiences an outpouring of fluid and electrolytes with associated abdominal muscle cramps, vomiting, fever and watery diarrhoea. The diarrhoea can be so profuse that a person can lose 10-15 liter of fluid during the infection. Death may result from the elevated concentration of blood proteins, caused by reduced fluid levels, which leads to circulatory shock and collapse. Onset of the illness is generally sudden, with incubation periods varying from 6 hours to 5 days.

**Associated Foods:** Cholera is generally a disease spread by poor sanitation, resulting in contaminated water supplies. Sporadic cases occur when shellfish harvested from fecally polluted coastal waters are consumed raw.

**Diagnosis:** Cholera can be confirmed only by the isolation of the causative organism from the diarrheic stools of infected individuals.

**Prevention:** Following recommendations are there to prevent cholera outbreak:

- Drink only water that you have boiled or treated with chlorine or iodine. Other safe beverages include tea and coffee made with boiled water and carbonated, bottled beverages with no ice.
- Eat only those foods that have been thoroughly cooked and are still hot, or fruit that you have peeled yourself.
- Avoid undercooked or raw fish or shellfish.
- Make sure all vegetables are cooked, avoid salads.
- Avoid foods and beverages from street vendors.

A simple thumb rule is **"Boil it, cook it, peel it, or forget it"**.

**Control:** Individuals infected with cholera require oral rehydration therapy with NaCl plus sucrose, sodium bicarbonate and potassium chloride to stimulate water uptake by the intestine. The antibiotics of choice are a tetracycline or aproflaxin. The most reliable control methods are based on proper sanitation, especially of water supplies. The mortality rate without treatment is often over 50%. Medical treatment to prevent dehydration prevents all complications.

**Check Your Progress Exercise 1**

**Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Briefly discuss the Salmonella food infection.

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2. How do you prevent food borne infection?

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## 11.6 *VIBRIO PARAHAEMOLYTICUS* GASTROENTERITIS

While most other known food poisoning syndromes may be contracted from a variety of foods, *V. parahaemolyticus* gastroenteritis is contracted almost solely from seafood. It can grow in presence of 1-8% NaCl, in pH range 9.8-11.0 with 7.6-8.6 being optimum.

**Symptoms:** A total of greater than one million organisms may cause disease. Symptoms of intoxication which range from mild to severe and fatal, include abdominal pain, which maybe intense; a burning sensation of the stomach; vomiting and diarrhoea with watery stools and sometimes bloody discharges; fever. The mean incubation period is in range of 3-76 hours after the ingestion of the organism.

**Associated foods:** Vehicle foods for outbreak are raw, improperly cooked, or cooked, recontaminated seafoods, such as, oysters, shrimps, crabs, lobsters, clams and related shellfish. Cross-contamination may lead to other foods as vehicles. Improper refrigeration of seafoods contaminated with this organism will allow its proliferation, which increases the possibility of infection.

**Diagnosis:** Diagnosis of gastroenteritis caused by this organism is made by culturing the organism from the diarrheic stools of an individual.

**Prevention:** Consumption of raw or improperly cooked seafoods should be avoided as they are susceptible to infection by *V. parahaemolyticus.*

## 11.7 SHIGELLOSIS

Shigellosis or bacterial dysentery, is caused by facultatively anaerobic, gram-negative, non-spore forming, rod-shaped organisms belonging to the genus *Shigella* within the family enterobacteriacae. In general, shigellosis is a self-limiting disease, lasting 5 to 6 days if untreated, however in young malnourished children, the elderly and the immuno compromised (eg, AIDS patients), the disease may be fatal. It is estimated that shigellosis is responsible for the death of 500,000 children worldwide each year. There are many points of similarity between *Shigella* and *Salmonella*. They dwell primarily in the gastrointestinal tract, with optimum temperature of 37ºC, grow both aerobically and anaerobically they grow freely in warm, bland, moist foods. But unlike salmonellae, the shigellae have no flagella and thus are non-motile. The species involved are *Shigella sonnei, S. dysenteriae, S. flexineri* and *S. boydii*. As few as 10cfu of *S. dysenteriae* are known to initiate infection in susceptible individuals. The illness caused by *Shigella* accounts for less than 10% of the reported outbreaks of food borne illness in US. The organisms tolerate salt concentration of 5-6% and are relatively heat sensitive.

**Occurrence:** Poor personal hygiene is a common factor in food borne shigellosis, with shellfish, fruits and vegetables, chicken and salads being prominent among vehicle foods. The prominence of these foods is due to the fecal-oral route of transmission. Outbreaks have been also traced to foods such as chocolate pudding, salads.

**Symptoms:** Pathogenicity involves the release of lipopolysaccharide endotoxin which infects the intestinal mucosa. Shigellosis ranges from fairly mild to very severe and fatal. The onset is usually abrupt, requiring from 1-7 days of incubation, but sometimes requiring as many as 14 days. Symptoms are abdominal pain and cramps caused by inflammation of mucus surface of large intestine, nausea, diarrhoea, vomiting, elevated temperature. The mortality associated with *S. dysenteriae* infection is around 20% but it is much lower with other species. In severe instances, excessive diarrhoea leads to electrolytic imbalance in the bloodstream and ulceration in large intestine. There may be kidney failure, jaundice and persistent internal bleeding. The infection is localized and organs other than the large intestine are not invaded.

**Diagnosis:** Serological identification of culture isolated from stool helps to diagnose the disease.

**Prevention and Control:** The control of *Shigella* food borne infection is similar to that of salmonellae; avoiding contamination of foods by animal or human carriers or their excrement, thorough cooking and prompt cooling. Proper personal hygiene should be maintained. In severe cases of shigellosis, dehydration of the body may necessitate intravenous replacement of fluid with electrolytes. Ampicillin antibiotic can decrease the duration of the disease.

## 11.8 CAMPYLOBACTERIOSIS

It is caused by *Campylobacter jejuni*, a Gram negative rod. It is a microaerophillic organism, which means it has a requirement for reduced levels of oxygen. It is often isolated from healthy cattle, chickens, birds and even

flies. It is also sometimes present in non-chlorinated water sources such as streams and ponds. The bacteria cause between 5 and 14 per cent of all diarrhoeal illnesses worldwide. C. jejuni primarily affects children under 5 years old and young adults (15-29 years old).

**Symptoms:** *C. jejuni* infection causes diarrhoea, which may be watery or sticky and can contain blood and fecal leukocytes (white cells). Other symptoms often present are fever, abdominal pain, nausea, headache and muscle pain. The illness usually occurs 2-5 days after ingestion of the contaminated food or water. Illness generally lasts 7-10 days, but relapses are not uncommon (about 25% of cases). Most infections are self-limiting and are not treated with antibiotics. The infective dose of *C. jejuni* is considered to be 400-500 bacteria.

**Associated Foods:** *C. jejuni* frequently contaminates raw chicken. Survey shows that 20-100% of retail chickens are contaminated. Many healthy chickens carry these bacteria in their intestinal tracts. Raw milk is also source of infections. The bacteria are often carried by healthy cattle and by flies on farms. Non-chlorinated water may also be a source of infection.

**Prevention:** the various ways to prevent campylobacteriosis are:

- Wash hands before preparing foods.
- Wash hands immediately after handling raw poultry or other meat.
- Proper cooking of chicken to internal temperature of 170ºC.
- Drink pasteurized milk and chlorinated water.
- Wash hands after handling pet feces or visiting zoos.

**Control:** If a person is suffering from campylobacteriosis, he can take an antibiotic such as ciproflaxin or azithromycin. Erythromycin also helps to treat the diarrhoea. Those having diarrhoea should take plenty of water.

### Check Your Progress Exercise 2

**Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. Give the causative organism and symptoms of Bacillary Dysentry.

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2. What are the symptoms and foods associated with campylobacteriosis?

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## 11.9 YERSINIOSIS (*YERSINIA ENTEROLYTICA* INFECTION)

In the genus Yersinia, 11 species are recognized, including *Y. pestis*, the cause of plague. The species of primary interest in foods is *Y. enterolytica*.

**Occurrence:** *Y. enterolytica* is widely distributed in the terrestrial environment and in lake, well and stream waters which are sources of warm-blooded animals. It is more animal adapted and is found more often among human isolates than the other species.

Animals from which *Y. enterolytica* has been isolated include cats, birds, dogs, beavers, guinea pigs, rats, camels, horses, chickens, deer, cattle, swine, fish and oysters. It is widely believed that swine constitutes the single most common source of *Y. enterolytica* in humans.

In addition to gastroenteritis, this organism has been associated with human pseudoappendicitis, mesenteric lymphadenitis, reactive arthritis, colon and neck abscesses and cholecystis. It has been recovered from urine, blood, cerebrospinal fluid and the eyes of infected individuals. It is also recovered from the stools of gastroenteritis victims.

**Associated Foods:** The organism has been isolated from cakes, vacuum-packaged meats, seafood, vegetables, milk and other food products. It has been isolated also from beef, lamb and pork. Of all sources, swine appears to be the major source of pathogenic for humans.

**Symptoms:** Symptoms of the gastroenteritis syndrome develop several days following ingestion of contaminated foods and are characterized by abdominal pain and diarrhoea. Children appear to be more susceptible than adults and the organism may be present in stools for up to 40 days following illness. A variety of systemic involvements may occur as a consequence of the gastroenteritis syndrome.

The usual symptoms, including severe abdominal pain, fever and diarrhoea occur 24 to 36 hours after consumption of the product. The abdominal discomfort is quite specific and usually manifests itself as a sharp pain in the lower right quadrant of the abdomen. For this reason it has frequently been described as pseudoappendicitis.

Although the organism has been isolated from many foods, there have been relatively few food-borne outbreaks attributed to *Y. enterolytica*. The isolation from pasteurized milk is probably the result of post pasteurization contamination. The unique characteristic of the organism is its ability to grow at commercial refrigeration temperatures, i.e. less than 5ºC.

## 11.10 *LISTERIA MONOCYTOGENES* INFECTION (LISTERIOSIS)

*Listeria monocytogenes* is a gram-positive, motile, non-sporing rod. It is widely distributed in nature and can be found on decaying vegetation and in soils, animal feces, sewage, silage and water. In cattle it can result in abortion and mastitis and the infected animals shed the organism in milk. Other infected organisms including sheep and chicken can serve as source of the organism in the food supply.

**Syndrome:** Listeriosis in humans is not characterized by a unique set of symptoms since the course of the disease depends upon the state of the host. Non-pregnant healthy individuals who are not immunosuppressed are highly resistant to infection by *L. monocytogenes*. When susceptible adults contract the disease, meningitis and sepsis are the most commonly recognized symptoms. Pregnant females who contract the disease may not present any symptoms, but when they do, they are typically mild and influenza-like. Abortion, premature birth or still birth is often the consequence of listeriosis in pregnant females. When a newborn is infected at the time of delivery, listeriosis symptoms typically are those of meningitis and they begin at 1 to 4 weeks after birth, although a four week incubation has been recorded. The usual incubation time in adults ranges from one to several weeks.

Since *L. monocytogenes* can grow over the temperature range of about 1º to 45ºC and the pH range 4.1 to around 9.6, it maybe expected to survive in foods for long periods of time.

Some of the ways in which *L. monocytogenes* is disseminated throughout the environment, along with the many sources of the organism to humans, are illustrated below.

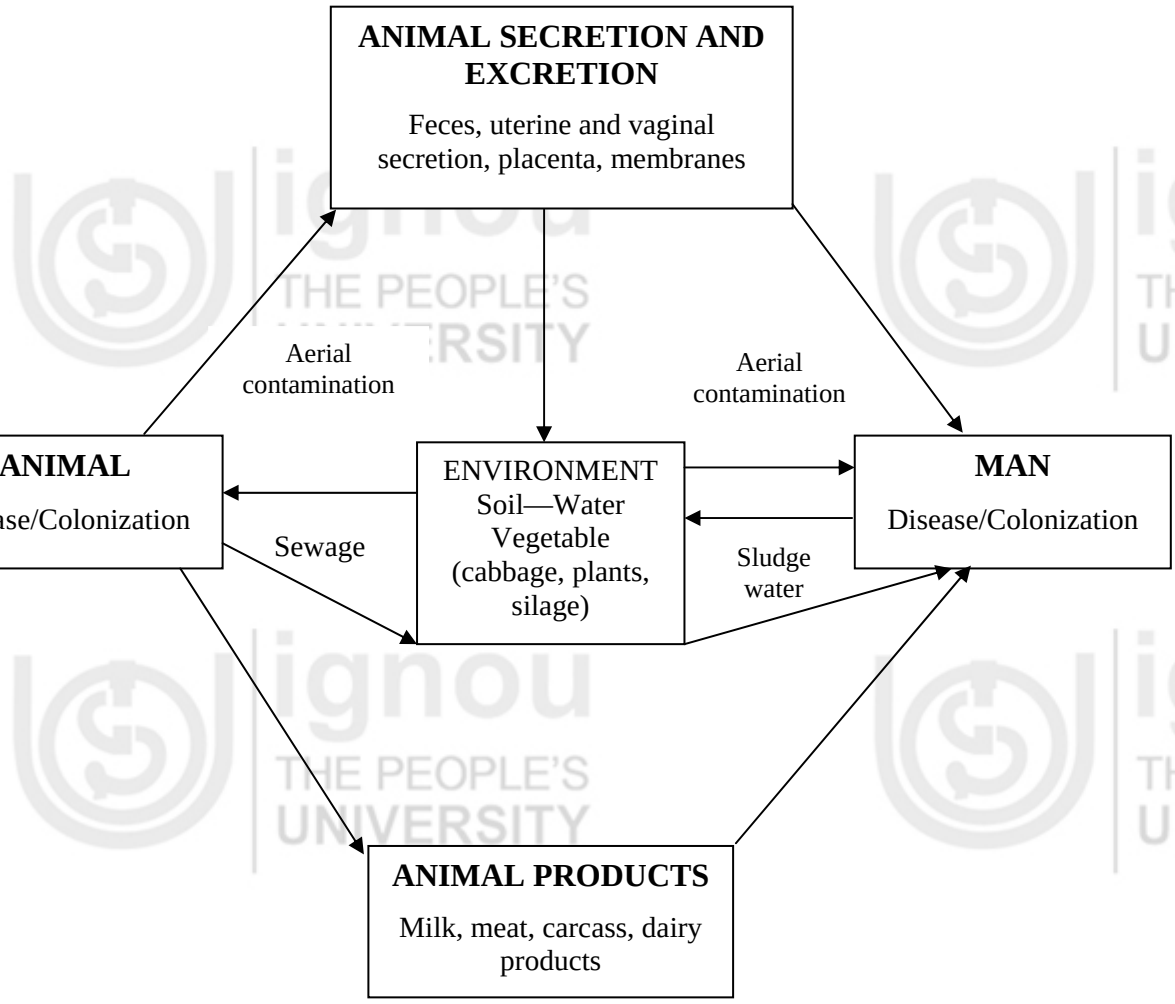


**Figure 13.1: Ways in which *L. monocytogenes* is disseminated in the environment, animals, foods and humans**

**Check Your Progress Exercise 3**

**Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What is yersiniosis? Give its symptoms.

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2. How is *L. monoctogenes* infection transmitted?

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**Tips on Foodborne Illness Prevention for Consumers**

*Salmonella, Escherichia coli, Shigella, Campylobacter, Listeria,* and the list goes on. Interesting names for little organisms that can cause big bad health problems. Bacterial foodborne diseases have become an acute public health crisis in this country, responsible for about 6.5 to 81 million illnesses and 9,000 deaths per year. While it is unrealistic to think there would ever be a zero level of contamination in our food supply, 90% - 95% of all foodborne bacterial illness is preventable. You cannot see, taste, or smell most bacterial foodborne problems, so here's what you can do to safeguard your family.

In General:

- Don't ever consume products such as unpasteurized milk or unpasteurized apple cider or other foods made with unpasteurized products. Thoroughly cook all meat, poultry and fish products. Meats are thoroughly cooked at 71ºC, poultry at 82ºC, and fish when they easily flake with a fork.
- Break open any hamburger patties (other ground meat dishes such as meatballs, too) prior to ingestion to make sure there is no pink meat and that the juices run clear.

***When Dining Out***

- Hot food should be served hot and cold food should be served cold or send it back.
- Talk to the restaurant manager. Find out how much importance they place on sanitary and bacterial issues. Do they routinely use thermometers? Do

they own and routinely use a thermocouple which is a special thermometer used to accurately test temperatures of thin food? If you receive undercooked food (especially ground meat) express your displeasure and nicely inform them of the risks. Let them know how important food safety is to you.

***When Shopping***

- Take great care to avoid dripping raw juice from meat, poultry or fish onto your hands or other foods, especially produce. Raw juices often contain bacteria.
- Shop for cold and frozen foods last and take them immediately home to the refrigerator or freezer. Use ice chests in your car during transport, especially in the summer months or when running errands.
- Buy food only if it is in good condition. Frozen foods should be solid, refrigerated case food should be well-chilled, and canned goods should be free of dents and bulging lids. Point out any problems to the store manager.

***When in your Kitchen***

- Always wash your hands in hot soapy water before food preparation and after handling raw meat, poultry or fish.
- Keep your refrigerator's temperature as cold as possible without freezing your milk or produce (approximately 4°C). Keep your freezer's temperature cold enough to keep frozen food rock hard (approximately -18°C). If you are ever in doubt, temperatures can be checked with an appliance thermometer.
- After shopping, put any fresh meat, poultry, or fish, which won't be use within the next few days directly into the freezer.
- Thaw frozen food in the refrigerator or in a microwave followed by immediate cooking. ***Do not thaw food at room temperature on the counter***.
- Take great care to avoid dripping of raw meat, poultry, or fish juices onto or into other foods in the refrigerator. Use plates, platters or containers under them if necessary.
- Never put cooked food back on a plate/container which has had fresh juices on it. For example, when barbecuing take out an extra platter to put the grilled food on.
- Use non-porous plastic cutting boards for preparation and cutting of meat, poultry, and fish.
- Wash all cutting boards surfaces, platters, and containers which fresh meat, poultry, and fish have come in contact with, in hot, soapy water thoroughly before using for other foods.
- Avoid cross contamination by washing kitchen towels after contact with raw juices and by replacing sponges often. *Use paper towels wherever you can.* A good disinfectant for utensils and countertops is one tablespoon household bleach in few litres of water.

- When using eggs, cook them until firm. Don't use recipes calling for only partially cooked eggs. For example, raw cookie dough could be dangerous.

When using the microwave remember there can be cold spots, so stir and rotate food for thorough cooking.

## 11.11 THE MOST IMPORTANT POINT TO REMEMBER IS TO WASH YOUR HAND

Preferably with antibacterial soap for at least 20 seconds....

- ***before food preparation***
- ***after fresh meat, poultry, or fish handling and before you then touch other food, eat, or prepare baby bottles***
- ***after using the bathroom***
- ***after changing diapers***
- ***after helping toddlers in the bathroom***
- ***after cleaning the bathroom***
- ***after handling pets, cleaning litter boxes or dog runs***

**PLEASE REMEMBER: Foodborne bacterial illness can be very contagious.** This is called secondary transmission where a person gets ill not from ingesting the contaminated food but from coming in close contact with someone who has. Secondary transmission has been documented in the home, in day care centres, in preschools, in schools, in hospitals, and in senior citizen facilities. When someone you know has diarrhoeal illness, use extreme sanitary measures, to guard against the spread of the disease. The use of anti-diarrhoeal medication for treatment of foodborne bacterial diarrhoea is not recommended and in some cases can be harmful. If symptoms are severe, see your doctor. If food poisoning is suspected, call your local health department. Your prompt action could help prevent someone else from getting ill.

## 11.12 LET US SUM UP

In this unit, we attempted to familiarize you with certain outbreaks of bacteria which are responsible for food borne infections. We hope that you will be able to know the various bacteria which cause food borne infections. You will also be able to differentiate in the symptoms of the diseases caused and list the main reasons for the outbreak of the infections. This unit would also have helped you to know the information regarding the prevention of the outbreaks of the disease.

## 11.13 KEY WORDS

**Food Infection** : Food borne disease caused due to ingestion of large number of viable organisms which cause disease.

**Zoonotic Diseases** : Those diseases and infections which are naturally transmitted between vertebrate animals and man.

**Salmonellosis** : Food borne infection caused by *Salmonella gastroentritis*.

**Enterotoxigenic *E. coli*** : *E. coli* which produce toxins in the intestine.

**Cholera** : Food borne infection caused by *Vibrio cholarae*.

**Shigellosis** : Food borne infection caused by *Shigella sonnei, S. dysenteraei*.

**Yersiniosis** : Food borne infection caused by *Yersinia enterolytica*.

**Listeriosis** : Food borne infection caused by *Listeria monocytogenes*.

## 11.14 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

**Check Your Progress Exercise 1**

1. 
   - Salmonella food infection is caused by *Salmonella gastroenteritis*.
   - Transmitted by fecal contamination of foods.
   - Incubation period 12-36 hours.
   - Symptoms: nausea, vomiting, diarrhoea, abdominal pain and green watery stools.
   - About $10^6$-$10^9$ organisms must be ingested to cause infection.
   - *Salmonellosis* prevented by: prevention of contamination of food by Salmonella, avoiding intake of contaminated food and by destruction of organism at 66ºC for 12-15 min.

2. Prevention of Food borne infections:
   - Avoid consumption of contaminated foods and water
   - Eat properly cooked foods
   - Wash raw fruits and vegetables properly
   - Proper hygiene

**Check Your Progress Exercise 2**

1. 
   - Bacillary dysentery is caused by *Shigella* sp. (*Shigella sonnei, S. dysenteraei).*
   - Incubation period is about 1 to 7 days.
   - Causes abdominal pain, cramps, inflammation of intestinal mucousa, diarrhoea, vomiting, nausea and fever.
   - In severe cases; intestinal bleeding, electrolytic imbalance, ulceration, kidney failure and jaundice.

2. • Campylobacteriosis incubation period: 2-5 days after ingestion of contaminated food.

- Symptoms: Diarrhoea containing blood, fever, abdominal pain, nausea, headache and muscle pain.
- Transmission of infection by raw chicken, raw milk and non-chlorinated water.

**Check Your Progress Exercise 3**

1. 
   - Yersiniosis caused by the bacteria *Yersinia enterolytica*.
   - Causes severe abdominal pain, fever and diarrhoea.
2. 
   - Listriosis caused by *Listeria monocytogenes* infection.
   - Transmitted by animal excretions (fecal matter) and secretions, infected vegetables, aerial contamination, sewage, sludge, polluted water, rivers and infected animal products like milk and milk products, meat, fish etc.

## 11.15 SOME USEFUL BOOKS

1. Ayers, J.C., Mundt, J.O., Sandine, W.E. (1980) Microbiology of Foods, W.H Freeman and Co., San Franscisco. pp708.
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3. Pelczar, M.J., Chan, E.C.S., Kreig, N.R. (1997) Microbiology, Tata McGraw-Hill Publishing Co Ltd, New Delhi. pp 918.