

## **Module 02    Lecture 01**

# **Infectious foodborne pathogens**

# Infectious foodborne bacteria

## ***INFECTION***

***Invasion of and multiplication within the body by***

- ◆ ***Salmonella***
- ◆ ***Campylobacter***
- ◆ ***E. coli* (certain strains)**
- ◆ ***V. parahaemolyticus***
- ◆ ***V. cholerae***
- ◆ ***Y. enterocolitica***
- ◆ ***A. hydrophila***
- ◆ ***L. monocytogenes***

# Salmonellosis

- ***main symptoms***
  - ◆ diarrhoea
  - ◆ fever
  - ◆ abdominal cramps
  - ◆ vomiting
- ***persons at high risk***
  - ◆ young
  - ◆ old
  - ◆ pregnant women
  - ◆ immunocompromised
  - ◆ underlying disease states
- ***fatality rate***
  - ◆ < 1%
- ***incubation period***
  - ◆ usually 12-36 hours

# Salmonella

## ***2200 different serotypes***

- ◆ **200 of which cause foodborne disease in Europe in any one year**
- ◆ **70% cases caused by *S. enteritidis* and *S. typhimurium***
- ◆ **serotypes split into subtypes called phage-types (PT)**

# Raw food materials likely to be contaminated by *Salmonella*

- poultry
- meat
- milk
- eggs
- vegetables
- shellfish
- spices and herbs
- untreated water

# Thermal resistance of *Salmonella* in food

- *Salmonella* are heat-sensitive
- pasteurisation is sufficient to kill *Salmonella* in high-moisture foods
- heating at 70°C for 2 *min* can achieve a 6 *log reduction* in numbers

# Examples of time/temperature combinations for pathogen destruction

<i>Temp (°C)</i>	<i>Time (min:secs)</i>	<i>Temp (°C)</i>	<i>Time (min:secs)</i>
60	43:29	73	00:48
61	33:44	74	00:35
62	23:16	75	00:26
63	17:06	76	00:19
64	12:40	77	00:14
65	09:18	78	00:10
66	06:49	79	00:06
67	05:01	80	00:05
68	03:43	81	00:04
69	02:43	82	00:03
70	02:00	83	00:02
71	01:28	84	00:02
72	01:05	85	00:01

# Campylobacteriosis

## ➤ *main symptoms*

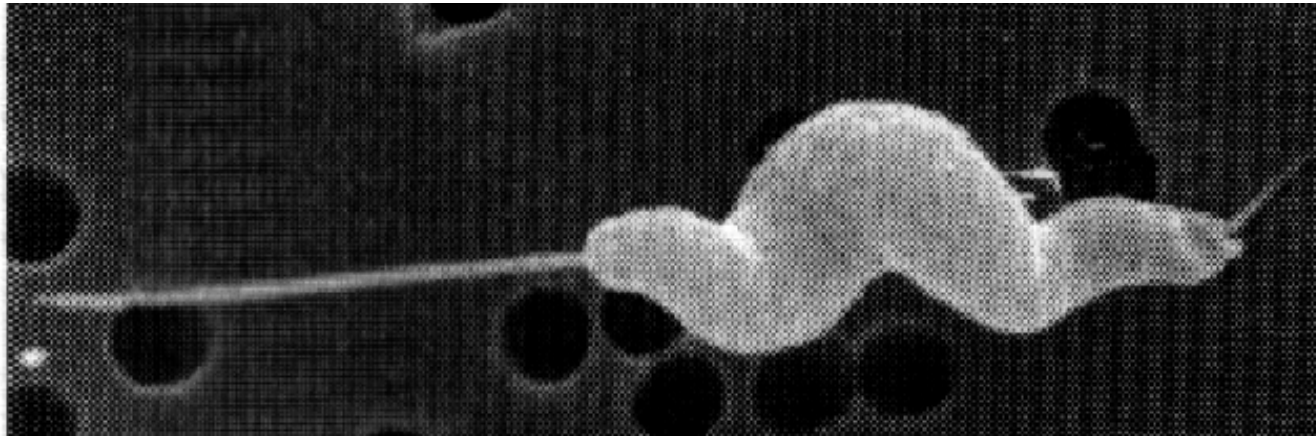
- ◆ mild to severe diarrhoea
- ◆ fever
- ◆ nausea
- ◆ abdominal cramps

## ➤ *persons at risk*

- ◆ babies and young people
- ◆ debilitated people

## ➤ *incubation usually 2-5 days*

# Electron microscope picture of *Campylobacter*



# Survival of *Campylobacter*

*A very fragile organism, it does not survive well in food processing environments*

- ◆ **heat-sensitive**
- ◆ **sensitive to drying**
- ◆ **survives freezing (several months in frozen meat and poultry)**
- ◆ **survives better at chilled conditions rather than at ambient temperatures**

# Pathogenic *E. coli*

- Enteropathogenic *E. coli* (**EPEC**)
- Enteroinvasive *E. coli* (**EIEC**)
- Enterotoxigenic *E. coli* (**ETEC**)
- Enterohaemorrhagic *E. coli* (**EHEC**)

# Pathogenic *E. coli*

***EPEC*** Acute watery diarrhoea - young children particularly susceptible

***EIEC*** Dysentery-like syndrome

***ETEC*** Acute watery diarrhoea - often in travellers

***EHEC*** Bloody diarrhoea syndrome

***Incubation 8-44 hours depending on type***

# Pathogenic *E. coli* associated with foodborne disease

<i>Type of E. coli</i>	<i>Reservoir</i>	<i>Source of food contamination</i>	<i>Cause of FBD outbreaks</i>
<b>EPEC</b>	Man	Food handlers - sewage - environment	Rare
<b>EIEC</b>	Man	Food handlers - sewage	Soft cheese - water
<b>ETEC</b>	Man	Food handlers - sewage	Soft cheese - water
<b>EHEC</b>	Cattle	Cattle faeces - meat handling facilities Dairies	Under-cooked ground beef (hamburgers etc.) Unpasteurised milk

# Raw food materials likely to be contaminated with pathogenic *E. coli*

- **meat**
- **fish**
- **vegetables**
- **milk**
- **polluted water**

# Infective dose

## *Host*

- ◆ age
- ◆ immune status
- ◆ gastric acidity - time of day
- ◆ immuno-competence
- ◆ nature of gut flora - carrier state
- ◆ pregnancy

# Infective dose

## *Organism*

- ◆ **vegetative cells or spores**
- ◆ **virulence of the strain**

# Infective dose

## *Food*

- ◆ **presence of fat**
- ◆ **acidity**

# Host factors

## *Consequences of previous foodborne infections*

- **lasting immunity**
  - ◆ **Hepatitis A**
- **short-term immunity**
  - ◆ *Campylobacter*
  - ◆ *V. cholerae*
- **no immunity**
  - ◆ *Salmonella* (unless a carrier)

# Minimum infective dose

➤ EPEC	$10^6$
➤ ETEC	$10^6$
➤ <i>Shigella</i> , EIEC	10-100
➤ EHEC	100
➤ <i>L. monocytogenes</i>	Unknown - probably low in risk groups
➤ <i>Salmonella</i> ( excluding <i>typhi</i> )	$10^6$ ( lower nos (i.e. 10-1000) may cause infection in fatty foods such as chocolate & cheese )
➤ <i>Campylobacter</i>	ca. 500
➤ <i>Salmonella typhi</i>	10-100
➤ <i>V. cholerae</i>	$10^6$

# Infectious pathogens - Key Messages

***Most FBD are caused by infectious rather than toxigenic pathogens***

- **globally most important are**
  - *Salmonella*
  - *Campylobacter*
  - *Shigella*
  - *E. coli*
- **infectious dose varies widely and depends on**
  - host
  - organism
  - food
- **lasting immunity is rare**
  - preventive measures therefore essential
  - vaccine available only for hepatitis A