AIRBORNE MICROORGANISMS BROCHOTHRIX THERMOSPHACTA, LISTERIA MONOCYTOGENES AND LACTOBACILLUS ALIMENTARIUS IN MEAT INDUSTRY AS A RISK IN FOOD SAFETY

Martin Dobeic[1], Gobec Ivan[1], Kenda Edvard [2]

[1]University of Ljubljana Veterinary faculty, Institute for Environmental and Animal Hygiene with Ethology, Gerbiceva 60, 1000 Ljubljana, , Slovenia, e-mail: martin.dobeic@vf.uni-lj.si *; [2]Veterinary Administration of the Republic of Slovenia, Internal Veterinary Inspection Ptuj, Muzejski trg 2, 2250 Ptuj*

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Introduction

The transfer of contamination through the airborne route is one of the most significant areas of high-care food production (1). The food industry specially the manufacturing of the chilled meat products strive for lower levels of the air contamination, therefore lot of experimental and numerical studies considers the concentration of airborne particulate contaminants, such as different species of food spoilage microorganisms (2). The risk is higher when air is contaminated with eventually foodborne pathogen microorganisms and spores. The risk of contamination derive prior to plant surfaces that includes both product-contact and non-product contact surfaces. Airborne contamination should be occurred by indirect contact by means of airborne particles which can be represented by spoilage or pathogene microorganisms (3). Decontaminating floor and other plant surfaces is most important to control under biofilm, the potential for entrapping and protect the microorganisms against disinfectants. Thus airborne transfer of microorganisms is now seen as a significant route for contamination of food products. The shelf life of products is reduced by airborne contamination. Airborne pathogens can cause serious risk for human health. The sources of airborne microorganisms in slaughterhouses are biological aerosols, dust and other viable and not viable particles (3). Microbial loads of microorganisms in the air depend on the extension of the incidence through the different pathways of critical production sites. Risk of contamination of product depend on the type, size, source, persistence and number of microorganisms and on the manner of storage and processing of the chilled ready food products. Packaging under vacuum or modified atmosphere such controlled atmosphere, vacuum, modified atmosphere, active and edible packaging is used to inactivate microorganisms associated with foods (4). In addition airborne contamination should deteriorate and drastically shorten the shelf-life of products. *Brochotrix thermosphacta*,

Lactobacillus alimentarius, Shewanella spp., (pseudo) *Aeromonas spp*. *Pseudomonas, Alcaligenes*, *E. coli*, *Carnobacterium* and *Micrococcus* made microbial profile of commercial, vacuum packaged pork meat (5). The potential airborne food spoilage microorganisms are *Brochotrix* and *Lactobacilllus*, the special emphasis should be taken to potentially airborne pathogen *Listeria monocytogenes* (5, 6). *Brochotrix thermosphacta* is of concern as a food spoilage microorganism and there is no evidence to support that it is pathogenic meanwhile is closely related to the genera *Lactobacillus* and *Listeria*. Airborne contamination of pork slaughterhouses has been considered like very important, especially in ready chilled products packaging area. Our research conducted on the incidence of airborne CFU and *Listeria* and to monitor microbial levels in the air of the meat processing plant packaging area. The objective of this study was to determine the number of CFU and *Listeria monocytogenes* in the air of the packaging room and report the level of airborne microorganisms in meat processing plant in the association with potentially risk of contamination level with *Brochotrix* and *Lactobacillus*.

Materials and methods

Air samples were taken in the air of the packaging room of meat processing plant during one day. Air samples were taken on 9-cm-diameter Petri dishes on 6 different areas (1-6) of the packaging room and 2 different altitudes of the room at a height from 0,5m (B) and 2,5m (A) from the floor, however samples were taken on the packaking device as well. Samples on the packaging device were taken onto the 2 different speeds (time of exposition) of packanig track (T) (1T=92 sec., 2T=46 sec.). Petri dishes were containing 20 ml of plate count agar for determinating CFU and filter porous paper for determinating *Listeria*. Samples for CFU were taken on both altitudes, samples for *Listeria* were taken on position B. Air temperature, air moisture and airflow speed were monitored by Testo air probes on same 6 areas where airborne microorganisms were determinated. Air measurements were recorded by 3-function probe for the simultaneous measurement. Air samples were taken between 9 a.m. and 4 p.m. The Merck air sampler was chosen for microbial collection on Petri dish agar (CFU-colony forming units) and filter porous paper (*L. monocytogenes*). The samples were taken at 2 flow rates of 0,109 m^3 /40 seconds and 0,225 m^3/ 85 seconds. The passive method relies on natural deposition of particles on Petri dish agar and filter surfaces exposed to the room air flows. Petri dishes were exposed on the packaging track of packaging device for a period of four (92 sec.) and eight (46 sec.) serial packings. Exposure method was used for

CFU and *Listeria* analyses. The collected CFU and *Listeria* are cultured and counted after been cultured for a period of about a week.

Results and discussion

Field studies at typical production sites provided input data of airborne bacterial counts and natural deposition of bacteria. Table 1 presents airborne CFU of the air in packaging room of meat processing plant. Mean airborne bacteria on the lower altitudes (B) were lower (P>0.05) than those on higher ones (A). While the level of bacteria on higher positions was initially higher, standard deviation of airborne CFU was lower comparatively

Table 1: Bacterial count in the air in packaging room of meat processing plant

Area	CFU	Area	CFU	Area	CFU
1A 109	**92**	1B 109	**88**	1B 225	**143**
2A 109	**68**	2B 109	**71**	2B 225	**100**
3A 109	**85**	3B 109	**90**	3B 225	**153**
4A 109	**71**	4B 109	**99**	4B 225	**157**
5A 109	**93**	5B 109	**89**	5B 225	**172**
6A 109	**89**	6B 109	**0**	6B 225	**176**
Mean	83	mean	73	mean	150
corr. coef. -0,19551 S.dev. 10,86	sign. 0,611	n=12 S. dev. 36,82		N=6	

1-6 areas; 109,225 air sampler flow rates; CFU colony forming units

to lower positions where standard deviation of CFU was relatively high. Obviously the direction and airflow speed (Table 3) affects air contamination. It seems that the airflow depends on movement of workers and location of openings of the duct mounted air ventilation (8). However a trend for a lower air contamination did exist on higher areas of the packaging room. Monitoring of CFU and *Listeria* on packaging track only on agar plates in the absence of comparative tests on meat products was performed due to the risk of initial contamination of meat products. The level of CFU according to 92 sec. of exposure time was slightly higher according to 46 sec. of exposure time (Table 2).

Table 2: Colony forming units (CFU) on Petri dish agar on packaking track according to 92 sec. of exposure time (1T) and to 46 sec. of exposure time (2T)

Area (track)	CFU	Area (track)	CFU	Area (track)	CFU	Area (track)	CFU
1T 01	**0**	1T 06	**1**	2T 01	**0**	2T 06	**0**
1T 02	**1**	1T 07	**0**	2T 02	**0**	2T 07	**1**
1T 03	**1**	1T 08	**0**	2T 03	**0**	2T 08	**0**
1T 04	**0**	1T 09	**0**	2T 04	**0**	2T 09	**0**
1T 05	**0**	1T 10	**1**	2T 05	**0**	2T 10	**0**

1-10 num. of sample

Both speeds of the track were typical for food packaging devices and obviously too short for the satisfactory deposition time for standard CFU determination. According to present results of CFU the analyses of the presence of airborne *Listeria monocytogens* show

its absolute absence in all monitored areas. If we consider that *Listeria monocytogenes* has become one of the most dangerous foodborne pathogens is important that the emphasis should be placed on air quality, especially for the reason that *Listeria* is a potential airborne pathogenic microorganism in meat processing plants. Saprophytic microorganisms *Brochotrix thermsophacta* and floras of *Lactobacillus alimentarius* developed on food products by storage under modified and controlled athmosphere, are potential airborne meat spoilage microorganisms and should be considered a processing critical control point (7, 5). The meat industry atmosphere can be prevented by effective air cleaning systems to reduce the incidence of CFU airborne contamination and successively restrict airborne distribution like *Listeria, Lactobacillus* and *Brochotrix microorganis*ms.

Table 3: Measurements of temperature (^{0}C), relative moisture (%) and airflow speed (m/s) on aeras (1-6) and two altitudes (A, B)

Area	Altitude A	Altitude B
1	T=12,0^{0}C, M=62,1%, V=0,04 m/s	T=12,0^{0}C, M=61,9%, V=0,07 m/s
2	T=11,3^{0}C, M=55,2%, V=0,05 m/s	T=11,3^{0}C, M=57,5%, V=0,17 m/s
3	T=11,9^{0}C, M=48,6%, V=0,05 m/s	T=12,2^{0}C, M=48,6%, V=0,14 m/s
4	T=12,2^{0}C, M=46,4%, V=0,24 m/s	T=12,0^{0}C, M=62,1%, V=0,04 m/s
5	T=12,6^{0}C, M=41,8%, V=0,21 m/s	T=12,3^{0}C, M=42,7%, V=0,02m/s
6	T=12,6^{0}C, M=41,8%, V=0,21 m/s	T=12,3^{0}C, M=42,7%, V=0,20 m/s

T (^{0}C) air temperature; M (%) relative moisture; V (m/s) airflow speed

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