Evaluation of listeriosis risk related with the consumption of non-prepacked RTE cooked meat products handled at retail stores in Greece
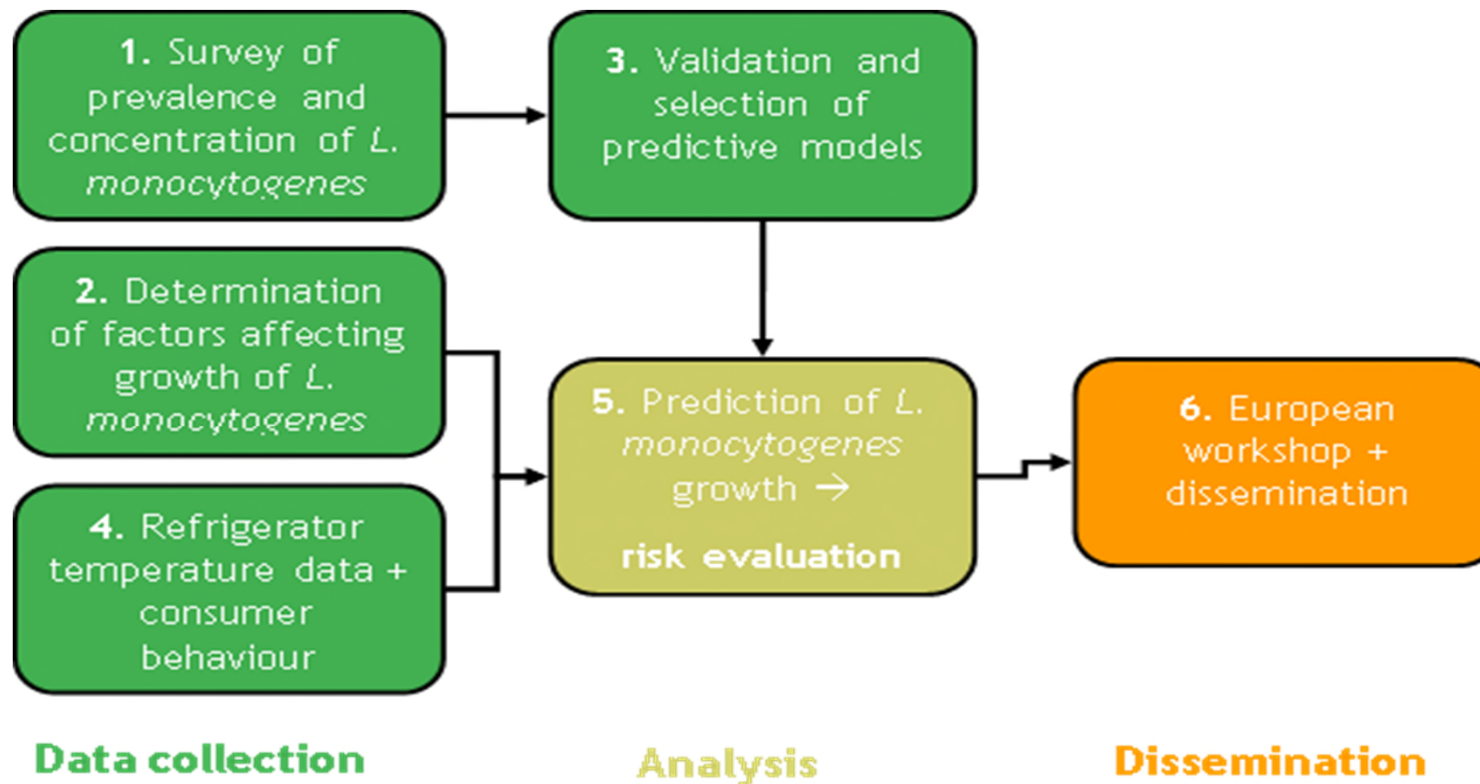
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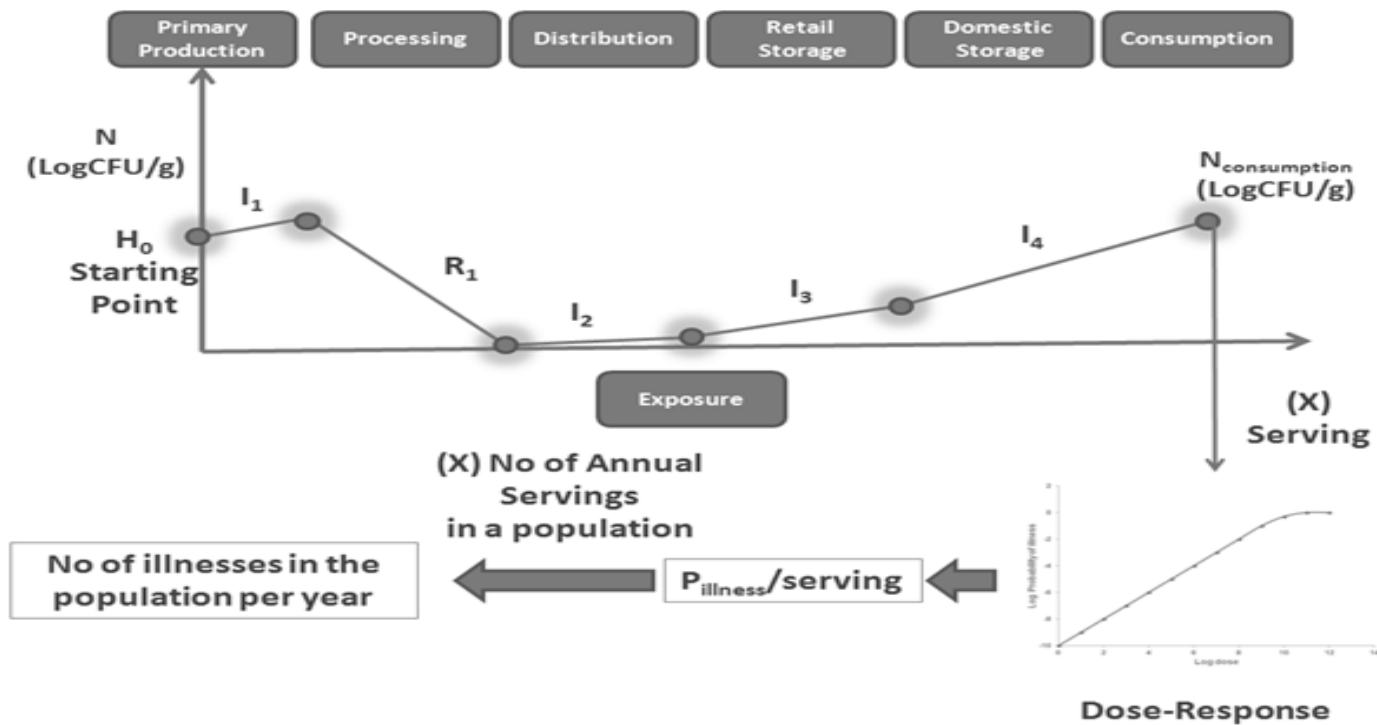HELLENIC FOOD AUTHORITY

Objective

- To assess the risk of listeriosis related with the consumption of non-packed RTE **cooked** meat products sliced at retail food service environments in Greece.

- To identify and propose mitigation strategies for reducing the risk of listeriosis related with the consumption of non-packed RTE foods
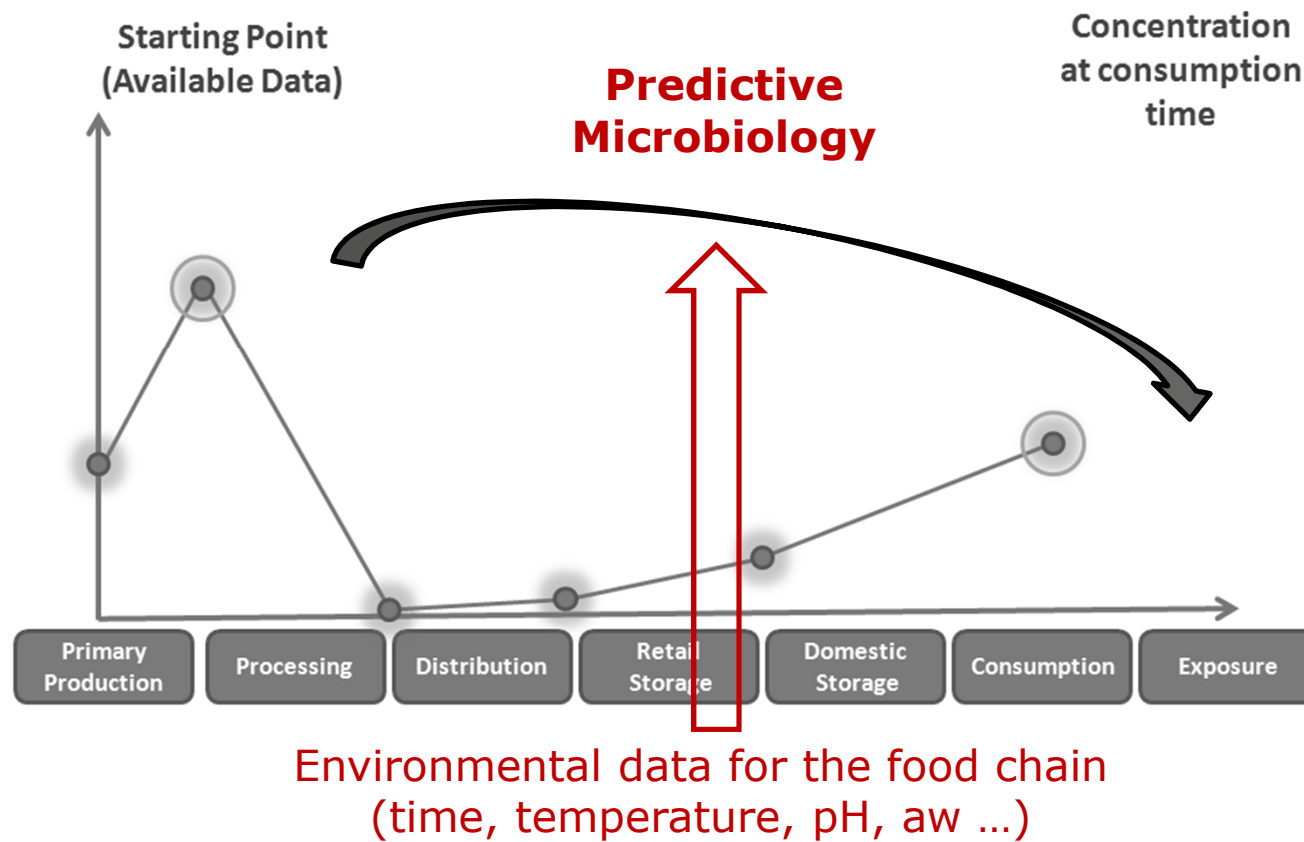
Overview of the tasks

Risk Assessment Infograph

Dose-Response

Predictive Microbiology

Starting Point (Available Data)

Predictive Microbiology

Concentration at consumption time

Environmental data for the food chain (time, temperature, pH, aw …)

Primary Production | Processing | Distribution | Retail Storage | Domestic Storage | Consumption | Exposure

Data requirements

Prevalence and concentration of Lm at starting point (time of slicing)

Product characteristics affecting growth of Lm (pH, aw, nitrites, LAB)

Time-Temperature data for domestic storage

Accurate model predicting growth during domestic storage

Serving size/Survey

Dose response relationship (for normal and susceptible populations)

Annual number of servings (for normal and susceptible populations)

Prevalence and concentration of *L. monocytogenes*

- Mapping retail points (data from major supermarkets, registry from EFET, SEVEK etc)
- 886 retail points
- Simple random sampling using SAMPLELATOR (EFSA, 2018)
- Target of 300 sampling points (351 selected in order to take into consideration any error)
- Swab tested and product if positive swab
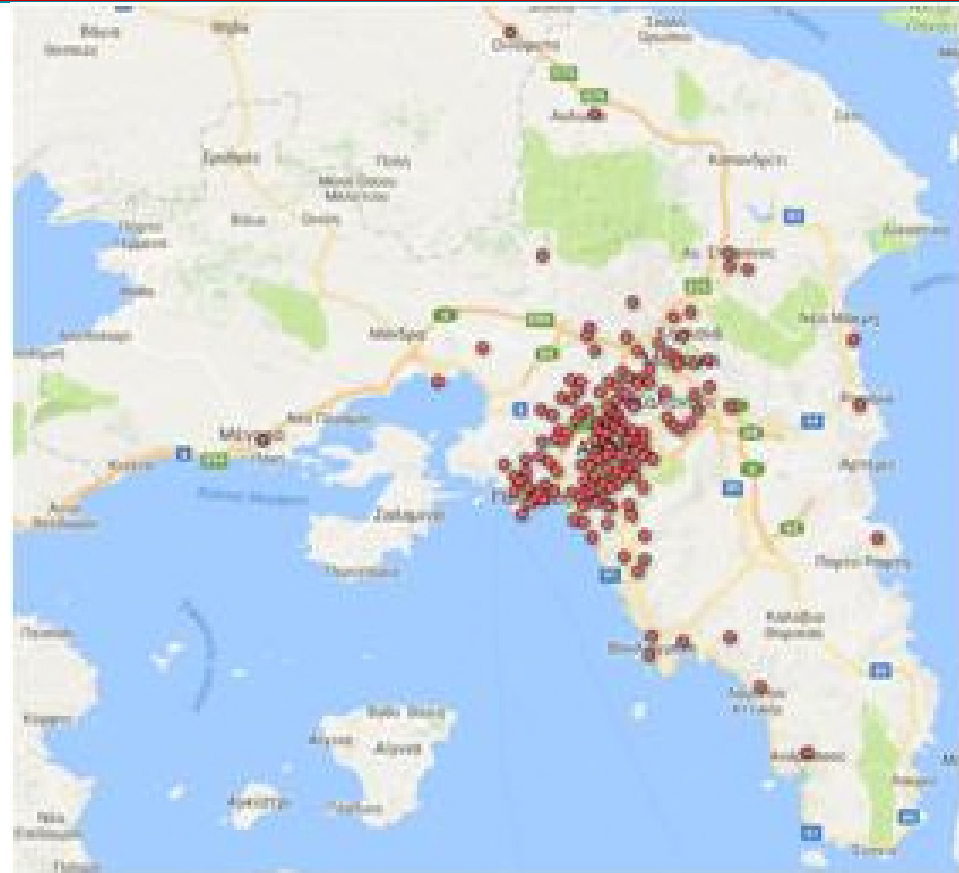
Prevalence and concentration of Lm at starting point

- Positive samples of swabs of the entire exposed area of the cutting tool used for slicing of the non-prepackaged RTE cooked meat product were identified in **2 out of the 300** samples (**0.67%**).

- In only **one of the 2 cases**, where the swab tested positive for *L. monocytogenes*, was the microorganism also detected on the meat product previously sliced (**0.33%**)

- Concentration below the limit of quantification (LOQ:10 cfu/gr)

Product characteristic affecting Lm growth

➢ In total **87 products** with 4 replicates for each product were analyzed for pH, water activity, concentration of nitrites and concentration of the lactic acid bacteria (LAB)

➢ Products represent >85% of total sales

Summary statistics for pH, aw, LAB and nitrites of cooked meat products available on the Greek market

	pH	a_w	LAB (log cfu/g)	NaNO$_2$ (ppm)
Mean	6.34	0.979	4.74	26.60
Standard error	0.016	0.000259	0.059	1.84
Median	6.35	0.98	4.7	17.04
Mode	6.35	0.982	4.6	1.4
Standard deviation	0.2908	0.0046	1.05	32.76
Range	1.55	0.028	4.25	207.4
Minimum	5.63	0.965	2.55	0.16
Maximum	7.18	0.993	6.8	207.6

Validation of predictive models for LM growth

- The FSSP model was selected as the most appropriate since it includes all parameters affecting growth (Temperature, pH, water activity, concentration of nitrites and concentration of the lactic acid bacteria)
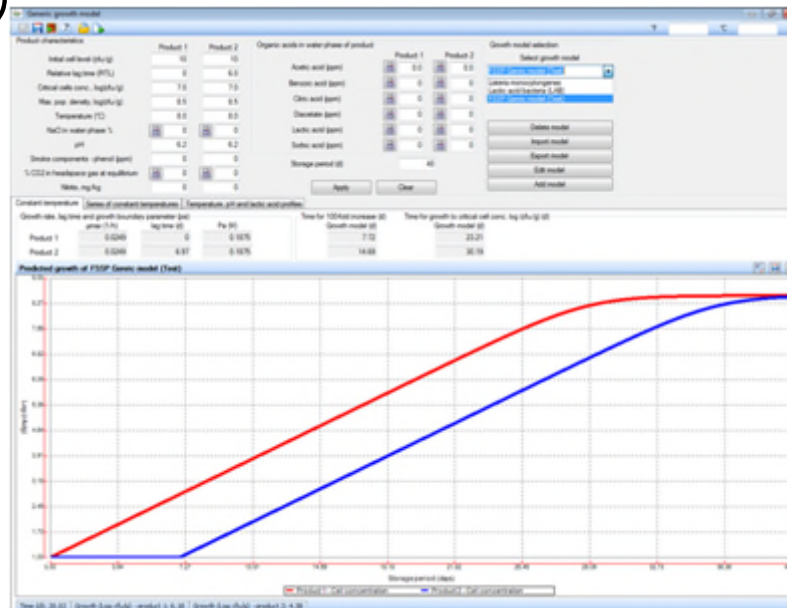
Validation of predictive models for LM growth

> Three RTE meat products (A: boiled turkey, B: boiled ham, C: smoked turkey) were selected representing a high, medium and low concentration of NaNO2.

> Products were inoculated with the strain 154 isolated form the slicing machine and stored <u>at three static</u> (4, 7, 12° C) and <u>two dynamic</u> temperatures simulating temperature conditions during domestic storage

> Observed growth of Lm and LAB was compared to predicted growth by FSSP

Validation of predictive models for LM growth

Characteristics of products used for experiments on static temperature at 4°C for 16 days

Characteristics	Product A	Product B	Product C
pH	6.27	6.2	6.1
a_w	0.989	0.985	0.982
$NaNO_2$ (ppm)	46.5	15	0
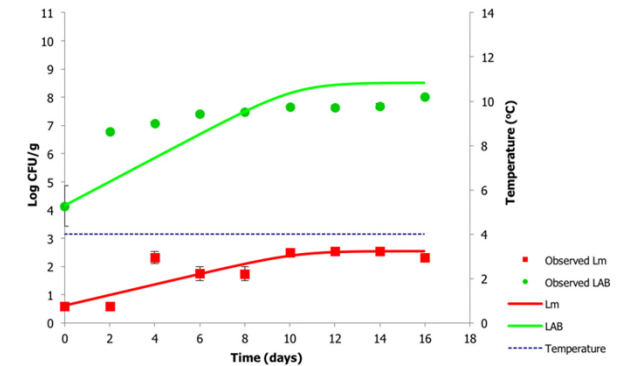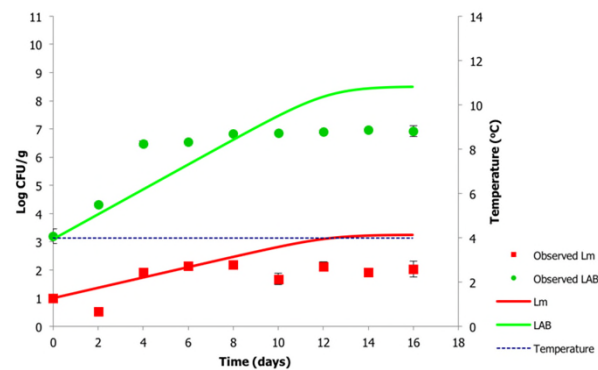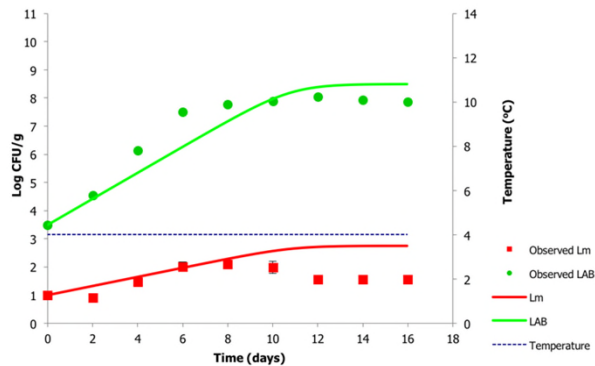
Time - Temperarure during domestic storage

➤ 90 domestic refrigerators were surveyed in North Greece. The data loggers were programmed to record the temperature every 15 min for 24 h and were located at the middle shelf of the refrigerator. Temperature data were combined with those from a previous survey (100 domestic refrigerators) presented in Koutsoumanis et al., (2010).
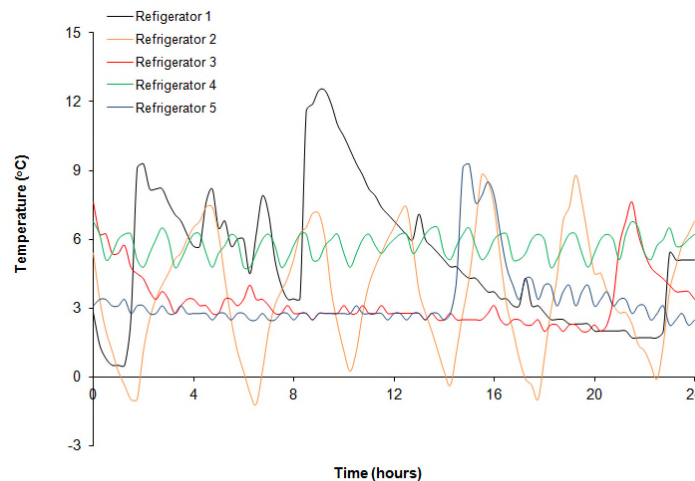
Time - Temperature during domestic storage

Statistics of temperature data in domestic refrigerators

Mean temperature of 24 h profiles	
Average	5.97
Standard Error	0.20
Median	6.00
Standard Deviation	2.73
Sample Variance	7.46
Kurtosis	0.78
Skewness	-0.17
Range	15.49
Minimum	-2.40
Maximum	13.09
Count	190
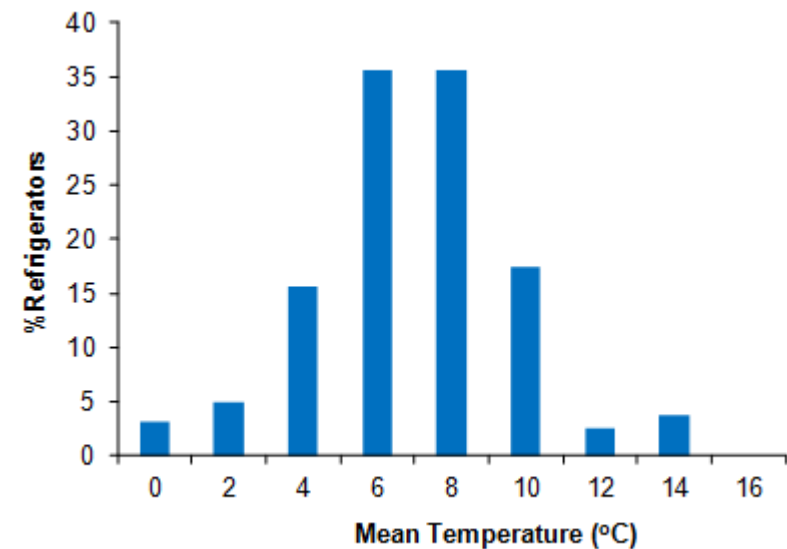
Time - Temperature during domestic storage

Length of storage of the meat products

	Usual number of days		Maximum number of days	
	(N)	**%**	**(N)**	**%**
Up to 3 days	124	16	61	8
4-7 days	580	72	539	67
8-10 days	66	8	126	16
11-15 days	12	2	44	5
More than 15 days	3	0	8	1
I don't know/answer	15	2	23	3

Survey on food handling practices and risk perception of Greek consumers of non-prepackaged RTE meat products

➢ The aim of the survey was to record

  ➢ Consumer demographic data

  ➢ Approximate consumption of non-prepackaged RTE meat products

  ➢ Consumers' handling practices

  ➢ Consumers' risk perception regarding non-prepackaged RTE meat products

Demographics of the households/persons of non-prepackaged RTE meat products consumers that participated in the survey

Members in the household	Number of households	Estimated number of persons	Number of households with at least 1 high-risk person	Number of persons at high-risk	Estimated number of persons at no high risk
1	103	103	50	50	53
2	230	460	131	194	266
3	172	516	74	103	413
4	215	860	56	73	787
≥5	80	480	35	54	426
Total	**800** (100%)	**2419**	**346** (43%)	**474 (19%)**	1945 (**81%**)

Consumers of non – prepackaged RTE meat products

	Number of consumers	Total sample (N=2355)	Consumers only
		%	%
Smoked turkey	944	40.08	53.64
Boiled turkey	707	30.02	40.17
Parizer	438	18.60	24.89
Mortadella	218	9.26	12.39
Smoked ham	147	6.24	8.35
Boiled ham	129	5.47	7.33
Smoked steak	86	3.65	4.89
Smoked chicken	85	3.60	7.83
Boiled chicken	71	3.01	4.03

Usual consumption per person per eating occasion for each type and combination of RTE meat products per month (N=1760 individuals)

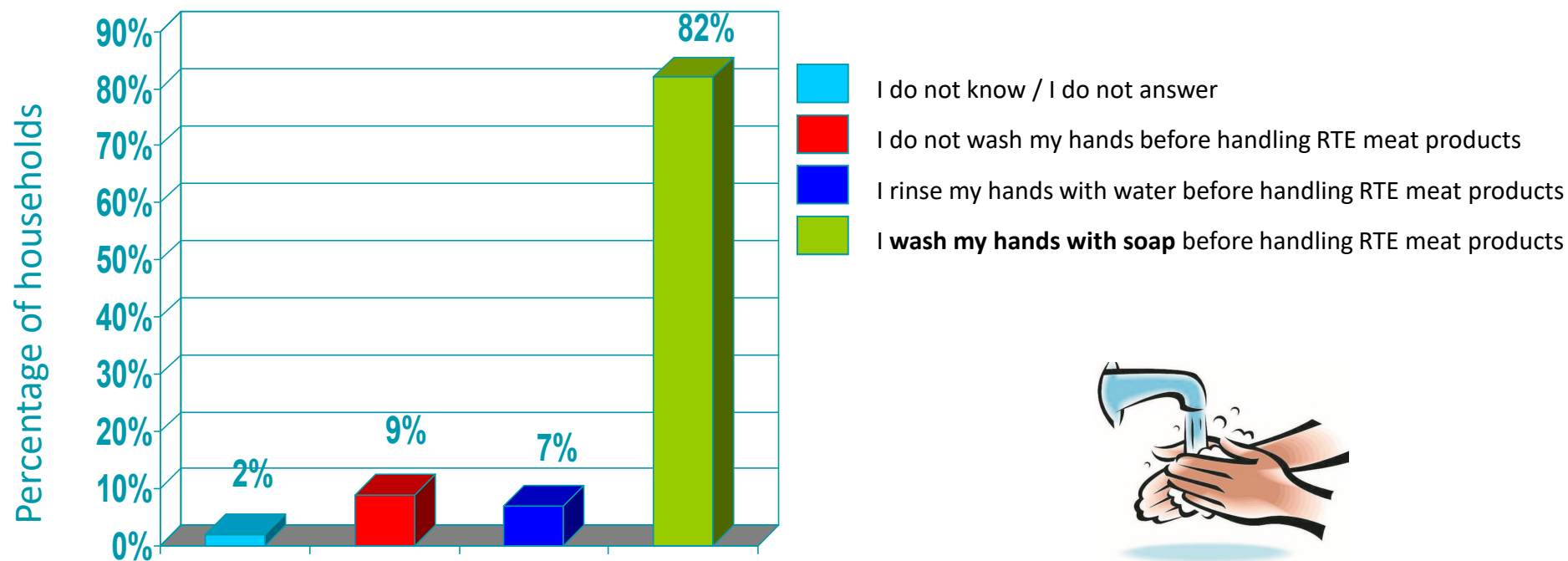| Number of slices	Mortadella N=218	Parizer N=438	Boiled turkey N=707	Smoked turkey N=944	Boiled ham N=129	Smoked ham N=147	Smoked steak N=86	Boiled chicken N=71	Smoked chicken N=85	Combination of RTE meat products
	%	%	%	%	%	%	%	%	%	%
1	51	64	65	71	58	55	67.5	72	74	64
2	28	20	20	17	19	22	17.5	16	12	19
3	9	5	5	5	5.5	11	9.5	4	5	6
4	6.5	5	3	1.5	2.5	2	3.5	3	3	3.5
5	3	1	2.5	1.5	8	2.5	1	0	0	3
6	0	1	0.5	1	1	0.5	0	1	0	1
7	0.5	0	0.5	0	0	0	0	0	0	0
8	0.5	0	0.5	0.5	0	1	0	0	0	0
9	0	1	0	0.5	0	3	0	0	1	0.5
≥ 10	1.5	3	3	2	6	3	1	4	5	3

Consumers' perception regarding Listeria

Consumers' perception regarding *Listeria*

- Knowledge of the foodstuffs associated with the growth of *Listeria* and the risk of listeriosis

	Spontaneous N=38	Prompted N=399
– Smoked, sliced meat products	35%	15%
– Cooked, sliced meat products	27%	21%
– Ready-to-eat sandwiches containing meat products	10%	23%
– Soft cheese (e.g., anthotiros, mizithra)	5%	14%
– Smoked fish (e.g., salmon)	4%	9%
– Ready-to-eat, pre-cut salads	2%	14%
– Other	13%	
– Do not know	27%	

Never heard of Listeria 50%

Have heard of Listeria 50% (N=399)

Practice of washing hands before handling non-prepackaged RTE meat slices

Percentage of households

- 2%
- 9%
- 7%
- 82%

- I do not know / I do not answer
- I do not wash my hands before handling RTE meat products
- I rinse my hands with water before handling RTE meat products
- I **wash my hands with soap** before handling RTE meat products

Use of internet to stay informed about food-related issues

Twitter	Facebook	Google+	News and commentary videos on YouTube	News sites and internet blogs	None
5%	26%	29%	12%	32%	41%
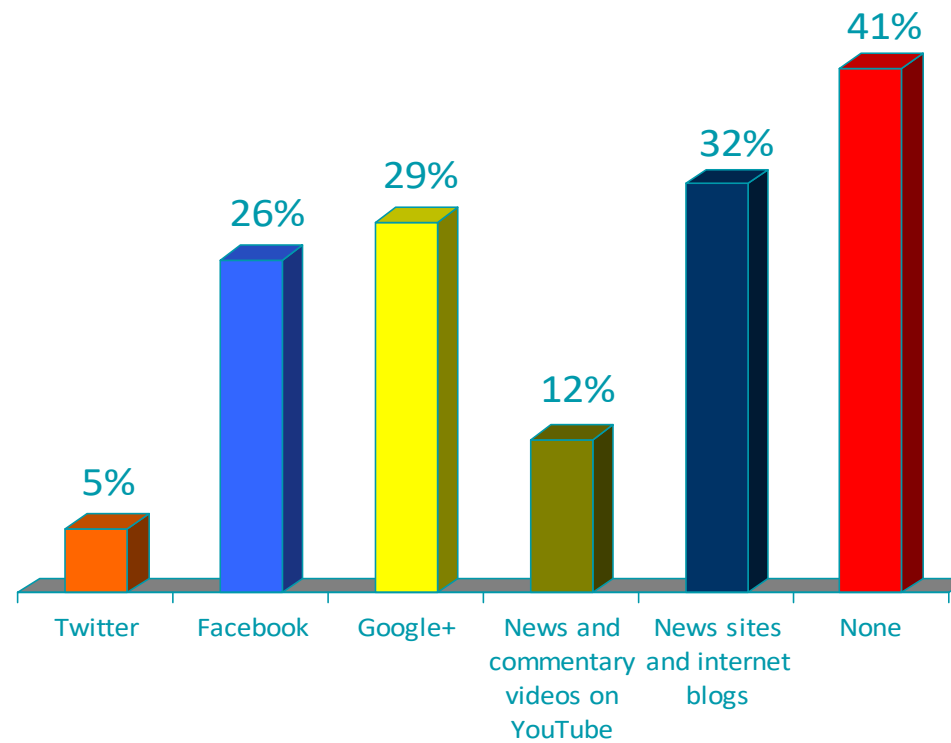
Habit of removing the RTE meat slices from their supermarket wrap, before placing them in the refrigerator

	%	
Always	30	42%
Usually yes	12	
Sometimes yes, sometimes not	6	
Usually not	11	52%
Never	41	

Risk Assessment

The data collected and the validated model were used to develop a QMRA model predicting the risk of listeriosis related to the consumption of non-prepackaged RTE meat products handled at retail stores in Greece.

The model was used to predict the risk per serving for each of the 87 tested products and the annual listeriosis cases for each of the nine product categories and for consumers <65 and $\geq$>65 years old.

Risk characterization – Risk per serving

## Risk per Serving

Code	Type of meat product	Type of processing (boiled or smoked or roasted)	Producing company (code)	aw	pH	Nitrite	Risk per Serving Consumers <65 years old			Risk per Serving Consumers >65 years old		
							Median	95th Perc.	99th Perc.	Median	95th Perc.	99th Perc.
1	Pariza - Salami	Boiled	A	0.976	6.3	14.4	-15.512	-12.656	-11.352	-14.297	-11.427	-10.110
2	Pork Shoulder	Boiled	A	0.978	6.5	17.6	-15.433	-12.567	-11.242	-14.226	-11.348	-10.007
3	Mortadella Bologna	Boiled	A	0.982	6.0	10.1	-15.457	-12.590	-11.245	-14.255	-11.350	-10.034
4	Turkey toast	Roasted	A	0.982	6.2	9.5	-15.476	-12.574	-11.180	-14.255	-11.338	-10.014
5	Turkey toast	Boiled	A	0.977	6.4	11.2	-15.471	-12.617	-11.307	-14.274	-11.394	-10.069
6	Pariza - Salami	Boiled	B	0.971	6.6	25.7	-15.567	-12.815	-11.583	-14.370	-11.567	-10.336
7	Turkey fillet	Boiled	B	0.983	6.6	150.8	-15.848	-13.343	-12.352	-14.662	-12.098	-11.137

Risk characterization – Risk per serving

Ranking of the 87 products based on the Risk per Serving
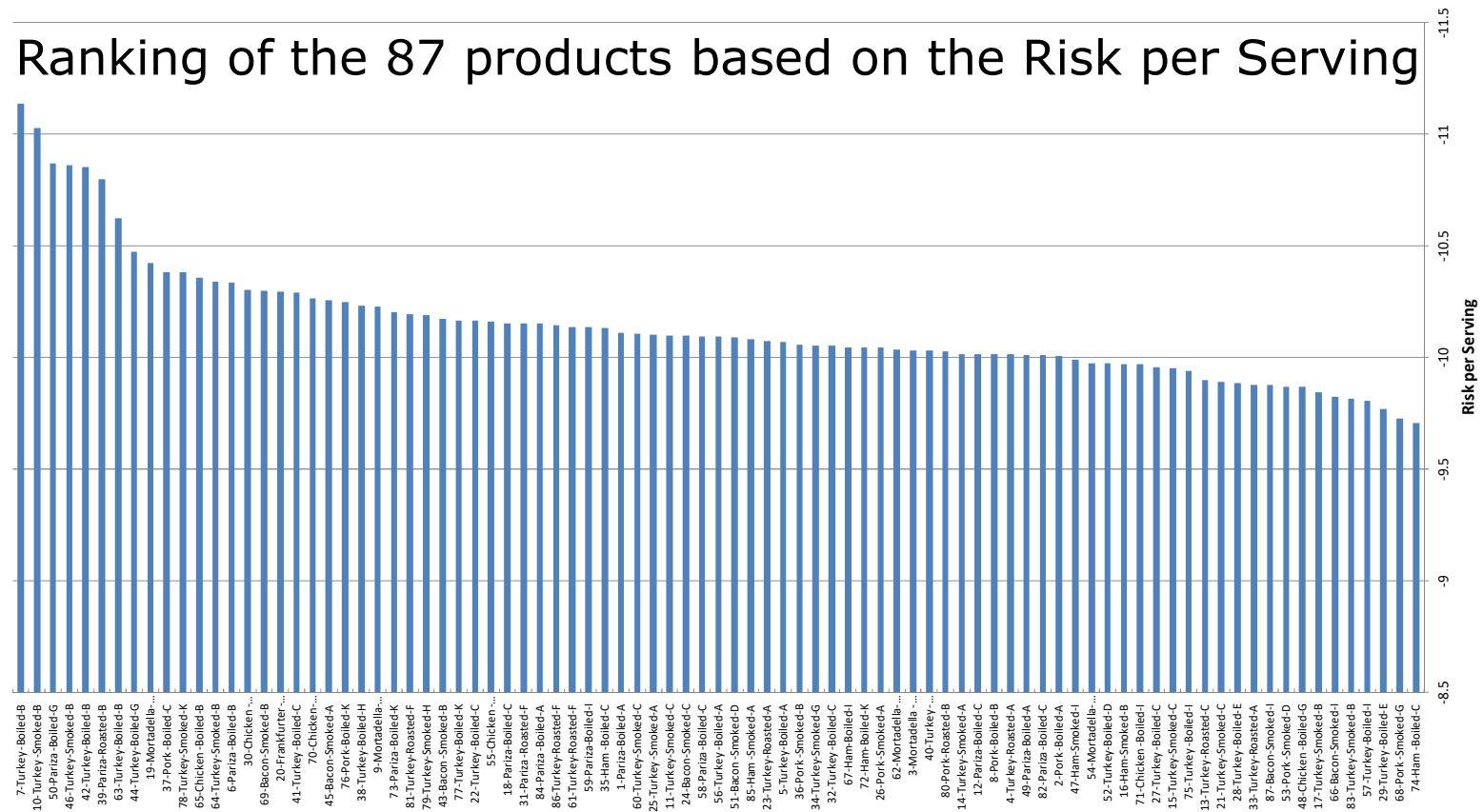
Risk characterization – Risk per serving

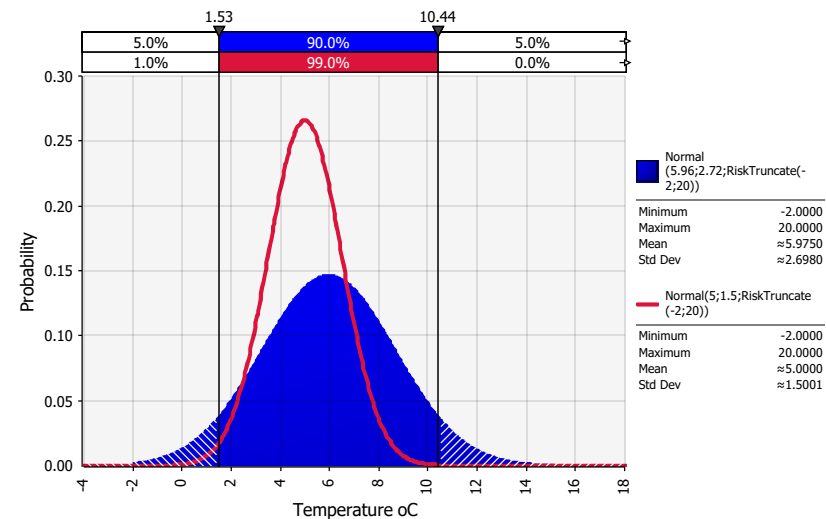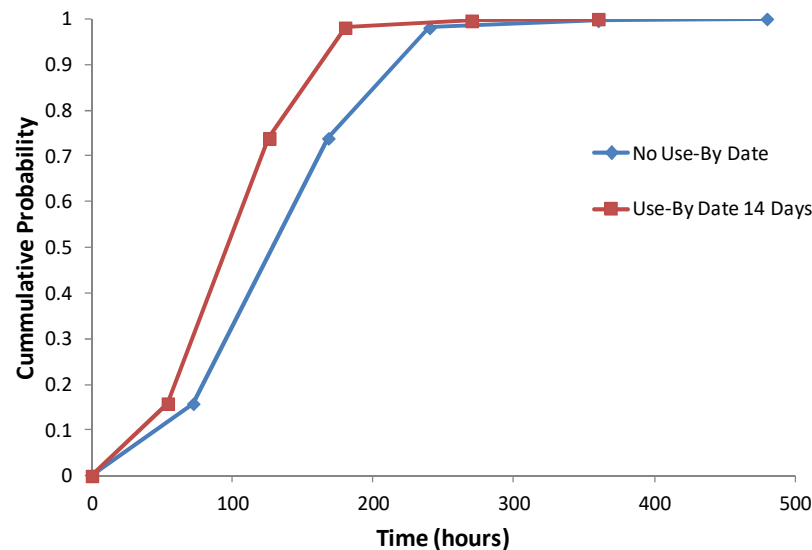## Ranking is highly related with nitrite concentration
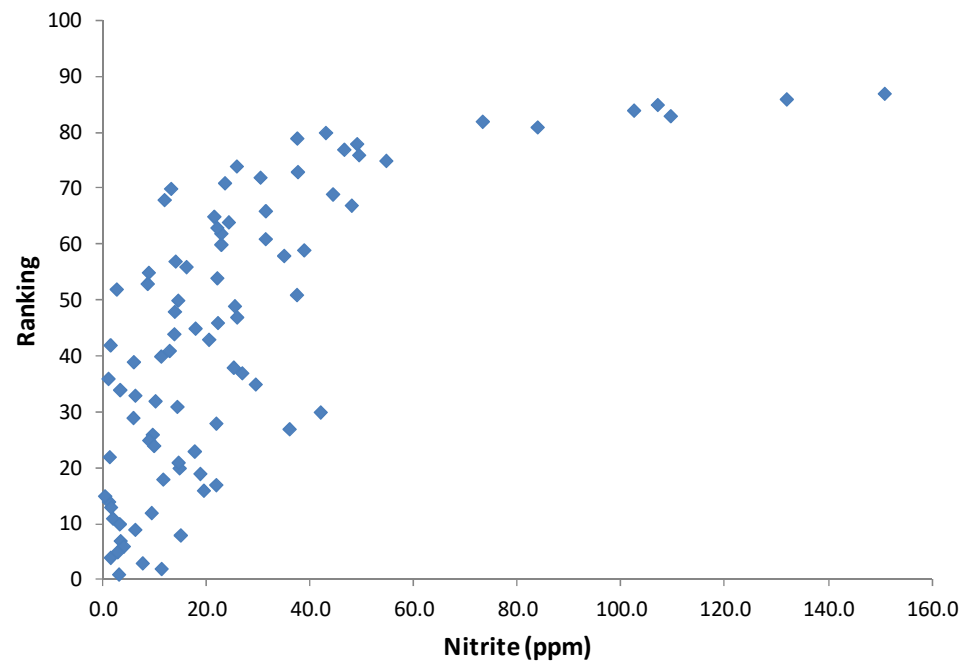
Risk characterization – Annual cases

Predicted annual listeriosis cases in Greece related with the consumption of non-prepackaged RTE cooked meat products sliced at retail

|	Consumers <65 yo			Consumers ≥65 yo			All consumers		
	Median	P95	P99	Median	P95	P99	Median	P95	
Parizer	0	1	2	0	2	2	0	3	
Mortadella	1	3	4	2	4	5	3	7	
Boiled turkey	0	1	2	1	3	3	1	4	
Smoked turkey	1	2	3	1	3	4	2	5	
Boiled ham	0	1	2	0	2	2	0	3	
Smoked ham	0	1	1	1	3	3	1	4	
Smoked steak	0	2	2	0	1	1	0	3	
Boiled chicken	0	1	1	0	1	2	0	2	
Smoked chicken	0	1	1	0	1	2	0	2	
Total	2	13	18	5	20	24	7	33	

Scenario Analysis

1. Setting a use-by date in non-prepackaged ready-to-eat (RTE) cooked meat products

2. improving the temperature of domestic refrigerators

Results
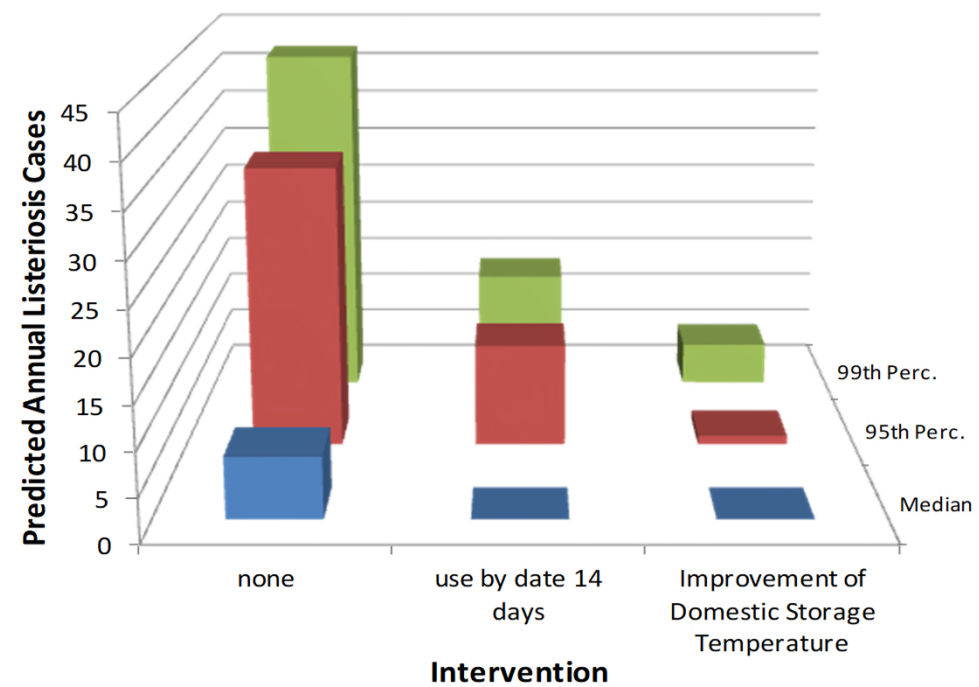
European workshop - Communication

A European Workshop on "Evaluating the risk from the presence of Listeria monocytogenes in ready-to-eat meat products" was organised by EFET, AUTH and EFSA on 14 and 15 February 2019.

In total 80 participants attended the workshop, out of which 21 from the following MS: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Cyprus, Finland, France, Germany, Ireland, Italy, Latvia, Norway, Poland, Spain, Sweden, and the Netherlands.

The abstracts of the presentations are described in the following session while the presentations are made available at www.efet.gr.

European workshop - Communication

4. Key Recommendations for Consumers

- Check the temperature of your household refrigerator regularly. If it does not have an in-built thermometer, place one inside the fridge. Set the temperature of your refrigerator at <5° C.
- Clean the inside walls and shelves of your refrigerator as frequently as possible.
- *Listeria monocytogenes* can grow at low (refrigerator) temperatures. This means that the longer you keep these products, the greater the probability of its growth to numbers that may cause infection known as listeriosis. Keep foods that can support its growth no more than 2 weeks after purchase at temperatures below 5° C.
- Wash your hands thoroughly and regularly with soap, especially before and after handling RTE (meat) products. Your hands can be a vehicle for spreading pathogens in your kitchen. By washing your hands before the handling of meat products you minimize the risk for contaminating these products with pathogens.
- Wash utensils, cutting boards and any surfaces that food touches after each use.
- Minimise the time that RTE meat products spent at room temperature. Use insulated grocery bags in hot weather conditions and when the time spent between purchase of these products and their placement in the refrigerator is expected to be longer than usual.
- For non-prepackaged RTE meat slices: if you remove RTE meat slices from supermarket wraps, pay attention to place them in a clean, well-sealed container. Try to avoid placing them in containers with other products that can carry or support the growth of *L. monocytogenes* such as soft cheese.
- For prepackaged RTE meat slices: Use foods within their use-by-date.

Conclusions

Risk assessment

➢A quantitative RA model predicting the risk of listeriosis related to the consumption of non-prepackaged ready-to-eat (RTE) cooked meat products handled at retail stores in Greece was developed.

➢The QMRA was used for ranking the 87 tested products based on the probability of illness per serving. In general the ranking was highly related with the concentration of nitrites.

➢A median number of seven listeriosis cases per year was predicted for the total population upon consumption of the products handled at retail food service environments in Greece. The predicted 95th percentiles of the listeriosis cases totaled 33 of which 13 cases were <65 years old and 20 cases ≥65 years old.

➢The higher number of cases was predicted for mortadella, smoked turkey, boiled turkey and parizer, which were the most frequently consumed categories.

Conclusions

➢ Regulation does not require a use-by-date for RTE meat products sliced at retail. The developed model predicted that the establishment of a use-by date of 14 days as a potential mitigation strategy would result in the elimination of the median number of annual listeriosis cases. The improvement of the temperature during domestic storage was also found to be an effective control meausure.

Consumer survey/risk perception

➢ Poor awareness and insufficient knowledge of consumers regarding the temperature of the refrigerator.

➢ Long storage duration of non-prepackaged RTE meat products (> 1 week) in some households

➢ Short duration of exposure of RTE meat products to room temperature from purchase to their placement in the fridge (<30min)

➢ Placement of RTE meat slices usually in well-sealed containers alone, if removed from the supermarket wrap

Conclusions

➢ Low awareness regarding *Listeria* with only 50% of the participating households having heard of it

➢ Poor knowledge of foods that can cause listeriosis

➢ Need for easily accessible by consumers information on safe food handling practices

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