

The problem of Pathogens in low moisture foods

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Low Moisture Foods

- **Over recent years numerous outbreaks of food poisoning associated with low Aw foods**
- **Becoming a large issue**
- **Information required by industry/food producers**
- **ILSI Europe has taken a lead to provide information.**

In Preparation at present:



ILSI



ILSI Europe Report on 'Persistence And Survival Of Pathogens In Dry Food Processing

This Presentation

- **Review the issue**
- **Which pathogens**
- **Level of problem**
- **Conclusions**

Which Pathogens ?

- **Mainly enteric pathogens**
- **Salmonella - biggest issue at present- ****
- **VTEC - has to be considered**
- **Cronobacter sakazakii - infant feeds**
- **Toxin producing Staphylococci - growth needed**
- **Aflatoxin producing Moulds - growth needed**

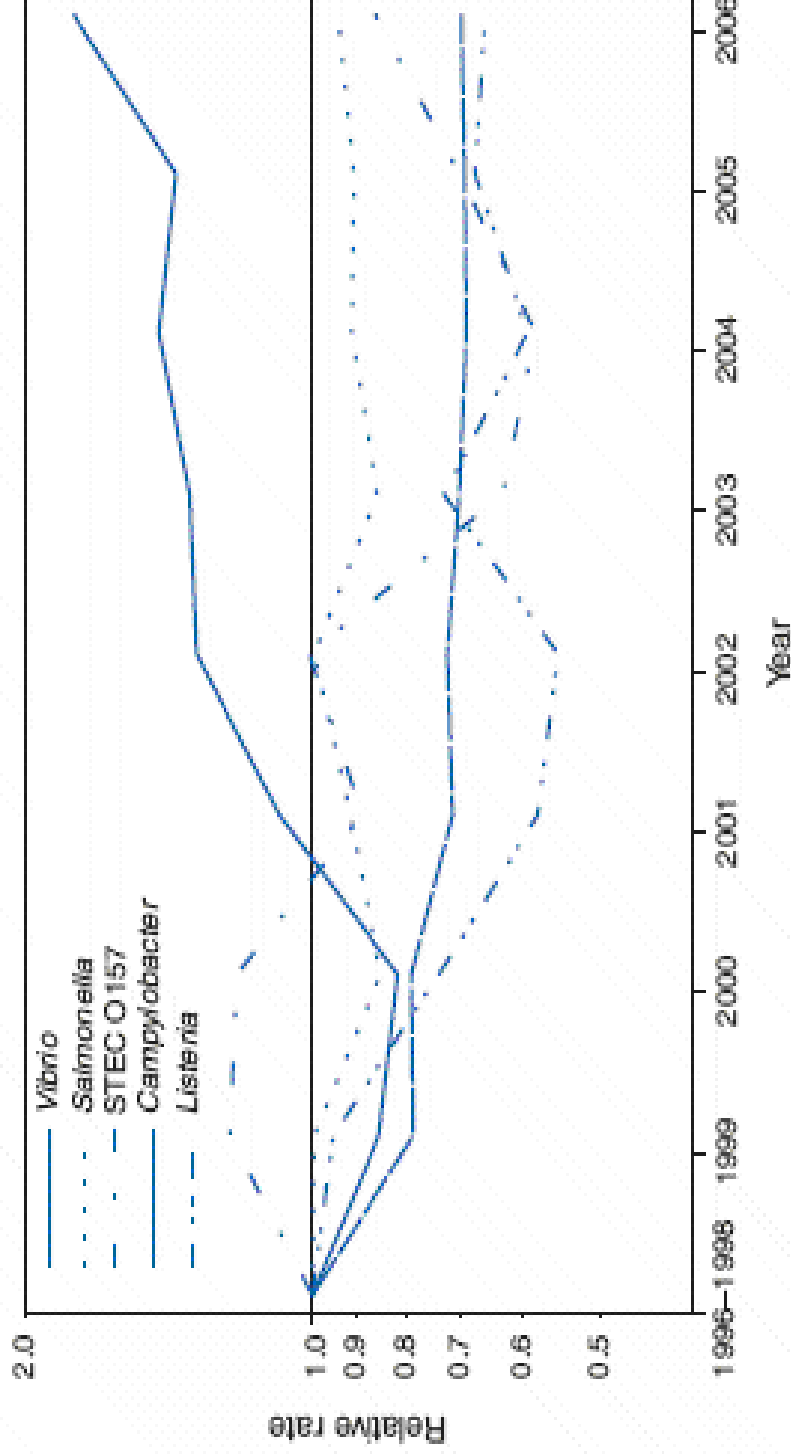
The problem with Salmonella

is---

- **we know it so well**
- **we understand where it is & how it grows**
- **we know the important serotypes & where they come from**

The Figures

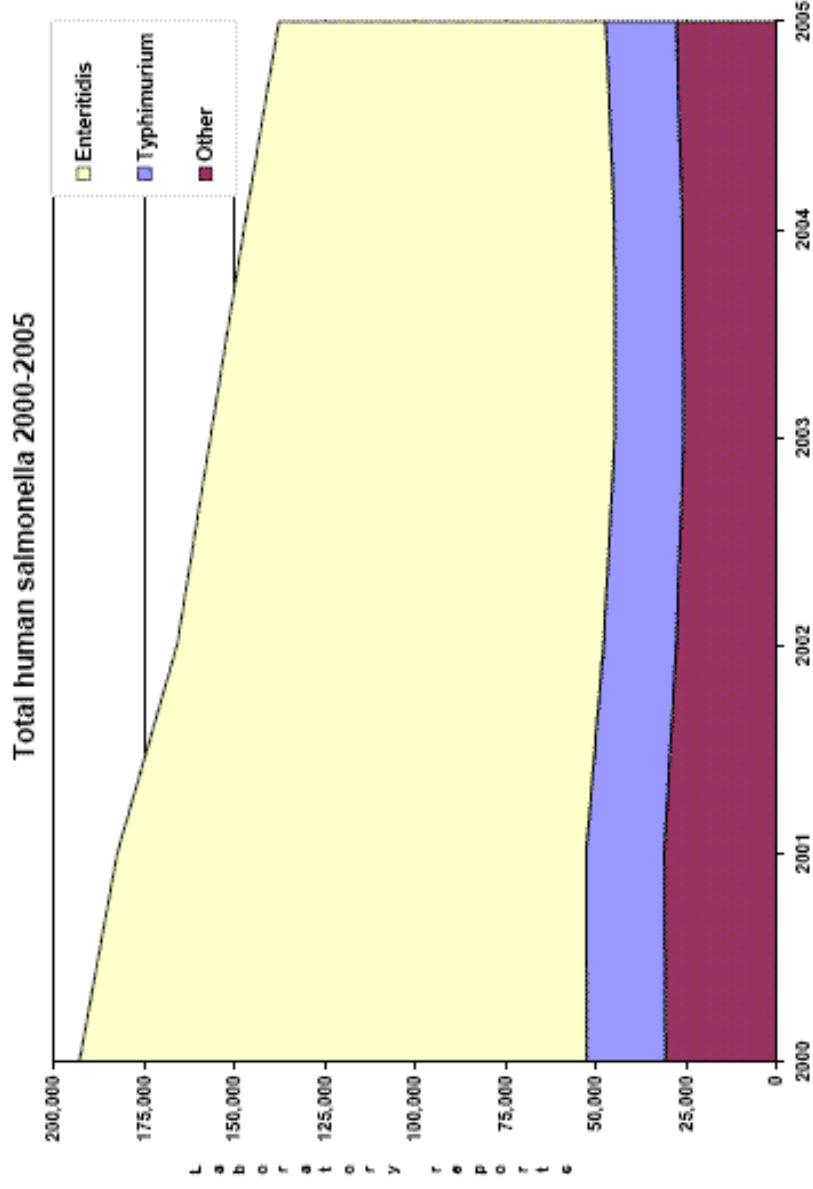
FIGURE 1. Relative rates compared with 1996–1998 baseline period of laboratory-diagnosed cases of infection with *Campylobacter*, STEC* O157, *Listeria*, *Salmonella*, and *Vibrio*, by year — Foodborne Diseases Active Surveillance Network, United States, 1996–2006



* Shiga toxin-producing *Escherichia coli*.

The Figures

Graph Trends of salmonellosis 2000-05 (data from 26 countries)



Salmonella Growth Limits

- **limits Microbiologists all know cardinal for Salmonella**
- **pH min = 3.8 (4.5)**
- **Temp min = 5.2 (7)**
- **Aw = 0.94**
- **Therefore if we are outside of these we are safe ?**

Low Water Activity and Pathogens

- **Using low Aw can provide a long shelf life**
- **Spoilage organisms grow slowly or are prevented from growing**
- **Pathogens are prevented from growing**
- **But if pathogenic organisms are present in high numbers, or the infective dose is low, then the risk to the consumer remains**

The Risk Realised- The Outbreaks

• Almonds	S.Enteritidis	USA	2000	168
• Almonds	S. Enteritidis	USA	2003	29
• Almonds	S. Enteritidis	Sweden	2005	15
• Cereals	S.Agona	USA	2008	28
• Cereals	S.Agona	USA	1998	209
• Chocolate	S.Eastbourne	UK	1985	95
• Chocolate	S.Napoli	UK	1985	245
• Chocolate	S.Typhimurium	Nor/Fin	1987	361
• Chocolate	S.Montevideo	UK	2006	56
• Coconut	S.various	Australia	1953	>50
• Coconut	S.Java	UK	1999	18
• Halva	S.Typhimurium	Aust/Eur	2001	>70
• Infant feed	S.Ealing	UK	1985	76
• Infant feed	S.Enteritidis	UK	1995	5
• Marshmallow	S.Enteritidis	UK	1995	24

Outbreaks Associated with Dried Foods

• Peanuts	S.Mbandaka	Australia	1996	54
• Peanuts	S.Tennessee	USA	2006	628
• Peanuts	S.Typhimurium	USA/Can	2008	684
• Pepper	S.Oranienburg	Norway	1981	126
• Pepper	S.Montevideo	USA	2010	>245
• Crisps/chps	S. various	Germany	1993	1000
• Infant feed	C.sakazakii	Iceland	1986	3
• Infant feed	C.sakazakii	USA	1988	4
• Infant feed	S.Tennessee	Can/USA	1993	3
• Infant feed	S.Anatum	UK	1996	12

Outbreaks Associated with Dried Foods

• Infant feed	C.sakazakii	Belgium	1998	12
• Infant feed	C.sakazakii	USA	2001	11
• Infant feed	S.Give	France	2008	8
• Power milk	S.Derby Trinidad	1973	3000	
• Salami	S.Newport	Australia	1981	279
• Salami	E.coli O157	USA	1994	4
• Salami	S.Typhimurium	Italy	1995	83
• Snack-corn	S.Manchester	UK	1989	47
• Snack-rice	S.Wandsworth	USA	2007	75
• Snack-sav	S.AgonaUK/USA/Israel	1994	>2200	
• Tahini	S.Montevideo	Aust/NZ	2002	68
• Tea	S.AgonaGermany	2003	42	

Some Issues of Concern in Low Aw environments

- **Infective Dose**
- **Protective effects of food**
- **Heat resistance characteristics**

Potential Infective Dose

- Can potentially appear to be very low in low *A_w* foods:

Salmonella Concentrations

S.Napoli	chocolate	<50 cells	(Greenwood 1983)
S.Typhimurium	chocolate	1 cell ingested	(D'Aoust 1994)
S.Heidelberg	cheddar cheese	100-500 cells	(Fontaine et al 1980)
S.Nima	chocolate	4-24 cells	(Hockin 1989)
S. Eastbourne	chocolate balls	2 -3 cells/g	(Craven et al 1975)

Salmonella Concentrations

S. Typhimurium PT10	Cheddar cheese	4.2 cells/g	(D'Aoust 1985 & 1989)
S. Oranienberg	Chocolate	2-3 cells	(Werber et al.2005)
S. Saintpaul S. Rubislaw S. Javiana	Chips + paprika	4-45 cells	(Lehmacher 1995)
S. Mbandaka	Peanut butter	3 cells/g	(Scheil et al 1998)
S.Ealing	Infant formula	1.6 /450g	(Rowe et al 1987)
S. Montevideo	Chocolate	0.3 /100g	(Independnt 2006)

Take Care With Figures

- **Salmonella enumeration methods are not widely used**
- **Usually based on forms of MPN**
- **We should question homogeneity at very low contamination levels**
- **We should question potential clumping in some food types**
- **We do need good Salmonella enumeration methods to investigate Salmonella related contamination**

Protective effects of Foods on Salmonella

- **Salmonella survive in low A_w foods**
- **Some interesting effects have been reported with multiple stresses**
- **As A_w falls below that needed for growth, Salmonella die slowly**
- **Rate of death decreases as A_w gets lower and as temperature reduces**

Protective effects of Foods on Salmonella

Food	Temperature	Survival
Pasta	Ambient	1 log reduction in 90 - 360 days
Chocolate	Ambient	2 log reduction in 19 months
Honey	10C	Survival for 2years
Dry seasonings	22C	Survival for over 29 weeks
Peanut Butter	21C	4 log reduction in 24 weeks

Protective Effects of Foods during Infection

- To cause food poisoning **Salmonella** must reach the small intestine
- To do this they must overcome the low pH in the stomach
- Many low A_w foods are high in fat or lipid
- Fat or lipid coating the cells may help cells survive a low pH environment

Heat Resistance- Salmonella

- In media adjusted with sucrose

Water Activity D value (min) at 70 C

0.98	<0.05
0.94	0.3
0.90	0.6
0.89	0.99
0.85	2.8

Heat Resistance-Salmonella

- In inoculated media/foods

Medium	Temperature	D value
BHIB	62C	24 sec
Milk	68.3C	0.3 to 0.5 sec
Whole egg	60C	183 sec
Ground beef	60C	27 sec
Chocolate	71C	4.5 to 20 h
Wheat flour	62C	14.6 h

Heat Resistance-Salmonella

- Heat resistance is very dependent on Aw
- Wheat flour 62C
 - Aw 0.4, D 875 min
 - Aw 0.5, D 100 min

What Foods Are a Problem Now

- **Consider all Food Alerts noted on RASFF in 2009**
- **All foods, all countries, potentially pathogenic micro-organisms**
- **112 Alerts noted**
- **25 (22%) associated with low Aw foods or ingredients**

RASFF figures 2009

Organism	Food	Country
Salmonella	Basil	NL
Salmonella	Peanut butter snacks	EC
Salmonella	Peanut butter snacks	EC
Salmonella	Sesame seed	Germany
Salmonella	Pistachio	DK
Salmonella	Roast peanuts	EC
Salmonella	Peanut butter snacks	SL
Salmonella	Peanut butter snacks	UK
Salmonella	Peanut butter snacks	EC
Salmonella	Peanut butter snacks	EC
Salmonella	Sesame seed	UK

RASFF Figures

Salmonella	Sesame seed	Germany
Salmonella	Onion seed	Germany
Salmonella	Sesame seed	Germany
Salmonella/ C.sakazakii	Dry baby food	Spain
Salmonella	Alfalfa seed	Finland
Salmonella	Dairy powder	NL
Salmonella	Buckwheat flour	LX
Aflatoxin	Melon seed	Germany
E.coli (count)	Tarragon	DK
Salmonella	Sesame seed	Germany
Salmonella	Lemon grass	Sweden
Salmonella	Sesame	Germany
Salmonella	Halva	Germany
Salmonella	Cumin	Germany

What does it show?

- **Worldwide distribution of some low Aw products**
 - **contaminated peanut butter in USA caused food recalls throughout Europe due to wide distribution and use as an ingredient in many snack food products and prepared foods.**
- **Main reported organism- Salmonella**
 - **But have to consider what tests are routinely done-were other potential pathogens actually looked for ?**
- **Route cause of contamination**
 - **at source- seeds**
 - **through poor process hygiene at factory**
 - **use of contaminated raw materials**

Some Conclusions 1

- **Survival of Salmonella in low Aw foods is a real food safety issue**
- **Foods affected-**
 - **Low Aw Raw Animal products ?**
 - **Low Aw vegetable material,**
 - **foods which use these as ingredients but are not given a process after addition**
 - **foods that can be contaminated in production**
 - **cleaning/hygiene issues**

Some Conclusions 2

- **Reducing Aw increases heat resistance**
- **Reducing Aw increases survival time in food**
- **Some low Aw Foods may Provide a protective effect in the stomach**
- **Care with low Aw ingredients that may be added to higher Aw ingredients, risks will increase**