



Bord Iascaigh Mhara
Irish Sea Fisheries Board

Information Note

Listeria monocytogenes in Seafood Processing

Background

The market place has evolved to one with an array of highly processed products that are ready-to- eat or require minimal preparation in the home. Food safety is therefore a vital issue for the consumer.

Listeria monocytogenes is a foodborne pathogen of public health concern as reflected in statistics for severe foodborne illness. Its relative high incidence in ready- to -eat and heat treated fishery products has raised concerns about the survival and growth of the organism in such products as they are not processed further before consumption.

In order to ensure the safety of food products in respect of potential food borne bacterial pathogens, growing, harvesting, handling, storage, processing and associated food supply systems must be managed by food producers and processors in such a way as to reliably control the growth of *Listeria monocytogenes* which must be prevented from multiplying to potentially harmful levels.

This information note is intended as a guide to understanding *Listeria monocytogenes* and its implications for the Seafood Processor. It is hoped that it will provide an overview of the organism as well as practical steps that can be taken to control its growth in plant environments.

Key principles discussed include personal hygiene, prevention of cross- contamination, general personnel practices and traffic patterns. It should also provide food industry workers with an understanding of how their activities impact on product safety.

This information note highlights those areas and operations that may allow *Listeria monocytogenes* species to enter and survive in the processing plant and control measures that can be taken to reduce the numbers of the organism.

Introduction

Listeria monocytogenes

The bacterium *Listeria monocytogenes*, is a food borne pathogen (causes disease) which is widely distributed in the environment and occurs naturally in many raw foods. Essentially, of the number of species of *Listeria* that have been identified, only *L.monocytogenes* and *L.ivanovii* are potentially pathogenic (cases of the latter are extremely rare).The most commonly occurring species in food are *L.innocua* and *L. monocytogenes*.

L.monocytogenes is commonly found in soil and water and on plant material, particularly that undergoing decay, with these environments being regarded as the natural habitat of the organism.

Because *L.monocytogenes* is ubiquitous in nature, fish and seafood harvested from natural environments have been identified as potential sources of *Listeria* in the human diet. Many of these products undergo various processing procedures. *Listeria* can enter the product both during and after processing as a result of poor sanitation conditions or manufacturing practices.

The organism can survive longer under adverse environmental conditions than many other non-spore forming bacteria of importance in foodborne disease. This resistance, together with the ability to colonise, multiply, and persist on processing equipment makes *L.monocytogenes* a particular threat to the food industry.

At approximately 0°C to 45°C, the pathogen grows to varying degrees when present in a suitable medium. Temperatures below 0°C freeze the culture or food and preserve or moderately inactivate the pathogen.

The psychrotrophic nature (ability to grow at cold temperatures) of *L.monocytogenes* allows survival or even multiplication of this potential pathogen during refrigerated storage or temperature abuse situations.

This is of special concern for those products which receive minimal or no heat treatment before consumption.

Illness Caused by *L.monocytogenes*

Listeriosis is the name of the general group of disorders caused by *L.monocytogenes*. It is widely recognised that the consumption of contaminated foods is an important route of transmission of listeriosis.

Although other routes of transmission have been reported, indistinguishable strains have been isolated from epidemic cases and from the food implicated, clearly identifying the role of food in the epidemiology of listeriosis.

L.monocytogenes has been recovered from the gastrointestinal tract of about 4-6% of healthy people. Numerous animal species are susceptible to listerial infection and in domestic livestock, listeriosis is being recognised with increasing frequency.

While the incidence of listeriosis is low (2-15 cases per million people), the case fatality rate is high and is reported to be between 20-40%.

Healthy individuals are not usually affected when they consume foods containing this organism but certain groups of individuals *are* at great risk.

Highly susceptible individuals include pregnant women, newborn babies (owing to post natal infection from the mother or other infected babies), the elderly and immuno-compromised individuals (see below).

Infected pregnant women may have no symptoms or experience only a mild flu-like illness. However, infection during pregnancy can lead to premature labour, meningitis in the newborn or even miscarriage.

L.monocytogenes has been implicated as the cause of infection in pregnancy. This can range from a mild flu-like illness in the mother to a severe illness for the unborn child, leading to spontaneous abortion, stillbirth or meningitis.

Asymptomatic or mild illness can occur in adults (non-pregnant) who have eaten contaminated food. This can progress to more serious forms of infection in those whose immunity to infection is impaired, such as those suffering from leukaemia, transplant patients and cancer, HIV infected patients and patients with AIDS.

Infection can occur in healthy people or children. Currently in Irish hospitals routine examination of faeces from patients with gastroenteritis for *L.monocytogenes* is rarely, if ever, practised.

Prevalence of *L.monocytogenes* in Fish and Fishery Products

Although the natural niche of the organism is soil and vegetation, *L.monocytogenes* is widely present in fresh and marine waters, silage, dust, slaughterhouse waste, coastal waters subject to pollution or contamination from industrial, human or animal waste, birds, fish, poultry, cattle, sheep, goats, mud, freshwater ponds, faeces from wildlife, livestock and pets. Several studies have shown that 4%-10% of humans are carriers of the organism.

Raw Fish

Studies have found that the highest number of positive samples of the organism were found in waters exposed to agricultural or urban areas whereas spring water or free ocean water was usually negative for the organism.

Unpolluted seawater and ground water used in aquaculture are generally free from this organism and fish from these environments are uncontaminated. In temperate regions, the organism has been isolated from surface waters and lakes.

L.monocytogenes has been found in a wide range of raw and processed fish and seafoods, including finfish (smoked salmon, cod, trout), mussels, oysters, shrimp, crabmeat, lobster tails and surimi.

L.monocytogenes can be found on the surface of the fish, stomach lining, gills, intestines but the flesh is usually free of the organism unless it has been contaminated from other sources.

Different strains of the organism have been isolated from fish raw material and from final products suggesting that fish can be contaminated at any point between harvest and consumption.

L.monocytogenes can colonise the processing environment and this has been established as a primary mechanism of contamination for some products. Like other bacteria, the

organism can create a biofilm on surfaces such as stainless steel and can be detected from equipment, cold stores and floors.

Cold Smoked Fish

The presence of *Listeria* in smoked and lightly processed fish products is often a concern because many of these products are commonly eaten without further heating.

Cold smoked fish is produced by filleting raw fish, which is then salted, dried and smoked at a temperature < 30°C. The fish is then vacuum packed when cooled. Because of the low temperatures that are involved, cold smoking is not regarded as a cooking step.

During cold smoking, there is no point of the process that can fully ensure the absence of *L.monocytogenes*. Neither the smoking temperature or the salt content are enough to kill the organism.

Several studies have revealed that 10-60% of freshly processed cold smoked fish is contaminated with *L.monocytogenes*. The contamination level is usually <100cfu/g. (colony forming units per gram), the legal limit set for ready-to-eat foods throughout their shelf life.

A similar contamination rate has been observed on other lightly preserved fish and fishery products that are processed without a listericidal step.

Several detailed studies on the incidence and sources of *L.monocytogenes* in processing plants producing cold-smoked salmon showed the primary sources of the organism were surface areas of frozen or fresh raw fish coming into the plant.

As the processing of the fish progressed, the pathogen was transferred to other processing areas and these became secondary sources of the organism.

Cooked Fishery Products

Hot smoking is carried out at temperatures >68°C and is usually at a temperature of 70°C-80°C. In terms of safety this essentially represents a pasteurisation stage. The product is generally not cooked further before consumption, which means that any bacterial contamination and growth after the heat treatment presents a hazard that must be controlled by good manufacturing practices and factory hygiene.

In those studies which specifically identified hot smoked fish samples, *L.monocytogenes* was recovered from about 9% of samples despite the heat processing that these products received.

Legislation

All food business operators have a legal responsibility to produce safe food. Food business operators (with the exception of primary producers) are legally obliged to put in place, implement and maintain a permanent procedure(s) based on Hazard Analysis and Critical Control Point (HACCP) principles.

Regulation 852/2004 Article 5 *Food Businesses operators shall put in place, implement and maintain a permanent procedure or procedures based on the HACCP Principles.*

HACCP is a systematic approach to identifying and controlling hazards, in other words it identifies what can go wrong and plans how to prevent it. The Regulation on Microbiological

Criteria for Foodstuffs (Commission Regulation(EC)No.2073/2005) contains microbiological criteria for specific food/microorganism combinations and the implementing rules to be complied with by food business operators at all stages of the food chain. These criteria should be used by food business operators when validating and verifying the correct functioning of their HACCP based procedures and other hygiene control measures.

In relation to *L. monocytogenes*, food business operators manufacturing ready-to-eat foods must ensure that their products comply with the criteria (<100cfu/g) for this pathogen throughout their shelf life. In addition, food business operators manufacturing ready-to-eat foods which may pose a risk of *L. monocytogenes* must sample the processing areas and equipment for this pathogen as part of their sampling scheme.

Shelf life studies are particularly important for RTE foods that are able to support the growth of *L.monocytogenes*,i.e these studies must demonstrate that the limit 100cfu/g will not be exceeded when these foods are placed on the market during their shelf life. If these studies are not conducted (or the Food Business Operator cannot demonstrate to the satisfaction of the competent authority that the limit of 100cfu/g will not be exceeded), the food can only be placed on the market if it complies with the limit 'absent in 25g' before it has left the immediate control of the FBO who has produced it.

Effect of Processing Parameters on the Survival of *L.monocytogenes*

Providing effective control of *L.monocytogenes* is challenging and is product, process and plant specific.

Control of *L.monocytogenes* in the fish plant requires both reducing the number of bacteria on the products and equipment surfaces via physical and chemical means and preventing the growth and proliferation of the bacteria by managing the environment. Processors must ensure that cleaning and sanitising treatments given to the equipment, walls and drains should be adequate to destroy or remove *L.monocytogenes*.

The below information should be of relevance to the processor regardless of whether dealing with a cold/hot smoked product or packing and fresh cut operation.

Receiving Fish at the Factory

Regardless of whether fish has been caught in the wild or farmed, it may harbour a number of pathogens, i.e. organisms that are harmful to humans but not for the fish themselves, before it arrives at the factory. This may result from the waters where the fish were caught or they may have come into contact with pathogens from harvesting, handling on board, off loading or transport to the factory.

Processors must assure themselves of the microbiological quality of the product received from the supplier. It is essential that the processor is satisfied that good sanitation procedures were applied throughout harvesting, transportation, storage and post harvest handling to prevent avoidable problems being "imported" into the plant.

For the processor it is essential that the raw product receiving area be completely isolated from the processing and packaging area.

All incoming cases, pallets, containers, forklifts and cleaning materials such as brushes and other equipment must be assumed to harbour *Listeria* along with other microbial contaminants and therefore should never be allowed to enter the processing and packaging areas.

Washing, Rinsing, Thawing

Thawed or fresh fish must be thoroughly washed and rinsed after it has been received at the plant and then washed again after processing. Thawing fish must be done under sanitary conditions and following good hygiene practice. The water used must be cold, potable, i.e. (suitable for human consumption), and continuously flowing. After evisceration, heading, gutting skinning, or filleting the product must be checked for cleanliness. If the fish is to be smoked the above must be carried out in a room that is separate from the rest of the smoking and processing factory.

Frequent cleaning of surfaces and utensils coming in contact with the product as well as monitoring of chlorine levels in the water used for processing, forms the basis of the control points at this stage.

Sorting, Sizing and Salting

Salting of fish can be conducted by 2 methods, dry salting or brining. Salting reduces the moisture content of fish, affecting the texture and the shelf life. It imparts essential flavours and is used as a preservative and inhibitor of microbial growth. To minimise microbial growth and cross contamination, temperature control during brining is recommended.

Control measures that can be taken here include:

- Care in removing the salt from the bags, not allowing any direct contact between the salt and the bags outer surface.
- Ensuring that gloves, scoops, etc used in fish salting are cleaned and sanitised before and after the process.

L.monocytogenes if present on a single fish could contaminate an entire batch within the brining solution. If brine injection is used, needles can become contaminated and spread pathogens to other fish. Frequent cleaning and disinfection of needles is recommended.

Sorting and sizing the fish is an integral part of salting in cold smoked fish as the fish or portion of fish should be of uniform thickness so that all the portions should absorb sufficient salt.

The amount of salt, the volume of brine, weight of fish and duration and temperature of the process must be monitored by the processor. These parameters must be established with an objective of obtaining a final product with at least 3.5% salt concentration in the water phase if the product is to be vacuum packed.

Rinsing, Draining, Drying and Smoking

The fish is rinsed with fresh water and then placed on racks for drying and smoking. Cross contamination with pathogens that may be present on the fish is unlikely, provided the fish are rinsed thoroughly.

Control measures here include:-

- Cleaning and sanitising the smoking racks after each use. Storing the sawdust used in smoking in secure closed containers to avoid cross contamination.
- Emptying the sawdust into the hoppers as hygienically as possible
- If moistening the sawdust prior to using during smoking, using chlorinated water and good manufacturing practice.

Smoking

Smoking is one of the oldest methods used to preserve fish. In most cases, salting or brining precedes the smoking process. Smoking can either be carried out at relatively low temperatures where the main effect is to deposit flavours and preservative compounds on to the fish or at higher temperatures leading to cooking or partial cooking and drying of the product. There are many fish species that can be used for smoking such as salmon, trout, cod, mackerel and shellfish such as clams, oysters and mussels.

Controls for the processor before smoking include:

- Good hygiene practice to ensure the best quality fish is used.
- Chilling to refrigeration temperature immediately following smoking.
- Ensure products are stored in clean containers and off the floor.
- Where possible, cover product with clean material to reduce the chance of contamination.

By adhering to good manufacturing practice (including training staff) it is possible to reduce the prevalence of *L.monocytogenes*. Smoke houses with strict adherence to Good Manufacturing Practices are capable of producing cold smoked salmon with very low levels of *L.monocytogenes*, often less than 1 cell per gram. Although not eliminated, such low levels would ensure that the number of *L.monocytogenes* does not increase to above 100 cfus/g at time of consumption given that appropriate temperatures (5⁰C) and time (3-4 weeks) limits are met.

Slicing and Cutting

High priority must be given to the slicing and cutting step to help control possible recontamination or cross contamination of the cold smoked fish product with *L.monocytogenes*. Thoroughly clean and sanitised food contact surfaces and knives are essential.

Having an effective cleaning and sanitation programme will help to reduce the prevalence of *L.monocytogenes* on the slicing and cutting equipment and in the general processing environment. This will help reduce contamination of the smoked fish product and lessen the probability of *L.monocytogenes* becoming established in the processing environment.

Packaging and Labelling, Storage and Distribution

All finished product should be labelled with advice on refrigeration and storage time. The final product needs to be kept chilled and refrigerated during storage, distribution and retail until it is sold. Packaging should clearly tell consumers of the need to continue storing the product at chill temperatures after they have purchased it.

Packaging material must be stored in a clean dry area and protected from contamination. Packaging should be subject to minimal handling.

Regardless of its potential to control *L.monocytogenes*, the vast majority of smoked fish plants today use vacuum packing. Vacuum packing removes air from a package and seals it so a near perfect vacuum remains inside the package.

A number of films and packages exist to protect the product and extend the shelf life of cold smoked fish products. These can be stored refrigerated or frozen. The processor may freeze and hold the product in frozen storage prior to distribution.

Adequate refrigeration is the most important factor for the safe distribution of smoked fish products.

Control of *Listeria monocytogenes* in the Processing Environment

Factory Design

Design features that are widely considered to be essential for all types of food processing facilities include:

- Raw product receiving area that is completely isolated from processing and packaging areas.
- Tight fitting exterior windows and doors that will prevent animals or insects from entering processing and packaging areas.
- Easily cleaned and sanitised walls, floors and ceilings that are constructed of tile, metal or concrete and not porous material such as wood.
- Floors designed to drain rapidly and prevent pooling of water.
- Floor drains cited away from processing and packaging equipment.
- Traps on floor drains.
- Proper means of waste disposal outside the factory.
- Heating, ventilation and air conditioning designed to minimise airborne contamination.

Training of Staff

Staff must be trained to understand the importance of hygienic handling and prevention of recontamination.

Industry experiences indicate that the more staff that are aware of the problem and how to control it, the lower the prevalence of *L.monocytogenes*.

Reduction or Elimination of *L.monocytogenes*

Reduction or elimination of *L.monocytogenes* in the niches in which it has become established is a continuous effort. With the smoked fish industry, particular attention must be paid to the following points:-

Primary sites leading to product contamination are: Brining solutions, Injection Needles, Slicing equipment, Packaging equipment and Conveyors

Areas along the Processing line where the product comes in direct contact with surfaces, e.g. conveyor belts should also be closely monitored and regularly cleaned and sanitised. Floors, and particularly floor drains, may often harbour *L.monocytogenes*, therefore attention must be paid to cleaning and sanitising these areas as well.

Potential Sources of Contamination in the Processing Plant

Water/Ice used in storage

Transport racks, finished product

Hand tools, gloves, aprons contacting finished product

Blast freezers

Bins, tubs, baskets used for holding

Areas of the Environment Serving as Secondary Sources of Listeria

These are areas that may harbour the organism and under certain conditions lead to contamination of the product, contact surfaces or the food.

Examples

Equipment framework, Floors, Drains, Walls, Ceilings, Condensate, Insulation in walls, Trolleys, Forklifts, Walk-alongs, Cleaning tools (sponges, brushes, floor scrubbers), Maintenance

Specific Considerations in Plant Hygiene

Processing Areas

Steps to take to minimise the potential for cross contamination.

Separate Raw Product from Semi-Finished Product to Prevent Cross Contamination.

- Wherever possible, there should be a linear flow of product through the operation from the raw ingredients to the finished product. Plants should be rearranged where necessary to improve the flow of product, equipment and people to facilitate separation of raw from cooked or treated product.
- Compartmentalise operations as needed to enhance the separation of raw ingredients and processed products.
- Provide separate washing areas and clean-in-place systems for cooked or treated product equipment and raw processing equipment.
- Barrels for cooked or treated product areas should be labelled or colour coded and not used elsewhere in the plant. They must be cleaned and sanitised daily or more frequently if microbiological testing data indicates that this is necessary.
- Remove hoses from the manufacturing areas where ready-to-eat products are exposed before start of operation each day so that line workers are not tempted to use these for spot cleaning during production.
- Have separate utensils, carts, racks, cleaning utensils, colour coded where practical for the ready-to-eat product area.
- Where possible, eliminate overhead fixtures in the ready-to-eat area.
- Where possible, isolate wet process areas from other production areas. Remove standing water as soon as possible.
- Water used in processing operations that will come in contact with product must be of drinking water quality.

Control of Traffic Flow

Control traffic flow patterns between the raw ingredients and the processed products side of the operation to prevent transfer of *L.monocytogenes* from the raw side of the operation to the cooked side.

- Equipment utensils and people in raw and cooked areas should not be interchanged during the working day.
- Drains from the raw side should not be connected to those in the cooked side.
- If footbaths are installed, proper maintenance is important them or they can become a source of contamination. Footbaths should contain stronger concentrations of sanitizer than normal (e.g. pp, iodophor, 400-800 ppm quaternary ammonium compound) which should be regularly replaced before it becomes ineffective. A depth of 2 inches is recommended. Chlorine is not recommended for this as it quickly becomes inactivated. Footbaths are ineffective if cleaved boots are carrying large particles of dirt/plant waste.

Another option is:-

- Spray a foam disinfectant on the floor as people that are rolling stock enter the room.

Packaging and Storage

Pallets entering the packaging room must be clean, dry and in good condition, preferably not made of wood.

- Store and package exposed products in a clean, dry environment.
- Bacteria cannot multiply without water. If the environment is clean and dry, *Listeria* remains dormant or dies.
- There is less transfer of bacteria from surfaces if the surfaces are clean and dry.
- The spread of contamination by vehicular traffic and pedestrian traffic is reduced considerably if floors are clean and dry.
- Cooling units in packaging rooms and coolers for exposed product should have de-humidifying capability.

Equipment

- Use of equipment with a good hygienic design (i.e. avoidance of poor seals. Cracks, crevices, poor welds, hollow tubes, dead spaces etc.) will facilitate effective cleaning.
- Previously used equipment may harbour pathogens. Equipment must facilitate cleaning. Previously used equipment may harbour pathogens.
- Equipment must be maintained properly to minimise breakdown. Equipment that is damaged, corroded or cracked should be repaired or replaced. Equipment framework should not be hollow to prevent water gathering and harbouring *L.monocytogenes*.

- Lubricants can become contaminated with product residue and become a source of contamination-use food grade lubricants that additives (e.g. sodium benzoate) that will prevent the growth of *L.monocytogenes*.
- Racks used for transporting exposed cooked product should have cover guards over the wheels to prevent spray from the wheels being thrown onto the rack and the product as the racks are moved.

Cleaning the Racks

Racks used in operations after products are cooked can be a significant source of contamination if not properly cleaned and sanitised before use. The most reliable method of sanitising racks is with heat, using one of the following options:

1. Heat can be applied by hot water rinse (82.2°C) in a rack washer so the racks will reach a temperature of 71.1°C or higher.
2. Steam applied in a cabinet after cleaning in a rack washer.
3. Placing the racks into an oven and applying moist heat to raise the temperature of the racks to 71.1°C or higher.

Plant Sanitation

Use cleaning and sanitation procedures designed to control *L.monocytogenes*. Frequency of cleaning and sanitising the equipment and environment of a plant depends upon experience and microbiological data.

- Routine microbiological testing allows the plant to develop a base line for comparison purposes and also to detect a sanitation problem.
- Successful control of *L.monocytogenes* includes the following steps:-Cleaning and Sanitising

A Typical Procedure for Cleaning and Sanitising Processing Equipment

1. Pre-rinse the equipment
2. Visually inspect the equipment
3. Apply Detergent to the equipment
4. Clean the equipment
5. Rinse any residues remaining
6. Visually Inspect the equipment
7. Apply Sanitizer according to manufacturers' instructions
8. Rinse off any residues remaining
9. Verify that the equipment has been cleaned thoroughly
10. Dry the equipment

Sanitizing procedure at night – after cleaning the equipment, apply a high level of sanitizer (e.g. 800ppm quat). Allow it to stand for 20 minutes, rinse thoroughly and then apply the normal amount of sanitizer (200 ppm quat of chlorine).

At the end of the production week, the high level of sanitizer can be left on the equipment until before the start-up. Then rinse, apply the normal level and the room is prepared for start-up.

Quarternary Ammonium Compounds (quats) have been found to be effective against *L.monocytogenes* and leave a residual germicidal effect on surfaces.

Sanitizers containing peracetic acid and perotanoic acid are effective against biofilms containing *L.monocytogenes*.

Rotate the Sanitizers - rotating other sanitizers (e.g. chlorine/iodophors) may provide for greater effectiveness. Consider using new sanitizers.

Areas that should be sanitised with such compounds and a suggested frequency are as follows:-

- Drains – daily
- Floors – daily
- Waste Containers – daily
- Walls – weekly/monthly
- Condensate Drip – weekly/monthly
- Air Conditioning – weekly/monthly
- Coolers – weekly/monthly
- Spiral Freezers – annually

Sanitation - Using Hot Water/Steam

This is an alternative to chemical sanitization. This is effective where equipment is difficult to clean. However, the use of steam should be limited to equipment which is difficult to clean and to closed systems such as clean-in-place due to the hazards of aerosol formation and moisture condensation on equipment surfaces.

Temperature must reach 71.1°C throughout. A holding period of one or more hours is desirable

- Direct condensate to a drain via a hose
- Solid forms of sanitizers can be placed in drip pans
- Do not dismantle and wash equipment on the floor
- Floors - use a powdered citric acid, rinse and sanitize

Infrequent defrosting, cleaning and maintenance of spiral freezers used for freezing unpackaged product is a potential source of *L.monocytogenes* so these freezers must be cleaned regularly.

Cleaning the Floors

- Do not dismantle and wash equipment on the floor.
- Use a powdered caustic cleaner for cleaning floors. Apply water as needed then rinse and sanitise.

- Application of powdered citric acid to certain areas of the floor may be effective against *L.monocytogenes* provided the floor is clean and dry before application.
- Cleaning tools used for the floors should be sanitized using 600-1000 ppm quat solution and either stored dry or in quat solution maintained at a 1000 ppm.
- Floor drains must be designed and maintained to prevent blockages. If a back-up occurs, production must cease, the drain cleared and the area carefully cleaned with caustic, then rinsed and sanitised.
- Never use a high pressure hose to clear a drain. An aerosol will be created that will spread contamination throughout the room.
- Utensils for cleaning drains should be dedicated to that purpose to minimise the potential for contamination.

Personnel Hygiene

Good hygiene practice and effective implementation of HACCP procedures are essential in producing safe food. The processor must provide education and training in safe handling practices for his employees to achieve this.

The following information must be part of employee training for the control of *L.monocytogenes*.

Employees

Management must instil in the employee that each one is ultimately responsible for both the quality and safety of the food that is produced and ultimately consumed by the public.

All individuals with cuts or abrasions must have their wounds covered with a waterproof dressing to help prevent contamination of food, food contact surfaces, packaging material or equipment and need to be excluded from working in processing areas or from doing other tasks that may lead to contamination of food, food contact surfaces, or packaging material or equipment. Consumption of food together with the wearing of jewellery is banned.

- Hands must be washed thoroughly before starting work, on returning to work and after touching light switches, walls, floors, or any unclean surface.
- All factory workers need to be supplied with hair and/or beard nets.
- Clean gloves, smocks and aprons are essential to protect against product contamination.
- If possible use colour coded apparel for personnel dealing with raw material and those dealing with processed product.
- Use disposable gloves and aprons wherever possible in cooked product areas.
- Gloves should be replaced if damaged. The use of gloves does not preclude the need for employees to wash hands regularly. The objective of wearing clean garments is to prevent the product from contamination.
- Street clothes must not enter processing areas. Factory clothing must remain inside the factory. Do not store soiled clothing in lockers.

- Assign a person to the packing room to pick up any material from the floor but make sure that this person is kept away from handling product that is to be packed.
- Rubber boots worn should be non-porous and easily cleaned.

Environmental Monitoring Programme

Since the introduction of Regulation 2073/2005, businesses producing products which could pose a *L.monocytogenes* health risk are required to monitor for *L.monocytogenes*.

“Food Business Operators manufacturing ready-to-eat foods, which may pose a L.monocytogenes risk for public health, shall sample the processing areas and equipment for Listeria monocytogenes as part of their sampling scheme”

An environmental monitoring programme is recommended to assess the need for additional control measures for products that may be contaminated by *L.monocytogenes*. Research indicates that processors that have an ongoing monitoring and control programme that uses *Listeria* species as an indicator of potential *L.monocytogenes* contamination not only reduces the possibility of finding *L. monocytogenes* in the finished product but also other pathogens as well.

Each company usually has its own *L.monocytogenes* monitoring programme.

Environmental monitoring (microbiological testing) should focus on the detection of non-pathogenic *Listeria* species since these indicators will be found more frequently in the environment than *L.monocytogenes*, and where a positive result is obtained it would then be advisable to determine if it is the monocytogenes species.

The number of sampling points and the frequency of sampling may be adjusted based on results over time.

- Detection of *Listeria* species in an environmental monitoring sample does not necessarily indicate a microbiological control problem; it does indicate that additional investigation should be undertaken.
- When environmental monitoring results indicate a trend toward an increased incidence of *Listeria* species, plants should investigate to determine the reason(s) for the increase and should take action to reduce the level again.
- If a positive sample is detected, and the sample was a composite sample, the individual samples should be tested to pinpoint the location of the positive.
- Additional samples should be taken from the environmental area where the positive was detected. These samples may indicate that additional corrective actions are needed in this area.
- If, after corrective actions have been applied, additional samples are positive, the environment should be intensively cleaned and re-tested.
- Consider the need to sample (additional) food contact surfaces in the areas where environmental positives are detected.

Food Contact Surface Testing

- Food contact surfaces may be sampled routinely for *Listeria*-like organisms as verification that environmental controls are preventing *L.monocytogenes* contamination of surfaces; or they may be sampled only when environmental monitoring suggests there may be a problem.
- As with the environmental sampling, plants should determine the points to sample, the time of day for sampling, and the frequency of sampling based on knowledge of their specific operation and the controls that have been put into place, as well as any microbiological data available.
- Plants should investigate to determine the reason(s) for all positives on food contact surfaces. Investigative sampling must be capable of identifying equipment that contains niches where *L.monocytogenes* has become established. Until these sites are located, it is not always possible to correct an ongoing problem.
- Corrective actions should be taken for all food contact surface positives based on a pre-determined plan of action and the actions should be documented. Contamination of some product contact surfaces is of greater concern than others. Examples of corrective action include modifying cleaning and sanitising procedures, re-design of equipment, improved good hygiene practices etc.
- Plants should consider whether finding *Listeria*-like organisms on food contact surfaces should result in the need for product testing

Product Testing

- Plants may decide to test product as a result of positive food contact surfaces.
- In addition, random product testing may be used to verify that good hygienic practice and HACCP based procedures are effective in preventing contamination with *L.monocytogenes*.

All sample lots should be held until the laboratory results are available.

- Plants must determine the action to be taken in the event that *L.monocytogenes* is detected in a product sample.

Summary

In summarising, there are numerous ways that *L.monocytogenes* can colonise a food processing establishment where it has the potential to cause product contamination.

For the Processor, consideration of factory design, good raw materials, staff training, good manufacturing and hygiene practices, effective cleaning and sanitation, maintenance and disposal of waste appears to be the best strategy for preventing contamination of the product.

Disclaimer

This information note does not purport to be comprehensive or to be a legal interpretation or to constitute legal or other professional advice.

Changes to the legislation may be expected that will necessitate this information note to be further updated.