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Listeria monocytogenes IN MILK AND DAIRY PRODUCTS

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Review paper

Abstract: *Listeria monocytogenes* is ubiquitous bacteria. It causes listeriosis, a serious infectious disease which occurs as consequence of consumption of food contaminated with this pathogen bacterium. The frequency of incidence of listeriosis is low (1%), but with high mortality rate (30%). In certain countries (USA and Switzerland) large outbreaks of listeriosis were associated with consumption of fresh cheeses and milk. Studies on presence of *L.monocytogenes* in raw milk, carried out in Europe, have shown that 2,5-6% of samples can be contaminated with *L.monocytogenes*. In the process of production of milk and dairy products, it most commonly occurs as consequence of post-pasteurization contamination. *L.monocytogenes* has the ability to multiply and grow at low temperatures (4^0C) and to survive even on freezing temperatures, and as such poses risk for health of consumers, if found in milk, cheese, ice-cream and other dairy products. In order to prevent the contamination of product with this bacterium, producers much implement prevention measures, and special attention must be focused on critical points in the production process and adequate sanitation. The general characteristics of *L.monocytogenes*, are presented in the study, also its resistance to environment, some listeriosis outbreaks, its presence in milk and dairy products and major hygiene measures.

Key words: *Listeria monocytogenes*, milk, dairy products.

Introduction

Milk and dairy products, because of their high nutritional value, are very suitable for development of microorganisms, including pathogenic bacteria *(Farber and Peterkin, 1991; Kasalica, 2000)*. To which extent it will develop depends primarily on the type of product, chemical composition, manufacturing, storing, etc.

Recently, special attention in the food industry has been directed to pathogenic bacteria *Listeria monocytogenes.* Nevertheless, until the sixties of the last century, *L. monocytogenes* was considered only to be cause of diseases in animals. Only after the discovery that *L.monocytogenes* can also cause many diseases in humans, the intensive study world wide of this bacterium started. Listeriosis is serious disease of humans, occurring sporadically or in the form of epidemic, with mortality rate of over 25% *(USDA, 1999)*.

The first communications/reports of the presence of *Listeria* in food are associated with dairy products, where cow milk is mentioned as carrier of the fatal listeriosis *(Farber and Peterkin, 1991)*. According to many communications, consumption of milk and dairy products contaminated with *L.monocytogenes* can lead to individual cases of listeriosis or true outbreak of this disease. Of all dairy products, soft cheeses and non-pasteurized milk are most common causers of listeriosis. Two large outbreaks in human population were associated with consumption of soft cheeses. In California, from June to August 1985, 142 persons became ill, of whom 48 died (*Linnan et al*.,1988), and in Switzerland, in the period from 1983 to 1987, 122 cases were recorded, of which 34 died (*Bille, 1990*). Also, during 2005 in Switzerland, 10 cases were recorded with 3 death outcomes, where source of infection was soft cheese manufactured by local producer (*Bille et al., 2006*). In Massachusetts, the listeriosis outbreak in 1983 was associated with consumption of pasteurized milk (*Fleming et al.,* 1985) which originated from a dairy farm where cattle were suffering from listeriosis. For long time it was considered that butter does not represent good environment for growth of *L.monocytogenes,* however, two outbreaks of listeriosis in Finland, in 1998 and 1999 were caused by butter *(Lyytiksinen et al., 2000; Maijala et al. ,2001).*

Mainly the reports obtained in developed countries speak of the presence of *L.monocytogenes* in food *(Maijala et al., 2001; Melanie and Siegfried, 2001; Karakolev, 2009)*. Microbiological studies of the presence of *L.monoytogenes* in Europe have shown that 2,5- 6 % of samples of raw milk can be contaminated with *L.monoyitogenes,* indicating potential risk for human population from dairy products manufactured from raw milk *(Kozak et al., 1996; Donnelly,2004)*. *Rudolf and Siegfried* (2001) studied the frequency of incidence of *Listeria* and *L.monocytogenes* in red smear cheese, in Europe. Various types of red smear cheeses were investigated/tested, and it was established that 15,6% of samples were contaminated with bacteria of *Listeria* genus*,* of which 6,4% were *L.monocytogenes.*

In dairy industry, many problems associated with *L.monocytogenes* contamination are related to post-pasteurization contamination. *L.monocytogenes* can survive for longer period at low temperatures and on process equipment, and the ability of bacteria to survive on the equipment used in production is often cause of the outbreaks described in the literature *(Conly and Johnston, 2008)*. In studies by *Pan et al. (*2006*)* it is stated that strains of *L.monocytogenes* were isolated from equipment used in food industry which survived on the equipment and showed

high resistance to sanitation measures, with ability to act as constant source of contamination.

In Serbia, the incidence of *L. monocytogenes* in milk and dairy products has not been sufficiently studied and therefore there is no objective picture of the situation and presence of this bacterium in domestic products. »Rulebook on general and specific food hygiene conditions in any stage of production, processing and trade« *(Official Journal of RS, 72/10)*, the mandatory control/testing of food on presence of *L.monocytogene* is introduced, which will in future period result in realistic, objective picture of presence of this bacteria in milk and dairy products.

Taking into consideration that this is pathogen bacteria included for the first time in the Rulebook, and that Serbian expert public does not have enough experience with this issue, objective of our study was to present some general characteristics of *L.monocytogenes*, its pathogenicity, frequency of incidence in milk and dairy products and prevention measures.

General characteristics of *L. monocytogenes*

According to *Bergey's Manual of Systematic Bacteriology (1994) Listeria* genus includes: *L. monocytogenes*, *L .ivanovii, L. innocua, L. seeligeri L. welshimeri* and *L. gray*. *L. monocytogenes* is pathogenic for humans and animals, and *L.ivanovii* is mainly pathogenic for animals, primarily sheep. Other species are considered to be non-pathogenic. *L .monocytogenes* has thirteen serotypes, but the most common causes of disease are 1/2 a, 1/2b, and 4b.

Members of the *Listeria* genus are short rods, facultative anaerobic, Gram positive, not forming spores and capsules, distributed individually and in form of short chains, sometimes in form of the letters V and Y. In direct smear they can be coccoid, and therefore mistaken with streptococci *(Todar, 2009)*. In old cultures they form longer rods, with long filaments, and also Gram-negative units can occur. Listeria is mobile at the temperature of 20-25^{0}C (they create peritrichous flagella) and immobile at 37^{0}C. They are catalase positive, oxidase negative, esculin hydrolysis positive. *L. monocytogenes* creates during exponential phase a toxin called listeriolysin O (hemolysin), which leads to *in- vitro* hemolysis on blood agar.

L. monocytogenes is widely spread in nature and has high resistance to external environment.

The effect of temperature. It is psychotroph with resistance to high temperatures. It has wide temperature range for growth. It multiplies at temperatures ranging from -1,5^{0}C to 45^{0}C. Optimal temperature for bacteria growth is 30-37 ^{0}C.

The effect of pH. *L. monocytogenes* reproduces/multiplies best at pH 7**.** It is resistant to acid (pH< 5) and alkali (pH 9,6) environment.

Water activity (a_w). It multiplies at a_w 0,90-0,97 and survives relatively low a_w< 0,90.

Halotolerant. *L.monocytogenes* grows at the NaCl concentration of more than 10%. During one year period it survived in concentration of 16% NaCl, at pH 6,0 (*Seeliger and Jones, 1984)*. *Conner et al. (1986)* state that the resistance of *L. monocytogenes* to NaCl intensifies at lower temperatures. It can survive 100 days in concentration of 10,5 - 30% NaCl, at 4^0C.

Resistance to UV radiation. It is resistant to UV radiation which greatly contributes to wide spreading of this bacterium. Researches carried out by *Bougle and Stahl (1994)* confirm its resistance to gamma and X radiation. Doses of 2,6 kGy completely destroys *L. monocytogenes* (10^4/ml) in milk, but at concentration of 10^5/ml certain number of pathogens will survive for 45 days, however bacteria have lost the ability to reproduce.

Resistance to sanitation preparations/chemicals. *L. monocytogenes* is resistant to most of sanitation preparations/chemicals. Preparations that have proven to be the best in destruction of *L.monocytogens* are following: preparations on the basis of iodoform peracetic and peroctanoic acid, quarternary ammonium compounds and chlorine solutions *(Tompkin et al., 1999; Schafer et al., 2000; Eifert et al., 2002)*.

Listeriosis

Listeriosis is infectious disease of humans and animals, caused in 99% of cases by consumption of food contaminated by *L. monocytogenes*, and rarely from the environment *(Farber and Petrekin, 1991; Todar, 2009)*. Some cases of listeriosis in humans caused by eating dairy product are presented in Table 1.

The clinical picture in diseased humans and animals is manifested in similar way. In humans it can lead to following diseases: meningitis, encephalitis, septicemia, diarrhea, skin infections, etc. Particularly vulnerable groups are: pregnant women (miscarriages or stillborn children), infants, older persons and persons with weakened immune system (*Todar,* 2009). The presence of listeriosis in humans is low in the percentages (1%), but with high percentage of fatal outcome (30%) *(Salamina, 1996; Vazquez- Boland et al., 2001)*. It is estimated that listeriosis annually causes 2500 of serious cases of illness with approx. 500 deaths *(Marriott and Gravani, 2006)*. Also, the presence of this bacterium in intestinal tract of 5 to 10% of healthy humans without any obvious symptoms of the disease, was established *(Todar, 2009)*.However, in healthy adult individuals it can be totally unnoticed or be illness like the flue. Sensitivity of humans towards *L.monocytogenes* is different and it depends on genetic predisposition *(Shelef, 1989)*.

Infective dose for this bacterium is not precisely determined. Most of researchers consider the amount of 100-1000 *L. mon.*/g of foodstuff to be enough to cause listeriosis in humans *(Ooi and Lorber, 2005)*, and data on epidemic cases show values in range from 10^7-10^{11}cfu/g of foodstuffs *(Dalton et al., 1997)*.

Table 1. Listeriosis in humans caused by consumption of dairy products (*McLauchlin et al., 2004)*

Country	Year	Foodstuffs	Total infected	Died
USA	1994	Past. Chocolate milk	45	0
France	1995	Fresh cheese	17	4
Finland	1998-1999	Butter	25	6
USA	2000-2001	Mexican type of soft cheese	12	5

Symptoms of infection with this bacterium can occur after incubation period in form of gastro-intestinal problems, muscle pains and high temperature. Listeria introduced into organism through food can enter through intestine wall, and from there in the blood stream, and through blood stream it reaches the central nervous system (brain and spinal cord). In pregnant women, it can be passed through placenta on to the foetus, and cause miscarriage, still birth or serious diseases in new born babies. Pathogenesis of this bacterium is based on its ability to survive and to multiply in phagocytes of the host *(Mačvanin, 2004)*.

Listeriosis affects domestic and wild animals, most often sheep and cattle, rarely goats, horses and poultry. Cows can excrete listeria after miscarriage or during udder infections followed by mastitis, through milk. This can be manifested in some cases for several years. Contamination of milk by these bacteria can also be of faecal origin. In sheep affected by listeriosis in late stage of the disease paralysis and circle movement of the animal occur.

Sources of contamination by *L. monocytogenes*

It is widely spread in nature, easily enters the food and as such can lead to contamination of the food. The bacteria was isolated in the soil; vegetation; water (sweet, salty and sewerage); raw and processed food (milk and dairy products); production facilities (ranges, floors, forklifts, washing tubs, working tables, knives, cutting equipment and machines, aprons, ripening premises, cold stores, open space, etc.); secretions of sick individuals *(McLauchlin et. al., 2004; Todda and Notrmansb, 2010)*.

Raw milk is one of the most common paths for transmission of *L.monocytogenes,* mainly due to sick animals on the farm. It is important to point out that healthy animals are often carriers of *L.monocytogenes* and as such can be source of contamination of the environment, or milk. There is the opinion that main source of contamination of animals by *L. monocytogenes* is poor quality of prepared silage *(Fenlon, 1986)*. According to some literature data, listeria was isolated in 1,2-60% samples as consequence of poor quality of prepared silage (pH > 5-5,6) *(Fenlon, 1986; Vilar et al., 2007)*. *Listeria* spp. was isolated in 2-6,1% samples of milk collected from cows fed silage *(Vilar et al., 2007)*. *Tasci et al. (2010)* isolated *L. monocytogenes* in 6,66% silage samples, in 1,17%. Of milk

samples obtained from cows fed this silage, whereas the samples of milk from cows which were not fed the same silage were free of *L. monocytogenes.*

As already stated, facilities of dairy plants are excellent environment for development and growth of *L.monocytogenes* considering high moisture and milk and dairy product remains on equipment used in production. *L.monocytogenes* has the ability to form phybrils through which it attaches/adheres to solid surfaces, creating biofilm, which is reason why it is very difficult to remove it from the equipment and production facilities, where it multiplies on the equipment surface resulting in re-contamination of dairy products.

Presence of *L. monocytogenes* in milk and dairy products

In dairy industry, occasional presence of bacteria *L. monocytogenes* in milk, dairy products and dairy facilities/plant, is major problem.

Pasteurization of milk destroys *L. monocytogenes*. However, to which extent the *L. monocytogenes* is destroyed in milk during the process of pasteurization depends on the resistance of individual strains within the same species. Pasteurization of milk which occurs at the temperature of 62,8^{0}C for 30 minutes and 71,7^{0}C for 15 seconds is enough to destroy listeria present in the population of 10^2 cfu/ml, but not in the population of 10^7 cfu/ml (*Jayamanne and Samarajeewa, 2010)*. According to research by *Pearson and Marth (1990)*, high pasteurization inactivates *L. monocytogenes,* but the minimum survival of the bacteria is still possible.

L. monocytogenes has the ability to reproduce at very low storage temperatures (4^{0}C), and some other pathogenic bacteria. This is major property of stated bacteria which can often be isolated at milk collection sites and in dairy facilities, which means that they can reach final dairy products *(Wilkins et al., 1972; Kasalica and Otenhajmer, 1995a,b,c, 1996)*.

L. monocytogenes is resistant to freezing temperature during longer period of time. In sheep milk, frozen at -38^{0}C, and subsequently stored at -18^{0}C and -38^{0}C during the period of 7,5 months, one strain of *L.monocytogenes* survived to great extent (95%), whereas the other strain, under same conditions, survived in a lesser degree (40-50%). Destroying of *L. monocytogenes* in curdle of feta cheese obtained from said sheep milk stored under same conditions, was greater than in sheep milk *(Papageorgiou et al., 1997)*. To which extent the *L. monocytogenes* develops or survives in milk and dairy products, stored at storage temperature or frozen, depends on the type of dairy product and strain of *L. monocytogenes (El-Gazar et al., 1992; Theodoridis et al., 2006)*.

L. monocytogenes was isolated from raw milk, cheeses, dairy products and dairy plants. According to many authors, *L. monocytogenes* is most commonly isolated from raw milk sampled from collection tanks on farms or in dairy plants, and various contamination degrees have been recorded. In some countries the percentage of contaminated samples was relatively high, which speaks of potential

danger from listeriosis if such milk is consumed without prior heat treatment (Table 2).

Table 2. Presence of *Listeria monocytogenes* in raw milk

Country	Sampling location	Presence of *L. monocytogenes%*	Reference
Estonia	Collection tank of the farm and dairy plant	37	*Haekkinen et al.,* 2001
Scotland	Collection tank of the farm	15,6	*Jay et al.,* 2005
Uganda	Collection tank of the dairy plant	13	*Mugampoza et* al.,2011
The Netherlands	Raw milk	4,38	*Beckers et al.,*1987
Sweden	Silo tank of the dairy plant Collection tank of the farm	19,6 1	*Waak et al.,* 2002
USA	Raw milk	4	*Pearson & Mart,* 1990
Iran	Raw milk in dairy plant	1,7-3,3	*Mahmoodi,* 2010
Turkey	Raw milk	1,17	*Tasci et al.,* 2010

Research *Kasalica and Oljačić (2007)* showed that in 30 samples of raw milk (sheep, goat and cow milk) the presence of *L.monocytogenes* was not established*)*. Also, during 2009, in samples of collective raw milk, sampled from three individual agricultural producers - holdings (33 samples) and from one dairy farm (11 samples) the presence of *L.monocytogenes* was not established *(Kasalica and Popović-Vranješ*, *no published research)*.

Presence of *L. monocytogenes* in cheese can be associated with type of cheese, the manufacturing, inadequate pasteurization, post-pasteurization contamination, inadequate production, ability to multiply during storage at low temperatures and resistance to sanitation preparations *(Bottarelli et al., 1999)*.

The composition of cheese, pH, % of moisture, % of salt, ripeness of cheese, storing conditions, starter cultures and virulence of pathogens influence the reproduction of *L. monocytogenes* in cheese *(Kovinčić et al., 1991)*. According to research conducted by many authors, cheeses produced from raw milk are more often contaminated with *L. monocytogenes,* compared to cheeses obtained from pasteurized milk. In Sweden, in samples (333) of soft and semi-soft cheeses collected from retail stores, *L.monocytogenes* was isolated in 6% of samples, of which 42% were produced from raw milk, and 2% from heat treated milk *(Lončarević et al., 1995)*. *Rudolf and Scherer (2001)*, as the result of repeated contamination of milk with *L.monocytogenes,* in 8,0% of cheeses produced from pasteurized milk, concluded the presence of *L.monocytogenes. Jacqueta et al. (1990)*, in the period 1988-1990, analyzed 340 samples collected in a dairy plant - from equipment, dairy production facilities and different types of cheeses, on

presence of *Listeria*. *L.monocytogenes* was isolated in 44 tested samples of cheese, also from equipment and dairy production facilities; cheese was contaminated during the ripening process.

Soft cheeses and cheeses with mould represent excellent environment for reproduction/multiplying of *L. monocytogenes* (high % of moisture and pH >4,2 and 5,6). In researches carried out by *Mc Lauchlin et al. (1990)*, soft cheeses, immediately after production, had low presence of *L. monocytogenes* (<10/g). However, after expiration date, their presence was significantly greater (10^5-10^7cfu/g), indicating how these cheeses are suitable for development and growth of *L. monocytogenes* (Table 3).

In semi-hard cheeses, in later stages of ripening, the pH value increases which is also suitable for growth of *L. monocytogenes*.

Hard cheeses, because of low water content, are not the best environment for growth of this bacterium.

Table 3. Contamination of soft and semi-hard cheeses with *Listeria monocytogenes*

Country	Cheese type	Presence *L. monocytogenes %*	Reference
Italy	Soft and semi-hard cheeses (red smear cheese)	17,4	*Rudolf and Scherer (2001)*
Germany		9,2	
Austria		10,0	
France		3,3	
England	Soft and ripe cow cheese	8,2	*Greenwood et al. (1991)*
The Netherlands	Imported soft cheeses made of raw milk	10,14	*Beckers et al. (1987)*
England	Retail cheese Cheese in the dairy plant (soft cheese)	64,0 50,0	*McLauchlin et al. (1990)*
Great Britain	Soft cheese	10,0	*Pini and Gilbert (1988)*
Spain	Soft cheese	8,1	*Vitas et al. (2004)*

Lactic acid bacteria (LAB) slow down or stop the growth of pathogens in fermented products *(Schaack and Marth, 1988; Haris et al.,1989; Kasalica, 1992; Kasalica,1997)*. Bacteria *L. monocytogenes* is characterized by different level of sensitivity to LAB.

In fermented products, *L. monocytogenes* has the ability to survive during production process and storing. It survives in yoghurt for several weeks depending on the degree of contamination by this bacterium *(Zuniga-Estrada et al., 1995)*. In dairy products fermented by using different LAB strains fermentation of milk (*L.bulgaricus,S.thermophilus* and yoghurt), the survival of *L. monocytogenes* depended on the used strain of LAB and it ranged from 1-12 days (in yoghurt) to 4-37 weeks (fermented milk with *S. thermophilus*) *(Schaack and Marth, 1988)*. The survival of *L. monocytogenes* in yoghurt, during storage at 4^0C, was influenced by pH value and dry matter of the yoghurt, and content of fat had no significant effect.

Namely, all tested strains of *L.monocytogenes* (3) survived longer in skimmed milk with high content of dry matter and high pH value compared to full fat milk with lower content of dry matter *(Griffit and Deibel, 1990)*.

L.monocytogenes was also isolated in ice cream and frozen food, which represents another proof that this microorganism can survive freezing temperatures *(Cordano and Rocourt, 2001)*. According to literature data, the frequency of incidence of *L.monocytogenes* in ice-cream ranges from 2,8-3,5%. However, according to some researches, it is even higher. In Addis Ababa, in ice-cream samples collected from September 2003 to April 2004, *L. monocytogenes* was isolated in 19,6 % of cases. Increased contamination of ice-cream by this bacterium is explained by very suitable environment for its growth, considering the pH value, water activity, availability of nutrients and storage temperature *(Molla et al., 2004)*.

Hygiene measures

In order to prevent the contamination of milk and dairy products with *L.monocytogenes* it is necessary to focus and direct the attention on hygiene in dairy plant production facilities. Sanitation measures (washing with detergents and disinfection of clean surfaces) must be carried out properly. Each dairy plant must have the plan of frequency of sanitation which includes precise schedule of washing and disinfection of equipment, floors, draining pipes, walls, cold stores, etc. Very important is selection of adequate washing preparations and disinfectants, keeping in mind that disinfectants have to be changed occasionally, because it is proven that over time *L.monocytogenes* acquires resistance to certain preparations.

According to *Food Safety Authority of Ireland (2005)* chemical preparations which are considered to be most efficient against L. *monocytogenes* in the process of sanitation of equipment are iodoform, quarter ammonium compounds, peracetic and peroctanoic acids and solutions on the basis of chlorine dioxide.

Preparations based on idoform are recommended for use in dairy industry because their residues don't inactivate the starter cultures. Recommended concentration of 200 ppm, acting for period of 10-20 minutes, is efficient against *L.monocytogenes* on equipment and other surfaces. Their efficiency is reduced at temperatures < 4^0C and they are unstable at high temperatures.

Quartery ammonium compounds are not recommended for direct use on surfaces which are in contact with food, because even the smallest residues of these compounds inactivate the starter cultures, but they are very efficient for washing of floors, drains, walls and cold stores.

Peracetic and peroctanoic acids have proven as very efficient means against *L.monocytogenes* and formed biofilms and can be used without any limitations and restrictions (equipment, floors, walls, etc.).

Solutions on the basis of chlorine dioxide are efficient in disinfection of surfaces that do not corrode.

Steam can be used as alternative for chemical disinfection. Use of steam should be limited to equipment that is difficult for washing and cleaning, and closed systems due to forming of aerosol and condensation on equipment.

Warm water (> 82^0C) can be used in combination with disinfectant, if producer allows preparation in warm water, and in this way the efficiency of the disinfectant is increased. When chemical disinfectants are used, the water hardness must be taken into consideration and concentrations determined by the producer must be respected. Combinations of detergents and disinfectants are not recommended because disinfectants require precise time/duration of contact with the equipment or surface in order to be efficient. In the process of sanitation it is much better to use detergents and disinfectants separately.

Floors and sewers and drains should not be washed with high pressure - water, as this can lead to forming of contaminated aerosols in the production facility which can easily lead to contamination of products.

Accessories/utensils used for washing, after use, must be washed and disinfected using quartery ammonium compounds (600-1000 ppm). Also, as much as possible, the equipment, floors, accessories/utensils and all other work surfaces need to be kept dry.

It is very important that trained staff monitors the process of sanitation in dairy plant in order to ensure proper sanitation process. By introduction of HACCP (Hazard Analysis and Critical Control Points), as a new way of control in the process of production and processing the risk of contamination of products with these pathogen micro organisms is reduced. Producers identify critical points, and it is very important to determine the frequency of sampling of products and equipment used in production and processing, for testing on presence of *L.monocytogenes*. In this way the risk of contaminated milk and dairy products reaching the consumers is reduced.

Conclusion

Outbreaks of listeriosis in some countries, caused by consumption of milk and dairy products contaminated with *Listeria monocytogenes,* indicates the risk and danger to consumer health should such products be placed on the market. This emphasizes the significance and need for permanent control, and timely detection of potential sources of contamination.

L.monocytogenes is isolated mainly in raw and pasteurized milk, ice-cream, butter and other dairy products, and most commonly in fresh cheeses. Despite intensified efforts to improve the hygiene conditions in the production process, it is difficult to completely eliminate *L.monocytogenes* from all products, which is stated in studies by numerous authors. Conditions present in dairy plants (moisture, organic residues, temperature, etc.) are extremely favourable for development and growth of *L.monocytogenes,* which forms a biofilm on all surfaces (equipment, floors, walls, etc.) that is very difficult to remove and eliminate. In order to prevent

the contamination of product with this bacterium, proper hygiene is of great importance, consistent compliance with determined sanitation plan with strict control of the whole process by trained staff.

Protection against the contamination of milk and dairy products with *L.monocytogenes* in the production process must be focused on control in all production stages, starting from the primary production of milk on the farm, in dairy plant, during storage and distribution.

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Listeria monocytogenes u mleku i mlečnim proizvodima

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Rezime

Listeria monocytogenes je široko rasprostranjena u prirodi. Izazivač je listerioze, ozbiljne infektivne bolesti, koja se javlja kao posledica konzumiranja hrane kontaminirane ovom patogenom bakterijom. Učestalost javljana listerioze je mala (1%), ali sa visokom stopom smrtnosti (30%). U pojedinim zemljama (SAD i Švajcarska) velike epidemije listerioze bile su povezane sa konzumiranjem svežih sireva i mleka.

Ispitivanja u Evropi, na prisustvo *L.monocytogenes* u sirovom mleku pokazala su da 2,5-6% uzoraka može biti kontaminirano sa *L.monocytogenes*. U procesu proizvodnje mleka i mlečnih proizvoda. najčešće se javlja kao posledica postpasterizacione kontaminacije.

L.monocytogenes ima sposobnost da se razmnožava na niskim temperaturama (4^0C) i da preživljava na temperaturama zamrzavanja, te kao takva predstavlja opasnost po zdravlje potrošača ako se nađe u mleku, siru, sladoledu i drugim mlečnim proizvodima. Da ne bi došlo do kontaminacije proizvoda sa ovom bakterijom proizvožači moraju da deluju preventivno, pri čemu treba posvetiti posbnu pažnju na kritične tačke u procesu proizvodnje i na pravilnu sanitaciju.

U radu su prikazane opšte karakteristike *L.monocytogenes*, otpornost prema spoljašnjoj sredini, neke epidemije listerioze, njeno prisustvo u mleku i mlečnim proizvodima i važnije higijenske mere.

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