

Mikrobiologi Susu

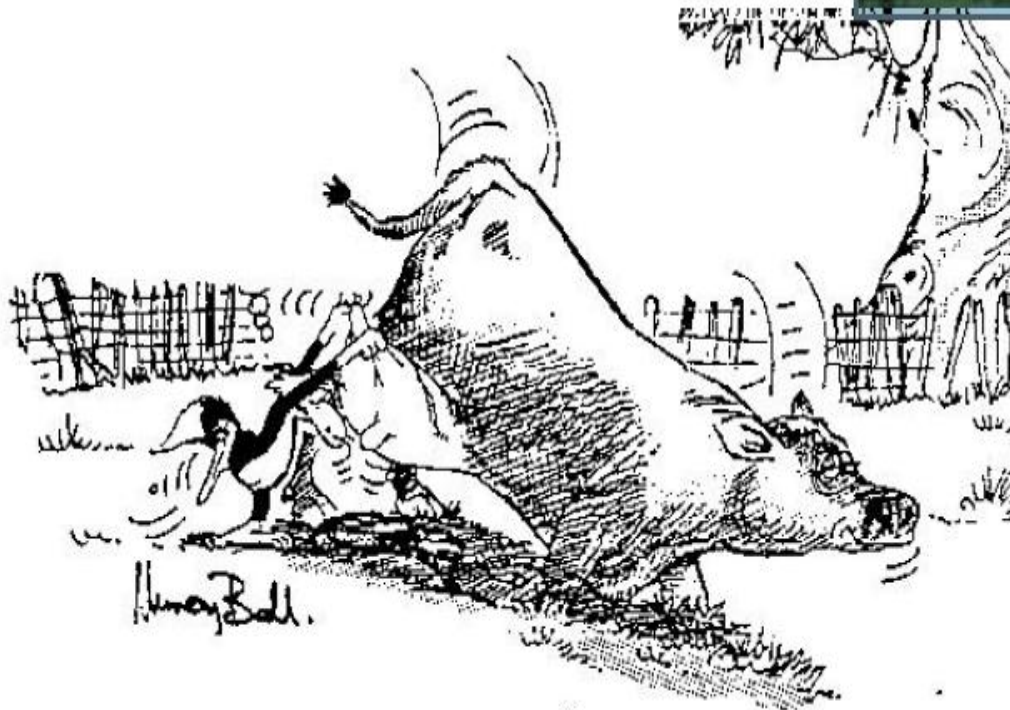
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Kandungan nutrisi susu (g/100g) (Wong et al., 1988)

	Cow	Dairy Sheep	Water Buffalo	Goat
Fat	3.9	7.2	7.4	4.5
Total Protein	3.3	4.6	3.8	3.2
Casein	2.6	3.9	3.2	2.6
Whey	0.7	0.7	0.6	0.6
Lactose	4.6	4.8	4.8	4.3
Ash	0.7	0.9	0.8	0.8
Total solids	12.5	17.5	16.83	12.8

Kerusakan Mikrobiologis Susu Segar dan Olahannya

Sources of Food Contamination e.g RAW MILK



Sumber Kontaminasi Susu Segar

Contamination from diseased udder

- *Brucella abortus*
- *Mycobacterium bovis*
- *Pyogenic streptococci*
- *Corynebacterium diphtheriae*
- *Bacillus anthracis*
- *Listeria monocytogenes*
- *Staphylococcus aureus*
- *Escherichia coli*
- *rickettsia Coxiella burnetii*

Contamination from equipment

- unsterile milking utensils
major source of bacteria in milk
- 80-90% of all high counts traced back to this source.
- Streptococci
- Enterobacteria
- Psychrotrophs
- *Bacillus* spp.
- Thermophilic



Microorganisms are very small



YOGHURT

World population is
5.5 BILLION
i.e. 5 500 000 000

1 cup
of yoghurt contains
22 X this number!
i.e. 120 000 000 000
separate living
organisms.

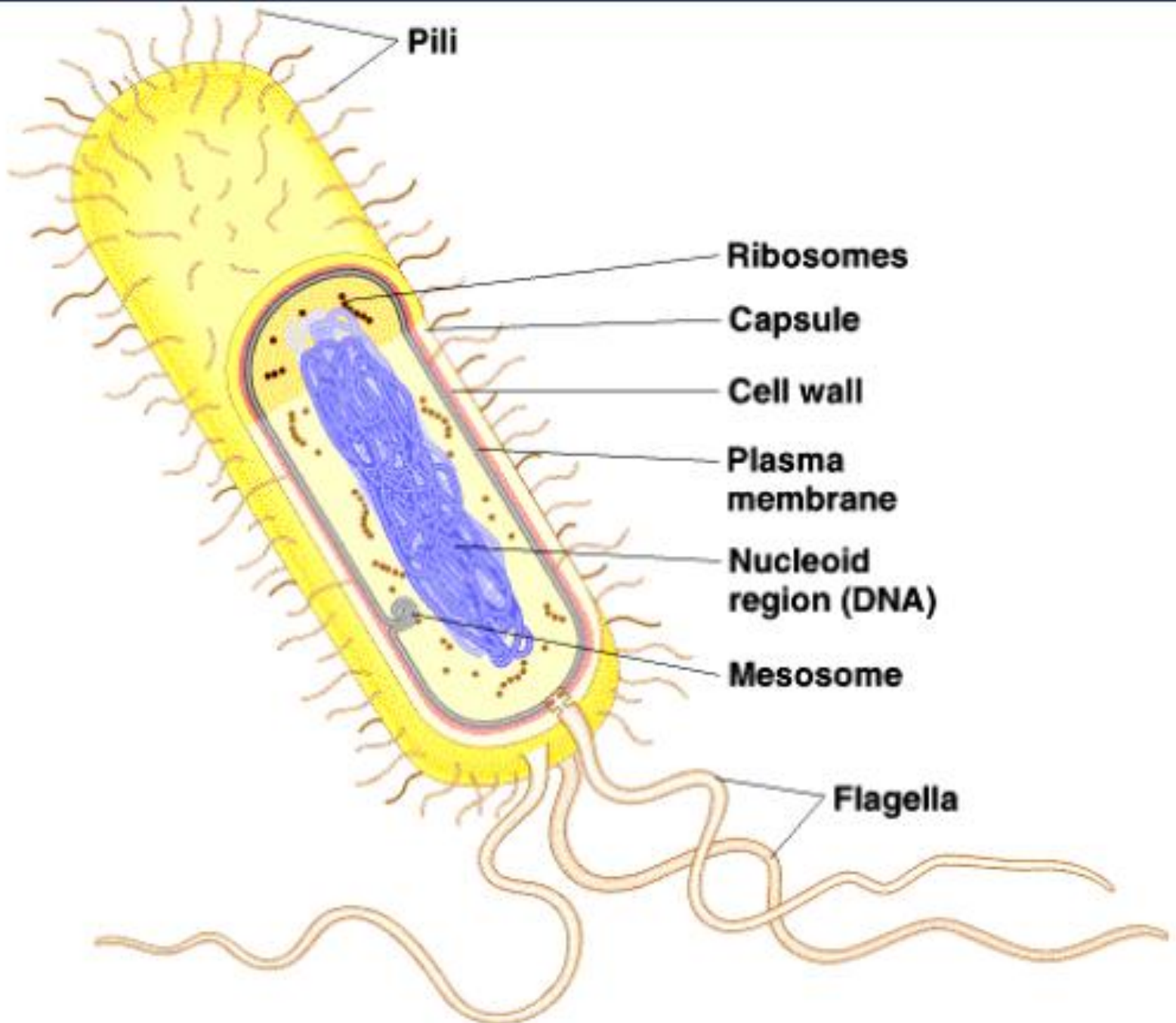
Bakteri (Sel Tunggal)

- ▶ *E. coli*



- ▶ *Salmonella*





Pili

Ribosomes

Capsule

Cell wall

**Plasma
membrane**

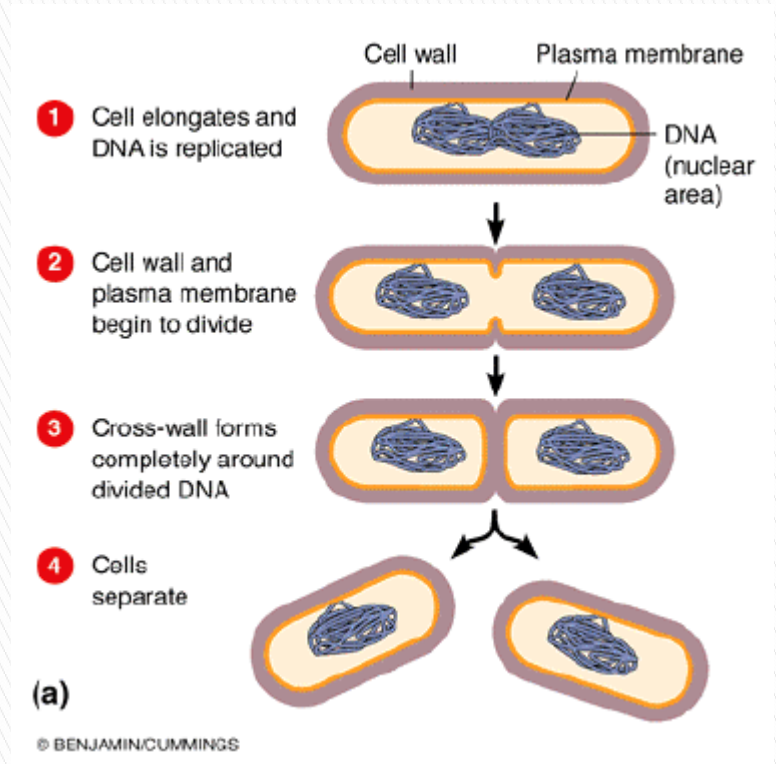
**Nucleoid
region (DNA)**

Mesosome

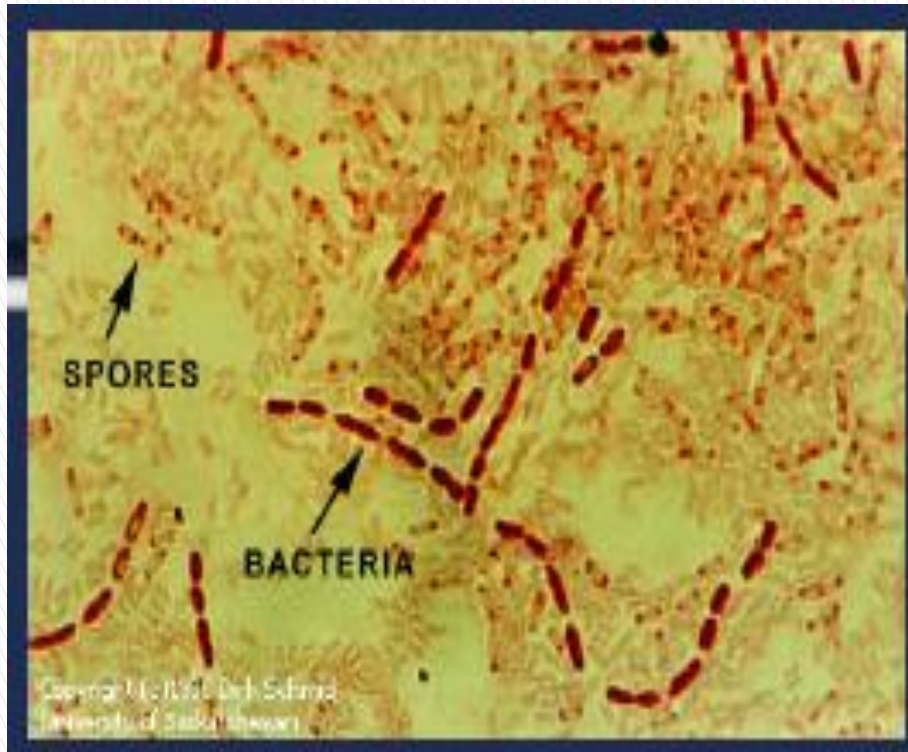
Flagella

Pertumbuhan Bakteri

- ▶ Lebih mengacu pada Jumlah Sel bukan Ukuran Sel
- ▶ Bakteri tumbuh dan membelah dengan *binary fission* (pembelahan menjadi dua bagian) dan merupakan proses yang simpel

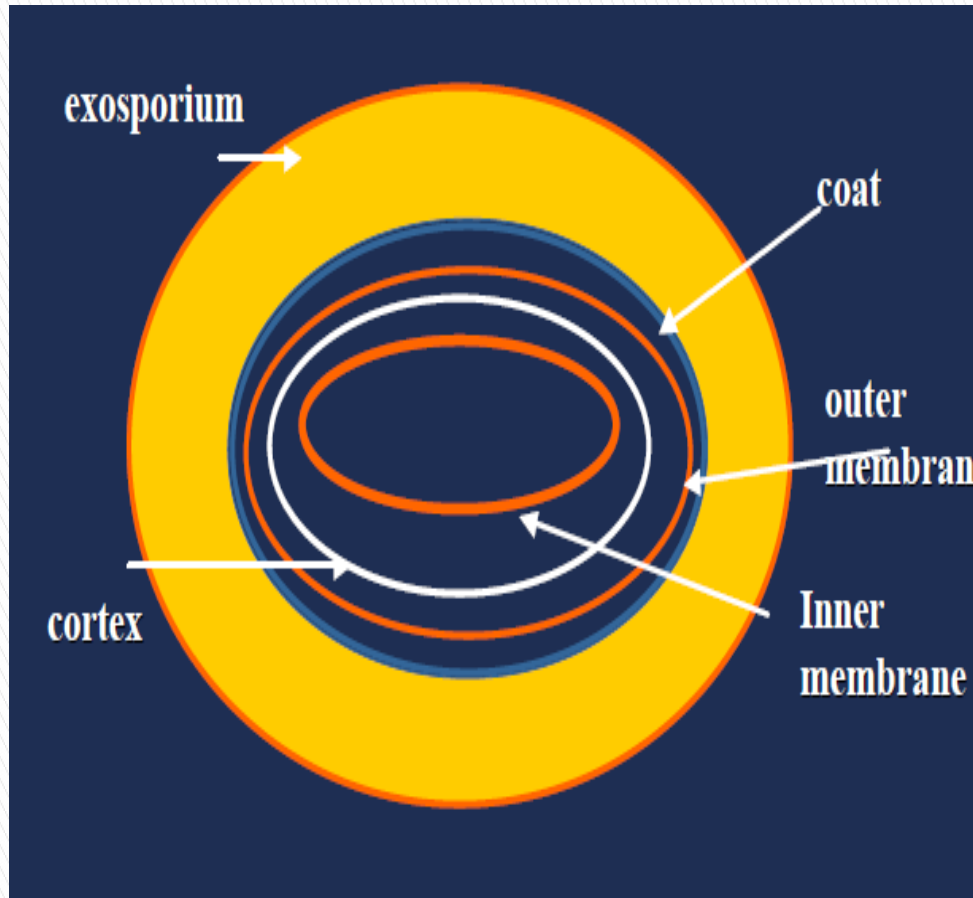


Endospora



- ▶ Disintesis didalam sel
- ▶ Diproduksi dalam kondisi stress
- ▶ Dorman (seperti biji)
- ▶ Tahan pemanasan 10 menit (pasteurisasi)
- ▶ Tahan pengeringan
- ▶ Tahan desinfektan
- ▶ *Bacillus, Clostridium* (dalam tanah)
- ▶ *Bacillus anthrax*, penyebab penyakit antraks

Endospora



Spora

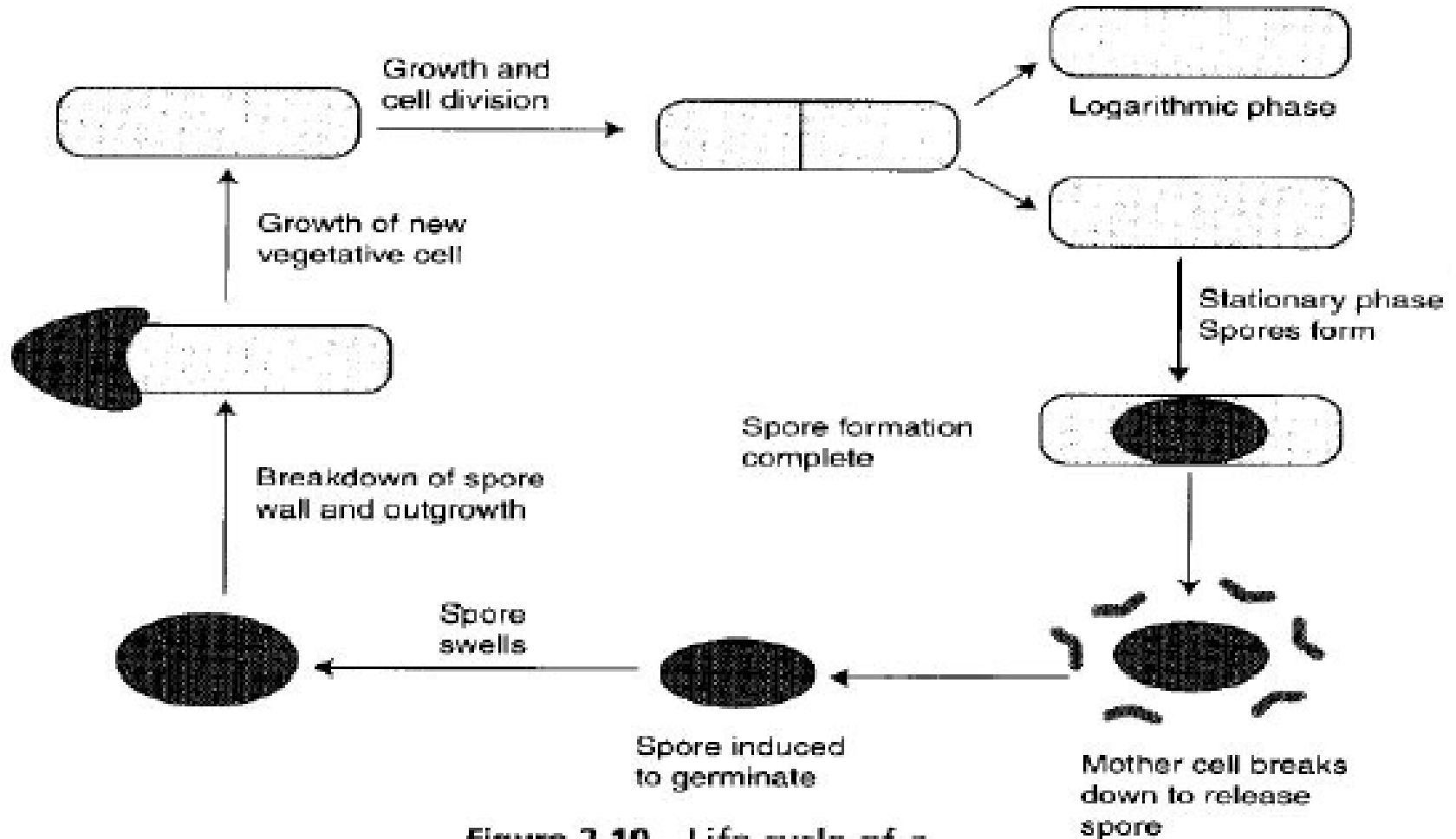


Figure 2.10 Life cycle of a spore-forming bacterium

Penyakit Terbawa Pangan

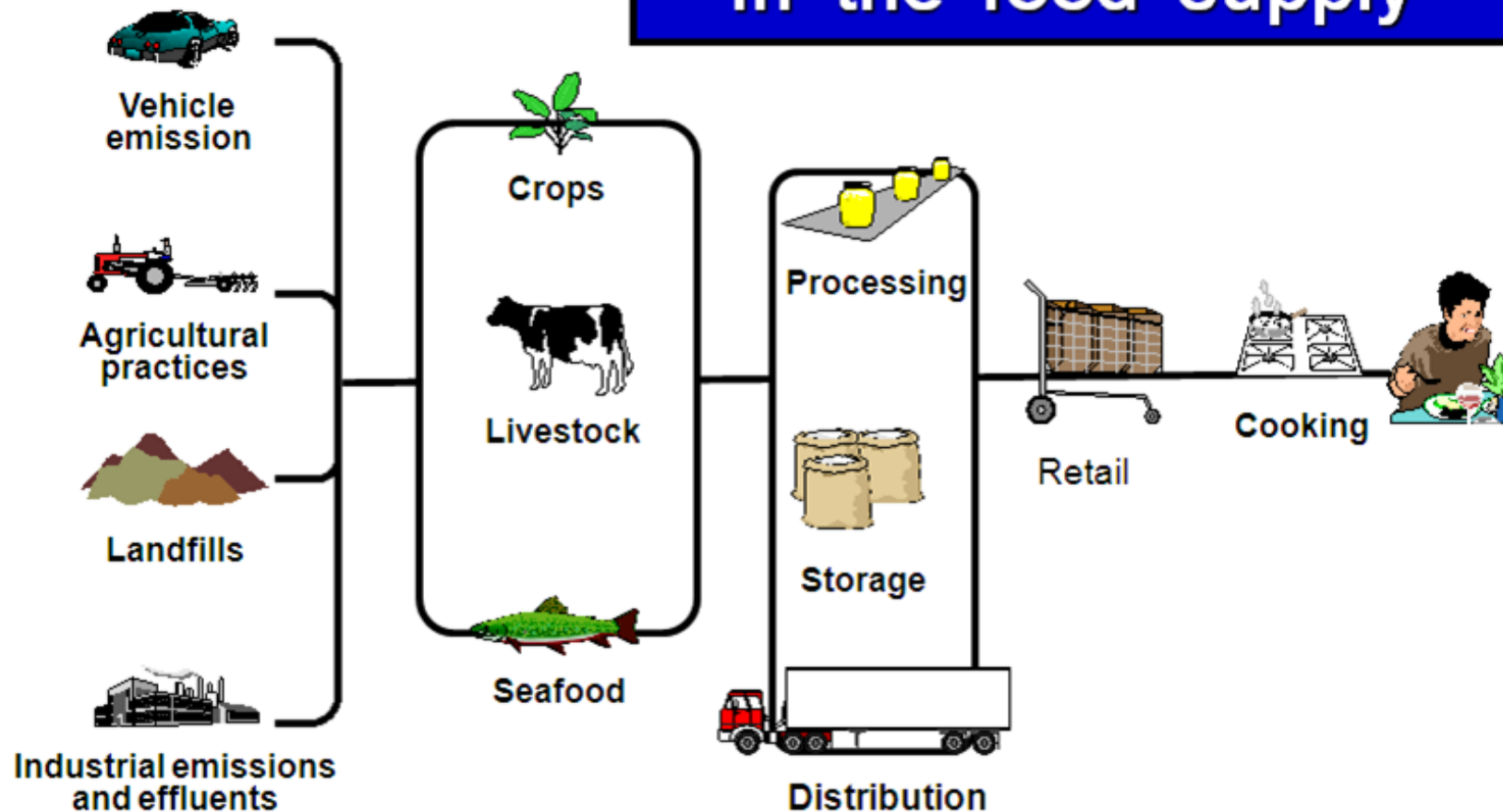
▶ Keracunan Pangan:

- Mengonsumsi bahan pangan yang mengandung toksin yang dihasilkan mikroorganisme
- Gejalanya sangat cepat

▶ Infeksi Pangan:

- Mengonsumsi bahan pangan yang sudah terinfeksi mikroorganisme patogen
- Mikrobial tumbuh dan menghasilkan toksin
- Gejala lebih lama

Where hazards arise in the food supply



Major bacteria causing foodborne disease

Aeromonas spp.

Bacillus cereus

Brucella spp.

Campylobacter jejuni

Clostridium botulinum

Clostridium perfringens

Escherichia coli

Listeria monocytogenes

Mycobacterium bovis

Salmonella spp.

Shigella spp.

Staphylococcus aureus

Vibrio cholerae

Vibrio parahaemolyticus

Vibrio vulnificus

Yersinia enterocolitica

Salmonella

**Gram negative motile rods,
facultative anaerobe,**

2400 serotypes

e.g S. typhimurium; enteriditis, typhi

Infective dose: 1 - 10^6 type host/Salmonella

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

polluted water

soil



Bacillus cereus

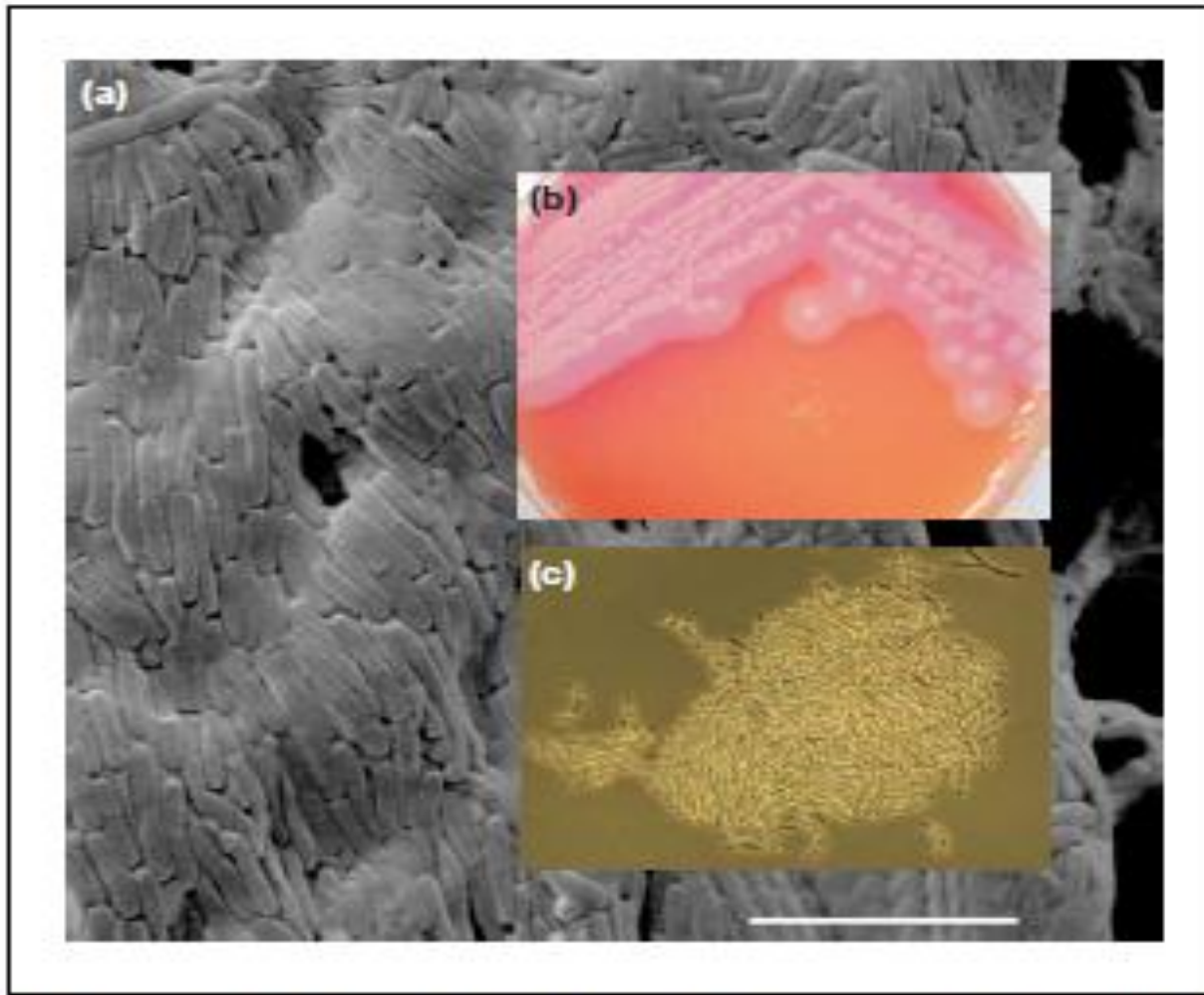


Figure 1. Examples of food-borne pathogens. *Bacillus cereus* vegetative cells (a), aggregated sporulating stationary phase cells (b), and *B. cereus* colonies growing on mannitol egg yolk polymyxine (MYP) medium (c). Scale bar 10 μm .

Mycotoxins

<i>Mycotoxin</i>	<i>Source</i>	<i>Associated Food</i>
Aflatoxins	<i>Aspergillus flavus</i> and <i>A. parasiticus</i>	Corn, peanuts, tree nuts, milk
Trichothecenes	Mainly <i>Fusarium</i>	Cereals and other foods
Ochratoxin A	<i>Penicillium verrucosum</i> <i>A. ochraceus</i>	Wheat, barley, corn
Ergot alkaloids	<i>Claviceps purpurea</i>	Rye, barley, wheat
Fumonisin	<i>Fusarium moniliforme</i>	Corn
Patulin	<i>P. expansum</i>	Apples, pears
Zearalenone	<i>Fusarium</i> spp.	Cereals, oil, starch

Major factors contributing to foodborne illness

Contamination

Cross - contamination
Unclean equipment
Unsound / unwholesome food
Chemical contamination
Insects / rodents
Infected handlers

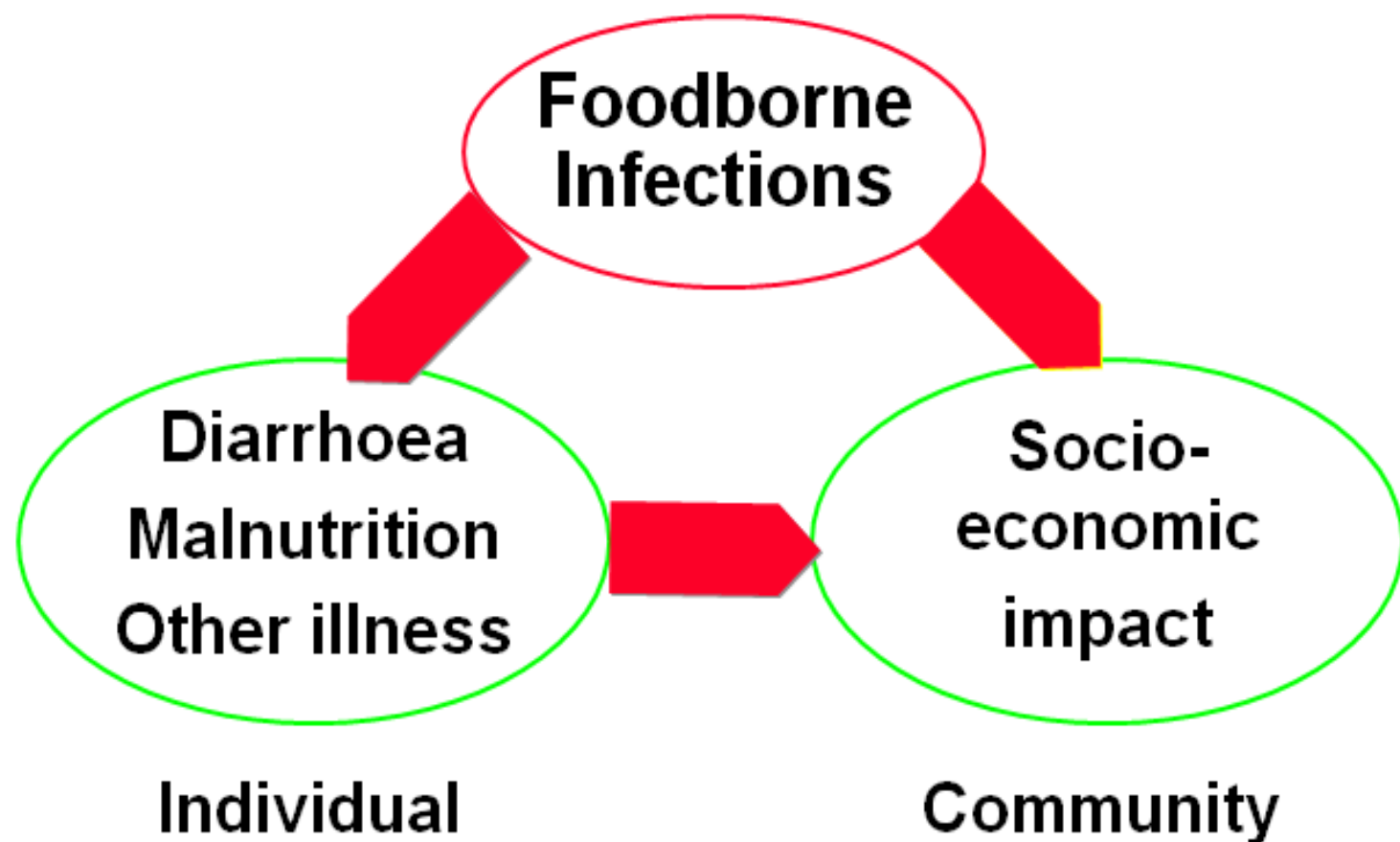
Survival

Inadequate cooking / reheating

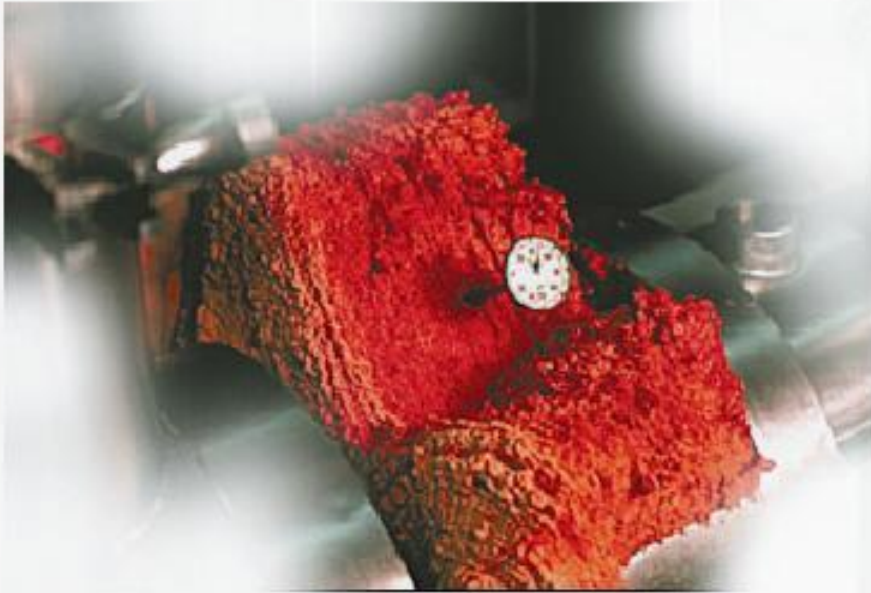
Growth

Insufficient cooling / hot holding

Consequences of foodborne infections

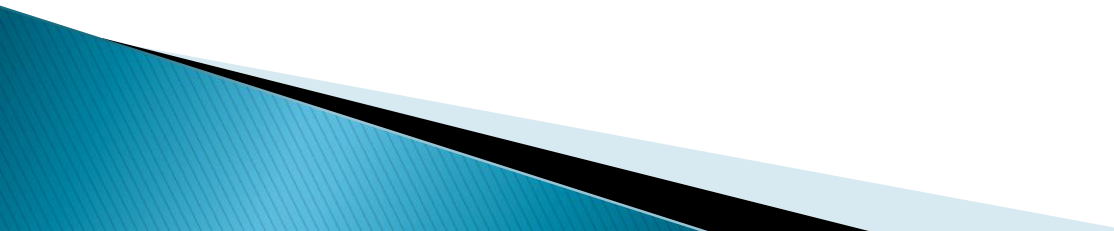


To Put Things in Perspective

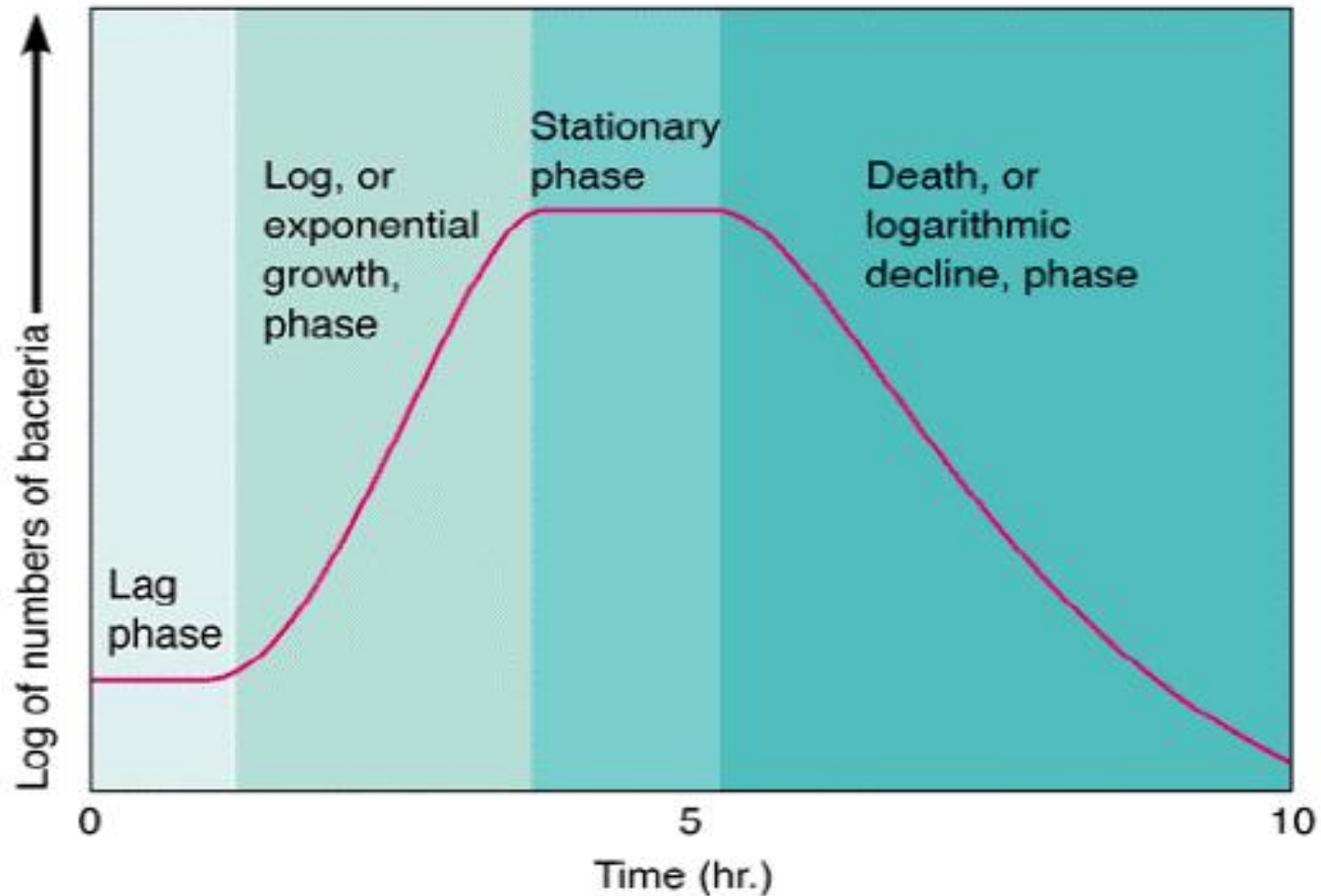


- ▶ Microbial pathogens in food cause an estimated 76 million cases of human illness annually in the United States
- ▶ 325,000 hospitalized
- ▶ 5,000 deaths

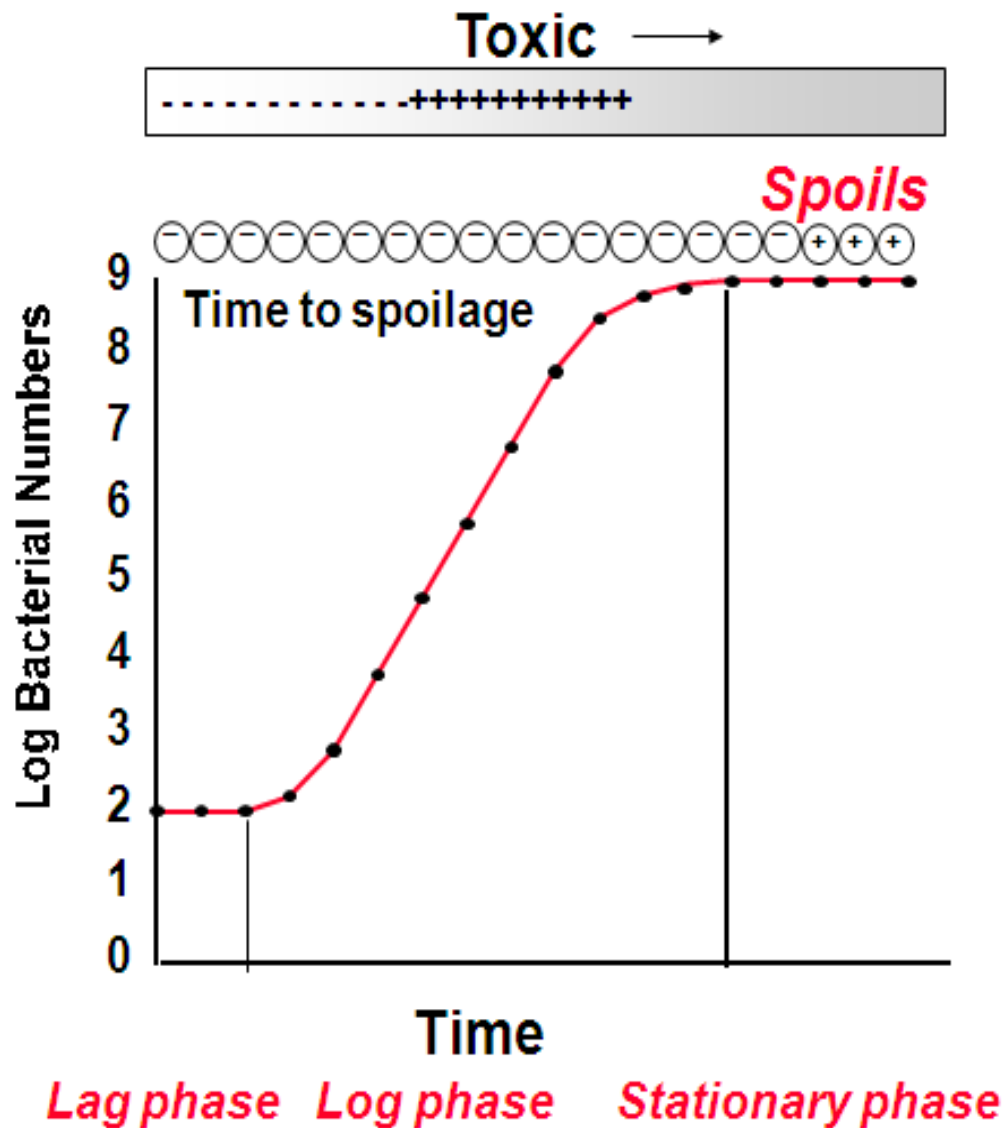
Penanganan Bahan Pangan (Susu)

- ▶ Pendinginan (penyimpanan suhu kulkas)
 - ▶ Pemanasan (susu UHT, susu Sterilisasi)
 - ▶ Pengasaman/fermentasi (yoghurt, susu asam, yakult, kefir, keju)
 - ▶ Pengeringan (susu bubuk)
 - ▶ Pemanisan (susu kental manis)
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Empat (4) Phase Pertumbuhan Bakteri



Bacterial growth curve



Prevention of foodborne disease

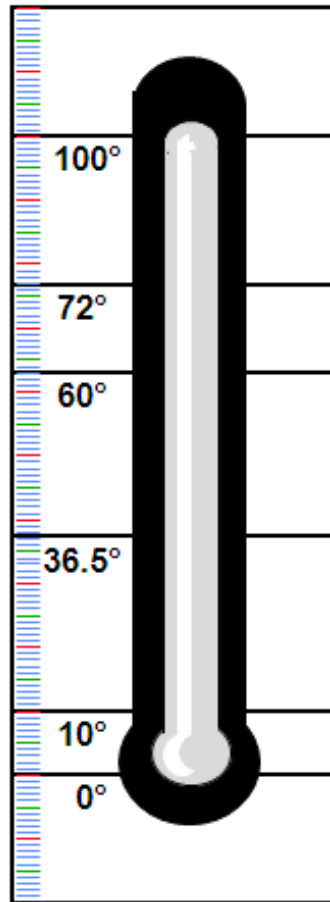
Boiling point

Pasteurizing temperature

Body temperature

Fridge

Freezer

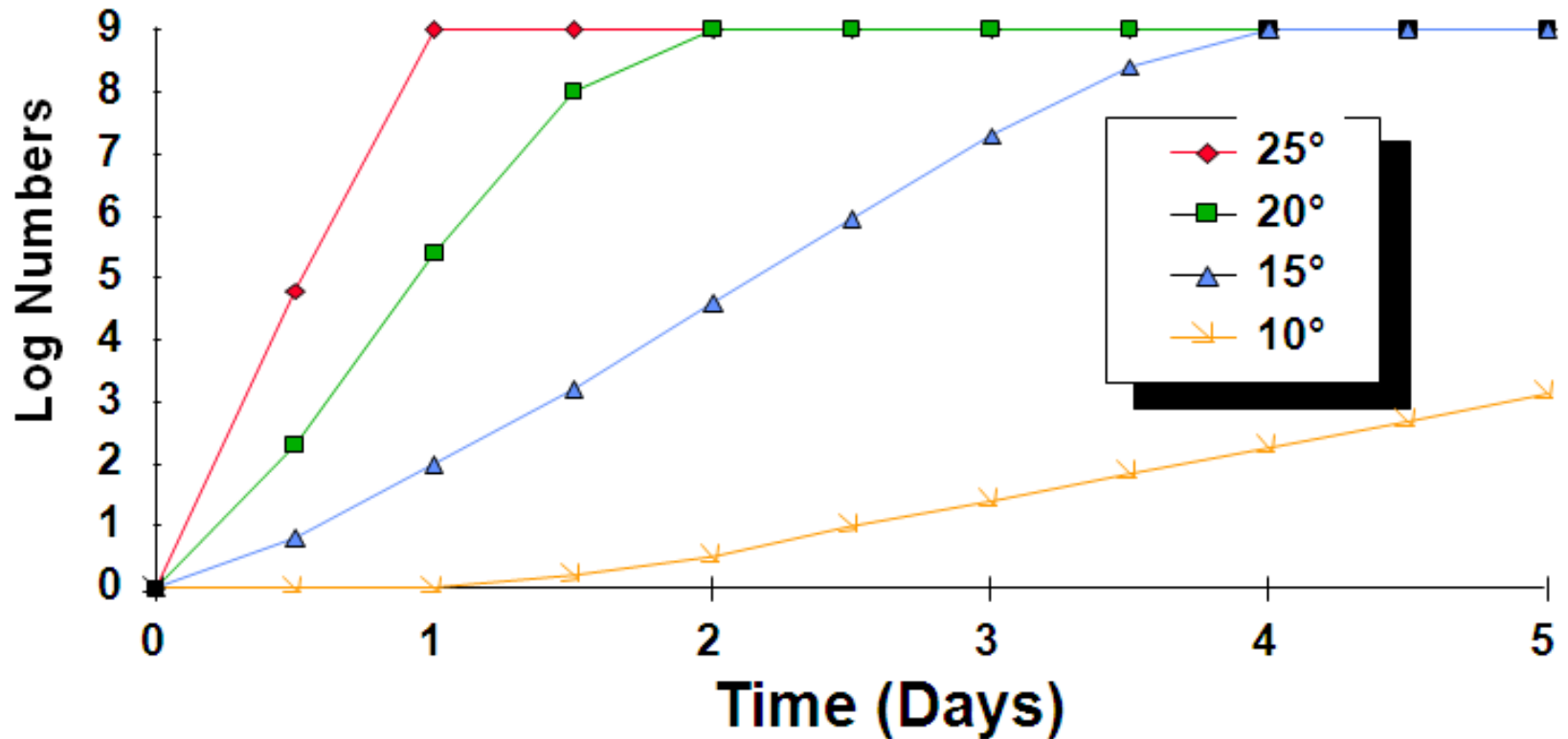


SAFETY

DANGER

SAFETY

Growth of *S. typhimurium* at different temperatures



Pasteurization schemes

- ▶ **Low temperature:**
 - ▶ 63° C for 30 min
- ▶ **High temperature:**
 - ▶ 72° C for 15 sec
- ▶ **Ultra-high temperature:**
 - ▶ 135° C for 1 sec

pH

Acidification

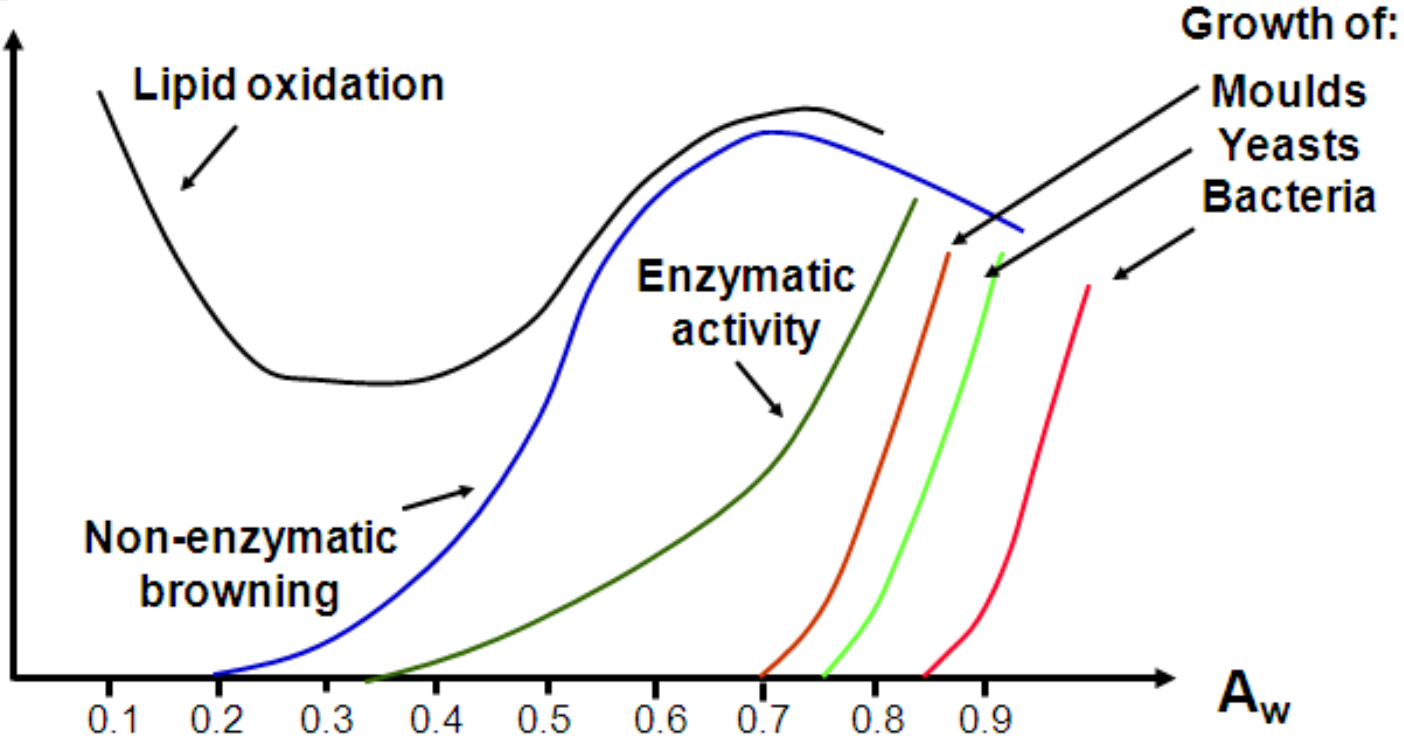
- *addition of vinegar*

Fermentation

- *organic acid*
- *competitive exclusion*
- *antimicrobial agents*

Water activity

Reaction rate



Minimum levels of a_w permitting growth (at near optimum temperatures)

Moulds	<i>Aspergillus chevalieri</i>	0.71
	<i>Aspergillus ochraceus</i>	0.78
	<i>Aspergillus flavus</i>	0.80
	<i>Penicillium verrucosum</i>	0.79
	<i>Fusarium moniliforme</i>	0.87
Yeasts	<i>Saccharomyces rouxii</i>	0.62
	<i>Saccharomyces cerevisiae</i>	0.90
Bacteria	<i>Bacillus cereus</i>	0.92
	<i>Clostridium botulinum</i> (proteolytic)	0.93
	<i>Clostridium botulinum</i> (non-proteolytic)	0.97
	<i>Escherichia coli</i>	0.93
	<i>Salmonella</i>	0.95
	<i>Staphylococcus aureus</i>	0.83

Pemanasan dan penambahan Gula

- ▶ Evaporated Milk
Proses pemanasan cukup membantu mematikan mikrobia perusak / patogen pangan
- ▶ Sweetened Condensed Milk
Proses penambahan gula (sukrosa) meningkatkan tekanan osmotik sehingga menghambat mikrobia tumbuh



Concentration of NaCl and glucose at various a_w values (at 25°C)

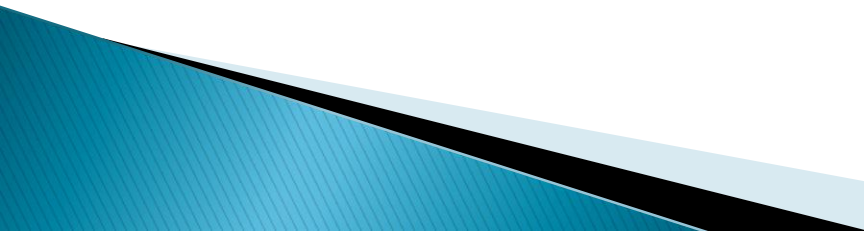
a_w	% W / W NaCl	% W / W Glucose
1.00	0.00	0.00
0.99	1.74	8.90
0.98	3.43	15.74
0.96	6.57	28.51
0.94	9.38	37.83
0.92	11.90	43.72
0.90	14.18	48.54
0.88	16.28	53.05
0.86	18.18	58.45

Control of E_h

- Vacuum packaging
- Modified atmosphere packaging by gas flushing: CO_2 , N_2

Simpulan dan Saran

Penganganan Susu segar idealnya:

- ▶ Kandang harus bersih
 - ▶ Ternak kambing atau sapi juga harus bersih
 - ▶ Yang pemerah (tangan dan pakaian) harus bersih
 - ▶ Tempat penampungan (wadah/ember) harus bersih
 - ▶ Setelah diperah langsung disimpan kulkas atau langsung dipanaskan untuk menekan mikrobia
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TERIMA KASIH