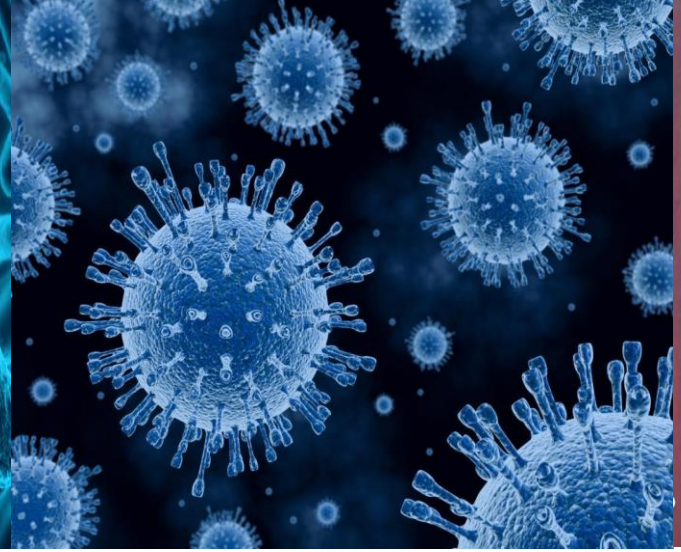
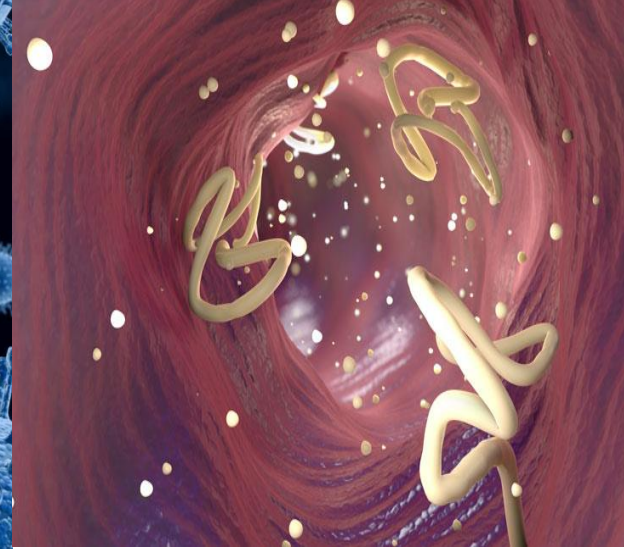




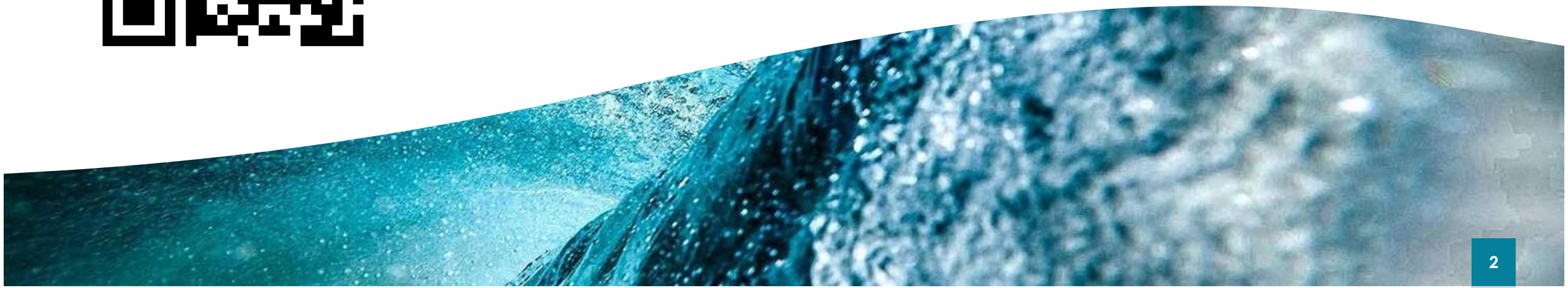

INTRODUCTION TO FOODBORNE PATHOGENS

NORLIA MAHROR

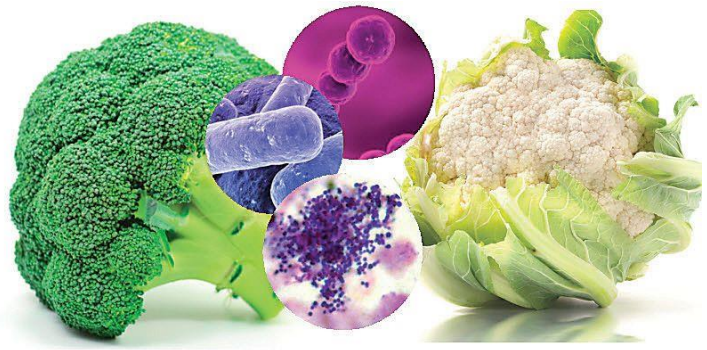
29032021

WHAT ARE MICROORGANISMS?

Mentimeter.com



Microorganisms



Beneficial microorganism

- Used in food fermentation. E.g. cheese, yogurt, kimchi, *budu*
- Microorganisms metabolise complex substrate to produce enzyme (*breakdown the indigestible compound*), flavour compound, and antimicrobial agents to inhibit pathogen growth, extend shelf life, provide product attribute.
- *E.g. Lactobacillus acidophilus, Lactobacillus thermophilus*

Spoilage microorganism

- Microorganism that grow in foods and cause spoilage. E.g. produce undesirable flavour, odour, texture, appearance (but not harmful).
- These organisms are often smelled, seen, or tasted but they won't make you sick.
- E.g. *Lactobacillus* spp., *Pseudomonas* spp., yeast and mould,.

Pathogenic microorganism

- Microorganisms that grow in foods and cause foodborne disease / illness to the consumer.
- Unfortunately these organisms cannot be seen, smelled, or tasted.

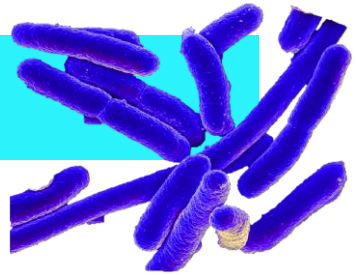
Pathogens

- **Pathogens** are microorganism that are capable of **causing disease** in the host species (human, animals, plants)which results in **symptoms** with an outcome of either **morbidity** or **mortality.**

- Pathogens are classified based on their transmission patterns and movement among different host and vectors.

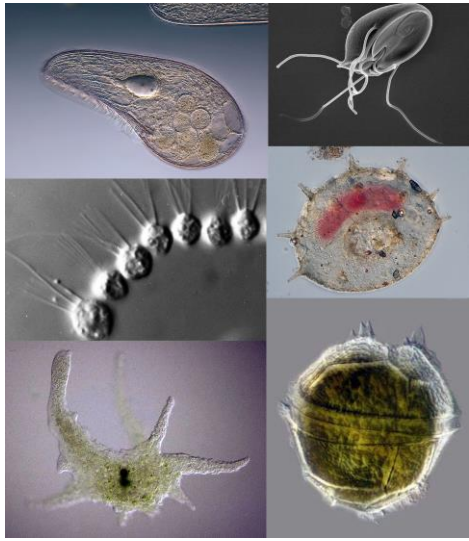
1. **Zoonotic**: animal → human [eg. *E. coli* O157:H7, *S. aureus*, *Salmonella enterica* serovar Typhimurium, *C. jejuni, Yersinia enterocolitica*].
2. **Geonotic**: soil, water → human [e.g. *Listeria monocytogenes*]
3. **Human origin**: person → person [*Salmonella enterica* serovar Typhi, *Shigella* spp. *Hepatitis* A]

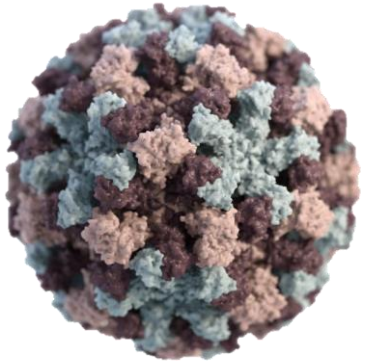
Foodborne pathogens



Gram-negative bacteria (e.g. *Salmonella* spp., *E. coli*., *Vibrio* spp., *Campylobacter* spp.)

Gram-positive bacteria (e.g. *Listeria monocytogenes, Staphylococcus aureus, Bacillus cereus, Clostridium botulinum, Clostridium perfringens*)





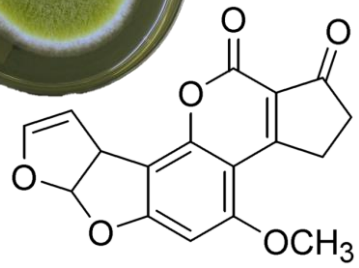
BACTERIA

VIRUSES

Norovirus
Hepatitis A
Rotavirus

PARASITES

Protozoa (e.g. *Giardia lamblia, Cryptosporidium parvum*
Helminth (e.g. Trematode – liver fluke (*Fasciola hepatica*)
Cestode – tapeworms (*Taenia*).



FUNGI

Mycotoxigenic fungi

(e.g. *Aspergillus* spp., *Penicillium* spp., *Fusarium* spp.)

Mycotoxins(e.g. aflatoxins, ochratoxins, patulin)

FOODBORNE DISEASE/ILLNESS

What is the definition of foodborne illness?

What are the 3 types of foodborne illnesses?

1. **Foodborne……**
2. **Foodborne……**
3. **Foodborne……**

Definition

Foodborne **disease** is defined as a disease that is carried or transmitted to humans by **food**. The 3 types of foodborne diseases are:

1. Foodborne infection
2. Foodborne intoxication (food poisoning)
3. Foodborne toxico-infection

Foodborne infection

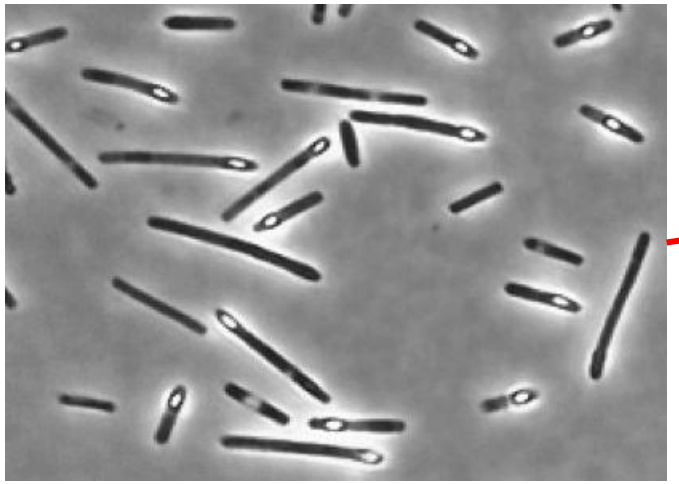
- Infection is caused by ingestion of food that is contaminated with live pathogens such as bacteria, viruses, or parasites and they act directly on the intestines.
- The pathogen multiplies in food until it reaches the minimum infective dose (MID) – (number of microorganisms needed to cause illness in human).
- MID: *Shigella* spp. 10 cells, *S. aureus* 10^5 cells, *C. perfringens* 10^8
- E.g. *Listeria monocytogenes, Campylobacter jejuni, Yersinia enterocolitica.*
- Symptoms may take longer time to appear and may also last longer than intoxication.

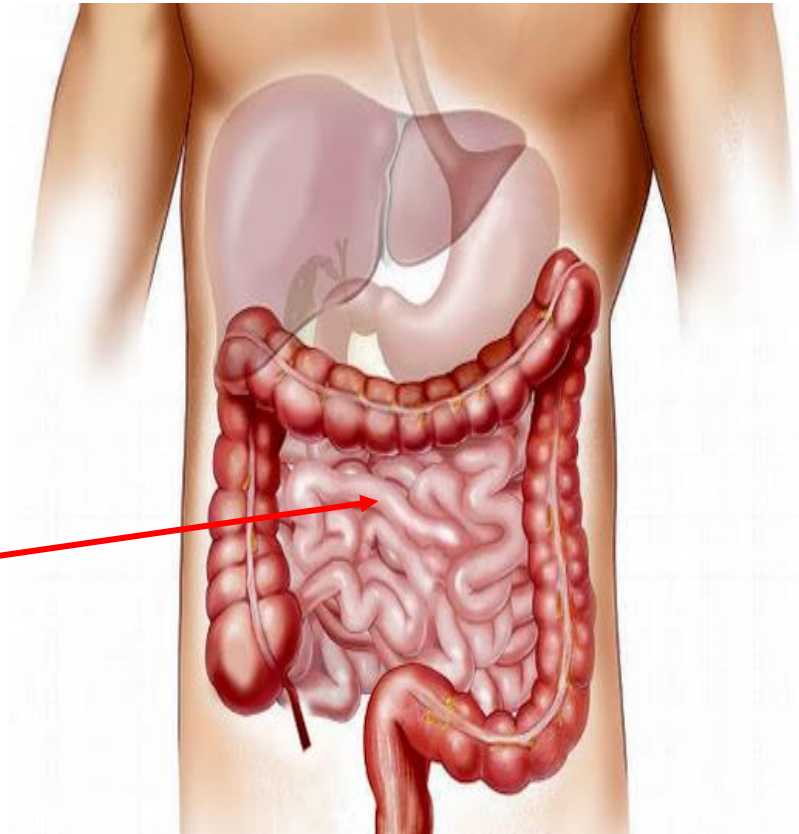
Food intoxication (poisoning)

- Intoxication is caused by ingestion of food which is already contaminated with toxins produced by bacteria (**pre-formed toxins**)
- E.g. *Staphylococcus aureus, Clostridium botulinum*
- Symptoms may occur very soon and result in sudden/uncontrollable vomiting and/diarrhea.

Foodborne toxico-infection

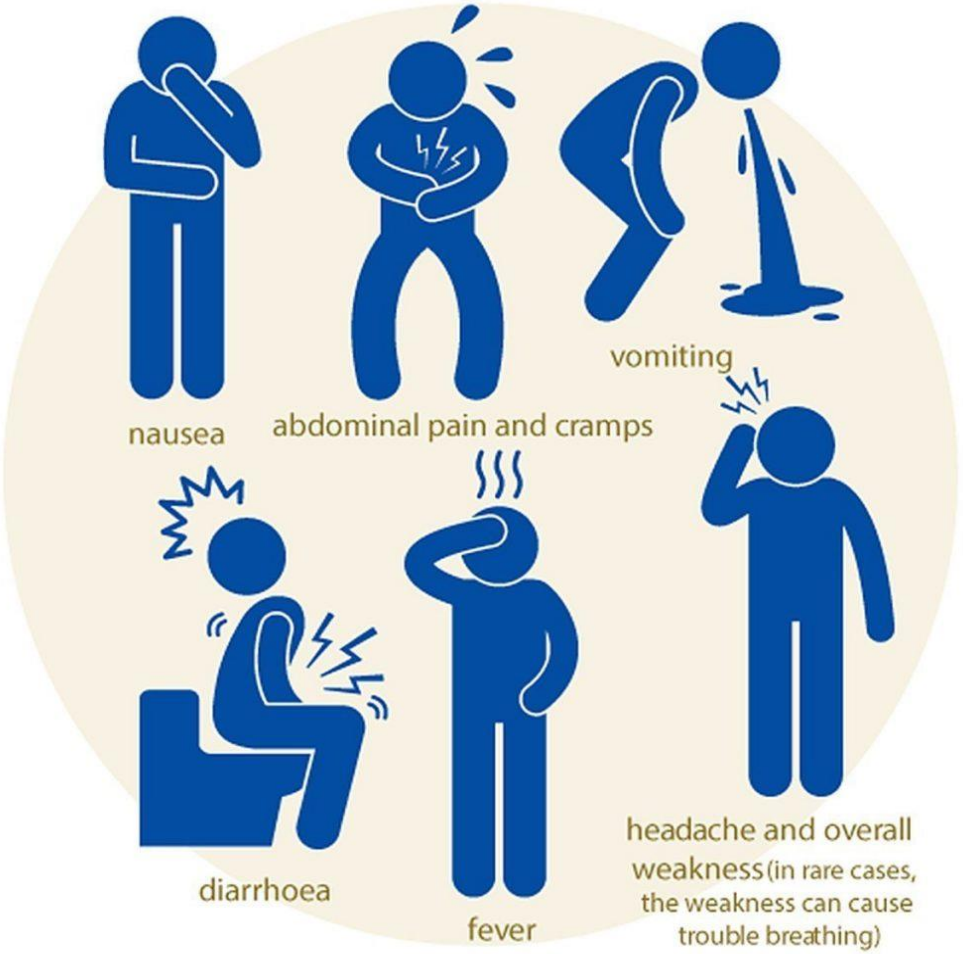
- Toxico-infection is caused by ingestion of food contaminated with live pathogens and they produce toxins in the host.
- The bacteria either sporulate (spore-formers) or die (cell lysis)(non spore-formers) and release toxins in the gastrointestinal tract (intestines).
- E.g. *E. coli* O157:H7, *Bacillius cereus, Clostridium perfringens*.





Foodborne disease outbreak

- A foodborne disease outbreak occurs when **two or more people develop a similar illness** after **ingesting** the **same contaminated food or drink** (WHO, 2008).
- The food or drink can be contaminated with **pathogens or toxins**.
- The severity of illness depend on the type of pathogens or toxins ingested, the amount of food, and the health status of individual.
- In some countries, only one case of a rare but severe foodborne disease – like botulism or chemical intoxication – is also considered an outbreak.



Level of disease occurrence

Endemic

The amount of a particular disease that is usually present in a community within a geographic area is referred to as the baseline or endemic level of the disease.

e.g. malaria in African countries

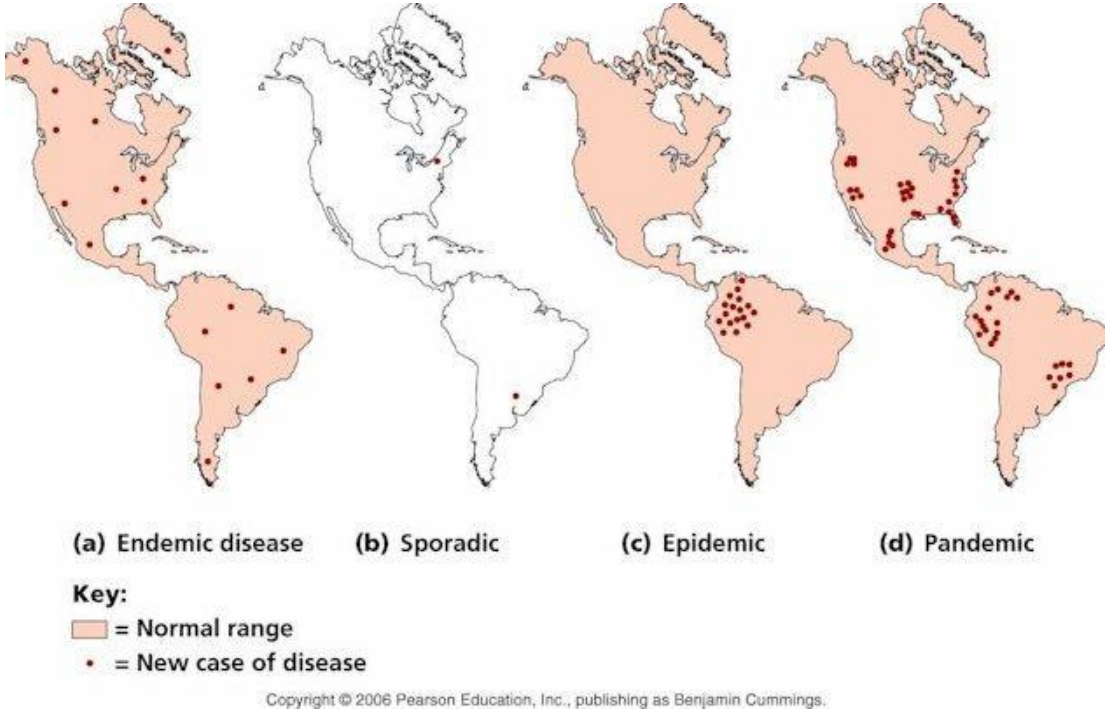
Cholera in South Asia & South East Asia

Epidermic

Epidemic refers to an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in that area

The disease spreads fast to a large population within a short period of time.

e.g. Covid-19 in Wuhan



Pandemic

Pandemic refers to an epidemic that has spread over several countries or continents, usually affecting a large number of people.

e.g. Covid-19 in all over the word

Pathogen illness per year

NUMBER OF CASES

Viruses = 9,278,500

Bacteria = 4,420,000

Parasites = 1,270,658

The total number of **illnesses** from foodborne pathogens per year range from **6 to 81 million**. It is hard to get an accurate number since most cases are not reported and many are never diagnosed

The CDC estimates that **78%** of pathogen outbreaks occur as a result of **poor food handling practices in commercial and institutional** establishments while only **22%** occur due to **food handling practices in private residences.**

Causal factors related to food poisoning

- Cross contamination
- Inadequate heat treatment/cooking
- Storage temperature
- Infected food handler
- Unprocessed contaminated ingredient
- Poor personal hygiene
- Poor handwashing facilities

Prevention of foodborne illness

CLEAN

SEPARATE

COOK

CHILL

Carriers

- **Healthy carrier** – Shed microbes but no symptom. YOU might be one of them!
- **Chronic carrier** – Had foodborne illness, recovered but shed microbes for **more** than 12 months.
- **Convalescent carrier** – Had foodborne illness, recovered but shed microbes for **less** than 12 months.

Typhoid Mary – "*a healthy carrier*"

"TYPHOID MARY"

MOST HARMF

The Extraordinary Predicament of Mary Mallon, a Prisoner on New York's Quarantine Hospita

By Dr. Wm. H. Park, New York Board of Health.

The Extraordi and Dis

The Official

10 minutes break

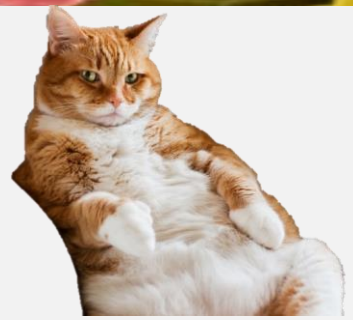
Please find information on 'Thyphoid Mary'

HOW ARE YOU GOING TO CONTROL THE GROWTH OF MICROORGANISM IN FOODS?

“NATURE OF THE FOODS VS NATURE OF THE MICROORGANISMS”

FACTORS AFFECTING MICROBIAL GROWTH

FACTORS AFFECTING MICROBIAL GROWTH



FAT TOM

Food Acidity Time Temperature Oxygen Moisture

FOOD

Foods

1. What are the available nutrients in the food?

Microorganisms

1. Microorganism requires nutrients (from food) to grow and multiply.
2. These includes: carbohydrates, proteins, phosphates, calcium, etc…
3. The bacteria will not multiply without the food supply.

ACIDITY

Foods

What is the acidity of food?

pH ranges of some common foods	
Food	pH Range
Beef	5.1 – 6.2
Chicken	6.2 – 6.4
Fish	6.6 – 6.8
Corn	7.3
Egg yolk (white)	6.0 – 6.3 (7.6 – 9.5)

Microorganisms

Acidophiles

Favourable pH for growth: Neutral

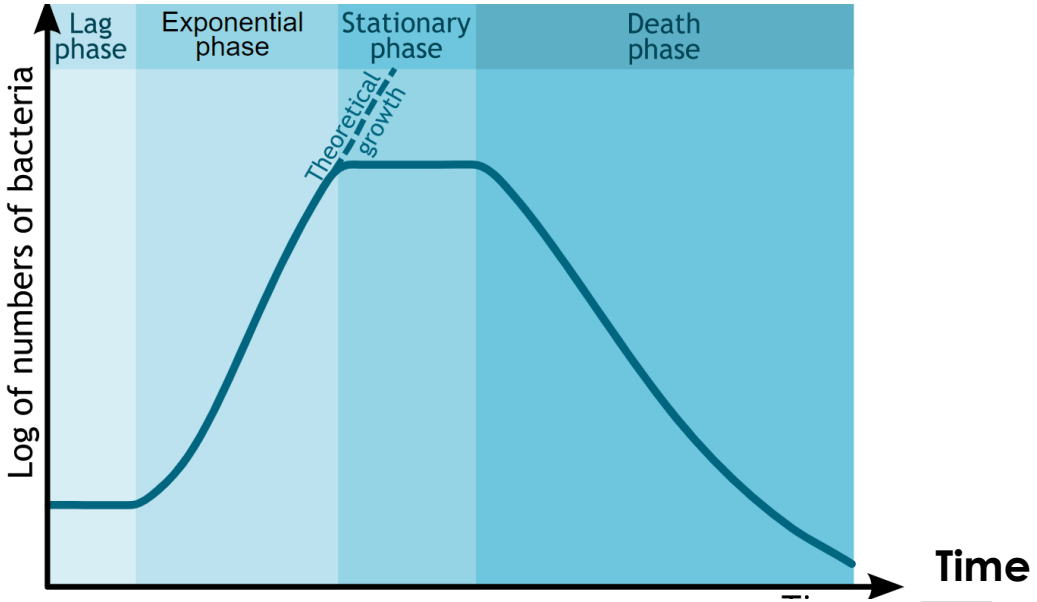
TIME

Foods

1. How long the foods have been exposed to "*danger zone*"?

Microorganisms

1. What is the lag time and generation time for the microorganism at particular temperature?



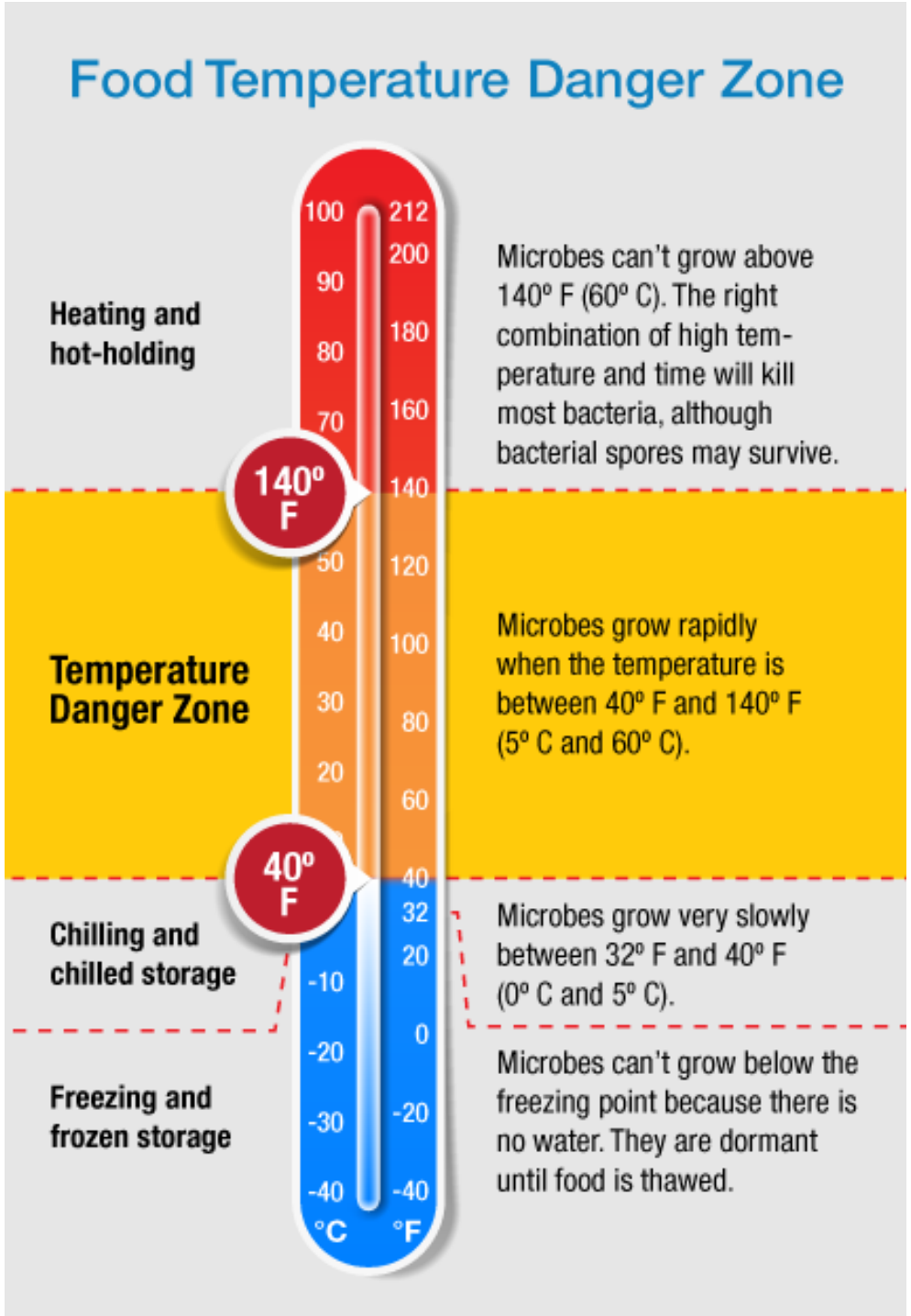
TEMPERATURE

Foods

1. What is the processing/cooking temperature of the food?
2. What is the storage temperature of the food?

Microorganisms

1. Thermophile
   (Range: 45-70°C; Opt: 50- 55°C)
2. Mesophile
   (Range: 20-45 °C; Opt: 30-40°C)
3. Psychrophiles
   (Range: 0-25°C; Opt: 20-25°C)


Food Temperature Danger Zone
Heating and hot-holding
Microbes can't grow above 140° F (60° C). The right combination of high temperature and time will kill most bacteria, although bacterial spores may survive.
140° F
Temperature Danger Zone
Microbes grow rapidly when the temperature is between 40° F and 140° F (5° C and 60° C).
40° F
Chilling and chilled storage
Microbes grow very slowly between 32° F and 40° F (0° C and 5° C).
Freezing and frozen storage
Microbes can't grow below the freezing point because there is no water. They are dormant until food is thawed.
100 90 80 70 50 40 30 20 -10 -20 -30 -40 °C
212 200 180 160 140 120 100 80 60 40 32 20 0 -20 -40 °F

Pathogens able to survive in refrigerated foods[5]

Microorganism	Common food sources
Campylobacter jejuni	Raw chicken, foods contaminated by raw chicken, unpasteurized milk
Listeria monocytogenes	Ready to eat foods including raw milk, cheese, ice-cream, raw vegetables, raw and cooked poultry, raw meats
Yersinia enterocolitica	Raw milk, chocolate, milk, raw meats
Aeromonas hydrophila	seafoods

Garima et al., 2016

OXYGEN

Foods

1. How are you going to keep/protect your food?
2. What are the means of packaging?
   - vacuum packaging
   - MAP

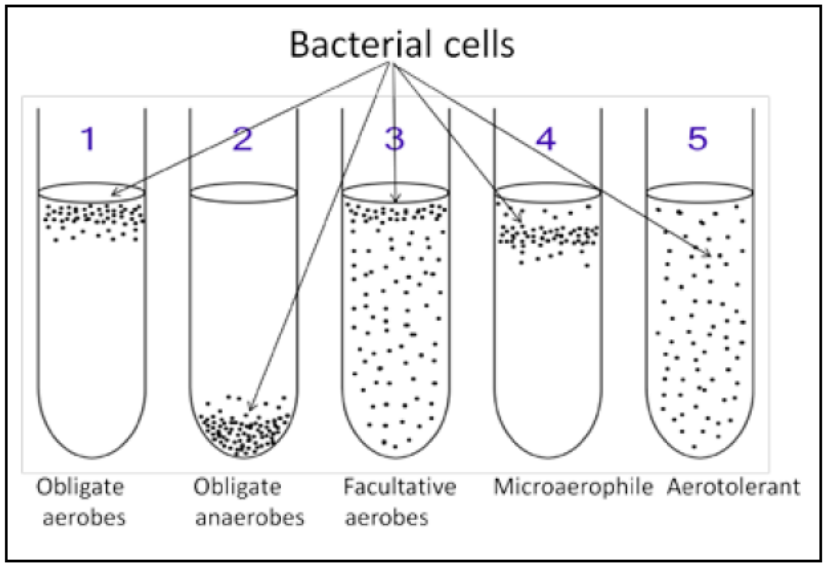
Microorganisms

Aerobes

Anaerobes

Facultative anaerobes

Microaerophilic



MOISTURE

Foods

1. What is the moisture content of the food?
2. How about the water activity of the food?
3. What is the storage condition?

Microorganisms

1. Most bacteria and fungi love high moisture foods.
2. Potential spore-formers in dry condition. E.g. *Bacillus, Clostridium*
3. Water activity?

   Most bacteria: > 0.91

   Most yeast: > 0.88

   Most mould: > 0.80

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Mars recalls chocolates over salmonella fear

9 June 2017 Shar

Then, how about this??

The Telegraph

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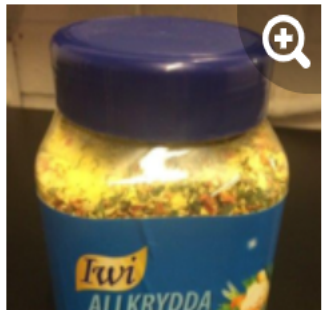
Salmonella scare hits Cadbury's chocolate

More than 150 people have been sickened by Salmonella in Sweden with authorities linking the illnesses to spice mix.

Folkhälsomyndigheten (the Swedish public health agency) said 153 people have been reported in the outbreak of Salmonella Enteritidis which started in December from spice mix (Allkrydda) and some had been hospitalised.

The agency said it is normally di
cause was a food with a long sh



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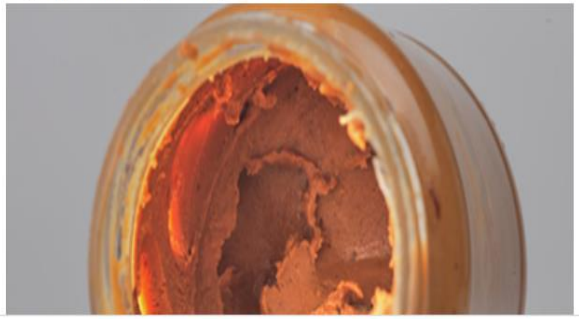
CDC: Salmonella Outbreak May Be Linked to Recalled Nut Butters

By Cathy Siegner on December 2, 2015

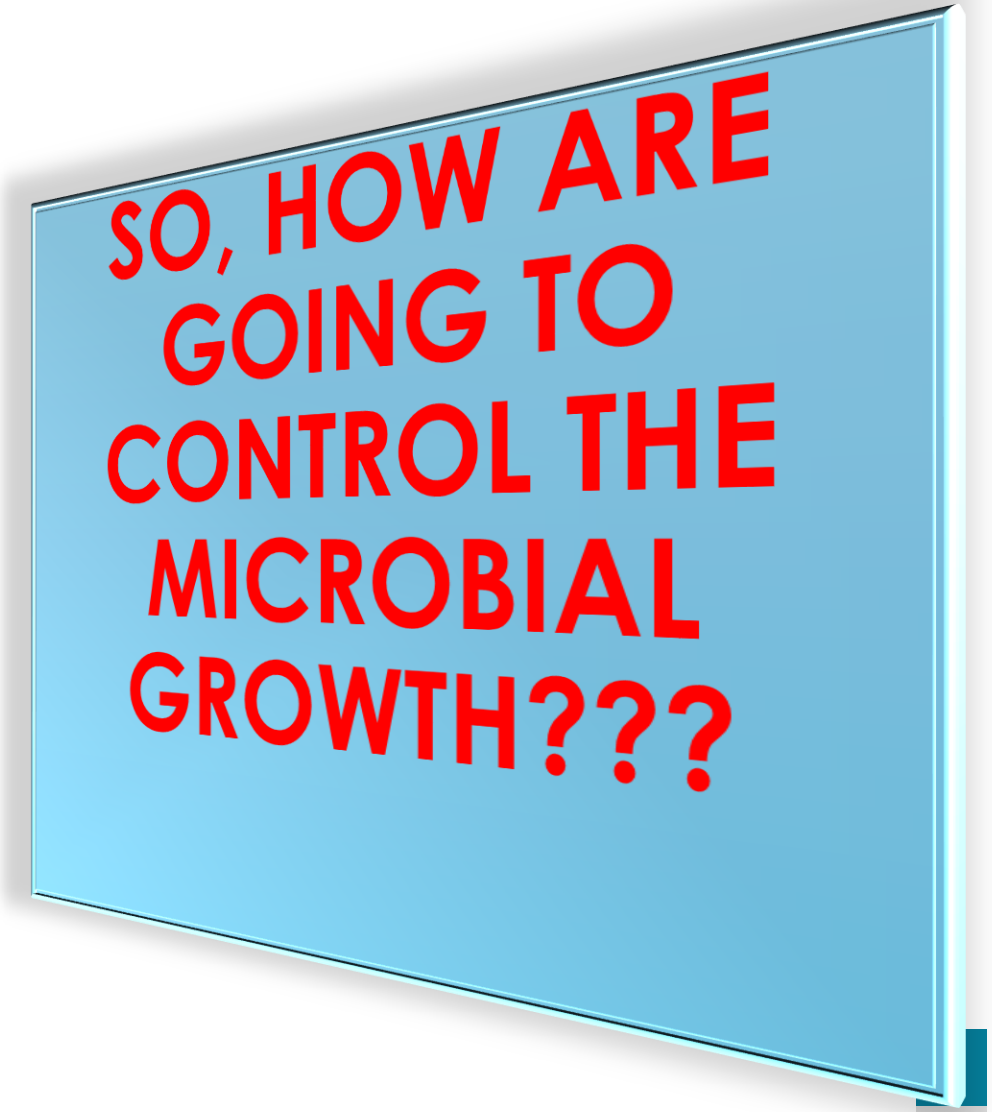
A U.S. Centers for Disease Control and Prevention (CDC) investigation is underway into 11 *Salmonella* illnesses in nine states which may be linked to recently recalled nut butters. The initial outbreak announcement will be posted sometime Thursday, Dec. 3, Laura Burnworth, a CDC health communication specialist, told **Food Safety News**. The confirmed cases are being reported from Oregon (3), she said, with one each in California, Colorado, Georgia, Hawaii, Idaho, Illinois, North Carolina and New Jersey. The *Salmonella* serotype has been identified as Paratyphi B variant L(+) tatrate(+), which used to be called *Salmonella* Java. That is



us_SE....jpg | campylobacter jeju....jpg | 800px-Salmonella....png | 5613656967_96

OTHER FACTORS….

1. Physical damage
2. Cross-contamination
3. Surface contact area
4. Normal flora
5. Environment
6. Antimicrobial agents
7. Season



Topics in Foodborne Pathogens

Topic
Introduction to foodborne pathogens
Salmonella spp.
E. coli
Vibrio spp.
Cronobacter sakazakii
Yersinia enterocolitica
Campylobacter jejuni & coli
Aeromonas spp.
Viruses
Mycotoxigenic fungi

Topic
Outbreak investigation
Identification method
Listeria monocytogenes
Staphylococcus aureus
Bacillus cereus
Clostridium perfringens
Clostridium botulinum
Protozoa
Helminth


“
FOOD SAFETY INVOLVES EVERYBODY IN THE FOOD CHAIN
-Mike Johanns, US Senator
”

THANK YOU