

# Food Contaminant-Listeria Monocytogenes

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**Abstract**---Listeria monocytogenes is pathogenic to humans and a large number of animals. Infection usually occurs sporadically, although it can also manifest itself as an epidemic. Until 1980, listeriosis was known as a disease of goats and sheep with the most common manifestations of abortion and encephalitis. Listeriosis is a serious infection caused by the germ Listeria monocytogenes. People usually become ill after eating contaminated food. The disease primarily affects pregnant women, newborns, older adults, and people with weakened immune systems. It's rare for people in other groups to get sick with Listeria infection.

**Index terms**---Listeria monocytogenes, Listeriosis, food, foodborne disease,



## 1 INTRODUCTION

There are three types of microorganisms in food: useful, food spoilage triggers and pathogens. Useful microorganisms include those that can lead to the formation of novel foods or nutrients in the fermentation process (eg yeasts and lactic acid bacteria) and probiotics. The spoilage-causing microorganisms, through their growth and enzymatic reactions, alter the taste of the food through the degradation of aroma, texture or color. Pathogenic microorganisms can cause disease.

There are two types of pathogenic microorganisms that grow or are transmitted through food that cause intoxication and infection. Intoxication results from the growth of microorganisms and the production of toxins (which leads to

disease) in food. Infection is a disease that results from the intake of disease-causing microorganisms. Infectious microorganisms can cause disease by producing enterotoxins in the gastrointestinal tract (1).

Contaminated food is the most common cause of disease in humans (2). The potential contaminants are numerous. Restaurant foods and ready-made meals are one of the main sources of food-borne illness (3). The main causes of general epidemics are Listeria monocytogenes, Clostridium perfringens, Salmonella, Staphylococcus aureus, and Bacillus cereus.

## 2 LISTERIA MONOCYTOGENES-GENERAL CHARACTERISTICS

Listeria is a gram-positive rod bacteria that can grow under either anaerobic or aerobic conditions (4,5).

It does not produce spores. L. monocytogenes has been recognized as an important pathogen in humans and animals, and in the last two decades has become the subject of interest in medical, veterinary and nutritional microbiology.

Of the six Listeria species, only L. monocytogenes causes disease in humans (5). These bacteria reproduce best at 30 to 37 °C, but they also reproduce better than all other bacteria at the temperature of refrigerators, which allows the temperature to be used as a means of distinguishing Listeria from other contamination bacteria (5).

Also referred to as a "conditioned pathogen". Listeria has been reported to cause about 2,600 cases of serious illness per year (6). As one noted expert, summarizing the history of this bacterium and its importance for public health, it may not be surprising, therefore, that "Listeria monocytogenes disease causes significant public health concerns in the US, Europe and other areas of the world" (7).

Listeria monocytogenes is the cause of zoonosis and is often the cause of newborn sepsis, meningitis in children and adults. It leads to sterility, is defined as a disease caused by food (dairy products), and is found in soil, plants and animals. From a sick mother transplacental can infect the fetus.

Although Listeria monocytogenes was recognized as an animal pathogen 80 years ago, the first epidemic to confirm indirect transmission from animals to humans was reported in 1983. in the Canadian Maritime Provinces. In that epidemic, cabbage kept in the cold during the winter was contaminated with Listeria through exposure to infected sheep. The next epidemic in California in 1985. confirmed the role of food in the spread of listeriosis. Listeria has been implicated in many outbreaks caused by contaminated food, most often through exposure to contaminated dairy and meat products, including turkey meat, pate, hot dog, seafood and fish (7).

Given its widespread distribution in the environment and its food supply, Listeria intake has been described as an "extremely common occurrence" (5).

## 3 FREQUENCY OF FOOD CONTAMINATION BY LISTERIOM MONOCYTOGENES

The Listeria bacterium can be found widely in the environment, in soil, including vegetation, which is in the decaying phase, water, and can be part of the faecal flora of a large number of mammals, including healthy adults (4,5). According to the

FDA, "studies point out that 1-10% of people can be carriers of Listeria in the intestinal tract" (8). Another study confirmed that "the Listeria is isolated from the stool in approximately 5% of healthy adults" (5). In any case, seasonal trends have also been

reported, showing the peak of Listeria disease in the period from July to October (7). Introduced by mouth, Listeria is among the most virulent pathogens, with up to 20% of clinical infections resulting in death (7). This bacterium primarily causes severe illness and death in immunocompromised individuals (9,5). Therefore, most healthy adults may be exposed to this microorganism with a low risk of infection and

## 4 LISTERIOSIS

Listeriosis is a serious infection that results from the ingestion of foods contaminated with *Listeria monocytogenes*. This disease is a major health problem in America and Europe. The risk of disease can be reduced by monitoring safety measures that prevent food contamination with *Listeria monocytogenes* during food production, preparation and storage.

Outbreaks caused by this bacterium are rare, mostly occurring in individual cases, ie sporadically. Whether or not *Listeria monocytogenes* is introduced into the body will lead to the development of listeriosis depends primarily on the person's immune system. Listeriosis is most commonly affected by the elderly, pregnant women, newborns, as well as people with weakened immune systems, or people already suffering from a disease.

Typical symptoms of listeriosis are fever, malaise, and muscle pain, and gastrointestinal problems occur less frequently. The disease is also often accompanied by nervous problems, such as loss of balance, confusion, inflammation of the brain and headaches. Due to similar symptoms, this disease is often replaced by the flu, so it is not treated on time. If listeriosis is treated with antibiotics on time, the disease can be completely cured. However, very often listeriosis is a very serious disease and the mortality rate is as high as 25%. If a pregnant woman becomes infected with *Listeria monocytogenes*, there is a high possibility that there will be an abortion or delivery before the expected time, and that the birth will have some developmental disorders.

Newborns who survive childbirth may be born with septicemia or may have meningitis later. The mortality rate is about 30% in newborns and almost 50% when infection occurs within the

### 4.1. Clinical picture of the disease

The length of the incubation period, from consuming *Listeria monocytogenes* contaminated foods to clinical symptoms, can vary considerably. Sometimes incubation is less than 24 hours and can take several days (2-4), and up to several weeks. Usually, the infection manifests itself from an intermediate pathological condition similar to the flu to blood and brain infections. The clinical outcome of listeria infection depends on three main factors: the pathogenic properties of the listeria strain, the number of bacteria brought in by the food, and the host immune status. There are two basic forms of the disease: perinatal listeriosis and listeriosis in adult patients. Pregnant women are about 20 times more susceptible to listeria infection than other adults. The disease in pregnant women is often

disease (4,10).

Due to their characteristics (ability to grow at cooling temperature, widespread distribution in nature, ability to survive long-term in adverse environmental conditions as well as the ability to cause serious disturbances in humans and animals), *L. monocytogenes* is nowadays a growing foodborne pathogen.

first 4 days after birth (1).

Listeriosis is dangerous for people with AIDS. Because AIDS severely damages the immune system, those who suffer from it are more susceptible to diseases caused by contaminated foods such as listeriosis. Men with AIDS are more than 300 times more susceptible to listeriosis than those of the same age who are negative for AIDS.

Previously, listeriosis was considered rare in humans. However, the occurrence of foodborne diseases since 1980. has raised health organizations' concerns about this pathogen. Individuals in certain risk groups are more exposed to listeriosis. Pregnant women are approximately 20 times more susceptible than other healthy adults. *Listeria monocytogenes* is an opportunistic pathogen as it is not expected to cause serious illness in a healthy adult individual with a strong immune system.

An infectious dose of *Listeria monocytogenes* has not been established. The infectious dose depends on the type of listeria and on the person. However, it takes thousands or even millions of cells to infect an animal, while 1 to 100 cells can infect those with a weakened immune system.

In order to reduce the number of patients with *Listeria monocytogenes* and thus the number of deaths, great care must be taken to prevent it. The CDC has prescribed preventive measures that advise not to eat meat products without prior thermal treatment and also non-pasteurized milk and non-pasteurized milk products, to control the entire production process of meat products, from raw material to finished product, to take care of what foods are stored in the refrigerator and for what period of time they are stored.

symptomless or has signs and symptoms of a cold. Although mild or inconspicuous listeriosis in the mother, it may be fatal to her fetus. If the infection occurred at the beginning of pregnancy, abortion or premature birth or birth of a dead baby can occur. If the infection occurred later in pregnancy, the baby may be born alive but severely ill with sepsis, pneumonia, thrombocytopenia and brain inflammation. The death rate is in 50% of cases.

In adults, good immunity, except for pregnant women, listeriosis is a mild, febrile illness, which often goes undiagnosed. In people with impaired immunity due to illness and in the elderly, sepsis, pneumonia and inflammation of the brain and brain can develop.

## 5 DIAGNOSTICS

The diagnosis of the disease is made clinically, epidemiologically and laboratory. From laboratory findings, bacteria are isolated from various samples: cervical swab, blood, urine, cerebrospinal fluid, meconium. Serological tests for the presence of antibodies in the serum of patients may also be performed.

## 6 LISTERIE MONOCYTOGENES DISTRIBUTION

*Listeria monocytogenes* is a bacterium that is distributed worldwide. It has been isolated from many sources including soil, plants, decaying vegetation, sewage, various wastewater, rivers and salt marshes. It can be found as part of the normal flora of the digestive tract of humans and many animal species. The finding of *Listeria monocytogenes* in rivers, lakes, canals is a consequence of their contamination with the faeces of humans and animals. Faecal material from asymptotically infected livestock, containing *Listeria*, can enter the slaughterhouse environment and contaminate raw meat. The natural environment appears as the initial reservoir and source for the virulent *Listeria monocytogenes* species, which can enter and pass through the food production chain. Once it enters the production chain, due to its tolerance to many production processes, such as high salt concentrations, extreme pH and temperature, it can be difficult to eliminate. In the absence of good production and hygiene habits, the food processing environment can become a source of virulent *Listeria* species with the ability to colonize equipment and contaminate the food produced there. *Listeria monocytogenes* is isolated from almost all foods: milk and milk products, meat and meat products, fruits and vegetables, seafood, etc. The pathways of infection are numerous, most common through contaminated food and transplacental transmission from mother to fetus.

Food-induced infections are very common. They occur not only sporadically but also epidemically. Even in highly developed countries, with good quality control of food production and distribution, epidemics result from the use of contaminated

food. Most important is disease prevention, which involves screening food for the presence of *Listeria*. Imported foods, primarily meat and meat products, and milk and milk products should be inspected for the presence of *Listeria*. Domestic products should also be inspected, as this disease has been shown to be widespread in our country.

food.

The ability to reproduce at storage temperatures (+4°C) make this microorganism a major problem in the food industry and a potential hazard to human health (11). The optimal temperature range for reproduction of this microorganism is from 30° C to 37° C, it is considered as a psychotrophic pathogen which has high resistance to heat. It develops in over 10% saline and survives in saturated saline solutions. This pathogen survives freezing temperatures and is usually destroyed at treatment temperatures above 61.5 ° C.

*Listeria monocytogenes* is a ubiquitous pathogen that occurs in human carriers (about 10% of the population) and is found in the intestinal tract of over 50 domestic and wild birds and animals, including sheep, livestock, poultry and pigs, as well as in soil and rotten vegetation.

Fresh vegetables and fruits, which can also be contaminated with this bacterium, are a particularly high risk to consumer health. Most commonly, listeriosis occurs as a result of consuming fresh cabbage, lettuce, celery, tomatoes, cucumbers, potatoes, radishes and other vegetables (12).

This pathogen is most effectively transmitted through the consumption of contaminated food, but it can also be transmitted from person to person or by inhalation of this microorganism. For example, in a person who has been in direct contact with infected animals, soil or faeces, lesions on the hands and hands may develop. This pathogen is also easily found in home refrigerators, indicating the need for regular cleaning and disinfection of this equipment.

## 7 PREVENTIVE MEASURES TO REDUCE THE RISK OF LISTERIOSIS

Considering the fact that *Listeria* is very present in the environment, and the vast majority of infections are actually due to the consumption of contaminated food or water, the issue of food safety must be addressed first.

The CDC (Centers for Disease Control and Prevention) provides a list of recommendations and precautions to avoid *Listeria* infections:

- Thorough cooking of raw food of animal origin,
- Thorough rinsing of raw vegetables under a jet of water,
- Keep uncooked meat separate from vegetables, cooked foods and ready meals,
- Do not drink raw (unpasteurized) milk and do not eat meals prepared with such milk,
- Wash hands, knives, cutting boards and work surfaces after handling and preparing thermally unprocessed food,
- Easily perishable and prepared foods should be consumed as soon as possible.

Also, it should be kept in mind that *Listeria monocytogenes* can grow in refrigerated foods as well. It is advisable to use a

thermometer to check the temperature inside the device. The temperature inside the refrigerator should be 4° C or lower and the freezer temperature -17° C or lower. All spilled liquids, especially raw meat, need to be properly cleaned. Store ready-made meals in clean, shallow containers so that low temperatures reach all parts evenly. Consume such food within 3-4 days at the latest.

Destroying *Listeria* is impractical and very difficult. The critical question is how to control its survival. Various studies have shown that *Listeria monocytogenes* is resistant to the action of sanitary agents. This pathogen is resistant to trisodium phosphate (TSP) and needs to be exposed to a high concentration of TSP (8%) for 10 minutes at room temperature to reduce the bacterial count after formation of a colony on the surface of the object and biofilm formation. In addition, washing the skin with 0.5% sodium hydroxide (NaOH) has minimal effect on the reproduction of *Listeria monocytogenes*. This microorganism is more resistant to the cooking process than other pathogens, and cooking alone is not always a

sufficient measure to eliminate it from food. Although *Listeria monocytogenes* is sensitive to radiation, it is not recommended as a definitive solution for its removal from fresh meat (11).

*Listeria monocytogenes* can be fused to the surface of the food producing fibrils for attachment and then producing a biofilm that makes removal difficult when cleaned. Attaching *Listeria* to a solid surface takes place in two stages. The first phase represents the primary cell contact with the surface, and the second is the solid attachment that follows the incubation period. This microorganism attaches itself to the substrate by producing a large amount of interwoven polysaccharide fibers, which extend from the bacterial surface to form a "glycol-calyx", which, again, surrounds the cells of the colony and is intended to channel nutrients into the cell and release enzymes and toxins. These microorganisms are also potential contaminants of raw materials used in factories, which benefits their continued presence in the factory environment. The use of HACCP and other procedures to control the processing process is the most effective method for controlling this pathogen in a factory environment. The HACCP approach helped to identify critical points and evaluate the effectiveness of control systems in the verification process.

The most effective prevention against listeriosis is to avoid

## 8 CONCLUSION

From the point of view of epidemiology and epizootology, it is significant that *Listeria* reach the external environment with excretions, not only of diseased humans and animals, but also of larger and clinically healthy individuals. Some studies indicate that 1 to 10% of healthy people may be intestinal carriers of *Listeria monocytogenes* (13). At the same time, healthy animals, but carriers of *Listeria monocytogenes*, are a potential source for environmental contamination. Studies have shown that 11 to 52% fecal of healthy animals contain this bacterium, so its presence on the carcasses of slaughtered animals is usually attributed to fecal contamination immediately before and during slaughter.

Although intensive research on *L.monocytogenes* and listeriosis has been undertaken in recent years, the minimum infectious dose leading to human disease is still unknown. Different countries have adopted different precautions for the potential presence of *L. monocytogenes* in food.

The main step in prevention is proper access to food, from

consuming raw milk, raw meat, and foods made from contaminated ingredients. It is especially important that pregnant women avoid contact with infected animals. Procedures for producing *Listeria*-safe products have not yet been discovered and developed. Therefore, the food industry must rely on a rigorous environmental sanitation program and HACCP principles to obtain a controlled workflow. The most important areas in the prevention of contamination are the area of design and functionality of the plant, the design of equipment, procedures for controlling work processes, sanitary procedures and the area of verification of control of the bacterium itself.

In an effort to reduce, or eliminate, the presence of *listeria* in foods, the U.S. Food and Drug Administration (FDA) in 2006. first approved the use of *Listeria*-specific bacteriophages as additives to meat products consumed without further heat treatment (12).

This microorganism can survive extreme environmental conditions that would otherwise destroy all other pathogenic bacteria. Therefore, everyone should focus on reducing the presence of this microorganism in their products, although it is almost impossible to completely eliminate this pathogen from foods.

handling and cooking to consumption. It is important to pay attention to the proper washing of raw vegetables and thorough cooking of food, as well as the importance of heating food at a sufficiently high temperature. Another important aspect of preventative action is advising high-risk groups (such as pregnant women and patients with weakened immune systems) to avoid all non-pasteurized dairy products, which include soft cheeses such as feta, brie and camembert, etc. Cheese spreads and yoghurts are considered a safe choice. Early diagnosis and a better understanding of the pathogenesis of listeriosis contribute significantly to the prevention, improvement of treatment, and reduction of the severe consequences of this disease.

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