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Listeria monocytogenes contamination in pork can originate from farms

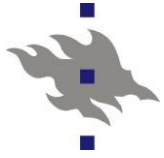
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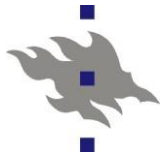
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Background

- In Europe, pork is the most frequently consumed meat
- *Listeria monocytogenes* is among the most severe biological hazards transmitted by pork as regards lethality and hospitalization as well as socioeconomic consequences
- *L. monocytogenes* is frequently isolated from pork and processed pork products



L. monocytogenes outbreaks associated with pork products

Year	Listeriosis	Vehicle	No. Cases (deaths)	Reference
1992	Invasive	Jellied pork tongue	279 (85)	Goulet et al., 1993
1993	Invasive	Rillettes	38 (1)	Goulet et al., 1998
1999-2000	Invasive	Rillettes	10 (3)	de Valk et al., 2001
1999-2000	Invasive	Jellied pork tongue	32 (5)	de Valk et al., 2001
2008	Gastroenteritis	Jellied pork	12 (0)	Pichler et al., 2009

***Listeria monocytogenes* Contamination in Pork Can Originate from Farms**

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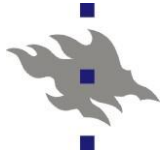
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- Evaluate the presence of *L. monocytogenes* throughout the pork production chain and to investigate points of contamination of the pathogen.

- Farm to fork approach

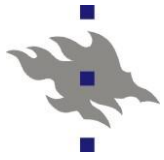


Study

- Altogether, 1962 samples were collected and the 424 *L. monocytogenes* isolates were analyzed by PFGE.
 - Samples from farms, slaughterhouse and cut meats
 - Each individual pig was followed from farm to slaughter
 - Cut meats were from same slaughterhouse lots

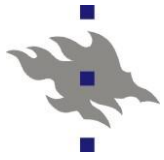
- Organic and conventional farms

- Evaluation of farm management practices with the prevalence of *L. monocytogenes* to uncover the risk factors associated with the presence of *Listeria* at farm level.
 - ✓ Siekkinen et al. Assessing hygiene proficiency on organic and conventional pig farms regarding pork safety: A pilot study in Finland. *Livest. Sci.* 2006



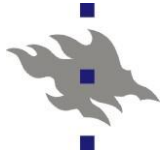
Prevalence of *L. monocytogenes* at farm-level

Production	Rectal swab				Feed / litter			
	N	Positive (%)	95% CI		N	Positive (%)	95% CI	
			Random ^b	Clustering ^c			Random	Clustering
Organic	121	4 (3)	1-8	0-20	15	3 (20)	4-48	1-74
Conventional	243	0 (0)	0-2	NC ^d	23	1 (4)	0-22	1-18
Total	364	4 (1)	0-3	0-7	38	4 (11)	3-25	2-34



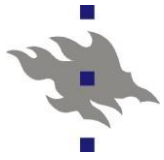
Prevalence of *L. monocytogenes* in pigs at slaughterhouse-level

Production	Intestinal content		Tonsil		Pluck set		Carcass	
	N ^a	Positive (%)	N	Positive (%)	N	Positive (%)	N	Positive (%)
Organic	119	4 (3)	119	56 (47)	120	15 (13)	120	2 (2)
Conventional	239	1 (0)	231	27 (12)	234	2 (1)	239	0 (0)
Total	358	5 (1)	350	83 (24)	354	17 (5)	359	2 (1)



Prevalence of *L. monocytogenes* in pigs at slaughterhouse-level

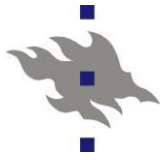
Production	Intestinal content				Tonsil				Pluck set				Carcass			
	N ^a	Positive (%)	95% CI		N	Positive (%)	95% CI		N	Positive (%)	95% CI		N	Positive (%)	95% CI	
			Random ^b	Clustering ^c			Random	Clustering			Random	Clustering			Random	Clustering
Organic	119	4 (3)	1-8	1-8	119	56 (47)	38-56	23-72	120	15 (13)	7-20	3-34	120	2 (2)	0-6	0-9
Conventional	239	1 (0)	0-2	0-3	231	27 (12)	8-17	5-24	234	2 (1)	0-3	0-3	239	0 (0)	0-2	NC ^d
Total	358	5 (1)	0-3	0-4	350	83 (24)	19-29	12-40	354	17 (5)	3-8	1-14	359	2 (1)	0-2	0-3



Prevalence of *L. monocytogenes* in cut pork meats

Production	Meat			
	N ^a	Positive (%)	95% CI	
			Random ^b	Clustering ^c
Organic	60	2 (3)	0-12	0-19
Conventional	80	3 (4)	1-11	0-19
Total	140	5 (4)	1-8	1-13

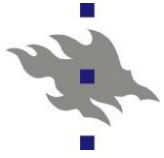
Farm	Feed /litter	Rectal swap	Intestinal content	Tonsils	Pluck set	Carcass	Meat
I C				134 (5)	134 (1)		
II O	70 (1)		26 (1)	26 (1)			
			50 (1)	67 (2), 151 (3)			
III O	10B (1)	82 (1)	162A (1)	10B (9)	162A (3)		
	162A (2)	162A (2)		31 (3)			
		71 (2), 195 (1), 205 (1)		82 (3)			
				162A (7)			
				10A(2), 160(2), 162B(2), 188(1)			
IV C				185 (1)			
V C	70 (1)			88 (1), 186(1)			
	78 (1)						
VIO				38 (2)	38 (2)	38 (1)	70 (2)
				16(1), 26 (1), 170 (1)	70 (8)	70 (1)	
VII C				31 (9)			
				7 (1)			
VIII O			31 (1)	31 (12)	33 (1)		
			91 (2)	33 (1)			
				91 (7)			
				27 (1), 93 (1)			
XI C				92 (5), 183 (1)			5 (2), 99 (1)
XII C				50 (2)	50 (1)		
				16 (1)			
XIII O				78 (1)	78 (1)		
				51(1), 66 (2), 209 (5)			
XV C				33 (1)			



Farm	Pig	Rectal swab	Intestinal content	Tonsils	Pluck set	Carcass
I	23			134	134	
II	277		26, 50	26		
III	54			162A	162A	
	55			10B	162A	
	57	162A		10B, 31		
	66		162A	10B		
	68	71, 162A, 205		162A		
	71	82, 195		162A		
	74	71		82		
VI	157			38	38	38
	186			170	70	
	189				70	70
VIII	150		31, 91	31, 91		
	153			31, 91	33	
	154		91	27, 91		
XII	303			50	50	
XIII	335			78	78	

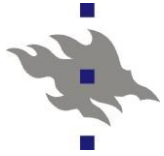
Variable	All farms		
	N ^a / observed	r ^b	p
Large group size, > 25 pigs/pen*	15 / 2	0.818	0.000
Solid or partly solid manure	15 / 5	0.782	0.001
Pigs have access to outdoor area*	15 / 4	0.718	0.002
Organic production*	15 / 5	0.687	0.004
Forage grass as coarse feed*	15 / 2	0.663	0.007
Pigs drink from trough	15 / 8	0.653	0.008
Stocking density (m ² /pig)	15	0.598	0.019
Hay as coarse feed	15 / 8	0.577	0.024
Manure spreading from pen to pen	15 / 12	-0.568	0.027
Partial cleaning of pens	14 / 6	0.578	0.030
Mechanical removal of manure	15 / 9	-0.554	0.032
Pets and birds have access to piggery	15 / 9	0.553	0.032
Rodents and birds have access to piggery	15 / 11	0.543	0.036
Cats have access to piggery	14 / 7	0.553	0.040
Straw as coarse feed	11 / 10	0.532	0.041

* Only at organic farms



Conclusios

- *L. monocytogenes* was present in the production chain, and transmission of the pathogen was possible throughout the chain, from the farm to pork.
- Specific farm management factors, i.e. large group size, contact with pet and pest animals, manure treatment, use of coarse feed, access to outdoor area, and drinking from the trough, influenced the presence of *L. monocytogenes* in pigs.
- Good farm-level practices can therefore be utilized to reduce the prevalence of this pathogen. Raw materials can be considered as a source of contamination into food processing facilities.



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