



IAFP's European Symposium on Food Safety
Munich, 4-6 May 2022

Occurrence of Foodborne Pathogens in Fermented Sausages and Involvement of Fermented Sausages in Foodborne Outbreaks in the EU

Valentina Rizzi

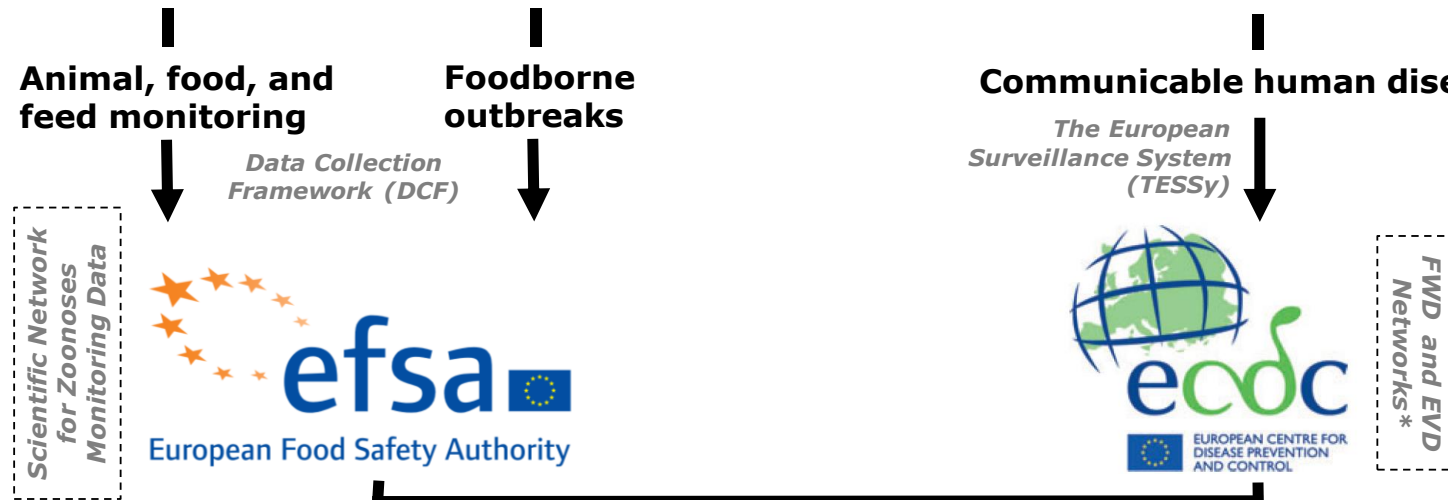
Team Leader BIOMO Team, BIOHAW Unit

Trusted science for safe food

- Occurrence of foodborne pathogens in fermented sausages
- Fermented sausages involved in foodborne events
- Notifications of contaminated products posing a risk to public health



EU Member States and other reporting countries



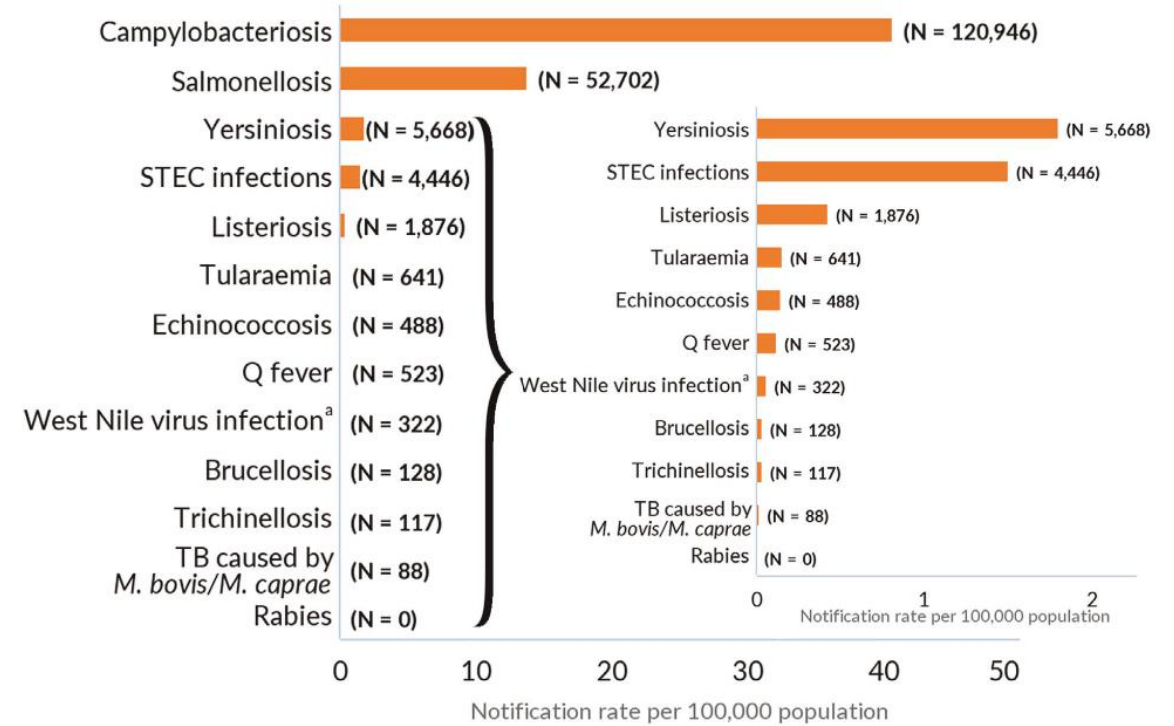
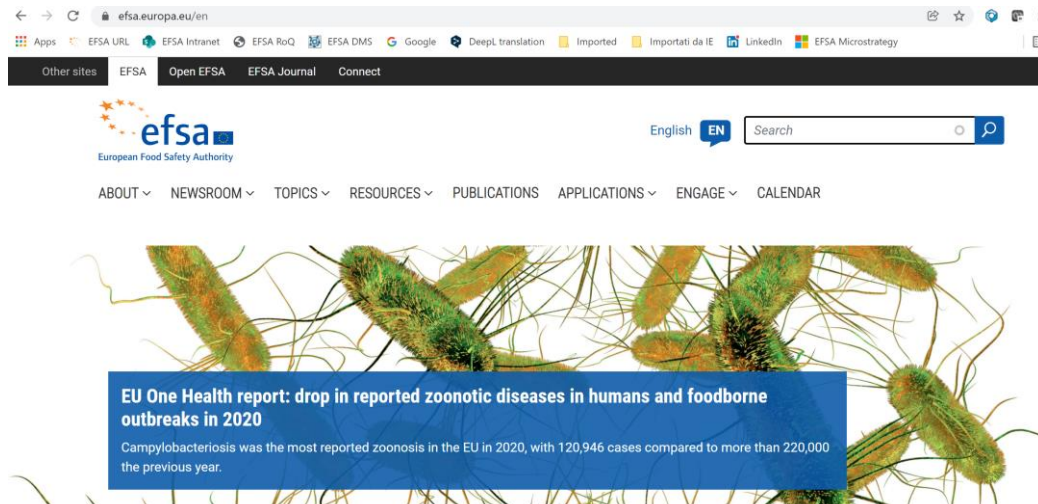
Annual joint EFSA-ECDC report

<https://efsa.onlinelibrary.wiley.com/doi/epdf/10.2903/j.efsa.2021.6971>

*FWD Network: European Food and Waterborne Diseases and Zoonoses Network; EVD Network: European Emerging and Vector-borne Disease Network

EU One Health Zoonoses 2020 report

<https://www.efsa.europa.eu/en/efsajournal/pub/6971>



Reported numbers of cases and notification rates of confirmed human zoonoses in the EU, 2020

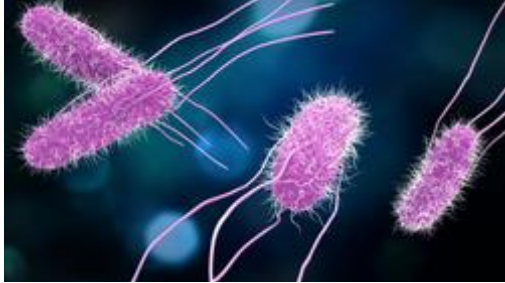
EFSA is publishing two interactive communication tools on foodborne outbreaks – a [story map](#) and a [dashboard](#). The story map provides general information on foodborne outbreaks, their causative agents and implicated food vehicles. The dashboard allows people to search and query the large amount of data on foodborne outbreaks collected by EFSA from EU Member States and other reporting countries since 2015.

Zoonotic agents in fermented sausages, 2014-2020

Agent	Total units tested	Total units positive	Positive %
<i>Campylobacter</i>	137	2	1.46
<i>Escherichia coli</i>	1967	35	1.78
<i>Histamine</i>	5	1	20.00
<i>Listeria</i>	15584	612	3.93
<i>Salmonella</i>	12482	59	0.47
<i>Staphylococcal enterotoxins</i>	5	0	0
<i>Staphylococcus</i>	9	0	0
<i>Trichinella</i>	5	5	100
<i>Yersinia</i>	25	0	0
Total	30219	714	2.36

Salmonella in fermented sausages

Salmonella in fermented sausages, overview 2014-2020



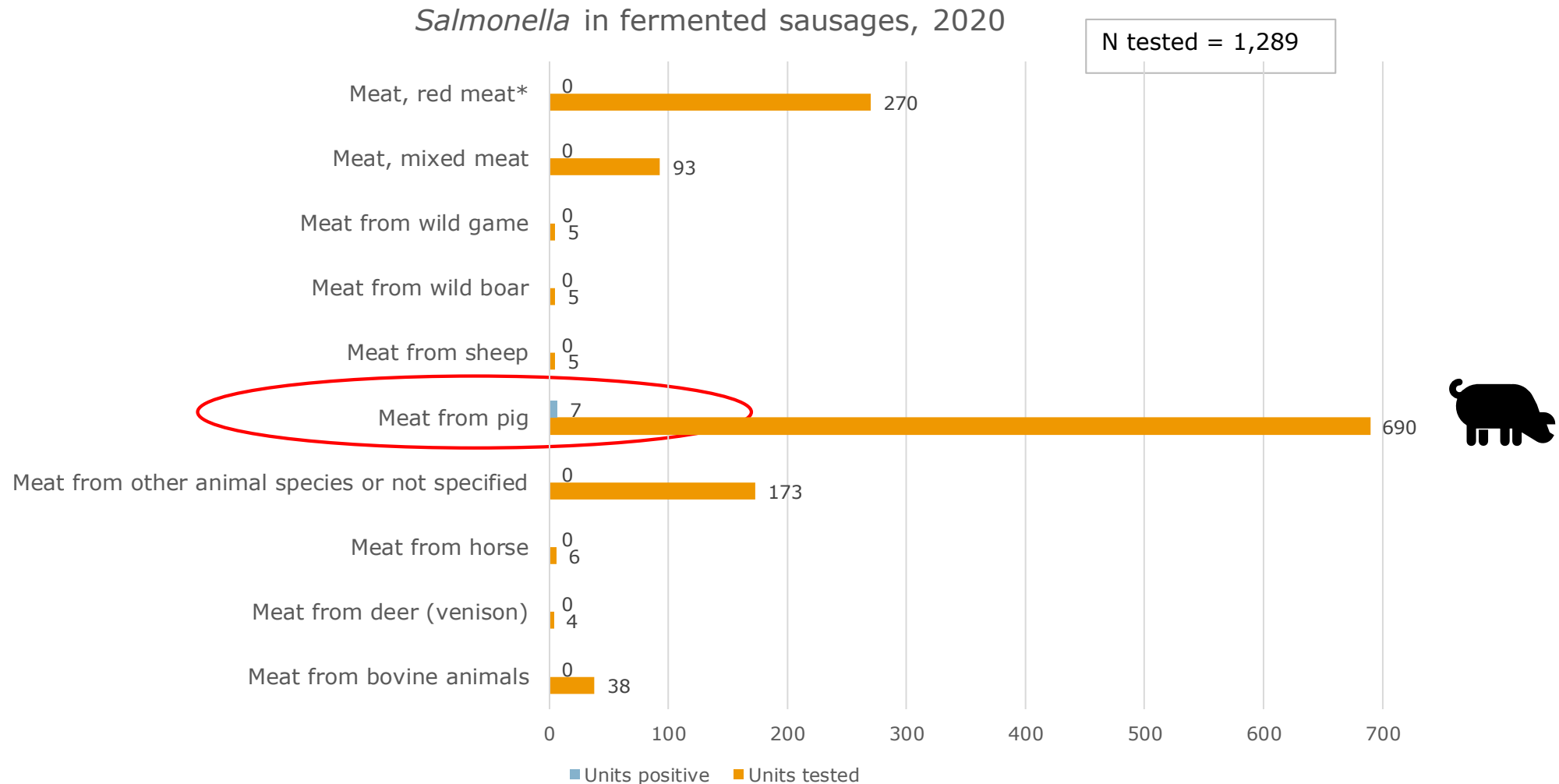
Reporting year	Total Units Tested	Total Units Positive	Positive %	Number of countries reporting
2014	2,336	5	0.21%	7
2015	1,903	9	0.47%	8
2016	1,909	7	0.37%	11
2017	2,365	13	0.55%	13
2018	1,085	6	0.55%	14
2019	1,595	12	0.75%	13
2020	1,289	7	0.54%	13



Food category: Meat product - fermented sausages	Distribution: wholesale and retail sale		Manufacturing		Others		Primary production		Total		
	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	% positive
Meat from bovine animals	16	0	18	0	4	0			38	0	0
Meat from deer (venison)	2	0	1	0	1	0			4	0	0
Meat from horse	4	0	2	0					6	0	0
Meat from other animal species or not specified	125	0	48	0					173	0	0
Meat from pig	421	2	268	5	1	0			690	7	1.01
Meat from sheep	4	0					1	0	5	0	0
Meat from wild boar	3	0	1	0	1	0			5	0	0
Meat from wild game	1	0	4	0					5	0	0
Meat, mixed meat	33	0	60	0					93	0	0
Meat, red meat*	196	0	48	0	26	0			270	0	0
Total	805	2	450	5	33	0	1	0	1289	7	0.54

* Meat from bovines, pigs, goats, sheep, horses, donkeys, bison and water buffalos

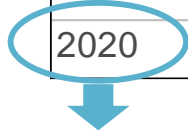
Salmonella in fermented sausages



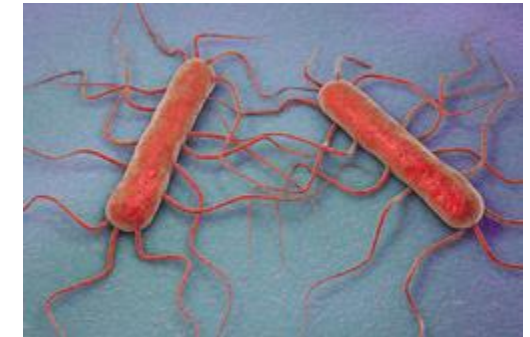
* Meat from bovines, pigs, goats, sheep, horses, donkeys, bison and water buffalos

Listeria monocytogenes in fermented sausages

Reporting year	Total Units Tested	Total Units Positive	Positive %	Number of countries reporting
2014	1,558	39	2.50%	7
2015	2,096	53	2.53%	11
2016	2,598	49	1.89%	12
2017	2,753	133	4.83%	14
2018	1,832	52	2.84%	16
2019	2,355	146	6.20%	16
2020	2,392	140	5.85%	18



Listeria monocytogenes in fermented sausages, overview 2014-2020

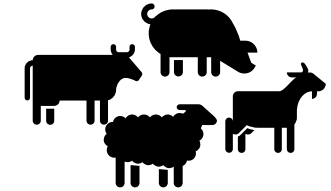
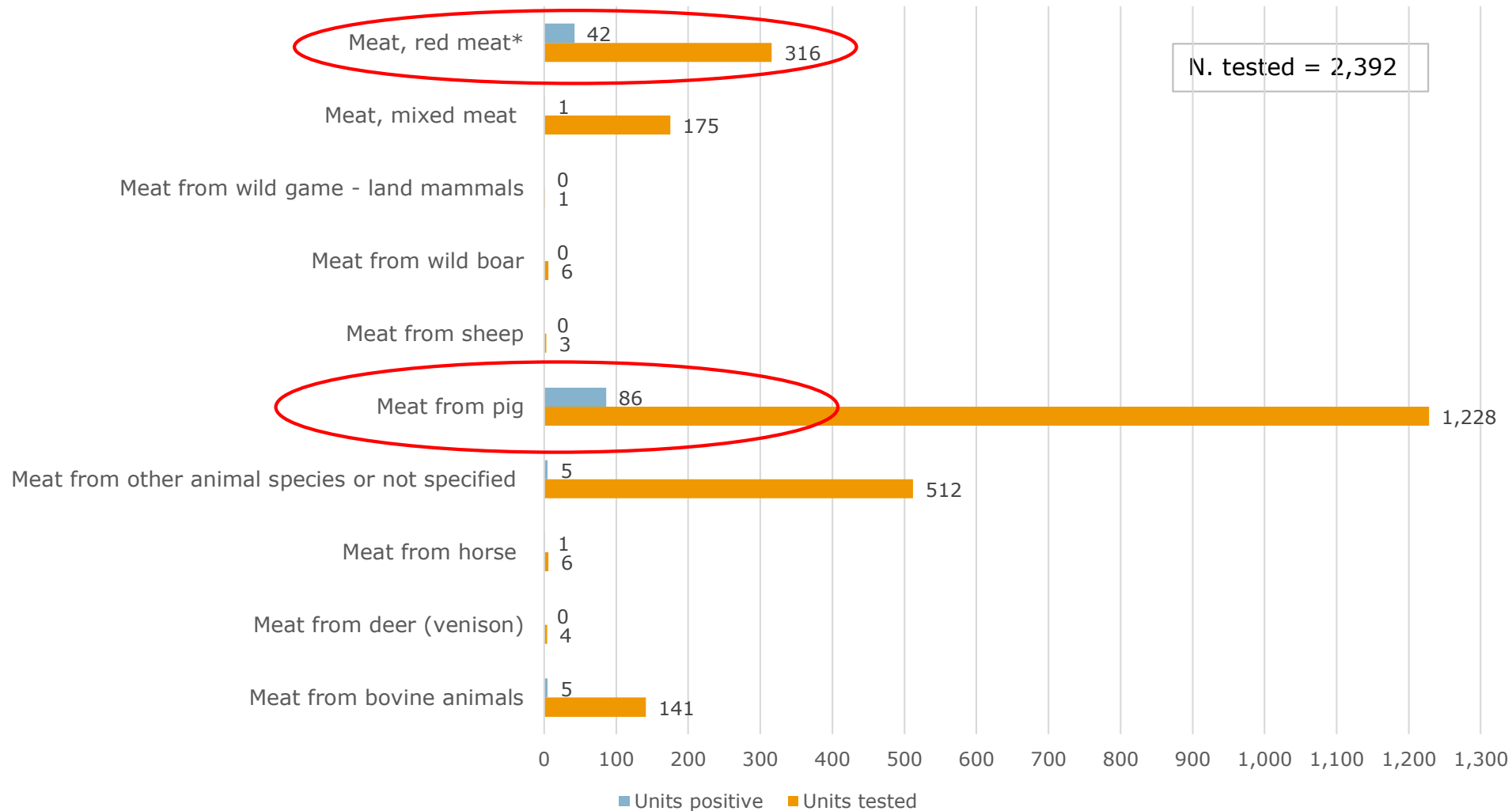


Food category: Meat products - Fermented sausages	Wholesale and retail sale		Manufacturing		Others		Total		
	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	% positive
Meat from bovine animals	127	4	13	1	1	0	141	5	3.55
Meat from deer (venison)	2	0	2	0			4	0	0.00
Meat from horse	5	1	1	0			6	1	16.67
Meat from other animal species or not specified	375	1	137	4			512	5	0.98
Meat from pig	867	37	360	49	1	0	1,228	86	7.00
Meat from sheep	3	0					3	0	0.00
Meat from wild boar	5	0			1	0	6	0	0.00
Meat from wild game - land mammals			1	0			1	0	0.00
Meat, mixed meat	82	0	93	1			175	1	0.57
Meat, red meat*	235	29	67	13	14	0	316	42	13.29
Total	1,701	72	674	68	17	0	2,392	140	5.85

* Meat from bovine animals, pigs, goats, sheep, horses, donkeys, bison and water buffalos

Listeria monocytogenes in fermented sausages

Listeria monocytogenes in fermented sausages, 2020



* Meat from bovines, pigs, goats, sheep, horses, donkeys, bison and water buffalos

Chapter 1. Food safety criteria

Food category	Micro-organisms/their toxins, metabolites	Sampling plan ⁽¹⁾		Limits ⁽²⁾		Analytical reference method ⁽³⁾	Stage where the criterion applies
		n	c	m	M		
1.1 Ready-to-eat foods intended for infants and ready-to-eat foods for special medical purposes ⁽⁴⁾	<i>Listeria monocytogenes</i>	10	0	Absence in 25 g		EN/ISO 11290-1	Products placed on the market during their shelf-life
1.2 Ready-to-eat foods able to support the growth of <i>L. monocytogenes</i> , other than those intended for infants and for special medical purposes	<i>Listeria monocytogenes</i>	5	0	100 cfu/g ⁽⁵⁾		EN/ISO 11290-2 ⁽⁶⁾	Products placed on the market during their shelf-life
		5	0	Absence in 25 g ⁽⁷⁾		EN/ISO 11290-1	Before the food has left the immediate control of the food business operator, who has produced it
1.3 Ready-to-eat foods unable to support the growth of <i>L. monocytogenes</i> , other than those intended for infants and for special medical purposes ⁽⁴⁾ ⁽⁸⁾	<i>Listeria monocytogenes</i>	5	0	100 cfu/g		EN/ISO 11290-2 ⁽⁶⁾	Products placed on the market during their shelf-life

EFSA assumes that '**fermented sausages**' belong to the category of foods that are unable to support the growth of *L. monocytogenes*, because foods classified under this category of RTE products undergoes ripening/fermentation and are expected to have low pH and moderate a_w values.

Listeria monocytogenes in fermented sausages

Proportions (%) positive single samples from official sampling by CA in the context of verification of the implementation by food business operators of the *Listeria monocytogenes* FSC, EU, 2020

RTE food category ^(a)	Processing stage ^(b)		Retail ^(c)	
	Analytical method ^(d)			
	Detection	Enumeration	Detection	Enumeration
Products of meat origin, fermented sausages: data reported from BE, BG, CY, ES, HR, HU, SK				0.42 (N = 481; 7 MS)
Products of meat origin, other than fermented sausages: Data reported from AT, BE, BG, CY, CZ, EE, ES, HR, HU, LV, LU, RO, SK, SI	2.2 (N = 6,108; 10 MS)			0.52 (N = 3,243; 12 MS)

MS: Member State; N: number of single samples tested.

Grey boxes are not applicable in relation to the analytical method for the specific food category and sampling stage in the context of Regulation (EC) No. 2073/2005.

(a): In the absence of relevant physico-chemical data (pH, a_w), EFSA assumes that foods listed under 'fish and fishery products', 'soft and semi-soft cheeses', 'unspecified cheeses', 'milk', 'products of meat origin other than fermented sausages', 'other dairy products' and 'other products' belong to the category of foods that are able to support the growth of *L. monocytogenes*. EFSA assumes that 'fermented sausages' and 'hard cheeses' belong to the category of foods that are unable to support the growth of *L. monocytogenes*.

Listeria monocytogenes in fermented sausages

Proportion of single samples at processing (a) and retail (b) non-compliant with EU *Listeria monocytogenes* food safety criteria based on the monitoring data collected by EFSA, 2008–2015

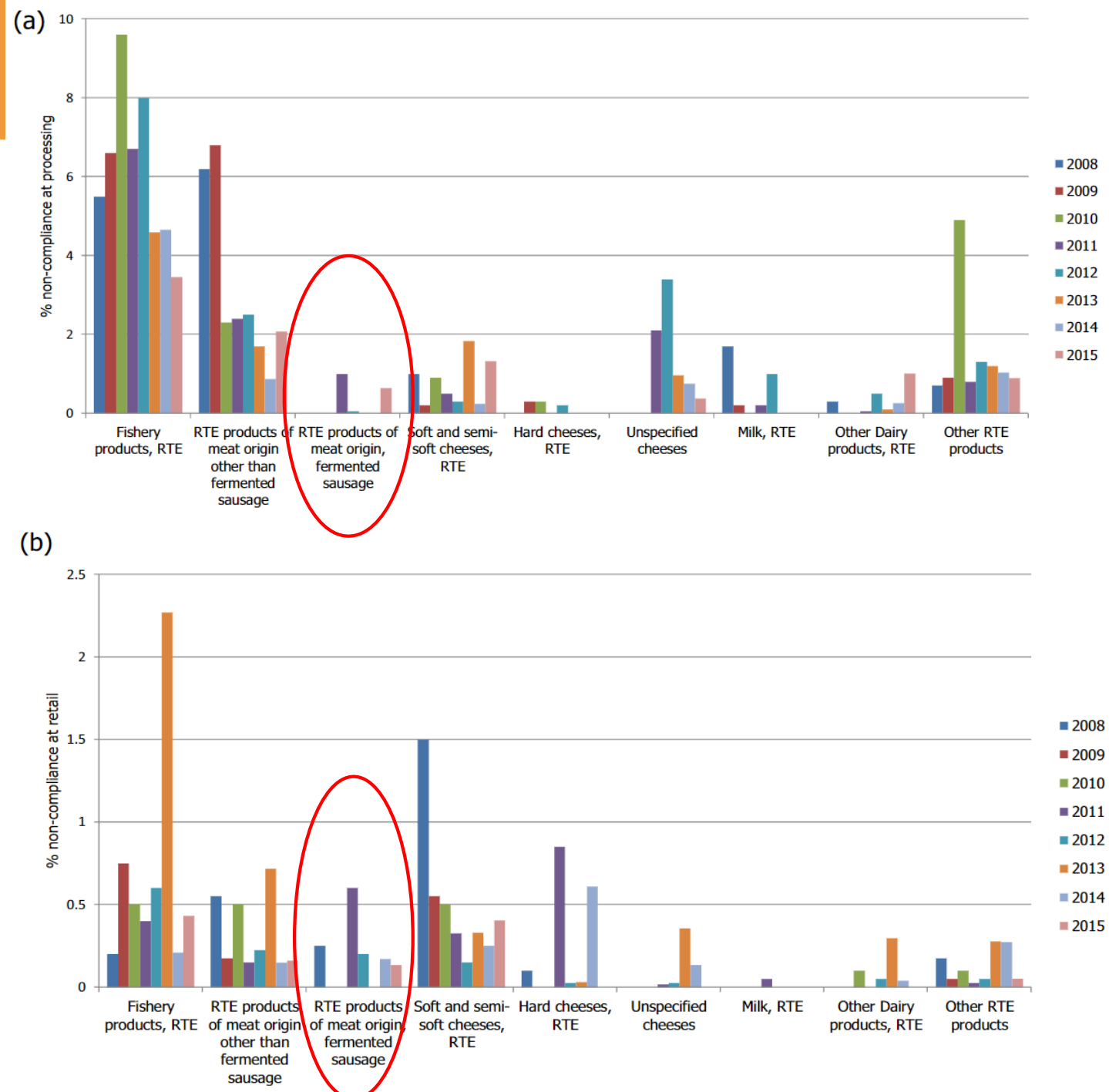


Figure 11 from: EFSA BIOHAZ Panel (EFSA Panel on Biological Hazards), 2018. Scientific Opinion on the *Listeria monocytogenes* contamination of ready-to-eat foods and the risk for human health in the EU. EFSA Journal 2018;16(1):5134, 173 pp

STEC in fermented sausages

Reporting year	Total Units Tested	Total Units Positive	Positive %	Number of countries reporting
2014	433	4	0.92%	3
2015	193	2	1.04%	3
2016	127	3	2.36%	2
2017	612	19	3.10%	3
2018	205	1	0.49%	3
2019	187	1	0.53%	3
2020	208	5	2.40%	3

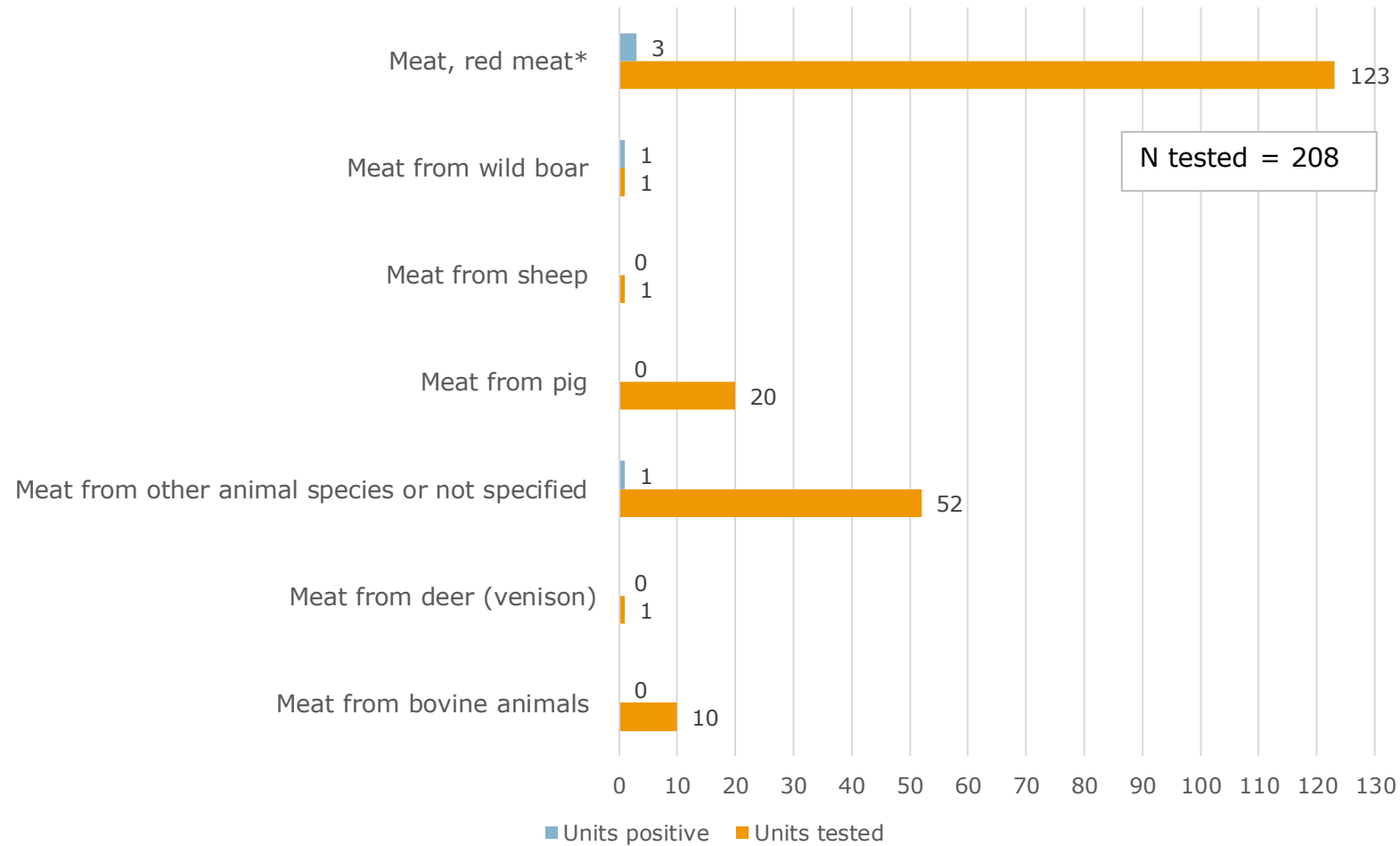
STEC in fermented sausages, overview 2014-2020

Food category Meat products - Fermented sausages	Distribution: wholesale and retail sale		Manufacturing		Others		Total		
	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	Units tested	Units positive	% positive
Meat from bovine animals	7	0	2	0	1	0	10	0	0
Meat from deer (venison)			1	0			1	0	0
Meat from other animal species or not specified	37	0	15	1			52	1	1.92
Meat from pig	6	0	14	0			20	0	0
Meat from sheep	1	0					1	0	0
Meat from wild boar	1	1					1	1	100
Meat, red meat*	85	1	36	2	2	0	123	3	2.44
Total	137	2	68	3	3	0	208	5	2.40

* Meat from bovines, pigs, goats, sheep, horses, donkeys, bison and water buffalos

STEC in fermented sausages

STEC in fermented sausages, 2020



* Meat from bovines, pigs, goats, sheep, horses, donkeys, bison and water buffalos

- **Campylobacter**: overview 2014-2020

Reporting year	Total Units Tested	Total Units Positive	Positive %	Number of countries reporting
2014	73	1	1.37%	1
2015	27	0	0.00%	3
2017	26	1	3.85%	3
2018	5	0	0.00%	2
2019	4	0	0.00%	1
2020	2	0	0.00%	1

Note: no data for 2016

No positive samples in the last years

- **Trichinella**: 5 positive samples (in 2015 and 2018) out of 5 tested by a single country
- **Histamine**: 1 positive sample (in 2017) out of 5 tested by a single country
- No positive samples for **Yersinia**, **Staphylococcus** and **staphylococcal enterotoxins**.

- ▾ All Lists [A0C5X]
 - ▾ Food [A0B6Z]
 - Plant commodities (RPCs) [A0BXE]
 - Primary products derived from plant commodities [A0BXV]
 - Animal meat commodities (tissue RPCs) [A0BXF]
 - ▾ Processed or preserved meat [A0BXT]
 - ▾ Charcuterie meat products [A0EYM]
 - Processed whole meat products [A04ND]
 - Preserved/processed fat tissues [A0EYN]
 - ▾ Sausages [A024F]
 - Fresh raw sausages [A024G]
 - ▾ Preserved or partly preserved sausages [A0EYP]
 - Cured unripened raw sausages [A024Q]
 - ▾ Cured ripened raw sausages [A024V]
 - Salami-type sausage [A024X]
 - Pepperoni/paprika-type sausage [A025B]
 - Matured charcuterie products for cooking [A025H]
 - Cooked sausages (generic) [A025J]
 - Pre-cooked sausages to be cooked before consumption [A026A]
 - Meat specialties [A026J]
 - Animal meat dried [A022L]
 - Edible casings [A0F1J]
 - Marinated meat [A0EYQ]
 - Canned-tinned meat [A024B]
 - Plant commodities (RPCs) [A0BXE]
 - Primary products derived from plant commodities [A0BXV]
 - Animal meat commodities (tissue RPCs) [A0BXF]
 - Processed or preserved fish (including processed offal) [A02KB]
 - Processed or preserved seafood [A0BZ4]
 - Milk and milk products (dairy) [A0BXZ]
 - Eggs and egg products [A031E]
 - Composite (recipe based) food classes (including some strictly related RPCs or RPC derivatives) [A0BAG]
 - Isolated purified ingredients (including mineral or synthetic) [A0BXX]
 - Other edible ingredients from animal and plant commodities [A16PP]
 - Feed [A0BB9]
 - Natural sources [A0B8X]
 - Non-food matrices [A0BYQ]
 - Groups for hierarchies [A0C61]
 - Facets [A0B8V]

Term naming and definition
Implicit facets
Reportability

Type of term

Level of detail

Term code

Term extended code

Term name

Term extended name

Scope notes and links

The group includes any type of Cured ripened raw sausages such as matured sausages or dried sausages or smoked firm sausages. Ripened raw-fermented sausages are uncooked meat products and consist of more or less coarse mixtures of lean meats and fatty tissues combined with salts, nitrite (curing agent), sugars and spices and other non-meat ingredients filled into casings. They receive their characteristic properties (flavour, firm texture, red curing colour) through fermentation processes. Shorter or longer ripening phases combined with moisture reduction ("drying") are necessary to build-up the typical flavour and texture of the final product. The products are not subjected to any heat treatment during

en.wikipedia.org - google.co.uk

Implicit attributes:

Label	Value	
Common n...	matured sausages	
Common n...	dried sausages	
Common n...	smoked firm sausage	
foodexOld...	A.01.000844	

- > Live plants (as part-nature) [A0BA0]
- > Live animals (as part-nature) [A069F]
- > Plant commodities-related food (as part-nature) [A066M]
- ▼ Animal commodities-related food (as part-nature) [A069C]
 - ▼ Animal commodities (as part-nature) [A069D]
 - Carcase (as part-nature) [A069G]
 - > Meat (as part-nature) [A069H]
 - > Fat tissue (as part-nature) [A069J]
 - Mechanically separated meat (as part-nature) [A069K]
 - > Offal and other slaughtering products (as part-nature) [A069L]
 - ▼ Processed or preserved meat (as part-nature) [A06AN]
 - ▼ Charcuterie meat (as part-nature) [A0EML]
 - Preserved meat cuts (as part-nature) [A06AP]
 - Preserved/processed fat tissues (as part-nature) [A06AQ]
 - ▼ Sausages (as part-nature) [A06AS]
 - Fresh raw sausages (as part-nature) [A06AT]
 - Preserved or partly preserved sausages (as part-nature) [A06AV]
 - Meat specialities (as part-nature) [A06AX]
 - Dried meat (as part-nature) [A0EMN]
 - Edible casings (as part-nature) [A0F2L]
 - Marinated meat (as part-nature) [A0BZ6]
 - Canned/jarred meat (as part-nature) [A0EMK]
 - > Processed or preserved fish (as part-nature) [A0EMQ]
 - > Processed or preserved seafood (as part-nature) [A0EMR]
 - > Dairy (as part-nature) [A06AY]
 - > Eggs and egg-related (as part-nature) [A06BQ]
 - Animal and plant commodities-related food (as part-nature) [A16PR]
 - > Composite (recipe based) food (including related RPCs or RPC derivatives) (as part-nature) [A06CL]
 - > Mineral, synthetic or isolated purified ingredients (as part-nature) [A06BY]
 - > Microbiological or enzymatic (as part-nature) [A0C0X]
 - > Non-food animal-related matrices (as part-nature) [A0CEG]
 - > Non-food plant-related matrices (as part-nature) [A166E]

Term naming and definition Implicit facets Reportability

Type of term Level of detail

Term code

Term extended code

Term name

Term extended name

Scope notes and links

No available links.

Implicit attributes:

Label	Value

- > Generic process descriptors [A0C0Q]
- ▼ Physical division / dimension reduction [A07KS]
 - Portioning [A07KT]
 - Slicing [A07KV]
 - Dicing and stripe-cutting [A07KX]
 - Mincing / chopping / cutting [A07KY]
 - Grating [A07KZ]
 - Grinding / milling / crushing [A07LA]
 - Pulping / mashing [A0C6N]
 - Maceration [A0C0K]
- > Preservation treatments not changing nature [A0BYG]
- > Thermal treatment (heating for preservation) [A07HR]
- > Cooking and similar thermal preparation processes [A0BA1]
- > Protective packing [A0BYM]
- > Preservation with substances / ingredients [A0C0N]
- ▼ Modification with chemical and biological agents [A07JL]
 - ▼ Modification with substances / ingredients [A0C0P]
 - Alkalizing [A07LQ]
 - Acidifying [A07JM]
 - Bleaching [A07LR]
 - Carbonating [A07JN]
 - Bromating [A07LS]
 - Marinating [A07JT]
 - Pickling [A07KC]
 - Seasoning [A0CRH]
 - Hydrolysis (sugar/proteins/fats) [A07LX]
 - Hydrogenation [A07LT]
 - ▼ Biological treatment [A07JX]
 - > Fermentation [A0CQZ]
 - Enzyme treatment [A07KB]
 - Curing [A07KD]
 - Ripening [A0C6F]
 - Malting [A0C0L]
- > Physico-chemical modification [A07LD]
- > Subtraction of water [A07KE]
- > Addition of water [A07MP]
- > Separation of fractions / subtraction of components [A07MB]
- > Compounding, assembling, coating or filling [A07LZ]
- > Whole production processes [A0BZZ]

Term naming and definition **Implicit facets** Reportability

Type of term Level of detail

Term code

Term extended code

Term name

Term extended name

Scope notes and links

Cutting or chopping into very small pieces (usually said for soft solids), by using one or more knives.

No available links.

Implicit attributes:

Label	Value
LanguagCode	E0152
Production Treatment (S...	T146A

Foodborne outbreaks due to fermented sausages



Composite foods, multi-ingredients and other foods (N=56)

Fish and fishery products (N=65)

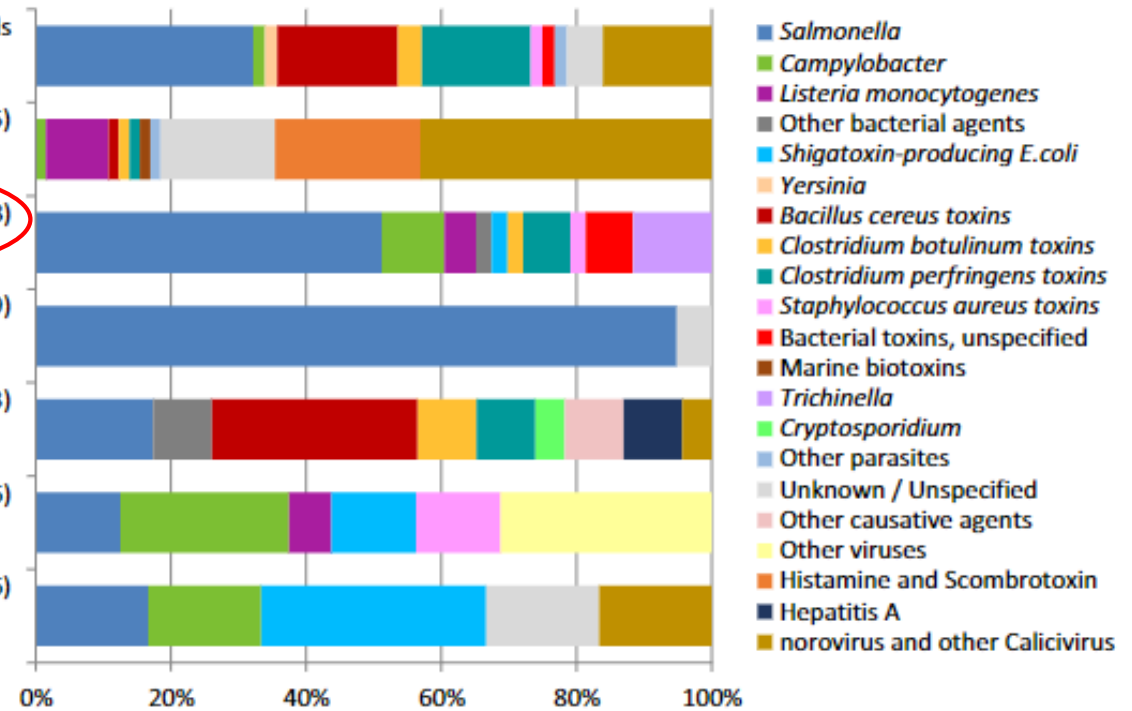
Meat and meat products (N=43)

Eggs and egg products (N=39)

Foods of non-animal origin (N=23)

Milk and milk products (N=16)

Water (and other beverages) (N=6)



Frequency distribution (%) of causative agents associated with strong-evidence food-borne outbreaks, by food vehicle, in reporting EU MS, 2020

Meat and meat products includes 'Bovine meat and products thereof', 'Broiler meat (*Gallus gallus*) and products thereof', 'Meat and meat products', 'Meat from bovine animals - meat products', 'Meat from bovine animals - meat products - ready-to-eat', 'Meat from pig - fresh', 'Meat from pig - meat products - fresh raw sausages', 'Meat from poultry, unspecified - meat products - non-ready-to-eat', 'Meat from wild boar - meat products - fresh raw sausages', 'Meat, mixed meat - meat products - ready-to-eat', 'Other or mixed red meat and products thereof', 'Other, mixed or unspecified poultry meat and products thereof', 'Pig meat and products thereof'.

- 2007: **S. Typhimurium** in DE → fermented raw sausage (salami)
 - Household event
 - 2 cases- 1 hospitalisation – no deaths
- 2007: **S. Panama** in DE → fermented raw sausage (salami) (Other or mixed red meat and products thereof)
 - Household outbreak
 - 31 cases - 4 hospitalisations - no deaths
- 2016: **S. Typhimurium** in DK → Dried, fermented, snack sausage - Picante Salami Snacks (Other or mixed red meat and products thereof)
 - Multiple places of exposure in more than one country
 - 12 human cases – no hospitalisations or deaths
- 2018: **STEC O26:H11**, vtx 1a, eae+, ST21 in DK→ Ready to eat fermented cured beef sausage (Other or mixed red meat and products thereof)
 - Multiple places of exposure in one country
 - 39 human cases – no hospitalisations or deaths

Risk management platform Rapid Alert System for Food and Feed (RASFF)

An official system for sharing information on hazards found in food and feed and trade of (potentially) contaminated batches between Member States, and for tracing these batches back and forward.

Aim: to ensure the flow of information to enabling swift reaction when risks to public health are detected in the food chain

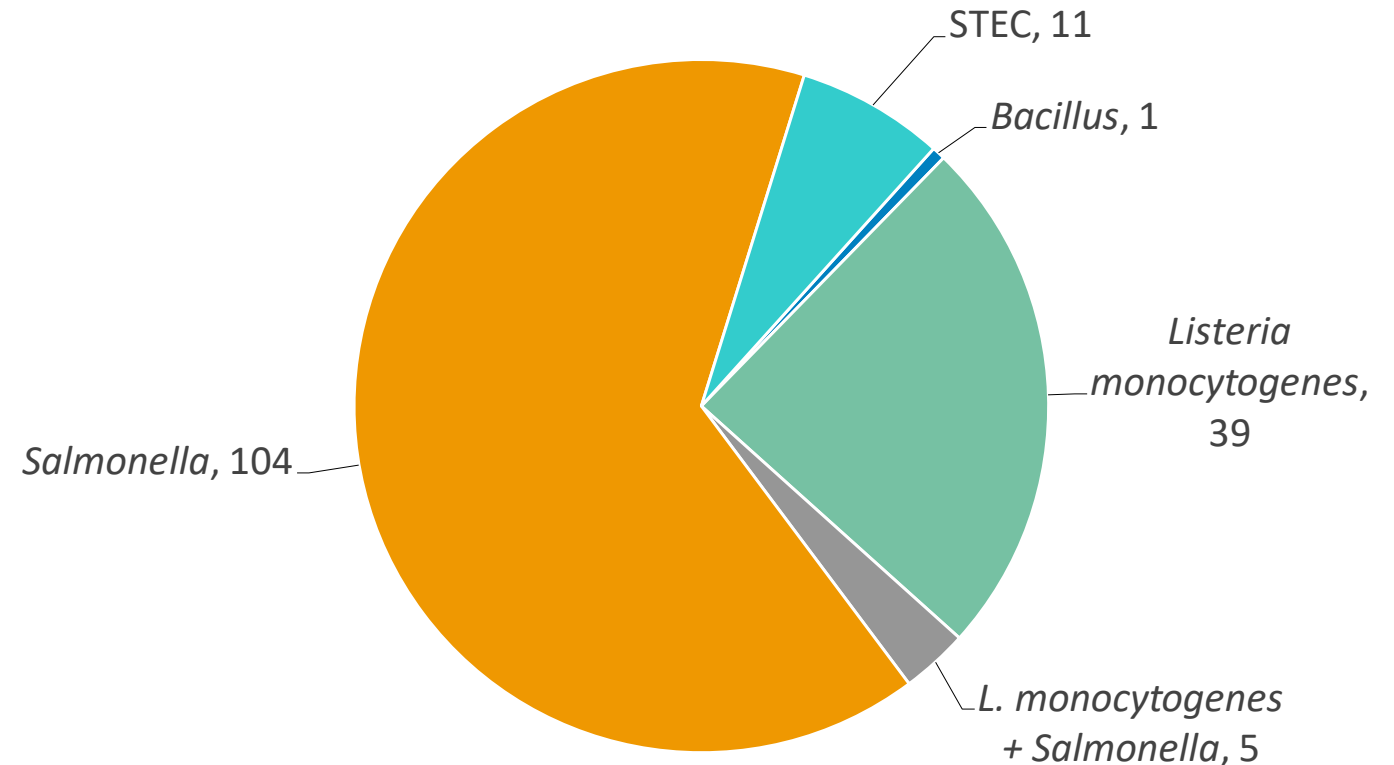
iRASFF: restricted access to competent authorities of RASFF member countries, designated officially by the Government of their Country as members of the RASFF, and the competent service of the European Commission



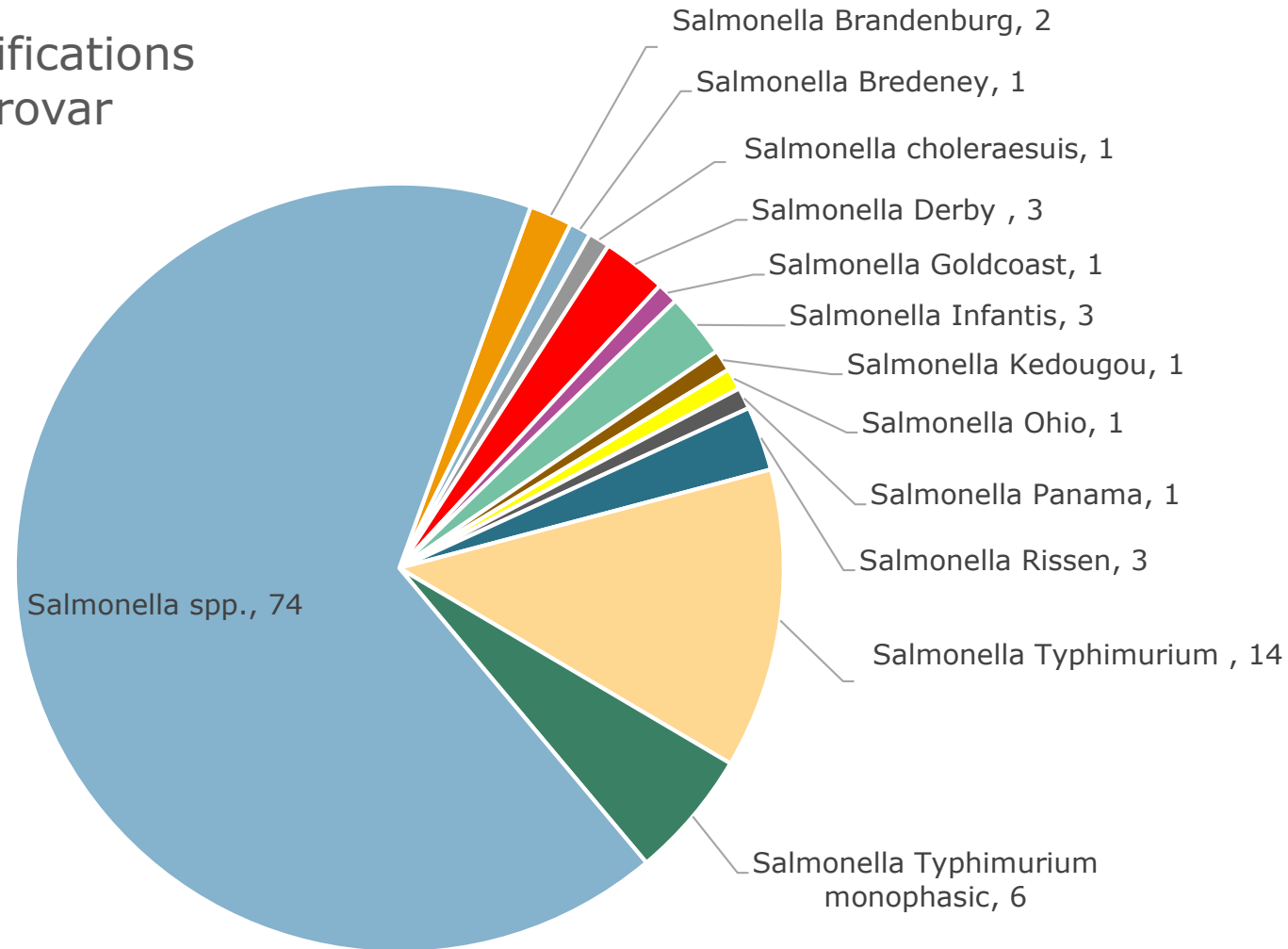
RASFF platform: restricted access

- 160 notifications linked to dry sausage, salami, fuet and similar products, of which:
 - 53 notifications between 2018-2022
 - 147 notifications on presence of pathogens in food
 - 9 notifications on foodborne outbreaks caused mainly by *S. Typhimurium* (in 8 cases)

Number of RASFF notifications per pathogen



Number of RASFF notifications per *Salmonella* serovar



- In 2019, EFSA monitored a multi-country cluster or/outbreak of monophasic *Salmonella* Typhimurium infection in EU Member States that was linked to pork dried sausage and minced beef.
- No Rapid Outbreak Assessments produced.

- In the context of the monitoring of zoonotic agents in animals and food, fermented sausages are reported by some countries as contaminated by different zoonotic agents.
- In few cases fermented sausages have been reported as the food vehicle of foodborne outbreaks.
- This food category (*'dry sausage, salami, fuet and similar products'*) has been notified in RASFF as contaminated with foodborne pathogens and possibly posing a public health risk.
- More details regarding the specific food categories (in particular, on the processing) would help in understanding its contribution to foodborne cases/ outbreaks.

Thank for your attention



Acknowledgements:

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- ❖ EFSA's BIOHAW and iDATA Units
- ❖ EFSA's Zoonoses Monitoring Data Network
- ❖ ECDC's FWD, EVD and TB Networks
- ❖ SANTE RASFF

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#OneEU2022