

Food-borne Diseases

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Food borne disease



- any disease caused or transmitted by food

Food borne Intoxication

- ingestion of a pre-formed toxin

Food borne Infection

- ingestion of live organisms which subsequently invade the host

MICROBIAL "FOOD POISONING"

Two major types



1. Foodborne intoxications.

The microorganisms makes a toxin in the food, and then the toxin is consumed.

2. Foodborne infections.

The causative microorganisms are ingested and then grow within the body and cause damage.

Foodborne intoxications



- viable cells may not be present
- quicker onset time (if preformed toxin)
- often short duration (unless toxin produced in body)
- no fever (usually)

Toxins



- exotoxin = extracellular protein toxin
- endotoxin = lipid A portion of Gram-negative outer membrane.
- enterotoxin = toxin that acts on gastrointestinal tract, producing typical food poisoning symptoms

Foodborne infections



- viable cells consumed
- relatively long onset time for symptoms
- relatively long duration
- fever a common symptom (body's response)

Conditions Required for Food borne Disease



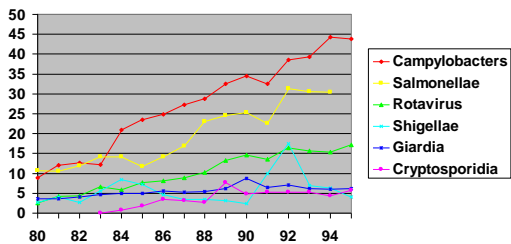
- source of bacterium
- favorable growth environment
- sufficient time for growth
- ingestion of sufficient quantity of food to cause illness (Inoculation Dose)

Factors Affecting Host Response



1. Virulence Pathogen/Toxin (how dangerous)
2. Immunity Host - Explains why one person gets ill and others do not.
 - Most susceptible
 - very young
 - very old
 - immunosuppressed
3. Infective dose.

Peningkatan Kuantitas Penyakit Terbawa pangan di UK



Keracunan Pangan di Australia

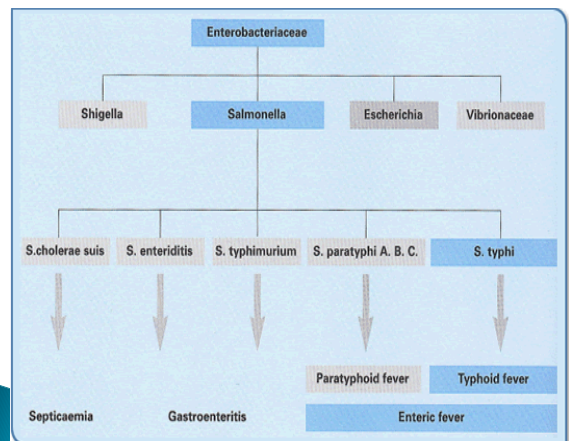
- ▶ Kontaminasi *Salmonella* pada mentega kacang
- ▶ Kontaminasi *Salmonella* pada daging babi
- ▶ Kontaminasi *E. coli* 0111
- ▶ Kontaminasi *Salmonella* pada produk kelapa kering
- ▶ Kontaminasi *Salmonella* pada Susu Bubuk

Enterobacteriaceae (EB)

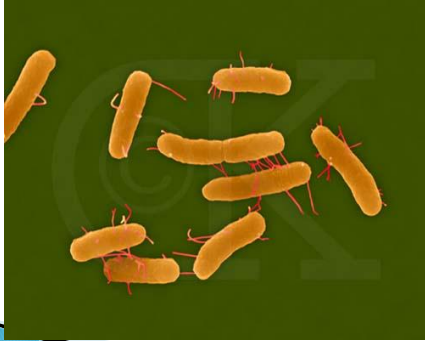
- ▶ Gram (-), fakultatif anaerob, batang
- ▶ Oksidase negatif (no *cytochrome oxidase*)
- ▶ Gastrointestinal diseases:
 1. *Salmonella*
 2. *Shigella*
 3. *Yersinia enterocolitica*
 4. *Escherichia coli*

Not EB:

Campylobacter
Chlamydia



Salmonella



Salmonella



- ▶ Penyebab utama penyakit terbawa pangan
- ▶ Identifikasi berbasis serologi ada 2400 serovars
- ▶ *S. enteritica* ada 7 subspecies I penyebab utama penyakit (*Enteritidis*, *Typhimurium*, *Choleraesuis*, *Dublin*, *Gallinarum*, *Pullorum*)

Salmonella

Gram negative motile rods,
facultative anaerobe,

2400 serotypes

e.g *S. typhimurium*; enteritidis, typhi

Infective dose: 1 - 10⁶ type host/Salmonella

Sources: widespread occurrence intestinal tract of animals (poultry, cattle, swine, insects, pests)

polluted water

soil

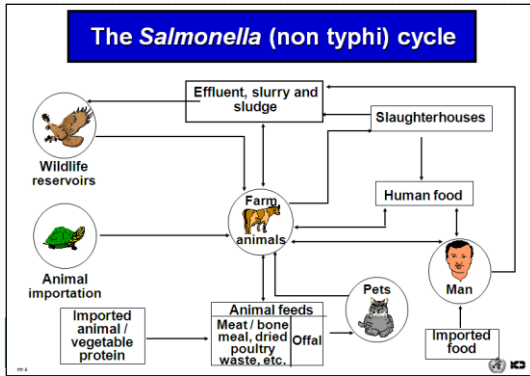


Salmonella

Growth:

- Temperature: optimum 37C
- generally sensitive to heat, resistant to freezing
- pH: optimum 6.5 - 7.5, minimum 4.0 to 5.5
- Moisture: minimum aw 0.93 to 0.95

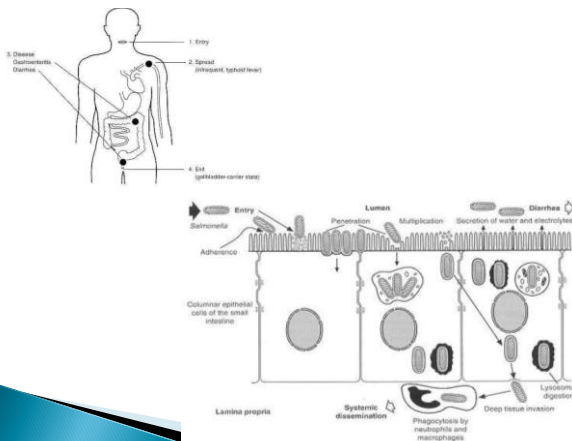




Mode of infection:



- *Salmonella* enters into the body (typically oral)
- bacterial cells which survive the stomach enter the small intestine
- bacteria live and multiply in intestinal tract
- attach to mucosal lining of intestinal tract and grow
- bacteria penetrate lining of intestinal wall
- illness caused by endotoxins which disrupt metabolism of intestinal epithelial cells



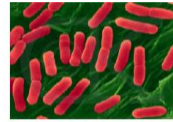
Illness Gastroenteritis



- onset 6 to 48 hours, typically 24 - 48 hours
- symptoms: diarrhea, abdominal cramps, fever, nausea, vomiting, chills
- duration: 2 to 3 days
- can have acute cases which require hospitalization and/or antibiotic therapy
- fatality rate: typically less than 1%

Enteric Fever

- typhoid fever
- onset: 7 to 21 days after infection
- symptoms: loss of appetite, headache, high fever
- duration: 3 - 6 weeks without treatment
- treatment: antibiotics, typically up to 4 weeks;
- fatality rate: very high without treatment
- Typhoid fever->Septicemia->Coma->Death
- Treatment: Chloramphenicol

Epidemiology:

- Food may become contaminated with a pathogen by means of human or animal carriers Salmonella infection of animals is common.
- If the food is stored at a warm temperature, the salmonellae can multiply to numbers sufficient to cause infection of humans

Salmonella Detection:

- pre-enrichment - peptone water
- selective enrichment - selenite cystine broth
- tetrathionate broth with brilliant green
- Bismuth sulfite (bismuth sulfite, brilliant green)
- Xylose Lysine Desoxycholate (desoxycholate)

Salmonella Detection

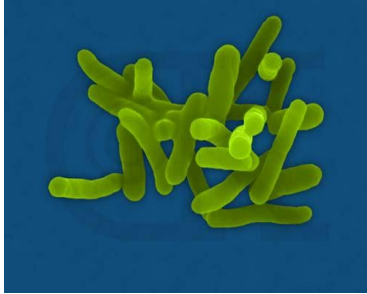
Coliforms and Proteus ferment lactose or sucrose and produce yellow colonies (Proteus have black centers).



Salmonella and Shigella utilize lysine (alkaline reaction) to produce red colonies (salmonellae may have black centers).

<http://www.vet.uga.edu/erc/swmp98/html/sld.html>

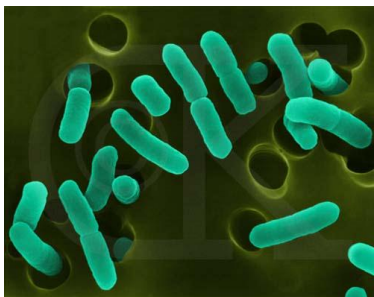
Shigella



Shigella

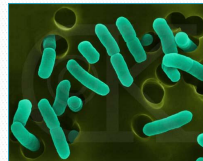
- ▶ *S. flexneri*,
S. boydii,
S. sonnei,
S. dysenteriae
 - bacillary dysentery
 - shigellosis
 - bloody feces
 - intestinal pain
- ▶ *Shigellosis*
 - Within 2–3 days
 - Epithelial cell damage
 - Man only “reservoir”
 - Mostly observed on young children
 - Transmitted by adult food handlers (unwashed hands, etc)

Escherichia coli



Escherichia coli

- ▶ *E. coli and Shigella*
 1. Genetically indistinguishable
 2. Many similarities in diseases
- 1. Enteropathogenic *E. coli* (EPEC)
- 1. Enterotoxigenic *E. coli* (ETEC)
- 1. Enteroinvasive *E. coli* (EIEC)
- 1. Enterohemorrhagic *E. coli* (EHEC)



Listeria monocytogenes

- Gram positive, short, non-sporing rod shaped bacterium
- Motile when cultured at 20-25°C but not at 37°C
- Optimum growth temperature 30-37°C but can grow at temperature from 4°C – 45°C
- Growth at:
 - ✓ pH 4.3-9.5
 - ✓ $a_w \geq 0.9$
 - ✓ NaCl $\leq 10\%$
- Hemolytic activity on blood agar to distinguish from other *Listeria* species
- 5-10% of human population carry this bacterium without any symptoms



http://en.wikipedia.org/wiki/Listeria_monocytogenes

Listeria monocytogenes

- Listeria species are widely distributed throughout the environment
 - ✓ natural habitat is soil, water, decaying plant and animals rests, dirt.
- Mainly soil bacteria but as a pathogen they are foodborne
 - ✓ soil→silage→ruminants→processed food→humans
- *L. monocytogenes* is the causative agent of listeriosis
 - ✓ *L. ivanovii* and *L. seeligeri* have also been linked to human cases
- The genus contains six species
 - ✓ *L. monocytogenes*, *L. ivanovii*, *L. innocua*, *L. welshimeri*, *L. seeligeri* and *L. grayi*

Growth:




- Temperature: optimum 30-35°C
- grow very well at refrigeration temperatures
- tolerant to freezing and other food processes
- pH: optimum 6.5 - 7.5, minimum 4.0 to 9.0
- Moisture: minimum aW

Listeria monocytogenes ...


- Survives
 - Several weeks at -18°C
- Death
 - > 72.5°C for 15 sec
- Prevention
 - GHP, GMP, HACCP
 - Cleaning food contact surfaces
 - Separation of high care and low care area
 - Personal Hygiene
 - Restriction on entry of visitors
 - Avoiding a high level of job rotation
 - Equipment design



L. monocytogenes and listeriosis



- Most likely to occur in pregnant women, neonates, the elderly and immunocompromised individuals – YOPI
- Symptoms
 - from mild influenza-like symptoms to meningitis, septicemia, endocarditis, abortion and death (30% death rate), gastrointestinal illness
 - in pregnancy extremely important because of risk of severe infection of the foetus or newborn infant that may result in death
- Pathogenicity
 - ✓ 13 serotypes, most human cases are because of **4b, 1/2a and 1/2b**
- MID
 - not known (generally thought to be >100 CFU/g), probably lower for susceptible or immunosuppressed persons




Epidemiology:


- U.S. Center for Disease Control (CDC) suggests that ~ 1600 cases of listeriosis with 415 deaths per year in the United States.
- mortality
 - meningitis - as high as 70%;
 - from septicemia 50%,
 - perinatal/neonatal infections > 80%.
- treatment with penicillin or ampicillin



Is *Listeria* a problem in food processing?




- *Listeria* form biofilm which allows them to attach to solid surfaces where they proliferate
 - ✓ e.g. stainless steel, glass, polypropylene, and rubber
 - ✓ extremely difficult to remove
 - ✓ general cleaning method not effective
- Can be persistent for many years




listeria monocytogenes


<http://www.denniskunkel.com/index.php>

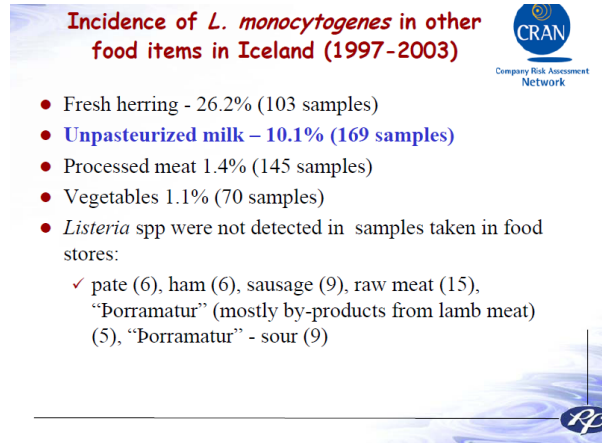
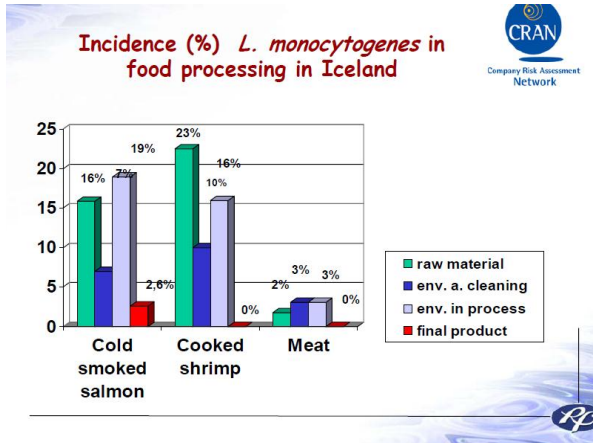


The incidence of *L. monocytogenes* in food - from the literature



● RTE meat products (cured and processed)	□ 3.6 - 23.6%
● Raw meat	□ 5 - 36.4%
● Poultry	□ 9.7 - 61%
● Cold smoked fish and cooked seafood	□ 4 - 78%
● In raw milk	□ 4.9% - 28%
● In ice cream	□ 2.8% - 3.5%
● In soft cheeses	□ 0.8% - 46%
● In gorgonzola cheese and blue mould cheese to be	□ 4.8% - 28.5%





Surveys of *Listeria monocytogenes* in dairy industry in Iceland

Sampling site	Number of samples	Number of positive <i>Listeria</i> samples	Number of positive <i>L. monocytogenes</i>
Dairy products	200	0	0
Dairy environment	307	8 (2.6%)	2 (0.6%)
Raw milk (reception)	2	2 (100%)	2 (100%)
Raw milk (143 farms)	430	13 (3.0%)	13 (3.0%)
Farm 3: Raw milk from cows	20	1 (5.0%)	1 (5.0%)
Farm 3: Environment and feed	30	9 (30%)	8 (26.7%)
Total	989	33 (3.3%)	26 (2.6%)

Study by Sigrun Guðmundsdóttir and Jóhann Örlýsson, IFL

Listeria Detection:



- enrichment in *Listeria* enrichment broth, (naladixic acid)
- selective enrichment, Fraser broth (esculin hydrolysis)
- selective plating
 - modified McBride
 - *Listeria* selective medium (lithium chloride, acriflavin, moxalactam)
- *L. monocytogenes* is rhamnose (+), xylose (-)