Journal of Consumer Protection and Food Safety (2023) 18:133–146
https://doi.org/10.1007/s00003-023-01424-1

Journal of Consumer Protection and Food Safety
Journal für Verbraucherschutz und Lebensmittelsicherheit

RESEARCH ARTICLE

Consumer attitudes and perceptions towards chilled ready-to-eat foods: a multi-national study

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Received: 27 August 2022 / Revised: 26 November 2022 / Accepted: 13 February 2023 / Published online: 8 March 2023

Abstract

Understanding consumers' behavior and their handling of high-risk foods at home is essential for reducing the number of foodborne illnesses. This study shows the results of a cross-national analysis of consumers' perception from nine countries, and the identification of customers' clusters and its characteristics in order to understand customers' behavior, and to build safe chilled ready-to-eat (RTE) foods prevention strategies. The cluster analysis resulted in two clusters: (1) "Precautious consumers" characterized by the orientation towards pre-packed RTE foods, with consumers mainly coming from Bosnia and Herzegovina, India, Poland, Portugal, Spain, and Turkey. Their attitudes and self-reported practices may be categorized as less risky in terms of food-borne illnesses connected with the consumption of RTE foods; (2) "Unconcerned consumers" preferred cutting and slicing RTE foods freshly at the point of purchase, usually sold at the delicatessen department in a supermarket or at open markets. Those consumers mostly came from Croatia, Serbia and Slovenia and their attitudes and self-reported practices were riskier. These results allow a better understating of what characterizes consumers of RTE foods in different countries.

Keywords Consumers' perception · Chilled ready-to-eat foods · Food handling · Food safety

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1 Introduction

Food-borne diseases include various illnesses ranging from mild gastrointestinal issues to life threatening illnesses such as meningitis, septicemia, spontaneous abortion, still birth, hemolytic–uremic syndrome, Guillain-Barre syndrome, etc. (Bari and Yeasmin 2018; Gandhi and Chikindas 2007). The World Health Organization (WHO) has estimated the burden of food-borne diseases, with annual incidents of more than 420,000 m cases and 230,000 deaths from diarrheal diseases, caused by consumption of contaminated food and/or water (Kirk et al. 2015). Although the majority of the cases occur in developing countries, food-borne diseases also occur in great numbers in developed countries (EFSA 2021; Painter et al. 2013). In 2020, more than 3,000 foodborne related outbreaks and more than 30,000 cases of illnesses have been reported only in EU (EFSA 2021), despite the COVID19 pandemic and Brexit.

RTE food consumption is growing due to a changing lifestyle. As they are typically consumed as raw or

minimally-processed, they may contain pathogens such as *Listeria monocytogenes*, isolated from various RTE foods and exhibiting a high survivability rate e.g. in Spain (Gómez et al. 2015; Jofré et al. 2019), Serbia (Borovic et al. 2014; Lakićević et al. 2010), India (Lakhanpal et al. 2016), Poland (Szymczak et al. 2020) or Turkey (Şanlıbaba et al. 2018). Among these, delicatessen meats, smoked and cured fish, soft cheese, ice cream, produce (diced celery, cantaloupe, mung bean sprouts, stone fruit, caramel apples, pre-packaged salads) and frozen vegetables have been implicated in various outbreaks (Chao et al. 2006; Cordano and Jacquet 2009; Gérard et al. 2018; Verraes et al. 2015; Zhang et al. 2021). Although the rates of listeriosis are relatively low compared to other foodborne pathogenic illnesses, it poses a significant risk to human health due to high mortality rate (Buchanan et al. 2017).

Chilled RTE foods are pre-sliced and pre-packaged cold chain distributed sold foods. Slicing is often applied as a final step of heat-treated foods before they are packaged, often in vacuum or modified gas packaging (Gonzalez-Fandos et al. 2021). At the same time, chilled RTE foods can be produced in bulk and then sliced fresh on point of purchase to individual consumers. These products are called cut-to-order, in-store packaged or non-pre-packaged RTE foods (Garrido et al. 2009; Tsaloumi et al. 2021). For pre-packaged RTE foods sold in original package from the producer, the contamination usually occurs during the manufacturing process. However, for retail packages, where the products are handled in retail establishments, the used slicers and the service personnel can potentially bring cross-contamination to the products (Gallagher et al. 2016; Lakicevic and Nastasijevic 2016). Contamination of RTE foods by *L. monocytogenes* can occur at different points within the processing and distribution chain, although the post processing contamination during slicing at retail stores may result in considerable higher prevalence of contamination when compared to pre-packaged food products (Endrikat et al. 2010; Gallagher et al. 2016; Garrido et al. 2009; Gombas et al. 2003). The results of comparative risk assessment indicated that retail-sliced RTE meat and poultry products are almost 5 times more likely to cause listeriosis than pre-packaged food products (Endrikat et al. 2010). At the same time, results of quantitative modeling performed by European Food Safety Authority (EFSA) have indicated that more than 90% of all invasive cases of listeriosis are caused by ingestion of RTE foods that contain > 2000 CFU/g, and one-third by factors caused by consumers (Ricci et al. 2018). Therefore, it is necessary to raise the awareness of all stakeholders in the RTE foods supply chain, including food producers, retailers and consumers, especially vulnerable groups of consumers about the problem of *L. monocytogenes* in RTE foods. In Greece, the results of recent quantitative risk assessment of *L. monocytogenes* in different RTE cooked meat products sliced at retail stores predicted a median value of 7 listeriosis cases per year for the total population. It also proposed mitigation strategies, such as labeling a use-by-date and improving the temperature of domestic refrigerators to decrease the number of potential cases (Tsaloumi et al. 2021).

Consumers are the last line of defense against foodborne illnesses (Redmond and Griffith 2003). Most cases of foodborne illnesses are believed to be sporadic, mild and unreported, and often occur in domestic settings (Murray et al. 2017; Nesbitt et al. 2009). Consumers often fail to follow individual recommended food safety practices, e.g. relating to time and temperature control of chilled RTE foods (Evans and Redmond 2014), but also they misinterpret the food labels (Van Boxstael et al. 2014). Understanding consumers' behavior and their home practices, as well as their handling of high-risk foods is essential for reducing the number of foodborne illnesses. Several studies have reported consumers' behaviors towards RTE foods (Cates et al. 2006; Evans and Redmond 2016; Van Loo et al. 2010; Levine et al. 2017), and evaluated how consumers perceive food safety risks in retail food store settings, using selected photographs and self-reported perceptions, attitudes, and behaviors, where consumers with a food science background had more knowledge about factors contributing to food safety risks than the average focus group participant. Jevšnik et al. (2008) reported that Slovenian consumers were not familiar with their role in the food safety chain or with the importance of maintaining a cold chain, and consequently allowing numerous opportunities for microbiological contamination of food (Jevšnik et al. 2008). Similar behavior and knowledge gaps concerning food safety issues are reported for Polish (Tomaszewska et al. 2020) and Turkish consumers (Ergönül 2013; Zorba and Kaptan 2011). Moreover, RTE seafood stored at inadequate temperatures in an open refrigerated display at a Spanish retail allowed pathogen growth (González et al. 2013). Temperature distributions in home refrigerators and their inadequate hygiene were of major concern of food safety issues in several studies performed in Serbia (Jovanovic et al. 2022), Portugal (Azevedo et al. 2005), India (Lagerkvist et al. 2021), Slovenia (Ovca et al. 2021) and Spain (Victoria Garrido et al. 2010; Jofré et al. 2019).

Due to previously reported geographical unique habits in food consumption and purchase (Chen and Antonelli 2020; Djekic et al. 2021), we hypothesized that survey participants would exhibit differences in attitudes and practices towards chilled RTE food. Therefore, a cross-national consumers' perception was studied that included 9 countries to identify customer segments and its characteristics. The aim of the segmentation was to identify consumer profiles with risky practices when consuming chilled RTE foods. This information is necessary for further recommendations and strategies of risk mitigation at the multinational level.

2 Materials and methods

2.1 Participants

An online survey was created using Google Forms®. It was conducted in Bosnia and Herzegovina, Croatia, India, Poland, Portugal, Serbia, Slovenia, Spain and Turkey. The responses were collected by convenience sampling through social media and e-mailing and via national contacts that were responsible for its distribution among pre-existing contact lists. In this way, the worldwide restrictions imposed by the COVID-19 pandemic were overcome. The participants were volunteers, aged over 18, not financially rewarded, and recruited through networks of families, friends, relatives and their networks. Participants who did not complete the whole questionnaire were excluded from the analyses. The data was collected between June and December 2021 and centrally stored. All study procedures were conducted in line with the Codex of professional ethics of the University of Belgrade (2016).

In total, 2723 questionnaires where included (Table 1): 449 from Bosnia and Herzegovina (16.5%), 353 from Croatia (13.0%), 210 from India (7.7%), 305 from Poland (11.2%), 352 from Portugal (12.9%), 387 from Serbia (14.2%), 106 from Slovenia (3.9%), 200 from Spain (7.3%), and 361 Turkey (13.3%). Despite the rather small country-by-country sample sizes for the purpose of this study, for the confidence level of 95% the margin of error varied between 4.6 and 9.5%, considering the populations in the individual countries. While at a confidence level of 90%, the margin of error varied between 3.9 and 8.0%. Therefore, the conclusions drawn from this study represent a reasonable alignment for the individual countries. Margins of error were calculated using the standard deviation of the population (σ), the sample size (n) and the z-score of the confidence interval (for 95% = 1.960, for 99% = 2.326): $z * (\sigma / \sqrt{n})$.

2.2 Questionnaire

An extensive questionnaire was initially written in English and subsequently translated by native speakers to ensure accuracy and preserve its original meaning into the languages of the participating countries, using the procedure of back-translation (Maneesriwongul and Dixon 2004). The questionnaire was designed with the objective to gather the information of consumers' attitudes and self-reported practices regarding food safety of chilled RTE foods. To measure internal consistency and reliability of the questionnaire, Cronbach's alpha test was calculated (0.736), which is considered acceptable (Bland and Altman 1997).

At the beginning of the questionnaire, the participants were introduced to the aim of this study and a definition of RTE foods that was given to ensure that all respondents understood the meaning in the same way. The definition was as follows: "Ready-to-eat food is food prepared in advance needing no further cooking or processing before being served/eaten. This study covers only chilled RTE dairy and meat foods." Along with this definition, other terms used in the questionnaire were also explained, such as "pre-packaged products" and "cut-to-order products".

The questionnaire consisted of 4 sections. The first section contained questions related to main demographic characteristics of participants including country, gender, age, education, number of family members and if there was a small child, pregnant women, age > 60 years, and people with compromised immune system (diabetes, liver or kidney disease, cancer, autoimmune diseases, people receiving chemotherapy or radiation therapy, people with organ transplant) in the household. In addition, this part of the questionnaire investigated the responsibility of buying, preparing and serving food.

The second section included questions related to habits of purchasing (pre-packaged in a supermarket/specialized shop, cut-to-order in a supermarket/specialized shop, open market/open bazaar and not buying) and habits of consuming chilled RTE foods (RTE foods, ingredient of thermally treated products, not buying), including fresh cheese, white brined cheese, kaymak, butter, sliced hard cheese, cooked ham, fermented ham, dried ham and salmon.

The third section included 22 statements related to consumers' attitudes towards food safety of chilled RTE, which were presented on a 5-point Likert Scale, ranging from "Strongly Disagree" to "Strongly Agree" (1→5). Final section of the questionnaire comprised of 15 statements related to self-reported practices with a five-point Likert Scale, ranging from "Never" to "Always" (1→5).

2.3 Data analysis

The obtained data were coded and analyzed in IBM SPSS version 21 by two-step cluster analysis. This is an exploratory and unsupervised multivariate data analysis technique that enables the clustering of large data sets. This method is based on a probabilistic approach, when the algorithm utilizes a likelihood distance measure as the similarity criterion, and the most suitable number of clusters is chosen on the basis of Schwarz's Bayesian inference criterion (BIC). The number of clusters is calculated based on the best fit, the BIC, and a silhouette coefficient. The silhouette coefficient is a measure of clustering quality that is independent from the number of clusters (K), and can be used to evaluate cluster validity. The clustering solution is considered poor when the silhouette measure is < 0.20,

Table 1 Demographic composition of participants (n = 2723)

Factor	Level	Number (n)	% of sample
Country	Bosnia and Herzegovina	449	16.5
	Croatia	353	13.0
	Poland	305	11.2
	Portugal	352	12.9
	Serbia	387	14.2
	Spain	200	7.3
	Slovenia	106	3.9
	Turkey	361	13.3
	India	210	7.7
Gender	Female	1830	67.2
	Male	875	32.1
	Prefer not to say	18	0.7
Age	Young (< 20 years)	168	6.2
	Adults (21–40 years)	1222	44.9
	Middle aged (41–60 years)	849	31.2
	Old (> 60 years)	484	17.8
Education	Elementary school	59	2.2
	High school	560	20.6
	Graduate	1499	55.0
	Post graduate	605	22.2
Employment	Unemployed	790	29.0
	Seasonal job	259	9.5
	Permanent job/Retired	1674	61.5
Responsible for purchasing	Yes, most of the time	1581	58.1
	Yes, sometimes	904	33.2
	No	238	8.7
Responsible for preparing	Yes, most of the time	1442	53.0
	Yes, sometimes	961	35.3
	No	320	11.8
Number of household members	1 member	241	8.9
	2–3 members	1292	47.4
	4–5 members	1020	37.5
	> 5 members	170	6.2
Small child (< 5 years old) living in the household	Yes	371	13.6
	No	2352	86.4
Old person (> 60 years old) living in the household	Yes	1009	37.1
	No	1714	62.9
Immune-compromised person living in the household	Yes	525	19.3
	No	2198	80.7
Pregnant women living in the household	Yes	148	5.4
	No	2575	94.6
Total		**2723**	**100**

values of > 0.50 indicate a good and intermediate values an acceptable clustering solution (Mooi and Sarstedt 2011). Two-step cluster analysis is considered to be more accurate and reliable compared to other clustering methods and was extensively used in different fields (Tkaczynski 2016) and in numerous consumer studies (Geeroms et al. 2008; Miloradovic et al. 2021; Zakowska-Biemans 2011; Zhllima et al. 2021).

For those reasons, a two-step cluster analysis has been used for the segmentation of the study participators, based on items describing place of buying various RTE foods and countries, as categorical variables. The two-cluster solution

was obtained automatically by BIC with 15 clusters set as maximum. Log-likelihood distance measure was used. To further characterize the clusters and to investigate any significant differences between the clusters, the Chi-squared tests and Mann-Whitney U tests were conducted for variables with nominal and ordinal outcomes, respectively. The level of significance was $p < 0.05$.

3 Results and discussion

3.1 Characteristics of the sample

Socio-demographic data showed that 2,723 participants have been interviewed. The survey was completed by 67.2% female, 32.1% male and 0.7% participants not willing to declare gender. The majority were adults 44.9% (between 21 and 40 years of age), followed by middle-aged adults 31.2% (between 41 and 60 years of age), older participants 17.8% (> 60 years). The smallest sample consisted of young people < 20 years (6.2%). The majority of survey participants obtained a College/University degree (55.0%), 22.2% of participants obtained Master/PhD degree, 20.65% finished high school and 2.2% finished elementary school. As mentioned earlier, participants from 9 countries were included in this survey (Table 1).

3.2 Cluster analysis

Considering each country of origin, the samples were divided into 2 clusters according to their preferences of purchasing and RTE foods:

- supermarket vs. delicatessen department/open market
- pre-packaged/not buying vs. cut-to-order.

These variables have been selected due to the fact that there is positive correlation between consumer's perception towards the product quality and choice of store (Catherine and Magesh 2016). Additionally, customers from different countries are expected to have different purchasing behavior, and thus different perception towards RTE foods (Djekic et al. 2021). Demographic characteristics and habits regarding place of buying RTE foods are presented in Table 2 and 3, respectively. Silhouette measure of cohesion and separation (0.30), and the ratio of largest to smallest cluster size (1.11) confirmed that having two clusters was the acceptable and optimal solution.

The chi-square test was used to check for significant differences between the 2 clusters for 12 socio-demographic variables (Table 2). Eight out of the 12 variables were significantly different ($p < 0.05$), namely country, age, education, employment, responsibility for purchasing and preparing foods and old person living in the household (Table 2). In addition, chi-square test was applied to determine significant difference ($p < 0.05$) between the 2 clusters for habits related to place of buying RTE foods and obtained results indicated significant difference between clusters for all food categories (Table 3).

3.2.1 Precautious consumers

Cluster 1 included 1434 participants in total (52.7%), and cluster 2 had 1289 (47.3%). Cluster 1 included predominantly consumers from Bosnia and Herzegovina (51.7%), India (71.4%), Poland (55.1%), Portugal (57.7%), Spain (58.5%) and Turkey (74.8%). Consumers that have been classified in this cluster were young (66.1%), adults (54.5%) and middle aged (52.8%), with the education of high school (53.4%), graduate (50.6%) and post-graduate (57.9%). Furthermore, this cluster includes participants from households that predominantly not living with a person > 60 years (55.1%), or pregnant women (53.2%). This group represents highly educated customers which suggest its involvement and higher level of safety awareness. At the same time, the participants of cluster 1 had a habit of buying pre-packaged dairy and meat RTE foods in a supermarket and specialized shops, or they were those not buy RTE products at all (Table 3). This cluster was labeled "Precautious consumers".

3.2.2 Unconcerned consumers

Cluster 2 consisted of 1289 participants, representing 47.3% of the total sample. This cluster included predominantly consumers from Serbia (71.1%), Croatia (63.2%) and less but over the average consumers from Slovenia (50.9%). Most had elementary education (54.2%), were aged > 60 years (56.8%), or living in a household with a person aged > 60 years (51.4%), or living in the household with a pregnant woman (56.1%). This cluster showed a habit of buying cut-to-order RTE foods at the delicatessen department of a supermarket, or at the open market (Table 3). Having all this in mind and due to the fact that cut-to-order foods are recognized as more risky foods, cluster 2 was labelled "Unconcerned consumers".

3.3 Attitudes towards chilled RTE foods

In general, chilled RTE foods are characterized as risky due to characteristics that permit the growth of *L. monocytogenes* (Kovačević et al. 2012; Luber et al. 2011; Uyttendaele et al. 2009). Pre-packaged sliced meat products, soft cheeses, smoked fish, sandwiches, processed meat products, etc. are among these foods. However, pre-packaged chilled RTE foods are considered less risky when compared to retail-sliced or cut-to-order foods handled in commercial

Table 2 Demographic characteristics of participants distributed among 2 clusters

		Cluster 1 "precautious consumers" (n = 1434)		Cluster 2 "unconcerned consumers" (n = 1289)		Chi-Squared test
		n	%	n	%	
Country	Bosnia and Herzegovina	232	51.70%	217	48.30%	$\chi^2 = 231.1$, df = 8, $p < 0.05$
	Croatia	130	36.80%	223	63.20%	
	Poland	168	55.10%	137	44.90%	
	Portugal	203	57.70%	149	42.30%	
	Serbia	112	28.90%	275	71.10%	
	Spain	117	58.50%	83	41.50%	
	Slovenia	52	49.10%	54	50.90%	
	Turkey	270	74.80%	91	25.20%	
	India	150	71.40%	60	28.60%	
Gender	Female	980	53.6%	850	46.4%	$\chi^2 = 1.935$, df = 2, $p < 0.05$
	Male	444	50.7%	431	49.3%	
	Prefer not to say	10	55.6%	8	44.4%	
Age	Young (< 20 years)	111	66.10%	57	33.90%	$\chi^2 = 31.2$, df = 3, $p < 0.05$
	Adults (21–40 years)	666	54.50%	556	45.50%	
	Middle aged (41–60 years)	448	52.80%	401	47.20%	
	Old (> 60 years)	209	43.20%	275	56.80%	
Education	Elementary school	27	45.80%	32	54.20%	$\chi^2 = 10.4$, df = 3, $p < 0.05$
	High school	299	53.40%	261	46.60%	
	Graduate	758	50.60%	741	49.40%	
	Post graduate	350	57.90%	255	42.10%	
Employment	Unemployed	462	58.50%	328	41.50%	$\chi^2 = 15.4$, df = 2, $p < 0.05$
	Seasonal job	126	48.60%	133	51.40%	
	Permanent job/retired	846	50.50%	828	49.50%	
Responsible for purchasing	Yes, most of the time	844	53.40%	737	46.60%	$\chi^2 = 6.9$, df = 2, $p < 0.05$
	Yes, sometimes	450	49.80%	454	50.20%	
	No	140	58.80%	98	41.20%	
Responsible for preparing	Yes, most of the time	767	53.20%	675	46.80%	$\chi^2 = 7.9$, df = 2, $p < 0.05$
	Yes, sometimes	479	49.80%	482	50.20%	
	No	188	58.80%	132	41.30%	
Number of household members	1 member	139	57.70%	102	42.30%	$\chi^2 = 6.5$, df = 3, $p = 0.088$
	2 till 3 members	655	50.70%	637	49.30%	
	4 till 5 members	556	54.50%	464	45.50%	
	> 5 members	84	49.40%	80	50.60%	
Small child (< 5 years old) living in the household	Yes	184	49.60%	187	50.40%	$\chi^2 = 1.6$, df = 1, $p = 0.218$
	No	1250	53.10%	1102	46.90%	
Old person (> 60 years old) living in the household	Yes	490	48.60%	519	51.40%	$\chi^2 = 15.4$, df = 1, $p < 0.05$
	No	944	55.10%	770	44.90%	
Immune-compromised person living in the household	Yes	265	50.50%	260	49.50%	$\chi^2 = 1.2$, df = 1, $p = 0.285$
	No	1169	53.20%	1029	46.80%	
Pregnant women living in the household	Yes	65	43.90%	83	56.10%	$\chi^2 = 15.4$, df = 2, $p < 0.05$
	No	1369	53.20%	1,206	46.80%	

Table 3 Distribution of participants among 2 clusters

RTE food product	Place of buying	"Precautious consumers" (n = 1434)		"Unconcerned consumers" (n = 1289)		Chi-Squared Test
		n	%	n	%	
Fresh cheese	Pre-packed, supermarket or specialized shop	1048	72.50%	398	27.50%	$\chi^2 = 592.9$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	143	20.50%	553	79.50%	
	Cut-to-order, open market/bazaar	89	28.30%	225	71.70%	
	I don't buy it	154	57.70%	113	42.30%	
White brined cheese	Pre-packed, supermarket or specialized shop	865	7300%	320	27.00%	$\chi^2 = 666.4$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	133	17.50%	626	82.50%	
	Cut-to-order, open market/bazaar	83	31.90%	177	68.10%	
	I don't buy it	353	68.00%	166	32.00%	
Kaymak/ butter	Pre-packed, supermarket or specialized shop	900	63.70%	512	36.30%	$\chi^2 = 362.6$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	138	24.50%	425	75.50%	
	Cut-to-order, open market/bazaar	50	22.70%	170	77.30%	
	I don't buy it	346	65.50%	182	34.50%	
Sliced cheese	Pre-packed, supermarket or specialized shop	1052	82.00%	231	18.00%	$\chi^2 = 1235.4$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	137	13.70%	863	86.30%	
	Cut-to-order, open market/bazaar	13	9.20%	129	90.80%	
	I don't buy it	232	77.90%	66	22.10%	
Sliced cooked ham	Pre-packed, supermarket or specialized shop	978	91.20%	94	8.80%	$\chi^2 = 1688.4$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	115	10.00%	1032	90.00%	
	Cut-to-order, open market/bazaar	9	9.20%	89	90.80%	
	I don't buy it	332	81.80%	74	18.20%	
Sliced fermented ham	Pre-packed, supermarket or specialized shop	923	92.00%	80	8.00%	$\chi^2 = 1693.4$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	44	4.60%	917	95.40%	
	Cut-to-order, open market/bazaar	9	7.90%	105	92.10%	
	I don't buy it	458	71.00%	187	29.00%	
Sliced dried ham	Pre-packed, supermarket or specialized shop	947	94.30%	57	5.70%	$\chi^2 = 1814.5$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	79	7.50%	975	92.50%	
	Cut-to-order, open market/bazaar	25	13.60%	159	86.40%	
	I don't buy it	383	79.60%	98	20.40%	
Sliced salmon	Pre-packed, supermarket or specialized shop	856	72.90%	319	27.10%	$\chi^2 = 619.1$, df = 3, $p < 0.05$
	Cut-to-order, supermarket delicatessen or specialized shop	58	10.50%	497	89.50%	
	Cut-to-order, open market/bazaar	9	16.40%	46	83.60%	
	I don't buy it	511	54.50%	427	45.50%	

establishments e.g. delicatessen stores or supermarkets (Endrikat et al. 2010; Gallagher et al. 2016; Garrido et al. 2009; Gombas et al. 2003). Our results showed that "Precautious consumers" were significantly more convinced than "Unconcerned consumers" that pre-packaged RTE foods are safer than cut-to-order (Table 4). They also viewed purchasing of cut-to-order RTE foods at the delicatessen department in a supermarket or at the open market as significantly less safe than it was for "Unconcerned consumers". This is in line with their habit of predominantly buying various chilled RTE foods, already pre-packaged by the food producers. Cluster 1 ("Precautious consumers") consisted mostly with people from Bosnia and Herzegovina, India, Poland, Portugal, Spain and Turkey, and their positive attitudes towards safety of pre-packaged foods is in line with their general habits of buying foods in large grocery stores and supermarkets, which can be seen as precautionary and preventive. The official epidemiological data indicated the incidence rate of listerosis in countries like Spain, Portugal and Poland was relatively high, being on the average 0.72, 0.47 and 0.28 per 100,000 population per year (EFSA 2021). Although consumers are not expected to read and analyze statistical data, the higher incidence rates in these countries can indirectly lead to more information covering this issue in the media. It is important to note that one of the greatest European outbreak caused by *L. monocytogenes*

Table 4 Attitudes towards RTE foods distributed within the whole population and within 2 clusters

Attitudes related to RTE foods	Overall (n = 2723)	Cluster 1 "precautious consumers" (n = 1434)	Cluster 2 "unconcerned consumers" (n = 1289)
I believe that pre-packed* RTE dairy products* are safer than cut-to-order	3.68 ± 1.18	3.76 ± 1.15[a]	3.59 ± 1.21[b]
I believe that pre-packed* RTE meat products** are safer than cut-to-order	3.41 ± 1.27	3.48 ± 1.26[a]	3.34 ± 1.28[b]
I believe that is safe to purchase cut-to-order RTE dairy products* at the open market/open bazaar	2.86 ± 1.18	2.71 ± 1.18[a]	3.03 ± 1.17[b]
I believe that is safe to purchase cut-to-order RTE meat products** at the open market/open bazaar	2.78 ± 1.23	2.63 ± 1.22[a]	2.96 ± 1.22[b]
I believe that is safe to purchase cut-to-order RTE dairy products* at the delicatessen department in the supermarket	3.68 ± 1.00	3.55 ± 1.05[a]	3.82 ± 0.93[b]
I believe that is safe to purchase cut-to-order RTE meat products** at the delicatessen department in the supermarket	3.7 ± 1.00	3.54 ± 1.05[a]	3.87 ± 0.90[b]
It is important to check the expiration date of pre-packed RTE dairy and meat products, during purchasing	4.66 ± 0.83	4.71 ± 0.76[a]	4.60 ± 0.91[b]
The expiration date of pre-packed and cut-to-order RTE dairy and meat products is the same	2.34 ± 1.27	2.31 ± 1.29	2.37 ± 1.25
I know the shelf-life and storage conditions of cut-to-order RTE dairy products* from the open market/open bazaar	2.72 ± 1.32	2.73 ± 1.34	2.71 ± 1.29
I know the shelf-life and storage conditions of cut-to-order RTE meat products** from the open market/open bazaar	2.71 ± 1.32	2.68 ± 1.33	2.75 ± 1.30
I know the shelf-life and storage conditions of cut-to-order RTE dairy products* from the delicatessen department in the supermarket	3.34 ± 1.24	3.31 ± 1.26	3.37 ± 1.21
I know the shelf-life and storage conditions of cut-to-order RTE meat products** from the delicatessen department in the supermarket	3.38 ± 1.25	3.32 ± 1.28[a]	3.45 ± 1.21[b]
It is important to store pre-packed RTE products according to storage instructions to ensure that it is safe to eat	4.57 ± 0.77	4.59 ± 0.76	4.55 ± 0.78
Ensuring a refrigerator runs at ≤ 5 °C is essential for maintaining the safety of RTE products	3.97 ± 1.12	4.01 ± 1.12[a]	3.92 ± 1.13[b]
It is essential to store different types of RTE products on separate shelves in the refrigerator to avoid contamination	3.99 ± 1.13	4.06 ± 1.10[a]	3.91 ± 1.16[b]
An unopened pre-packed sliced cooked ham, 2 days past its use-by date is still safe to eat	2.68 ± 1.37	2.68 ± 1.37	2.69 ± 1.38
An opened pre-packed sliced cooked ham is safe to eat as long as it is within the use-by date	2.98 ± 1.35	2.92 ± 1.37[a]	3.05 ± 1.32[b]
Cut-to-order sliced cooked ham from the supermarket delicatessen is only safe to eat for max. 2 days after purchase	3.24 ± 1.24	3.14 ± 1.26[a]	3.35 ± 1.21[b]
Sliced cooked ham out of the refrigerator is safe to eat as long as they are eaten on the same day	3.06 ± 1.39	3.16 ± 1.41[a]	2.94 ± 1.36[b]
I judge if RTE dairy products* are safe to eat based on the smell, taste or appearance	3.63 ± 1.25	3.57 ± 1.28[a]	3.69 ± 1.21[b]
I judge if RTE meat products** are safe to eat based on the smell, taste or appearance	3.54 ± 1.27	3.47 ± 1.31[a]	3.63 ± 1.22[b]
It is better to discard RTE dairy* and meat** after expiration date than to risk eating unsafe food	4.38 ± 1.00	4.38 ± 1.01	4.38 ± 0.99

Values represent mean values (± standard deviation) of the Likert scale (1 – disagree strongly; 2 – disagree; 3 – no opinion; 4 – agree; 5 – agree strongly)

[a,b] Values within a row with identical letters were significantly different ($p < 0.05$), as determined by Mann Whitney U test

*Examples of RTE dairy products are fresh cheese, white brined cheese, kaymak/butter

**Examples of RTE meat products are sliced cooked, fermented or dried meat products

contaminated RTE meat products resulted in more than 200 confirmed cases and 3 deaths (Fernández-Martínez et al. 2022). Also, in Portugal contaminated cheese induced an outbreak with more than 30 cases and 1 death (Magalhães et al. 2015). The importance of *Listeria* prevention in RTE foods may be also attributed to the fact that Poland

is an important producer of RTE foods for European market (Szymczak et al. 2020), and one *Listeria* outbreak was caused by smoked salmon produced in Poland (EFSA 2018). The media attention for these outbreaks may indirectly raise awareness among consumers and make them more precaution. Note that Turkey and India do not have an active surveillance system covering the incidence of listeriosis, and in Bosnia no cases of listeriosis have been previously reported (Musa et al. 2020).

Based on our results, people in cluster 2 ("Unconcerned consumers") believed that it was safe to buy cut-to-order RTE foods at the delicatessen department in a supermarket. When these participants have been asked about the safety of buying dairy and meat RTE foods at the open market, they were mostly neutral, but still significantly more agreeing compared to "Precautious consumers". This is in line with results reported for UK consumers, who have no concerns regarding food safety of various products from farmers' market (Worsfold et al. 2004). Note that a very small percentage of the total population that participated in this study regularly purchase dairy and meat RTE foods at the open market (Table 2). Open markets or sometimes called farmer markets are convenient places to purchase foods due to close location, the person-to-person interaction with the sellers, and the quality and freshness of the food, which is perceived to be better than at the supermarket. These markets are especially important for older consumers, as they have shopped there for years and often have developed a close relationship with the sellers (Polimeni et al. 2018). These have remained important places for purchasing local foods in eastern European countries (Polimeni et al. 2018), despite the competition from the supermarkets and industrially processed foods (Lovre and Brankov 2015).

In this study, participants in cluster 2 ("Unconcerned consumers") came mostly from Croatia, Serbia and Slovenia, holding food traditions and loyalty to local shops and open markets in high regard . This is in line with a study by Miloradovic et al. (2021), where greater percentage of consumers from Serbia and Croatia purchased artisan cheeses at the open markets compared to Spanish consumers. Nevertheless, some of these markets with a wide variety of foods are regarded as high-risk for dairy, meat and fish products (Sirsat et al. 2015). Specific processing and handling measures, time and temperature control are needed ensure the safety of the products sold to the consumers, and this is especially important for unpackaged and unwrapped RTE foods. Therefore, it is essential to design and develop training material to increase awareness and improve knowledge of the consumers regarding RTE foods sold at the open market. This is especially important, having in mind the latest European initiatives for resurgence of small producers, local foods and consequently local open markets, and in general short supply chain (Carey et al. 2011; Kneafsey et al. 2013; Warsaw et al. 2021). However, the incidence rate of listeriosis in Serbia and Croatia was reported to be lower than those in cluster 1, with average 0.12 and 0.13 per 100,000 population per year and no previous big outbreak (EFSA 2021; Institute of public health of Serbia 2019). This might explain the relaxed attitudes of the consumers in this cluster. On contrary, the incidence rate of listeriosis in Slovenia was higher, with 0.8 cases per 100,000 population per year (EFSA 2021), in line with the situation in countries belonging to cluster 1. These results might be related to the fact that Slovenian consumers were almost equally divided among the 2 clusters (Table 2).

To restrict the growth of any food-borne pathogen, but in particular to inhibit the growth of *L. monoytogenes*, temperature has to be controlled throughout distribution and storage, both at the retail and consumers' settings. The food producers are responsible to provide necessary information on the food label, such as recommended temperature of storage and the shelf-life (EC 2002; EU 2011). Cluster 1 was more aware of the need to check the expiration date on the food package and to adequately store RTE foods according to the producers' instructions than cluster 2 ($p < 0.05$). Despite the positive attitudes of cluster 1 towards these issues, the question is whether product declarations always provide sufficiently detailed information, especially when it comes to risky products. Results from a Belgian study reported that food labels of refrigerated RTE foods often lack any (5.7%) or specific (2.7%) recommendations about storage conditions (Ceuppens et al. 2016). The same study also showed that the most frequent recommended storage temperature on food labels was 7 °C, followed by 4 °C (Ceuppens et al. 2016). Nevertheless, domestic storage of chilled foods is highly variable and frequently performed at the temperatures higher than recommended (James et al. 2017; Jofré et al. 2019; Jovanovic et al. 2022; Koutsoumanis et al. 2010; Roccato et al. 2017). The results obtained in this study showed that for "Precautious consumers" ensuring temperature below 5 °C and adequate separation of foods in domestic refrigerators was significantly more important for safety of RTE foods than for "Unconcerned consumers" ($p < 0.05$). Therefore, it is important to adequately inform and educate consumers about the importance of temperature control in their households, as the improvement of the domestic refrigerators' temperature is seen as potential mitigation strategy for the reduction of number of listeriosis cases (Tsaloumi et al. 2021).

Modified atmosphere packaging is usually applied to food products to prolong shelf-life of RTE foods, by preventing growth and/or survival of various food-borne pathogens (Czerwiński et al. 2021; Kramarenko et al. 2016). However, once the package is stored open for a period of time, a potential outgrowth of present microflora is likely. Food legislation requires a list of mandatory information to be given for the pre-packaged food products, and appropriate storage

instructions and/or time limit for consumption after opening should be indicted only "where appropriate" (EU 2011; Serbia 2017; Tsaloumi et al. 2021). This leaves the food producers to decide themselves if they are going to provide information on the safe storage after opening or not. The UK Food Standard Agency have issued the recommendation to limit the shelf-life of RTE deli meats up to 2 days after opening at 5 °C (FSA 2022), while the U.S. Department of Agriculture (USDA) indicated a storage period for deli meats after opening to be 3–5 days at 5 °C (USDA-FSIS 2016). It is worth noting that the difference in recommended period of opened storage is most likely related to difference in setting criteria on *L. monocytogenes* in these products. US legislation applies "zero tolerance" approach for *L. monocytogenes* in RTE meat and poultry products (USDA-FSIS 2014), while EU uses a "risk-based" approach, considering acceptable values to be below 100 CFU/g throughout the entire shelf-life (EU 2005; Neri et al. 2019). The consumers from this study have been asked to indicate the level of agreement for the statement: "An opened pre-package of sliced cooked ham is safe to eat as long as it is within the use-by date". The average level of agreement for "Precaution consumers" was lower compared to "Unconcerned consumers" (Table 4). The lack of available information on the package of chilled RTE foods might explain the obtained results. Almost 80% of food labels from Belgium market contained no indication of the remaining shelf-life after opening the package (Ceuppens et al. 2016). To confirm this and to make adequate base for improvements in this field, further studies are needed to determine the necessary information on chilled RTE foods for the participating countries of this survey.

When it comes to the shelf-life of cut-to-order RTE foods, our results indicated that consumers from all involved countries did not know the shelf-life and storage instructions. Food legislation around the world requires a list of mandatory information to be given for the pre-packaged food products (EU 2011; India 2011; Off Gaz 2017; Official Gazette 2017). Nevertheless, according to EU regulation for non-pre-packaged foods the consumers must be provided with only limited information such as the name of food, allergens, a meat content (for meat products) and an irradiated food statement (for irradiated foods) (EU 2011). Therefore, it is not surprising that the population investigated in this study does not know the shelf-life of cut-to-order RTE foods, either bought at the delicatessen or at the open market, and no difference was determined among the two identified clusters ($p > 0.05$). Their perception and personal assessment will be the only available tool to judge the shelf-life duration of these risky foods. Having all above in mind, it can be concluded that cluster 1 consists of consumers that prefer cut-to-order RTE foods, are exposed to higher risks of food-borne illnesses, due to the risky nature of these products, as well as due to unavailability of storage instructions and time limitation for the home storage. The attitudes of cluster 2 can be seen as more traditionalist and oriented towards local markets, but at the same time more careless and unconcerned. This is further confirmed through their attitudes regarding the assessment of edibility of food products, as they were significantly more convinced that food safety of chilled dairy and meat RTE foods can be judged based on the appearance, smell or food taste, compared to the cluster 1 ($p < 0.05$). This is in line with other reported studies, which showed that consumers often use visually, olfactory and tasting factors combined with the shelf-life date to decide if they are going to consume food or not (Van Boxstael et al. 2014).

3.4 Self-reported practices towards chilled RTE foods

Not only the attitudes, but also the results of self-reported practices indicated less risky behavior from cluster 1 compared to cluster 2 (Table 5). In line with their opinion that the expiration date of the food products is important for food safety, cluster 1 checked the expiration date of RTE foods significantly more often during purchasing and before food consumption, compared to cluster 2 (Table 5).

It is important to assure that cross contamination between RTE and raw foods is prevented, and that household refrigerators are clean and operating at correct temperature (Jackson et al. 2007; Vegara et al. 2014). The results obtained in this study have indicated that cluster 1 checked the temperature and separated foods more often to prevent cross contamination in their domestic refrigerators compared to members of cluster 2 ($p < 0.05$). The overall variability of temperature in domestic refrigerators is reported to be in the range 7.0 ± 2.7 °C in Southern and 6.1 ± 2.8 °C in Northern European countries (Roccato et al. 2017). These temperatures are capable of supporting the growth of different food-borne pathogens especially for RTE foods stored for the extended period of time (Jackson et al. 2007).

Food that smells or tastes bad or shows an unusual appearance is mostly contaminated with spoilage microorganisms, while the presence of food-borne pathogens leave no obvious sign of contamination. Cluster 2 more often judged safety of chilled RTE foods based on the appearance, smell or food taste, compared to cluster 1, although the difference was not statistically significant. They were not aware that color, smell or appearance of food would not exclude food contamination (Carbas et al. 2013; Djekic et al. 2014; Martins et al. 2012; Smigic et al. 2016).

Cluster 1 significantly more often had the habit of discarding RTE foods after expiration date then cluster 2 ($p < 0.05$). Cluster 2 showed some concern related to the usage after the expired date of RTE foods for the preparation of some cooked meals, although the overall concern was low (Table 5). Along with this, reports show a

Table 5 Self-reported practices related to RTE foods within the whole population and within 2 clusters

Self-reported practices related to RTE foods	Overall (n = 2723)	"Precautious consumers" (n = 1434)	"Unconcerned consumers" (n = 1289)
When purchasing, I check the expiration date of pre-packed RTE dairy products*	4.58 ± 0.85	4.61 ± 0.83[a]	4.55 ± 0.86[b]
When purchasing, I check the expiration date of pre-packed RTE meat products**	4.50 ± 0.94	4.52 ± 0.96	4.48 ± 0.91
I ask the seller at the open market/open bazaar, how to safely store white brined cheese at home	2.71 ± 1.55	2.77 ± 1.58[a]	2.64 ± 1.52[b]
I ask the seller at the open market/open bazaar, for how long I can safely store fresh cheese at home	2.69 ± 1.55	2.74 ± 1.57	2.63 ± 1.52
Immediately after purchasing, I put RTE dairy and meat products in the refrigerator	4.68 ± 0.78	4.70 ± 0.77	4.66 ± 0.78
I regularly measure the temperature in my refrigerator at home	2.78 ± 1.46	2.88 ± 1.48[a]	2.68 ± 1.43[b]
In my home refrigerator, RTE meat and dairy products are placed on separate shelves from fresh fruits/vegetables	3.99 ± 1.23	4.15 ± 1.18[a]	3.80 ± 1.26[b]
Before eating, I analyze the expiration date of pre-packed RTE dairy products*	4.29 ± 1.05	4.37 ± 1.02[a]	4.20 ± 1.08[b]
Before eating, I analyze expiration date of pre-packed RTE meat products**	4.21 ± 1.12	4.28 ± 1.10[a]	4.13 ± 1.15[b]
Before eating, I judge the safety of RTE dairy products* by appearance, taste or smell	4.14 ± 1.13	4.10 ± 1.17	4.18 ± 1.07
Before eating, I judge the safety of RTE meat products** by appearance, taste or smell	4.09 ± 1.19	4.03 ± 1.26	4.16 ± 1.11
I discard RTE dairy products* after its expiration date	4.21 ± 1.11	4.27 ± 1.08[a]	4.14 ± 1.14[b]
I discard RTE meat products** after its expiration date	4.26 ± 1.10	4.34 ± 1.06[a]	4.17 ± 1.13[b]
When RTE dairy products* expire, I use them to prepare cooked meals (cheese pies/corn pies)	2.04 ± 1.36	1.97 ± 1.34[a]	2.12 ± 1.38[b]
When RTE meat products** expire, I use them to prepare cooked meals (pizza/rolls)	1.82 ± 1.25	1.80 ± 1.26	1.84 ± 1.25

Values represent mean values (± standard deviation) of the Likert scale (1 – never; 2 – rarely; 3 – sometimes; 4 – often; 5 – always)

[a,b] Values within a row with identical letters were significantly different ($p < 0.05$), as determined by Mann Whitney U test

*Examples of RTE dairy products are fresh cheese, white brined cheese, kajmak/butter

**Examples of RTE meat products: sliced cooked, fermented or dried meat products

general lack of understanding the terms to define shelf-life, including the misinterpretation of "best before" and "use by" date (Hall-Phillips and Shah 2017; Van Boxstael et al. 2014). Therefore, consumers who do not adequately understand information given on the food label are more prone to take risky actions at their own households. As already mentioned, the obligation to provide shelf-life and storage instruction is only applicable for pre-packaged chilled RTE foods, while there is no obligation for such information for cut-to-order foods. This leaves consumers to be even more self-reliant, which is also riskier in terms of foodborne illnesses.

This study has included consumers from 9 different countries that were selected by convenience. However, including northern European countries or countries from other continents would widen the complete picture. Limitation of this study is mainly related to variable number of participants obtained from each country, leading to different representations, although the overall number of participant was high. Also, practices towards RTE foods have been only assessed from the perspective of the consumers themselves, which might differ from their actual behavior at home. Finally, it would be interesting to investigate the influence of the income level on their preference towards purchasing of pre-packed or cut-to-order, having in mind the fact that the former is a more expensive food product. Note that participants from countries included in this study may have different financial status, cultural settings, family customs, purchase habits, and many other sociological factors which might influence the obtained data.

4 Conclusion

This research was conducted in different countries of the world, which are geographical dislocated. Consumers from these countries show substantial differences in diet, food products they buy, place of buying them and the way they consume them. Nevertheless, common shortcomings and difficulties were identified, and might be utilized for setting the recommendations at multinational level. This study contributes to the literature on chilled RTE foods by showing consumer habits towards both the purchasing place and the form of RTE foods, as well as country of origin to effectively discriminate between consumers' segments. The obtained results allow better understating of consumers' characterization of RTE foods in different countries. The obtained results can be exploited threefold. Firstly, it is important to raise the level of awareness for all consumers, and most specifically of the "Unconcerned consumers" in cluster 2, using easily assessable

advertisements/leaflets related to chilled RTE foods. Awareness-raising campaigns distributed through social networks might have significant contribution to improve their home practices and consequently reducing risk. In addition, it is of ultimate importance to increase consumers' understanding of food labels. Secondly, along with the increased awareness of all consumers, it is also needed to facilitate and improve messages that come from the food producers and are directed towards consumers. Undoubtedly, inconsistencies or lack of adequate instructions to be applied at home settings might result in consumers' ignorance of given information and activities that will be based solely on the personal beliefs and principles. In that sense, simple, uniform and targeted food labels can certainly make consumers easier to accept and consequently to follow particular instructions. Thirdly, it is important to emphases the role of retailers who are cutting and slicing RTE foods for individual consumers. Their role is very important to ensuring the safety of foods, as they operate in conditions of increased risk of contamination, which can be further transferred to foods sold to the consumers. Due to the lack of instructions regarding time and storage conditions of cut-to-order RTE foods, retailers must ensure that their customers are informed in any way about how to safely store these foods at home. Although the risk of contamination and the possibility of pathogen growth/survival are dependent on the food product itself, it is important to establish some minimum conditions that are common to different products and easily acceptable to different consumers. It is important to prevent situation in which consumers are left without adequate information how to handle RTE foods at their homes.

CRediT authorship contribution statement NS: Conceptualization, investigation, methodology, visualization, writing—original draft; SO: writing—review and editing; VMG-L: writing—review and editing; SMO: writing—review and editing; ZM: investigation, methodology, visualization, writing—review and editing, BA: writing—review and editing; JM: writing—review and editing; SS-M: writing—review and editing; AK: writing—review and editing; RG: writing—review and editing; JCG: writing—review and editing; JT: writing—review and editing; EC-S: writing—review and editing; GG: writing—review and editing; MB: writing—review and editing; DH: writing—review and editing; AN: writing—review and editing; AM: writing—review and editing; ID: investigation, methodology, visualization, writing—review and editing.

Declarations

Conflict of interest The authors declare that they have no conflict of interest.

References

Azevedo I, Regalo M, Mena C, Almeida G, Carneiro L, Teixeira P et al (2005) Incidence of Listeria spp. in domestic refrigerators in Portugal. Food Control 16(2):121–124

Bari ML, Yeasmin S (2018) Foodborne diseases and responsible agents. Food Saf Preserv. Elsevier, pp 195–229

Bland JM, Altman DG (1997) Cronbach's alpha. BMJ 314(7080):572

Borovic B, Baltic T, Lakicevic B, Jankovic V, Mitrovic R, Jovanovic J, Lilic S (2014) Prevalence of Listeria monocytogenes in ready-to-eat food of animal origin. Tehnol mesa 55(2)

Buchanan RL, Gorris LGM, Hayman MM, Jackson TC, Whiting RC (2017) A review of Listeria monocytogenes: an update on outbreaks, virulence, dose-response, ecology, and risk assessments. Food Control 75:1–13

Carbas B, Cardoso L, Coelho AC (2013) Investigation on the knowledge associated with foodborne diseases in consumers of north-eastern Portugal. Food Control 30(1):54–57

Carey L, Bell P, Duff A, Sheridan M, Shields M (2011) Farmers' market consumers: a scottish perspective. Int J Consum Stud 35(3):300–306

Cates SC, Morales RA, Karns SA, Jaykus LA, Kosa KM, Teneyck T et al (2006) Consumer knowledge, storage, and handling practices regarding Listeria in frankfurters and deli meats: results of a web-based survey. J Food Prot 69(7):1630–1639

Catherine S, Magesh R (2016) A study on consumer perception on store choice of branded grocery supermarket. Indian J Appl Bus Econ reserach 14(4):2359–2367

Ceuppens S, Van Boxstael S, Westyn A, Devlieghere F, Uyttendaele M (2016) The heterogeneity in the type of shelf life label and storage instructions on refrigerated foods in supermarkets in Belgium and illustration of its impact on assessing the Listeria monocytogenes threshold level of 100 CFU/g. Food Control 59:377–385

Chao G, Deng Y, Zhou X, Xu Q, Qian X, Zhou L, Zhu B (2006) Prevalence of Listeria monocytogenes in delicatessen food products in China. Food Control 17(12):971–974

Chen PJ, Antonelli M (2020) Conceptual models of food choice: influential factors related to foods, individual differences, and society. Foods 9(12)

Churchill KJ, Sargeant JM, Farber JM, O'connor AM (2019) Prevalence of Listeria monocytogenes in select ready-to-eat foods—deli meat, soft cheese, and packaged salad: a systematic review and meta-analysis. J Food Prot 82(2):344–357

Codex of professional ethics of the University of Belgrade (2016) Off Gaz Univ Belgrade, No 193/16 (**in Serbian**)

Cordano AM, Jacquet C (2009) Listeria monocytogenes isolated from vegetable salads sold at supermarkets in Santiago, Chile: prevalence and strain characterization. Int J Food Microbiol 132(2–3):176–179

Czerwiński K, Rydzkowski T, Wróblewska-Krepsztul J, Thakur VK (2021) Towards impact of modified atmosphere packaging (MAP) on shelf-life of polymer-film-packed food products: challenges and sustainable developments. Coat 2021 11(12):1504*Page 1504*

Djekic I, Bartkiene E, Szűcs V, Tarcea M, Klarin I, Černelić-Bizjak M et al (2021) Cultural dimensions associated with food choice: a survey based multi-country study. Int J Gastron Food Sci 26:100414

Djekic I, Tomic N, Smigic N, Tomasevic I, Radovanovic R, Rajkovic A (2014) Quality management effects in certified serbian companies producing food of animal origin. Total Qual Manag Bus Excell 25:3–4

EC (2002) Regulation (EC) no 178/2002 of the European Parliament and of Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the european Food Safety Authority and laying down procedures in matters of food safety. Off J Eur Communities 45(31):1–25

EFSA (2018) Multi-country outbreak of Listeria monocytogenes sequence type 8 infections linked to consumption of salmon products. EFSA Support Publ 15(10):1496E

EFSA (2021) The European Union One Health 2020 Zoonoses Report. EFSA J 19(12):6971

Endrikat S, Gallagher D, Pouillot R, Hicks Quesenberry H, Labarre D, Carl MS, Kause J (2010) A comparative risk assessment for Listeria monocytogenes in prepackaged versus retail-sliced deli meat. J Food Prot 73(4):612–619

Ergönül B (2013) Consumer awareness and perception to food safety: a consumer analysis. Food Control 32(2):461–471

European Commission Regulation (EU) No 2073/2005 on microbiological criteria for foodstuffs

European Commission Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers

Evans EW, Redmond EC (2014) Behavioral risk factors associated with listeriosis in the home: a review of consumer food safety studies. J Food Prot 77(3):510–521

Evans EW, Redmond EC (2016) Older adult consumer knowledge, attitudes, and self-reported storage practices of ready-to-eat food products and risks associated with listeriosis. J Food Prot 79(2):263–272

Fernández-Martínez NF, Ruiz-Montero R, Briones E, Baños E, García San Miguel Rodríguez-Alarcón L, Chaves JA et al (2022) Listeriosis outbreak caused by contaminated stuffed pork, Andalusia, Spain, July to October 2019. Euro Surveill 27(43):2200279

FSA (2022) Food Standard Agency, Listeria

Gallagher D, Pouillot R, Hoelzer K, Tang J, Dennis SB, Kause JR (2016) Listeria monocytogenes in retail delicatessens: an interagency risk assessment—risk mitigations. J Food Prot 79(7):1076–1088

Gandhi M, Chikindas ML (2007) Listeria: a foodborne pathogen that knows how to survive. Int J Food Microbiol 113(1):1–15

Garrido V, Vitas AI, García-Jalón I (2009) Survey of Listeria monocytogenes in ready-to-eat products: prevalence by brands and retail establishments for exposure assessment of listeriosis in Northern Spain. Food Control 20(11):986–991

Garrido Victoria, García-Jalón I, Vitas AI (2010) Temperature distribution in spanish domestic refrigerators and its effect on Listeria monocytogenes growth in sliced ready-to-eat ham. Food Control 21(6):896–901

Geeroms N, Verbeke W, Van Kenhove P (2008) Health advertising to promote fruit and vegetable intake: application of health-related motive segmentation. Food Qual Prefer 19(5):481–497

Gérard A, El-Hajjaji S, Niyonzima E, Daube G, Sindic M (2018) Prevalence and survival of Listeria monocytogenes in various types of cheese—a review. Int J Dairy Technol 71(4):825–843

Gombas DE, Chen Y, Clavero RS, Scott VN (2003) Survey of Listeria monocytogenes in ready-to-eat Foods. J Food Prot 66(4):559–569

Gómez D, Iguácel LP, Rota MC, Josécarramiñana J, Ariño A, Yangüela J (2015) Occurrence of listeria monocytogenes in ready-to-eat meat products and meat processing plants in spain. Foods 4(3)

Gonzalez-Fandos E, de Castro MV, Martinez-Laorden A, Perez-Arnedo I (2021) Behavior of Listeria monocytogenes and other microorganisms in Sliced Riojano Chorizo (Spanish Dry-Cured sausage) during storage under modified atmospheres. Microorganisms 9(7)

González D, Vitas AI, Díez-Leturia M, García-Jalón I (2013) Listeria monocytogenes and ready-to-eat seafood in Spain: study of prevalence and temperatures at retail. Food Microbiol 36(2):374–378

Hall-Phillips A, Shah P (2017) Unclarity confusion and expiration date labels in the United States: a consumer perspective. J Retail Consum Serv 35:118–126

India (2011) Food Safety and Standards Authority of India (FSSAI) Food safety and standards (packaging and labelling) regulation

Institute of public health of Serbia (2019) Health statistical yearbook of Republic of Serbia 2018 (**in Serbian**)

Jackson V, Blair IS, McDowell DA, Kennedy J, Bolton DJ (2007) The incidence of significant foodborne pathogens in domestic refrigerators. Food Control 18(4):346–351

James C, Onarinde BA, James SJ (2017) The use and performance of household refrigerators: a review. Compr Rev Food Sci Food Saf 16(1):160–179

Jevšnik M, Hlebec V, Raspor P (2008) Consumers' awareness of food safety from shopping to eating. Food Control 19(8):737–745

Jofré A, Garriga M, Aymerich T, Pérez-Rodríguez F, Valero A, Carrasco E, Bover-Cid S (2016) Closing gaps for performing a risk assessment on Listeria monocytogenes in ready-to-eat (RTE) foods: activity 1, an extensive literature search and study selection with data extraction on L. monocytogenes in a wide range of RTE food. EFSA Support Publ 13(12)

Jofré A, Latorre-Moratalla ML, Garriga M, Bover-Cid S (2019) Domestic refrigerator temperatures in Spain: Assessment of its impact on the safety and shelf-life of cooked meat products. Food Res Int 126:108578

Jovanovic J, Djekic I, Smigic N, Tomic N, Rajkovic A (2022) Temperature profile and hygiene in household refrigerators in Belgrade, Serbia and their relation to consumers food safety knowledge and characteristics of the refrigerators. Food Control 136:108813

Kirk MD, Pires SM, Black RE, Caipo M, Crump JA, Devleesschauwer B et al (2015) World Health Organization estimates of the global and regional disease burden of 22 foodborne bacterial, protozoal, and viral diseases, 2010: a data synthesis. PLoS Med 1–21

Kneafsey M, Venn L, Schmutz U, Bálint B, Trenchard L, Eyden-Woods T et al (2013) Short food supply chains and local Food Systems in the EU. A state of play of their Socio-Economic characteristics. European Commission Joint Research Centre Institute for Prospective Technological Studies

Koutsoumanis K, Pavlis A, Nychas GJE, Xanthiakos K (2010) Probabilistic model for Listeria monocytogenes growth during distribution, retail storage, and domestic storage of pasteurized milk. Appl Environ Microbiol 76(7):2181–2191

Kovačević J, McIntyre LF, Henderson SB, Kosatsky T (2012) Occurrence and distribution of listeria species in facilities producing ready-to-eat foods in British Columbia, Canada. J Food Prot 75(2):216–224

Kramarenko T, Roasto M, Keto-Timonen R, Mäesaar M, Meremäe K, Kuningas M et al (2016) Listeria monocytogenes in ready-to-eat vacuum and modified atmosphere packaged meat and fish products of estonian origin at retail level. Food Control 67:48–52

Lagerkvist CJ, Hatab AA, Nedumaran S, Ravula P (2021) A latent class analysis of food hygiene and handling practices among urban and peri-urban residents in Hyderabad, India. Food Control 121

Lakhanpal P, Panda AK, Thakur SD (2016) Low prevalence of Listeria monocytogenes in ready-to-eat foods of animal origin from various tourist destinations of Himachal Pradesh, India. J Commun Dis 48(3)

Lakicevic B, Nastasijevic I (2016) Listeria monocytogenes in retail establishments: contamination routes and control strategies. Food Rev Int 33(3):247–269

Lakićević B, Stjepanović A, Milijašević M, Terzićvidojević A, Golić N, Topisirović L (2010) The presence of Listeria SPP. and Listeria monocytogenes in a chosen food processing establishment in Serbia. Arch Biol Sci 62(4)

Levine K, Yavelak M, Luchansky JB, Porto-Fett ACS, Chapman B (2017) Consumer perceptions of the safety of ready-to-eat foods in retail food store settings. J Food Prot 80(8):1364–1377

Lovre K, Brankov TP (2015) The Supermarket Revolution in the Balkan Countries: the case of Serbia. Agroecon Croat 5(1):1–10

Luber P, Crerar S, Dufour C, Farber J, Datta A, Todd ECD (2011) Controlling Listeria monocytogenes in ready-to-eat foods: working towards global scientific consensus and harmonization – recommendations for improved prevention and control. Food Control 22(9):1535–1549

Magalhães R, Almeida G, Ferreira V, Santos I, Silva J, Mendes MM et al (2015) Cheese-related listeriosis outbreak, Portugal, March 2009 to February 2012. Euro Surveill 20(17)

Maneesriwongul W, Dixon JK (2004) Instrument translation process: a methods review. J Adv Nurs 48(2):175–186

Martins RB, Hogg T, Otero JG (2012) Food handlers' knowledge on food hygiene: the case of a catering company in Portugal. Food Control 23(1):184–190

Miloradovic Z, Blazic M, Barukcic I, Font i Furnols M, Smigic N, Tomasevic I, Miocinovic J (2021) Serbian, Croatian and Spanish consumers' beliefs towards artisan cheese. Br Food J (**ahead-of-p(ahead-of-print)**)

Mooi E, Sarstedt M (2011) A concise guide to market research A concise guid to Mark Res. Springer, Berlin

Murray R, Glass-Kaastra S, Gardhouse C, Marshall B, Ciampa N, Franklin K et al (2017) Canadian consumer food safety practices and knowledge: Foodbook study. J Food Prot 80(10):1711–1718

Musa S, Mulaomerovic M, Juric A, Blazevic M, Durmisevic J, Pupic M et al (2020) Annual report on infectious diseases and immunization carried out in the Federation of Bosnia and Herzegovina in 2019, Institute for Public Health (**in Bosnian**)

Neri D, Antoci S, Iannetti L, Ciorba AB, D'Aurelio R, Del Matto I et al (2019) EU and US control measures on Listeria monocytogenes and Salmonella spp. in certain ready-to-eat meat products: an equivalence study. Food Control 96:98–103

Nesbitt A, Majowicz S, Finley R, Marshall B, Pollari F, Sargeant J et al (2009) High-risk food consumption and food safety practices in a canadian community. J Food Prot 72(12):2575–2586

Off Gaz (2017) Ordinance on food declaration, labelling and advertising RS no 19/17, 16/18, 17/20118/20 (**in Serbian**)

Official Gazette (2017) Turkish Food Codex regulation on labelling and food information to consumers No. 29960 (**in Turkish**)

Ovca A, Škufca T, Jevšnik M (2021) Temperatures and storage conditions in domestic refrigerators - slovenian scenario. Food Control 123:107715

Painter JA, Hoekstra RM, Ayers T, Tauxe RV, Braden CR, Angulo FJ, Griffin PM (2013) Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. Emerg Infect Dis 19(3):407–415

Polimeni JM, Iorgulescu RI, Mihnea A (2018) Understanding consumer motivations for buying sustainable agricultural products at romanian farmers markets. J Clean Prod 184:586–597

Redmond EC, Griffith CJ (2003) Consumer food handling in the home: a review of food safety studies. J Food Prot 66(1):130–161

Ricci A, Allende A, Bolton D, Chemaly M, Davies R, Fernández Escámez PS et al (2018) Listeria monocytogenes contamination of ready-to-eat foods and the risk for human health in the EU. EFSA J 16(1):5134

Roccato A, Uyttendaele M, Membré JM (2017) Analysis of domestic refrigerator temperatures and home storage time distributions for shelf-life studies and food safety risk assessment. Food Res Int 96:171–181

Şanlıbaba P, Tezel BU, Çakmak GA (2018) Prevalence and antibiotic resistance of listeria monocytogenes isolated from ready-to-eat foods in Turkey. J Food Qual 2018:1–9

Sirsat SA, Gibson KE, Neal JA (2015) Food safety at farmers' markets: fact or fiction? In: Ricke SC, Donaldson JR, Carol AP (eds) Food Safety, Emerg Issues, Technol Syst. Academic Press, pp 319–329

Smigic N, Antic D, Blagojevic B, Tomasevic I, Djekic I (2016) The level of food safety knowledge among meat handlers. Br Food J 118(1):9–25

Szymczak B, Szymczak M, Trafiałek J (2020) Prevalence of Listeria species and L. monocytogenes in ready-to-eat foods in the West Pomeranian region of Poland: correlations between the contamination level, serogroups, ingredients, and producers. Food Microbiol 91:103532

Tkaczynski A (2016) Segmentation using two-step cluster analysis. Segmentation soc mark process methods Appl. Springer Singapore, pp 109–125

Tomaszewska M, Bilska B, Kołożyn-Krajewska D (2020) Do polish consumers take proper care of hygiene while shopping and preparing meals at home in the context of wasting food? Int J Environ Res Public Health 17(6):2074

Tsaloumi S, Aspridou Z, Tsigarida E, Gaitis F, Garofalakis G, Barberis K et al (2021) Quantitative risk assessment of Listeria monocytogenes in ready-to-eat (RTE) cooked meat products sliced at retail stores in Greece. Food Microbiol 99:103800

USDA-FSIS (2014) The U.S. Department of Agriculture, Food Safety and Inspection Service, Controlling Listeria monocytogenes in Post-lethality Exposed Ready-to-Eat Meat and Poultry Products

USDA-FSIS (2016) The U.S. Department of Agriculture. Food Safety and Inspection Service, Keep Food Safe! Food Safety Basics

Uyttendaele M, Busschaert P, Valero A, Geeraerd AH, Vermeulen A, Jacxsens L et al (2009) Prevalence and challenge tests of Listeria monocytogenes in belgian produced and retailed mayonnaise-based deli-salads, cooked meat products and smoked fish between 2005 and 2007. Int J Food Microbiol 133(1–2):94–104

Van Boxstael S, Devlieghere F, Berkvens D, Vermeulen A, Uyttendaele M (2014) Understanding and attitude regarding the shelf life labels and dates on pre-packed food products by belgian consumers. Food Control 37(1):85–92

Van Loo EJ, Ricke SC, Milillo SR, Seideman S, Crandall PG (2010) Consumer Food Safety perceptions of ready-to-eat Deli Foods in Northwest Arkansas. Food Prot Trends 30(11):635–643

Vegara A, Festino AR, Di Ciccio PA, Costanzo C, Pennisi L, Ianieri A (2014) The management of the domestic refrigeration: microbiological status and temperature. Br Food J 116(6):1047–1057

Verraes C, Vlaemynck G, Van Weyenberg S, De Zutter L, Daube G, Sindic M et al (2015) A review of the microbiological hazards of dairy products made from raw milk. Int Dairy J 50:32–44

Warsaw P, Archambault S, He A, Miller S (2021) The economic, social, and environmental impacts of farmers markets: recent evidence from the US. Sustainability 13(6):3423

Worsfold D, Worsfold PM, Griffith CJ (2004) An assessment of food hygiene and safety at farmers' markets. Int J Environ Health Res 14(2):109–119

Zakowska-Biemans S (2011) Polish consumer food choices and beliefs about organic food. Br Food J 113(1):122–137

Zhang X, Wang S, Chen X, Qu C (2021) Review controlling Listeria monocytogenes in ready-to-eat meat and poultry products: an overview of outbreaks, current legislations, challenges, and future prospects. Trends Food Sci Technol 116:24–35

Zhllima E, Mehmeti G, Imami D (2021) Consumer preferences for cheese with focus on food safety—a segmentation analysis. Sustainability 13(22):12524

Zorba NND, Kaptan M (2011) Consumer food safety perceptions and practices in a turkish community. J Food Prot 74(11):1922–1929