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Listeria Monocyogenes: An Overview

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Abstract:

A foodborne pathogen that is widely dispersed in the environment is Listeria monocytogenes. It can be found in raw plants, food, soil, and water. L. monocytogenes with Listeriosis infection can be mild but to cross the epithelial barrier of the intestinal tract, the fetoplacental barrier and the blood-brain barrier depends upon the capability of the pathogen which can result into several other illnesses especially on pregnant women and the person with the low immune system. It can also have the ability to form biofilms which further contribute to its ability to colonize food processing facilities. In food processing, it is resistant to many of stress imposed such as salt. As a public health threat, in terms of cost of analysis L. monocytogenes is one of the major economic burdens on industry. Good hygienic practices, Sanitation, and HACCP should be implemented to prevent the growth of this bacterium in food industries. Appropriate methodologies are also required for the isolation and detection. In this paper, we will discuss the characteristics, symptoms, transmission, diagnosis, growth, and control of Listeria monocytogenes.

Keywords: *Food, Symptoms, Listeria monocytogenes, Temperature.*

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Introduction

The organism belongs to order Bacillales, Family Listeriaceae, and Genus Listeria is Listeria monocytogenes. It is a ubiquitous bacterial foodborne pathogen which is a significant cause of foodborne illness. Listeria is mostly recognized for its ability to grow at low temperature (−0.4◦C) and cause listeriosis. In general population, the incidence of listeriosis is low, in spite of the wide circulation of the microorganism in the environment and in the isolation of foods. The incidence of systemic listeriosis is much higher in the populations like newborn infants, pregnant women, the elderly and individuals with compromised immune systems. In adding to possess cold tolerance, L. monocytogenes is also capable of living many more food-related stresses including high osmolality and low pH. In most of the cases, the illness is expressed as a mild, fevered illness, it can also lead to systemic (invasive) listeriosis with more severe symptoms and high hospitalization.

In 1990s improved control measures were applied which shows a great reduction in the prevalence of L. monocytogenes in many food categories, mainly in meat products. But during the last decade, the rate of illness has remained constant. L. monocytogenes is extensive spread in the environment, and a constant focus is required to control the Listeria in food production facilities. In better control measures and to reduce the incidence of listeriosis better understanding of the characteristics of the microorganism, interactions of virulence factors with host susceptibilities, and environmental impact is necessary.

In raw foods of both plant and animal origin, L. monocytogenes is and sometimes it can also be found in cooked foods due to post-processing contamination. Therefore from foods such as raw and unpasteurized milk, ice cream, cheese, fermented meats raw vegetables, and cooked sausages, raw and raw meats, cooked poultry, smoked seafood, etc. has been isolated. In recent years a number of surveys on L. monocytogenes in foods and processing environments within food processing facilities have been performed.

Characteristics of Organism

The organism which belongs to order Bacillales, Family Listeriaceae and Genus Listeria is Listeria monocytogenes. There are 8 species which are contained by genus Listeria, named as L .gravis, L. innocura, L. Ivanovic, L.monocytogenes, and L.welshimeri, and two new species, L.marhii, and L.rocourtiae. In Listeria monocytogenes 13 recognized serotypes are present. The bacterium is a small, non-capsulated, Gram-positive, non-speculated, aerobic or facultatively anaerobic, pleomorphic, oxidase negative, catalase positive, rod-shaped which ferments D-rhamnose, not D-xylose. Due to peritrichous flagella organism is motile at 20- 25˚C. On blood agar, beta hemolysis is produced by the organism and hold both somatic (O) and flagella (H). A biofilm is produced by them which allow the bacteria to attach to the solid surface and then proliferate which further becomes difficult to remove. It can survive in 1.5 to 45˚C, 4.3 to 9.6 pH and 5 to 10 % Carbon dioxide. L.monocytogenes can be found in the non-living environment such as soil, silage, sewage, and manure as well as in a wide variety of animals and plants commonly used for human consumption. It is ubiquitous in circulation.in milk, water, Soil and in plants Listeria monocytogenes can alive for a long time.

Growth and its Control

Growth

Temperature: Ideal 37°C, range -1.5 to 45 °C.

pH: Ideal 7.0, range 4.4-9.4.

Atmosphere: Grows optimally grows under the condition microaerophilic. But, also grows well both aerobically and anaerobically. It can grow in relatively high (e.g. 30%) CO2 but is repressed under 100% CO2.

The growth of the organism was not retarded by a 5-10% CO2 atmosphere.

Water Activity: Minimum a_w permitting growth = 0.92 (≡11.5 % sodium chloride (NaCl).

It will grow in media containing up to 10% NaCl.

Survival:

Temperature: Survives to freeze very well.

Atmosphere: Not influenced by the atmosphere.

Inactivation:

Temperature: this is quickly inactivated at temperatures above 70˚C. D time at 50˚C can be in the order of hours, at 60˚C 5-10 min, 70˚C approximately 10 sec.

pH: Inactivated at pH values less than 4.4 at rates depending on the temperature and acidulate.

Organic acids, such as acetic, are more effective than mineral acids (e.g. hydrochloric). The process of Inactivation occurs faster at higher temperatures.

Water activity: for long periods it can remain feasible in dry environments.

Sanitizers/Disinfectants: All samples of inoculated mung beans are not.

Sanitizers/disinfectants: in the absence of organic matter (aldehydes, phenols, alcohols, ethanol/phenols, substituted, dizochlorine, quaternary ammonium compounds (QACs)) are generally effective in the absence of organic matter.

Transmission

In listeriosis, numerous manners of transmission have been described. Ingestion of L.monocytogenes in food is one of the most important routes. It is probable that

food-borne exposure to Listeria is a routine event for all humans because of the ubiquity of L.monocytogenes. In peripartum and utero, the organism can be vertically transmitted from mother to fetus. There are also many other modes for transmission less frequent possible modes include animal to person transmission.

Symptoms

A wide range of infection like bacteremia, pneumonia, endocarditis, and osteomyelitis including gastroenteritis (vomiting and diarrhea also called the "stomach flu") can be caused by Listeria oncogenes. The incubation period of the disease is 7 to 60 days. In a normal healthy person, infection produces a mild influenza-like disease or it may be asymptomatic. In a serious concern, meningitis which is frequently accompanied by septicemia is one of the most common found diseases.

Pregnant women, infection of the fetus is extremely common which can cause to abortion, miscarriage, or delivery of an extremely ill infant. Besides this other symptom which is most usual is a mild influenza-like illness without meningitis. The persons with the weakened immune system are found to be at more risk of serious illness. The illness includes meningitis, pneumonia, and listeriosis etc. The beginning time of listeriosis may range from few days to three weeks even the serious form of listeriosis is unknown. The time of gastrointestinal symptoms is also unknown but it is probably greater than 12 hours. Due to L. monocytogenes, the diseases which are clinical are more frequently recognized by veterinarians, especially as meningoencephalitis in ruminants.

Diagnosis

In the clinical practices, serological tests are considered not specific useful. The diagnosis of the diseases can be done by culturing the organism from cerebrospinal fluid, blood, and food. In cases of gastroenteritis if L. monocytogenes is suspected from stool it can be isolated but there is a need that specimen needs to be transported under cool conditions and within the 4 hours of collection the patient need to arrive in the laboratory. In exception cases like if the transport is delayed it can be cooled at 4˚c for up to 48 hours. There is also a need for stool sample for the submission either unpreserved or preserved. It is suggested that lithium chloride-phenyl ethanol-moxalactam medium must be used for isolation. Because the media selected for stool cultures normally suppress the growth of Listeria. The medium for isolation, presumptive and enumeration identification of Listeria species and Listeria monocytogenes from food samples Brilliance Listeria Agar is used. But the standard selective isolation medium is still Oxford agar. For the detection of L.monocytogenes in foods, molecular tools can also be employed and it is recommended that simple, easy and low-cost method should be used which can be affordable for poor resource countries.

Methods for analysis of L. Monocytogenes

L. monocytogenes occurs in very small numbers in both food and in processing environment, therefore it is important to include enrichment steps which increase the number of L. monocytogenes to allow detection and the recovery of injured/stressed cells.

The most commonly used analysis methods are three

1. The International Standard (ISO-11290) method which uses a two-step enrichment in Fraser broth.
2. The United States Department of Agriculture (USDA) method which uses a two-step enrichment in University of Vermont media (UVM).
3. The One-broth Listeria method which has been approved for use by the Association Française de Normalization (AFNOR)

All of these three methods include coating on Listeria selective agar (traditional or chromogenic agars) and need validation of isolates as L. monocytogenes by biochemical or molecular tests.

In recent years for the detection of listeria the use of real-time PCR (RTi-PCR), in combination with traditional culture, Listeria has also been explored. Through PCR Listeria specific genes should be amplified and quantifying is done by the fluorescent probe attached to the DNA fragments. Within a few hours low numbers of the bacteria can also be detected as opposed to the several days it takes to complete traditional plating techniques. For best use, RTi-PCR should be combined with the traditional methods so that isolates can be obtained from the traditional method for strain typing. For the straight detection of L. monocytogenes in food PCR is not suitable because it lacks the essential sensitivity.

Antibody-based tests, immune-capture methods, enzyme linked immunosorbent assay (ELISA), molecular methods targeting different genes and biosensor methods are different type of wide range test methods for Listeria spp. and L. monocytogenes.

Review of literature:

Rocourt, *et al.* (2003) Microbiological risk assessment provides risk managers which included all the information at national and international levels to lower the risk associated with food-borne pathogens. This exercise demonstrates that that MRA is a multidisciplinary approach involving microbiologists experts, clinical veterinarians, food technologists and others in which food consumption modelers as well as clinicians and epidemiologists. There is strongly need

for more research on pathogens in foods and MRA should be used to guide such research. In public health, scientist plays a very vital role by providing risk assessors with the necessary data.

Ivanek, *et al.* (2004) pathogen L. monocytogenes makes the goal of total L. monocytogenes removal from food impractical. The study demonstrated that the incomplete knowledge regarding the specific points and slopes of both the cost and benefit curves of food safety. Further studies should be designed to provide estimates of total societal costs and benefits of the economics of L. monocytogenes. For US society the level of food safety is determined. To designing an alternative L. monocytogenes control program, understanding of the optimal food safety level will be contributed. The program would be most economic and effective.

Gambarin, *et al.* (2016) in preventing the growth of L. monocytogenes temperature plays a key role in preventing the growth of L. monocytogenes. Production companies when certifying their products must bear this in mind that how to establish a product safe in terms of L. monocytogenes. Products with pH characteristics that favor L. monocytogenes growth were the only ones to result positive to microbiological and PCR tests. The highest proportion related to serotype 1/2a and the genetic characterization using ribotyping validates the genomic variability of L. monocytogenes.

Park, *et al.* (2016) L. monocytogenes is a major problem for public health as this is common in many animals, raw materials, food products and the environment. By PFGE, serotyping, and virulence-associated genes stain were analyzed and the result shows that the highest contamination rates were fish, meat, and RTE foods. It also shows that RTE, meat, and fish are as one of the important enter pathogens, which are mainly responsible for listeriosis. The study shows specific PFGE types could not be connected with serotype. The result is consistent with other studies which have examined the relation of L. it results that most fish isolates could discriminate with C, G, and H pattern showing serotypes 1/2a, 1/2b, and 4b.

Buchanan, *et al.* (2017) to identify and strengthen policies to manage universal organism in food manufacturing and food service understanding of the physiology and ecology of L. monocytogenes will assist risk managers. In the understanding of L. monocytogenes, there is a need to further study assisting risk evaluators and risk managers for the better understanding of the organism and its control. By the food industry control measures can be enhanced by better recognition of growth/no growth conditions, knowledge about strain differences, particularly in complex foods illumination and their impact of persister cells and more comprehensive documentation of outbreaks leading to better understanding of the dose-response.

Hingston, *et al.* (2017) to assess the stress tolerance of different L. monocytogenes CCs this study is conducted. In the present study, the presence of genomic islands including SSI-1 and LGI1 provides isolates with no any major advantages under the stresses. Further researches are needed for the confirmation response to various stresses, potential roles of full-length inlA and plasmid-related genes in L. monocytogenes. In this study, a number of original genetic elements were also explained in which nine new L. monocytogenes STs, the absence of a cold stress associated gene (lmo1078) in 4b isolates, a new inlA PMSC and several connections between L. monocytogenes CCs and the presence/absence or variations of specific genetic elements. This highlights the regional prevalence of certain L. monocytogenes genotypes and emphasizes the need for more international collaborative studies.

Pal, *et al.* (2017) the principle cause of listeriosis is Listeria monocyogenes. It is a well-known developing food borne pathogen, which primarily affects pregnant women, newborn infants, adults and the elderly with the weak immune system. To minimize L.monocytogenese in foods, food trade, and food handlers, and enforcement of regulations should be designed by the food safety training. It is recommended to the persons at high risk should avoid unpasteurized foods.

Conclusion

The main cause of listeriosis is Listeria oncogenes which results in high mortality and morbidity. It is the most emerging food borne pathogen, which mainly affects the person with the low immune system, pregnant women and newly born infants. Through the injection of contaminated food infection occurs which will give a result from minor fever to serious problem. For the detection of L.monocytogense in foods, the most sensitive scientific method is Real-time PCR. To the detection and identification of this pathogen the technique which is greatly contributed is molecular diagnostic techniques. In this, the application of a combination of two or more procedure is more powerful and biased for the tracking of L. monocytogenes strains. On the other side, the regulation should be designed to minimize the use of L.monocytogenese in foods for the safety of health.

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