Microbial update

listeria

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Listeria are common organisms. They have been isolated from a range of different animal species and can often be isolated from environmental sources.

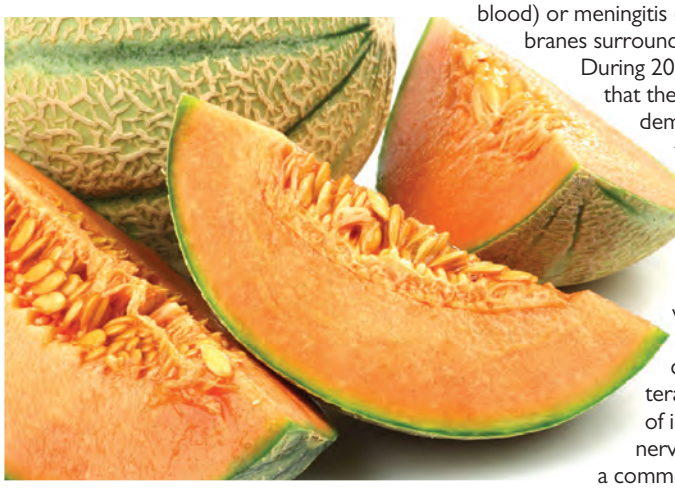
The Genus Listeria comprises six species (L. monocytogenes, L. innocua, L. ivanovii, L. seeligeri, L. welshimeri and L. grayi). A previous species called L. murrayi is now considered to be the same as L. grayi. Of all these species, only L. monocytogenes is considered to be a human pathogen. Unusually for pathogenic bacteria, listeria can grow at refrigeration temperatures, so whilst chilling will reduce their growth rate, it will not, on its own, stop them from growing.

Listeria originate from the environment and can be commonly found in soils and untreated water resulting in a risk that animals and plants destined for human consumption may be contaminated with the organism.

Food producers must remain aware of this, and develop ways in which this contamination can be controlled and removed. This is particularly important in any food considered 'ready to eat'.

Before the mid 1980s, listeria were not considered to be a food related problem. Food testing was never done, the organism being of interest only to research and veterinary microbiologists.

Then, from the mid 1980s, human listeriosis was seen to be increasing (mostly affecting pregnant women and the new born) and the link to foods – particularly chilled ready to eat foods – was made.



This resulted in the growth of research into methods to detect the organism, its growth characteristics and procedures to control it.

History

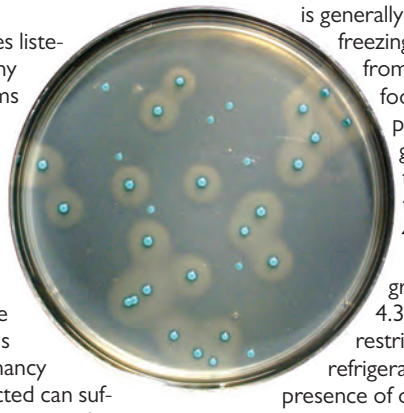
In 1926, Murray, Webb and Swarm published a paper in the Journal of Pathological Bacteriology entitled 'A disease of rabbits characterised by a large mononuclear leucocytosis, caused by a hitherto undescribed bacillus Bacterium monocytogenes'.

Later in the 1930s South African microbiologists isolated a bacterium from the livers of sick gerbils which was named Liserella hepatolytica, but it was not until 1940 that these two micro-organisms were recognised as the same, and renamed Listeria monocytogenes.

With such innocuous origins starts the history of Listeria monocytogenes, but it was to be many years before its importance in foods was recognised.

Illness

An infection by listeria causes listeriosis, an illness that has many forms. One of the main forms affects mothers and their unborn or newly born children. In such cases the symptoms suffered by the mother can be mild, with a slight fever and mild gastroenteritis.



For the child, however, the outcome can be very serious and often fatal. In non-pregnancy associated cases, those affected can suffer bacteraemia (viable organisms in the blood) or meningitis (swelling of the membranes surrounding the brain).

During 2006 it became apparent that there was a change in epidemiology for listeria infections within England and Wales. This involved an increase in the number of cases involving people that were over 60 years old who had an illness characterised by bacteraemia,but an absence of infection of the central nervous system (previously a common symptom of listeria infection). In reality the number of cases of this type doubled between 2001 and 2006. Similar patterns were noted in Scotland, Northern Ireland and many other European Countries.

Compared to other common foodborne pathogens (for example salmonella and campylobacter species), listeria causes few cases per year (usually between 100 and 200 in the UK), but it is estimated that between 25-30% of those contracting the illness will not survive, making the organism a key one to control in foods.

Growth requirements

L. monocytogenes is psychrotrophic, which means it can grow at chilled temperatures. As a result of this, refrigeration alone cannot be relied upon to prevent growth. Although growth may still occur, lower temperatures will result in slower growth and may interact with other factors to prevent growth.

Growth will not occur at temperatures less than -1°C, but the bacterium will survive and is generally considered resistant to freezing and has been isolated from a variety of frozen foods. The optimum temperature for growth is generally 30-35°C and the maximum temperature for growth is 44°C.

The minimum pH for growth is approximately 4.3 but growth is restricted below pH 5.0 at refrigeration temperatures. The presence of organic acids will raise the minimum pH for growth compared with the inorganic acids used in many laboratory studies.

L. monocytogenes is resistant to salt with all strains capable of growth in 10% salt (aw = 0.94). The minimum aw for growth is lower when sucrose is used as a humectant (0.92). When present in dry foods (for example milk powder) the bacterium can survive for many weeks.

The heat resistance of L. monocytogenes has been studied in both broth and food systems. It is now generally accepted that High Temperature Short Time (HTST) milk pasteurisation (71.7°C for 15 seconds) will eliminate this bacterium from liquid milk. With other foods, heating to 70°C for two minutes, or the thermal equivalent, is recom-

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mended for the destruction of this bacterium. Generally modified atmospheres have little effect on listeria as the organism can grow in the absence of oxygen. If, however a very high level of carbon dioxide were used (>60%), then growth can be limited.

Foods of concern

The main types of foods of concern with respect to listeria, are those considered ready to eat. Listeria is not resistant to heat, so a normal cook (this is usually taken to mean the application of a minimum process of 70°C for two minutes or equivalent) will inactivate the organism.

However, foods that are not given a heat process immediately before eating could become contaminated, and be a possible source of infection. Food producers have gone a long way to reducing or eliminating listeria in such ready to eat products, but, on occasions, some foods can become contaminated.

With animal derived foods, normal cooking is enough to destroy the organism, and the main control that has to be employed is the correct cooking time and temperature, followed by hygienic methods that prevent recontamination of the cooked material.

Some animal derived foods are not cooked, for example cold smoked fish; here good hygienic procedures are the only way forward. There have been a number of recalls of smoked fish because of listeria contamination. Indeed in 2013 in the USA numbers of recalls of cold smoked fish have been rising considerably.

It is well known that listeria can be a problem in some dairy foods. Raw milk can be contaminated with the organism, and there can be a risk that products made from raw milk can contain viable listeria, soft cheeses and butter being noted as the cause of a number of outbreaks of illness.

Plant based material such as vegetables, can be contaminated in the field. With vegetable items that are going to be cooked before eating this is not an issue; however salad vegetables are eaten raw and could be a source of a problem. Commercial ready-to-eat salad products are washed before packing, often using a sanitiser in the washing water.

This will remove soils and can kill contaminating micro-organisms and may be a control for low levels of contaminating listeria.

However, a serious listeria outbreak that occurred in the USA in 2011 was traced to contaminated cantaloupe melons. This outbreak affected around 146 people and resulted in 30 deaths. It was traced to poor practices in the site preparing and cutting the melons allowing listeria to proliferate and cross contaminate incoming fruits.

A wide variety of products have been implicated in outbreaks of listeriosis including: milk, soft cheeses, butter, cooked ready to eat meats, cold smoked fish, pate, raw vegetables and prepared sandwiches.

In 2012 in the USA over one million hard boiled eggs were recalled due to positive listeria test results indicating the risks can be found in almost all chilled food products.

Control of listeria

As noted previously, the main area of concern when considering listeria risk is in the production of chilled ready to eat foods. Such products will include: cooked sliced meats, fresh produce, uncooked fish, cheese, composite products (chilled mixed salads, quiche etc).

Some of these products will be cooked during production, others will not. Control will centre on the correct application of heat (in cooked products), the sourcing of good quality raw materials, the correct application of any non-heat based microbial reduction measures (for example washing of vegetables), and the prevention of recontamination after the microbial reduction process has been applied.

Much of the latter will revolve around maintaining exceptional factory hygiene, preventing points of listeria harbourage from occurring, reducing water build up in production areas, and maintaining good chilled temperature throughout production and distribution.

As noted previously listeria, unlike many other food pathogens (for example salmonella, E. coli and campylobacter) is psychrotrophic, and can grow at temperatures as low as 0°C. Although growth at such temperature is very slow, the listeria faces no competition from other micro-organisms at such low values, so there is a potential to grow to high numbers over time.

Of course, if the low temperature is not strictly enforced, and it rises, then listeria will grow more quickly. This is the real issue of listeria within chilled food production as it may not simply survive if conditions are unhygienic, but it can multiply. The organism is also really 'at home' in wet conditions.

Therefore, the high moisture conditions found in some chilled production areas provide ideal conditions for listeria to proliferate.

Control within production areas is critical and will be based on the following: strictly enforced hygiene barriers for personnel and equipment entering high care production areas; reducing levels of water/ moisture in production (stop water pooling on floors, ensure drains are freely flowing and have no standing water, prevent condensation etc); understanding any product entrapment areas in processing equipment and ensuring these are fully cleaned and sanitised during cleaning; well applied and regular cleaning and disinfection of production areas.

All of these actions need to be backed up by a monitoring programme that is good enough to identify any failure in these approaches, and any impending problems of product contamination.

Listeria and legislation

Testing for listeria is required in all ready to eat foods produced within the EU (there are a few exceptions noted within European Commission Regulation 2073).

The Microbiological Criteria noted within the regulation depends on whether listeria can grow in the food or not. If it is unable to grow then a level of 100 colony forming units (cfu)/g or less is considered acceptable throughout shelf life. If it is able to grow then listeria must be absent at the point of production, or at a level of no greater than 100cfu/g once it has left the production premises.

This makes a full understanding of the potential for listeria growth in ready-to-eat products a key requirement for manufacturers of these products.

Often a requirement to do predictive microbiology or challenge testing, backed up with substantial historical data is the only way to answer questions raised within EU legislation. In the USA, there is a 'zero tolerance' policy for listeria in ready to eat foods.

Conclusions

The move from knowing nothing of listeria in 1980, to today's widespread knowledge and understanding, shows the huge step forward the food industry has made with this organism.

Producers of 'at risk' products are more aware of problems associated with it, but critically are also better prepared with a knowledge of control measures that can be used to reduce the risks of the presence or growth of this organism, both in the manufacturing environment and in food products themselves. This does not mean we can now dismiss the risk. Even over recent years, we have seen large outbreaks associated with 'unusual' foods (the large outbreak associated with melon in the USA being a good example).

We must remain constantly aware of listeria, continually applying good effective controls and doing well targeted environmental and food testing to give assurance that our controls are working. ■

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References are available from the author on request