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MICROBIOLOGICAL QUALITY OF READY-TO-EAT PRODUCTS AND POTENTIAL RISKS FOR CONSUMERS IN LATVIA

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Ready-to-eat (RTE) foods are challenging for food business operators as they need to remain qualitative and safe for consumers. However, consumers tend to choose them more and more often because of fast and easy handling. The highest risk from RTE foods is microbiological contamination, particularly for vulnerable groups like children, elderly, and pregnant women. The aim of the research was to assess the microbiological quality of RTE meat and fish products to highlight possible risks for consumers. A total of 15 984 analyses performed on RTE meat and fish products were included in this study. It was found that RTE meat and fish product samples representative of the market in Latvia in the period 2012–2015 had high microbiological quality and only in rare cases was contamination with hygiene indicatororganisms (coliforms and Escherichia coli*) and pathogens (*Salmonella *spp.,* Listeria monocytogenes*,* Staphylococcus aureus*, and sulphite-reducing clostridia) detected. However, it is important to pay attention to customer habits of cooking and preparing RTE foods as well — thermal processing for products intended to be used cooked, use before expiration date and adequate storage rules for products, as these have important regarding microbiological risks for health.*

Key words: *ready-to-eat food, microbiological quality, public health, consumption.*

INTRODUCTION

Due to the common fast and stressful mode of life consumers, diet has changed and more ready-to-eat (RTE) foods have been included in the everyday diet. Ready-to-eat products are food products prepared in advance, which can be eaten as when purchased without the need for cooking or other processing (Anonymous, 2013). Cooked, sliced meat and fish, pates, products intended to be cooked before use (like frankfurters, semi smoked sausages etc.) can be found in the everyday diet of almost every family (Monteiro, 2010). Semi-dry, dried sausages, and smoked chicken legs are consumed more, while smoked whole chicken, pork chop, ham and chicken roulette are usually eaten on special days (Rozentāle *et al.*, 2015). As RTE-meats are consumed mainly without re-heating, the processing, transport and handling by retailer and consumer can all potentially compromise the safety of the food (Anonymous, 2013; Stahl *et al.*, 2015).

It is a challenge for food business operators to ensure quality and safety of ready-to-eat meat, poultry and fish products. Food safety assurance depends on application of adequate methods and resources during implementation of good manufacturing practice and hygiene. It is important that the food business operators use coordinated microbiological and safety criteria that make it possible to assess acceptability of foodstuffs in the production, processing and distribution stages (Melngaile, 2008; Marčenkova, 2010; Melngaile *et al.* 2014).

European Regulation (EC) No. 2073/2005 lays down the microbiological criteria for certain microorganisms in foods and the implementing rules to be complied with by food business operators in Europe when implementing general and specific hygiene measures. The regulation states that food safety is the responsibility of the food business operators (Anonymous, 2005; Melngaile, 2008; Álvarez-Ordóñez *et al.*, 2015).

Microbiological contamination is the most frequent cause for spread of most foodborne diseases. European legislation stipulate that food shall not contain microorganisms, toxins or metabolites thereof in amounts that cause risk for human health. Food may not be distributed if not safe, including food that is microbiologically contaminated (Anonymous, 2005; Marčenkova, 2010).

Listeria monocytogenes is considered to be the highest risk factor for ready-to-eat products, because of its ubiquity in the environment, tolerance to unfavourable environmental conditions, and ability to survive on equipment that results in contamination of end-products. The disease primarily affects older adults, pregnant women, newborns, and adults with weakened immune systems. There was a recent documented outbreak in Switzerland caused by consumption of ready-to-eat salads (Mataragas, 2010; Anonymous, 2013; Stephan *et al.*, 2015).

Salmonella species cause salmonellosis. Mortality from this infection disease for the population as a whole is low (< 1%), but there is raised risk for the elderly and infants. Meat and poultry area the main sources of *Salmonella*. Rates of contamination from this bacteria vary, but it is predicted that the highest contamination is in poultry products. Human salmonellosis is normally seen in the form of small family outbreaks and one of the final stages in the contamination chain is usually the cross-contamination of cooked food by raw food or by dirty working surfaces, the cooked food being left at room temperature for a number of hours (Forsythe and Hayes, 1998).

Symptoms of ingestion of food contaminated with *Staphylococcus aureus* appear quickly, within 1–6 hours. The most typical symptoms are vomiting, cramps and diarrhoea and mortality recorded is extremely low. An important source of *S. aureus* is human body, the main reservoir being the nose. There is a risk from cooked foods that have been handled by a *S. aureus* carrier and stored under warm conditions for a long period, for example, cured cooked meat, ham and cold meat and poultry products (Forsythe and Hayes, 1998).

Non-pathogenic *Escherichia coli* strains are typical for intestines of warm blooded animals; however, there are six groups of *E.coli* strains pathogenic to humans in different degrees (Forsythe and Hayes, 1998). Pathogenic *E. coli* strains cause diverse intestinal and extraintestinal diseases by means of virulence factors that affect a wide range of cellular processes (Kaper *et al.*, 2004).

There are no available data on clinically diagnosed cases of lysteriosis and poisoning with *S. aureus* in humans in Latvia, but in many cases they may remain undiagnosed. Other foodborne illnesses are more likely to be diagnosed and the potential pathogen can be found. The incidence of salmonellosis cases has decreased during the last three years, while incidence of undifferentiated gastrointestinal disease cases have stayed almost the same. There are a number of unknown cases of bacterial disease, particularly when clinical symptoms of food borne diseases are not severe (Anonymous, 2015).

The aim of this study was to identify potential risk for different groups of consumers by assessment of microbiological quality data on ready-to-eat meat and fish products that were representative of the Latvian market.

MATERIALS AND METHODS

Microbiological testing results for the last four years (2012–2015) were used to assess the microbiological quality of ready-to-eat meat and fish products sold or produced in Latvia. Food product sampling was conducted in the frame of quality control by producers within Hazard Analysis Critical Control Point (HACCP) procedures or by inspectors of the State Food and Veterinary Service (FVS) in the frame of official control programmes. Samples were removed from supermarkets, local shops, manufacturing and storage places, and border inspection posts. Sampling was conducted according to the FVS developed sampling procedure. All samples were stored at the temperature +4 ^{o}C after sampling and during delivery to the laboratory. According to the laboratory practice, standard sample description was added to each sample.

Information about the country of origin and/or production for RTE meat and fish products was obtained. The main countries of origin and/or production were Latvia, Lithuania, and Estonia; other countries were Madagascar, Spain, Poland, Germany, USA, Iceland, Finland, Uruguay, Norway, Bahama Islands, Belarus, Denmark, Greenland, Canada, China, Kazakhstan, and rarely undefined.

All samples were classified according to production technology and ingredients used in production, creating whole eight categories of RTE fish products (Fig. 1) and 16 categories of RTE meat products (Fig. 2). The most commonly tested groups were various types of sausages, cold and hot smoked RTE meat and fish products, non-sterilised and sterilised canned RTE meat and fish products, products from molluscs and invertebrates, and products from crustaceans.

Ready-to-eat meat and fish product samples were analysed for presence and counts of hygiene indicator organisms (coliforms and *Escherichia coli*) and pathogens (*Salmonella*

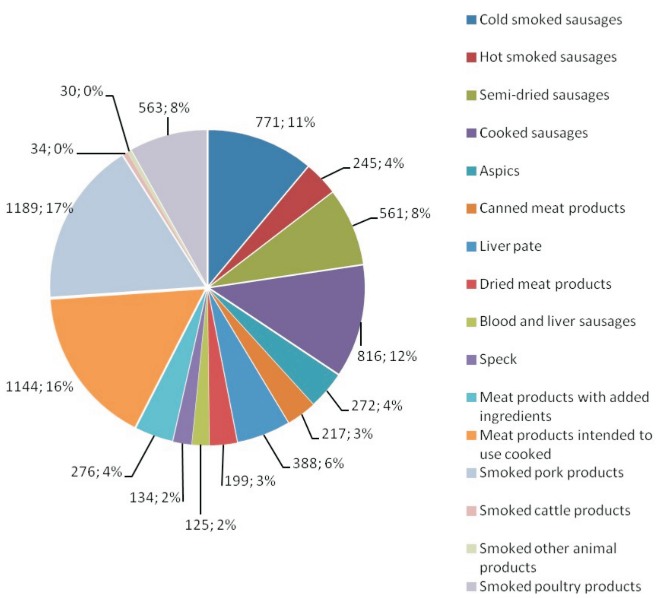

Fig. 1. Number of samples of RTE meat product types.

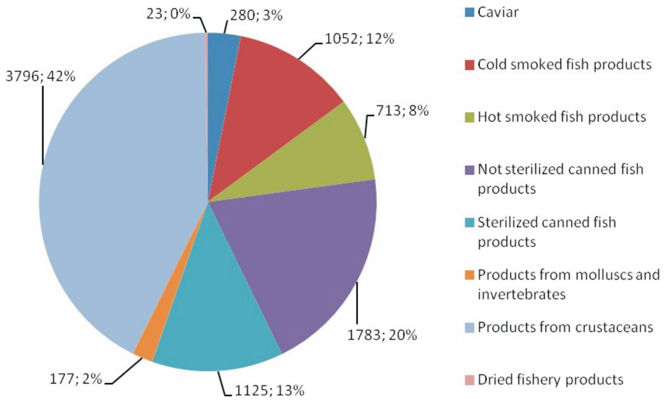

Fig. 2. Number of samples of RTE fish product types.

spp., *Listeria monocytogenes*, *Staphylococcus aureus,* and sulphite– reducing clostridia). Aerobic plate counts (APC) were made to provide a general overview of microbiological quality and industrial sterility was checked for sterilized products. Testing for lactic acid bacteria was conducted to determine spoilage and quality loss. In total, 8984 analyses for fish products and 6964 analyses for meat products were performed. The following standards were used for testing of microbiological quality of ready-to-eat fish (fish) and meat (meat) products: for determination of number of *Enterobacteriaceae* (meat n = 89; fish n = 948) — LVS ISO 21528-2:2007, presence of *Escherichia coli* (meat n = 195, fish n=15) and number of *E. coli* (meat n = 30) — LVS ISO 7251:2006; number of coagulase-positive staphylococcus (meat n = 138; fish n = 1020) — LVS EN ISO 6888-1/A1:2007; presence of coliform bacteria (meat n = 433; fish n = 288) — GOST R 50454-92, GOST R 52816-2007 and LVS ISO 4831:2006; number of coliform bacteria (meat n = 118; fish n = 113) — LVS ISO 4832:2006; aerobic plate counts (APC) (meat n = 1075; fish n = 1499) — GOST 10444.15-94, LVS EN ISO 4833-1:2014 and LVS EN ISO 4833-2:2014; presence of *Listeria monocytogenes* (meat n = 1042; fish n = 1196) — GOST R 51921-2002; number of *L. monocytogenes* (meat n = 714; fish n = 650) — LVS EN ISO 11290-2/A1:2007; industrial sterility (meat n = 231; fish n = 1083) — GOST 30425-97; presence of *Salmonella spp*. (meat n = 2319; fish n = 1270) — GOST R 52814-2007, LVS EN ISO 6579:2003/AC:2006; presence of *Staphylococcus aureus* (meat n = 86; fish n = 99) — GOST R 52815-2007 p.8.2.; presence of sulphite-reducing clostridia (meat n = 96; fish n = 49) — GOST 29185-91; number of sulphite-reducing clostridia (meat n = 140; fish n = 51) — ISO 15213:2003; number of β-glucuronidase *E. coli* (meat n = 258; fish n = 488) — LVS ISO 16649-2:2007; number of mesophilic lactic acid bacteria (fish n = 180).

Analytical data were statistically evaluated using the descriptive statistics method (MS Excel Pivot table and R).

Food consumption data were obtained from the National Food Consumption survey 2012–2014, which was conducted according to methods of the European Food Safety Authority (EFSA) (Anonymous, 2009). The data was obtained by 24-hour recall and food propensity questionnaires (n = 1840 adults and n = 1456 children aged 3–18).

RESULTS

Ready-to-eat meat products. APC were analysed for all RTE meat product types except smoked other animal products (Fig. 3). APC < 1 lg CFU/g were found in 12% of samples. A high APC were found in samples of cold smoked sausage (5.26 ± 2.50 lg CFU/g) and dried meat products (5.07 ± 1.24 lg CFU/g). Very high variation (s = 6.27) was observed for cold smoked sausage samples. The lowest APC was found in meat products with added ingredients (2.84 ± 1.03 lg CFU/g) and cooked sausages (2.85 ± 1.29 lg CFU/g).

Enterobacteriaceae counts in RTE meat products were > 1 lg CFU/g only in 4% of cases. A higher *Enterobacteriaceae* count (1.6 lg CFU/g) was found in one sample of aspic and in three samples (43%) of liver pate (3.4 ± 1.7 lg CFU/g).

Presence of *Salmonella spp.* was tested for all RTE meat products excluding canned meat products (n = 2319). *Salmonella spp.* were present in one sample of speck and two samples of meat products intended to be used cooked.

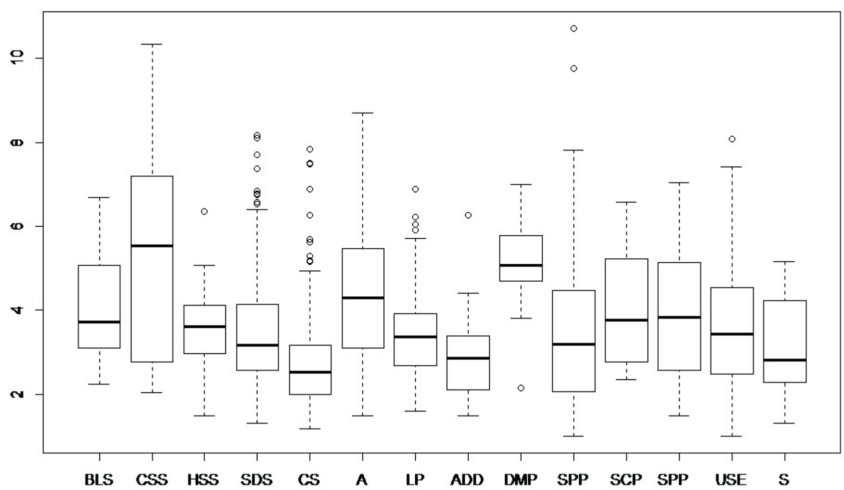

Fig. 3. ACP counts for RTE meat products, lg CFU/g. BLS – blood and liver sausages, CSS – cold smoked sausages, HSS – hot smoked sausages, SDS – semi-dried sausages, CS – cooked sausages, A – aspics, LP – liver pate, ADD – products with added ingredients, DMP – dried meat products, SP – smoked pork products, SCP – smoked cattle products, SPP– smoked poultry products, USE – products intended to be used cooked, S – speck.

Presence of coliform bacteria was tested in 13 types of RTE meat products. Coliform bacteria were often present in samples of liver pate (14%), smoked poultry products (11%), meat products with added ingredients (8%) and aspic (7%). Frequency of occurrence of coliform bacteria in other products was ≤ 5%. Coliform bacteria were found in one (25%) sample of dried meat products. Coliform bacteria were not found in hot smoked sausages, liver and blood sausages and speck.

Coliform bacteria counts were made in 12 types of RTE meat products. The counts were elevated in 8% of samples: in aspics (43%; 3.0 ± 0.96 lg CFU/g), meat products intended to be used cooked (29%; 3.3 ± 1.59 lg CFU/g), in one sample of dried meat (33%; 1 lg CFU/g) and liver pate (14%; 4.7 lg CFU/g).

E. coli was detected in 32% of tested RTE meat products. *E. coli* was commonly present in dried meat products (40%), cold smoked sausages (38%) and smoked pork product samples (12%). *E. coli* counts < 1 lg CFU/g occurred in cold smoked sausage, dried meat products and meat products intended to be used cooked.

β-glucuronidase E. coli counts in 91% of samples were < 1 lg CFU/g. 38% of samples of meat products intended to be used cooked had elevated counts of β-glucuronidase *E. coli* (1.8 ± 0.4 lg CFU/g). The β-glucuronidase *E. coli* count in one sample of liver pate was 4.4 lg CFU/g and that was the maximum number found among tested samples. In one sample of smoked poultry products the number of β-glucuronidase *E. coli* was 1.5 lg CFU/g.

Counts of coagulase-positive staphylococcus in frankfurters from chicken meat were 2.4 lg CFU/g. *S. aureus* was present in 2% of samples: in one sample of aspics and one sample of smoked cattle products.

L. monocytogenes tests were made in all types of products except canned meat. It was present in 2% of all samples: 17% of smoked cattle products samples, 9% of aspic samples, 4% of speck samples, 3% of cooked sausage and meat products intended to be used cooked, 0.9% of smoked pork product samples and 0.7% of cold smoked sausage samples. Counts of *L. monocytogenes* for all tested samples were < 1 lg CFU/g, excepting in one speck sample (1.7 lg CFU/g).

Sulphite-reducing clostridia were found in 4% of samples: two samples of smoked pork products and one sample of semi-dried sausages and meat products intended to be used cooked. Counts of sulphite-reducing clostridia were < 1 lg CFU/g in 94% of samples. Elevated levels of sulphite-reducing clostridia were found in 54% of samples of blood and liver sausages — 2.1 ± 1.5 lg CFU/g; the range for all samples was 1.0–4.4 lg CFU/g. In one sample of aspics the sulphite-reducing clostridia count was 1.5 lg CFU/g.

Regarding industrial sterility for canned meat products and liver pate, one sample out of 210 samples of canned meat products was not sterile.

Ready-to-eat fish products. APC counts were < 1 lg CFU/g in 6% of samples of RTE fish products (Fig. 4). A high level of APC was found in canned fish products that were not sterilised (4.07 ± 1.31 lg CFU/g) and in caviar (4.04 ± 1.87 lg CFU/g). A low level of ACP was found in dried fish products (APC 2.72 ± 1.31 lg CFU/g) and in one sterilised canned fish product sample (2.08 lg CFU/g).

Enterobacteriaceae counts were > 1 lg CFU/g in 18% of RTE fish product samples. Elevated *Enterobacteriaceae* counts were most common in canned fish product samples that were non-sterilised (40%; 3.1 ± 1.5 lg CFU/g). Elevated *Enterobacteriaceae* counts were found in 18% of samples crustacean products (1.7 ± 0.2 lg CFU/g), 9% of

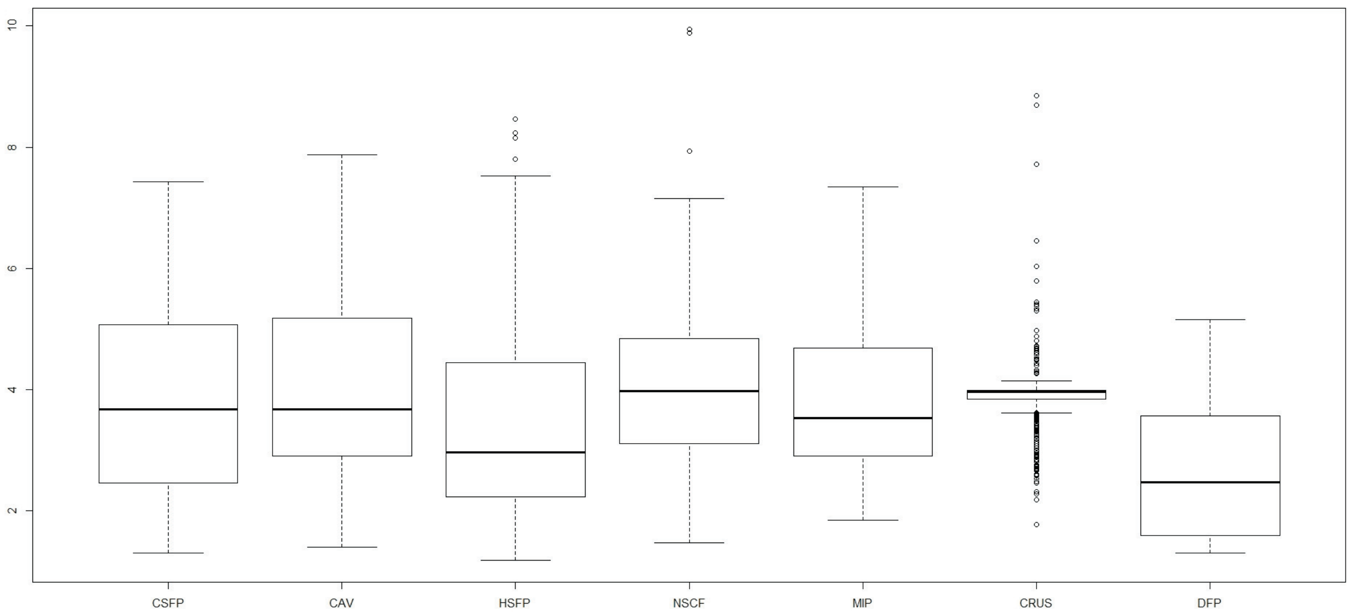

Fig. 4. ACP counts for RTE fish products, lg CFU/g. CSFP – cold smoked fish products, CAV – caviar, HSFP – hot smoked fish products, NSCF – non-sterilised canned fish products, MIP – products from molluscs and invertebrates, CRUS – products from crustaceans, DFP – dried fish products.

samples from hot smoked fish products (2.1 ± 1.1 lg CFU/g) and the maximum *Enterobacteriaceae* count in the only positive sample of cold smoked fish products (3.9 lg CFU/g).

Salmonella spp. were not detected in any type of RTE fish product.

Coliform bacteria were detected in 16% of RTE fish product samples. Coliform bacteria were commonly present in samples of cold smoked fish products (51%), and also found in 23% samples of caviar, 21% of samples of products from crustaceans, 13% of samples of hot smoked fish products, 6% of samples of products from molluscs and invertebrates and 5% of samples of non-sterilised canned fish products had. Coliform bacteria counts > 1 lg CFU/g were observed only in two samples (2%) — cold smoked fish products (3.15 lg CFU/g) and non-sterilized canned fish products (1.78 lg CFU/g).

E. coli was not detected in tested cold smoked fish product and non-sterilised canned fish product samples. Counts of β-glucuronidase *E. coli* > 1 lg CFU/g were found in two samples (22%) of products from molluscs and invertebrates (3.1 ± 0.6 lg CFU/g) and in one sample (1%) of non-sterilised canned fish products (4.96 lg CFU/g).

Counts of sulphite-reducing clostridia in tested RTE fish products were lg CFU/g; it was present in one sample of products from crustaceans.

Counts of coagulase-positive staphylococcus were found < 1 lg CFU/g for all tested samples, excepting in 1% of samples of products from crustaceans (1.7 ± 0.3 lg CFU/g). *S. aureus* was detected in two samples (33%) of hot smoked fish products and two samples (4%) of non-sterilised canned fish products.

L. monocytogenes was present in 8% of RTE fish product samples. It was most common in caviar samples (15%) and samples of products from molluscs and invertebrates (14%). *L. monocytogenes* was also present in samples of cold smoked fish products (11%), not sterilized canned fish products (8%), hot smoked fish products (5%) and in products from crustaceans (3%).

Counts of *L. monocytogenes* were < 1 lg CFU/g in 97% of samples; in 3% of samples of non-sterilised canned fish products the 1 lg CFU/g, one sample of caviar the *L. monocytogenes* count was 1.5 lg CFU/g. For cold smoked fish products, 4% of samples had *L. monocytogenes* counts > 1 lg CFU/g (2.1 ± 1.3 lg CFU/g), and there was high variation in this parameter.

The mesophilic lactic acid bacteria counts in 50% of samples of products from crustaceans were mesophilic lactic acid bacteria > 1 lg CFU/g with a mean value of 2.2 ± 0.7 lg CFU/g, range 1.3–3.7 lg CFU/g and median 1.9 lg CFU/g that is close to 1 lg CFU/g.

Table 1

AVERAGE CONSUMPTION OF MEAT AND FISH PRODUCTS (KG PER YEAR) AND MARGIN OF ERROR FOR DIFFERENT AGE GROUPS IN LATVIA

Average consumption, kg in a year and margin of error	Age					
	19–35 years		36–50 years		51–64 years	
Sausages	22.04	(1.23)	22.44	(1.27)	18.31	(1.29)
Meat	43.60	(1.47)	53.47	(2.72)	43.97	(1.78)
Tinned meat	1.99	(0.45)	1.62	(0.27)	1.49	(0.23)
Offal	1.21	(0.11)	1.74	(0.18)	1.50	(0.13)
Products from offal	1.37	(0.11)	1.80	(0.17)	1.78	(0.17)
Smoked meat	7.24	(0.44)	8.89	(0.54)	8.30	(0.57)
Fish	9.32	(0.59)	12.52	(0.80)	12.44	(0.86)
Fish products	2.30	(0.22)	2.46	(0.22)	2.55	(0.25)

Industrial sterility of canned fish products was tested and 0.5% of samples were not sterile.

Ready-to-eat meat and fish product consumption. Ready-to-eat meat at fish products are consumed by the major part of the population. More than 90% of respondents that consume industrially produced meat products indicated that they consume sausages, meat products and smoked meat. Tinned meat was consumed by 50% of the survey population and products from offal (that include pate) were consumed by 85%. Fish products were consumed by 86% of the survey population. It is difficult for consumers to obtain correct information about the production type of a product. Food marketing names can be misleading. For example, these not always state whether a product is cold smoked or hot smoked, and can be named only as smoked or even called in a traditional name. Therefore, the data on consumption of hot-smoked or cold-smoked products should be interpreted with caution, bearing in mind that there is no strong differentiation by consumers between these groups.

On average, 221.71 grams of meat and meat products and 37.62 g of fish and fish products were consumed daily by each person. Men consumed more meat than women (281 g and 166 g, respectively) and there are differences in the type of products consumed. Men daily used twice as much sausages, smoked meat and tinned meat as women, but for other categories consumption is similar. On average, respondents consumed 57 grams of sausages and 22 grams of smoked meat daily, which was almost one-fourth of all meat products consumed daily. There were differences in consumption by age classes. Younger people ate more sausages and tinned meat, but less of other types of meat and fish. Adults ate more offal and offal products and smoked meat (Table 1).

DISCUSSION

It is important to highlight risk from RTE food products for consumer health, to raise consumer awareness and to remind manufacturers to monitor hygiene during food production and storage. It is also important to remind sellers to maintain defined storage conditions and shelf life (Stahl *et al*., 2015).

Smoked pork products and meat products intended to be used cooked (frankfurters, grill sausages etc.) were the most often tested RTE meat products and were consumed by the larger part of population. Meat products intended to be used cooked were found most often to have positive presence and/or raised counts of microorganisms; for these it is highly recommended to follow cooking recommendations defined by manufacturers and to regard the storage time. This type of product can be risk product because of the tendency among consumers to use them without thermal treatment, especially in families with children. The potential risk is confirmed by elevated levels of coliform bacteria and β-glucuronidase E.coli found in these products.

The most often tested RTE fish products were products from crustaceans and non-sterilised canned fish products, as these have high potential risk due to their specific production method; they have a high level of moisture and added products that in suitable conditions create a favourable environment for microorganism growth (Melngaile, 2008; Marčenkova, 2010; Melngaile *et al.,* 2014). It is therefore not surprising that presence and/or raised number of microorganisms were common in these RTE fish products. The risk of a high level of *Enterobacteriaceae* in these products needs to be highlighted.

Fish and fish product consumption is not very high in Latvia. Although health recommendations are to consume fish at least two times a week, consumption data show that only half of recommended amount is reached.

The results of the study agree with literature data on microorganism contamination of food products and RTE products, in relation to the production method (Melngaile, 2008; Marčenkova, 2010; Melngaile *et al.,* 2014). High levels of APC occurred in cold smoked sausages and dried meat products, and in products with minimal heat treatment and many added fresh ingredients, for example, non-sterilised fish products like fish salads, salted fish fillets and caviar. Low APC were found in heat treated foods like cooked sausages and products with added other ingredients. *E. coli* was found in RTE meat products with minimal treatment, for example, dried meat products and cold smoked sausages. Similar studies on different types of ready-to-eat products in Latvia showed that the highest APC and coliform bacteria counts occurred in RTE products that were produced without heat treatment (Marčenkova, 2010).

The study confirmed that aspics, liver pate and blood and liver sausages, due to their specific composition, have to be considered as high risk products, as the conducted analyses showed positive cases. These products had higher levels of *Enterobacteriaceae* and specific hygiene indicator organisms then other RTE meat products. The observed contamination, which can be potentially toxic, may be due to hygiene problems in the handling process, a favourable environment for microorganisms, and fast spoilage.

L. monocytogenes was present at a low level in various products and more often found in RTE fish products. The presence of *L. monocytogenes* in a variety of RTE products containing confirms observations on its resistance to different environments. *L. monocytogenes* tended to be found more in samples of cold smoked cold smoked fish products and speck, as observed previously (Martins *et al.*, 2011; Anonymous, 2013; Álvarez-Ordóñez *et al.*, 2015; Campos *et al.*, 2015; Omaima *et al.*, 2015).

The observed levels of hygiene indicator organisms were low. There was no risk associated with presence or counts of sulphite-reducing clostridia (counts were slightly higher in blood and liver sausages than in others), coagulase-positive staphylococcus and *S. aureus, Salmonella spp.*, and industrial sterility (Anonymous, 2005). Counts of mesophilic lactic acid bacteria suggest some problems associated with storage and spoilage of products from crustaceans.

Taking into account that higher risk products are not consumed in very high amounts, the risk for Latvian consumers to consume contaminated RTE meat or fish products is very low. Manufacturer recommendations about storage, thermal treatment and expiration date need to be taken into account, as the results showed presence of potentially harmful microorganisms in products that are not treated properly.

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ĒŠANAI GATAVU PRODUKTU MIKROBIOLOĢISKĀ KVALITĀTE UN IESPĒJAMAIS RISKS PATĒRĒTĀJIEM LATVIJĀ

Ēšanai gatavo produktu (*ready-to-eat (RTE)*) kvalitātes un drošuma saglabāšana ir izaicinājums ražotājiem. Tomēr mūsdienās šos produktus patērētājs izvēlas arvien biežāk tieši tā iemesla dēļ, ka tos ir viegli lietot ikdienas uzturā. Lielākie riski RTE produktiem saistīti tieši ar iespējamo mikrobioloģiskie piesārņojumu, lielāks risks ir jutīgajām iedzīvotāju grupām — bērni, seniori un grūtnieces. Pētījuma mērķis bija noskaidrot RTE gaļas un zivju produktu mikrobioloģisko kvalitāti un iespējamo patērētāju risku. Pētījumā iekļauti 15 984 RTE gaļas un zivju produktu analīžu rezultāti, kas atspoguļo situāciju Latvijas tirgū pieejamajiem produktiem laika posmā no 2012. līdz 2015. gadam. Kopumā var secināt, ka produktu mikrobioloģiskā kvalitāte ir augsta un tikai retos gadījumos novērojams mikrobioloģiskais piesārņojums ar higiēnas indikatororganismiem (koliformas un *Escherichia coli*) un patogēniem (*Salmonella* spp.*, Listeria monocytogenes, Staphylococcus aureu*). Tomēr nepieciešams pievērst uzmanību arī patērētāju paradumiem, īpaši attiecībā uz RTE produktu lietošanu — termiskās apstrādes nepieciešamību, derīguma termiņiem un glabāšanas apstākļiem, šie apstākļi ir tikpat būtiski, lai izvairītos no iespējamā riska