Contamination What causes it?

Food Safety Hazards Biological, Chemical and Physical

4

Food Safety Hazards

- Learning Objectives:
  - Causes of contamination
  - What is the difference between an infection, an intoxication, and a toxin-mediated infection as classes of foodborne illness?
  - What are three types of hazards associated with foodborne illness?
  - What foods need Time/Temperature Control for Safety (TCS)?

Food Safety Hazards

Learning objectives:

- Who is at risk?
- What conditions do bacteria need to grow?
- What is the food temperature danger zone?
- How can foodborne hazards be controlled?

Contamination

- Presence of harmful substances in food.
- They might be present unintentionally or intentionally, but most of them occur unintentionally.

- Cross-contamination is the physical movement or transfer of harmful bacteria from one person, object or place to another. Preventing cross-contamination is a key factor in preventing foodborne diseases.

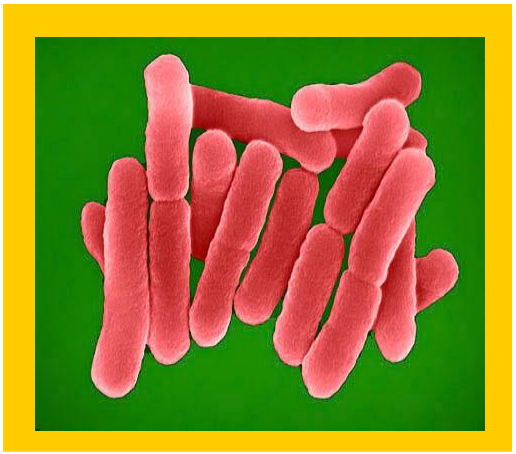
Cross contamination

- Pathogens are transferred from one surface or food to another food or surface
- This can happen in many ways:
  - Ingredients contaminated
  - Nor properly cleaned and sanitized surfaces
  - Poor food handler hygiene practices
- Cooking to correct temperature can prevent a foodborne illness caused by cross contamination

Contaminants

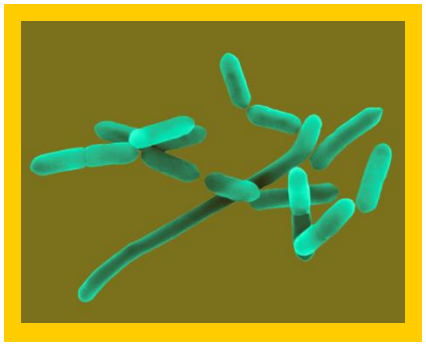
- Can be of biological, chemical o physical origin.
- They are called Biological, Chemical and Physical Hazards.
- They can also occur due to mishandling of food.

Foodborne Hazards Biological



Salmonella

Shiga toxin-producing *Escherichia coli*



Listeria monocytogenes

Biological hazards include:

- Bacteria
- Viruses
- Parasites
- Fungi.

Biological toxins include:

- Seafood
- Mushroom
- Ciguatoxin

Foodborne Hazards Chemical and Physical

Chemical hazard

Physical hazard

Physical hazards in foods typically occur by accident or by poor food-handling practices.

Chemical hazards can be man-made or naturally occurring.

Foodborne Illness

Biological contaminants are the cause of foodborne illness

Foodborne illnesses are classified as:

- Infections
- Intoxications
- Toxin-mediated Infections.

Foodborne Illness

Foodborne illnesses are classified as:

- **Infections** - *is an illness caused by eating food that contains living disease-causing microorganisms, such as bacteria and viruses. Once inside the human body, the organism grows in number and produces symptoms such as vomiting and diarrhea.*

Foodborne Illness

Foodborne illnesses are classified as:

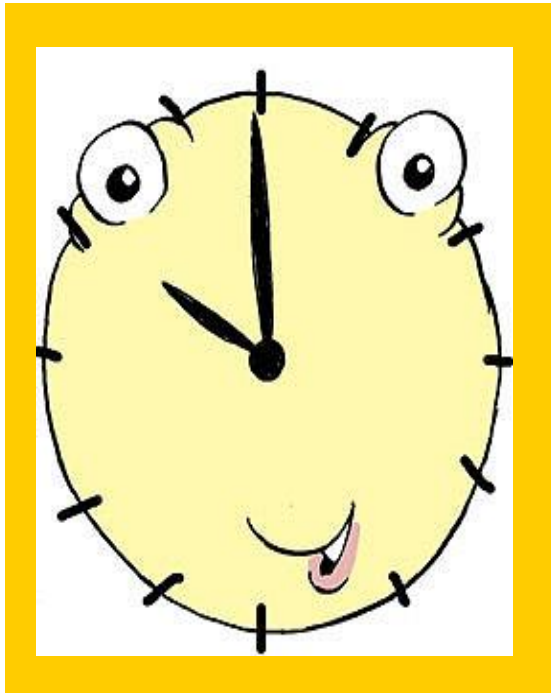
- **Intoxications** is an illness caused by eating food that contains a harmful chemical or toxin. Intoxications are caused by consuming chemical toxins that have been produced as waste products by bacteria that grow in or on food.

Foodborne Illness

Foodborne illnesses are classified as:

- **Toxin-mediated Infections** - is an illness caused by eating food that contains living microorganisms that produce a toxin once they get inside the human body. A toxin-mediated infection is different than an intoxication because the toxin is produced inside the human body.

Onset Time



The onset time for foodborne illnesses can vary from a number of minutes to a number of days.

Onset times will vary with pathogen, amount eaten, age, health condition.

Highly Susceptible Populations - HSP

- Anyone can become ill from eating contaminated foods, however, it can be life threatening for some people!
- Defined as persons who are more likely than other to people in the general population to experience foodborne disease

Highly susceptible populations

Highly Susceptible/Risk Population *

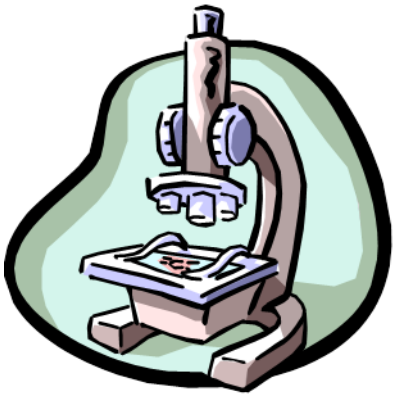
- Infants and young children, the elderly, those with suppressed immune systems such as auto-immune deficiency syndrome (AIDS), cancer, diabetes, and people taking medications.
- Those obtaining food at a facility that provides such as custodial care, health care, assisted living, adult or child day care., kidney dialysis center, hospital and nursing homes, senior citizens centers.
- * 2013 FC

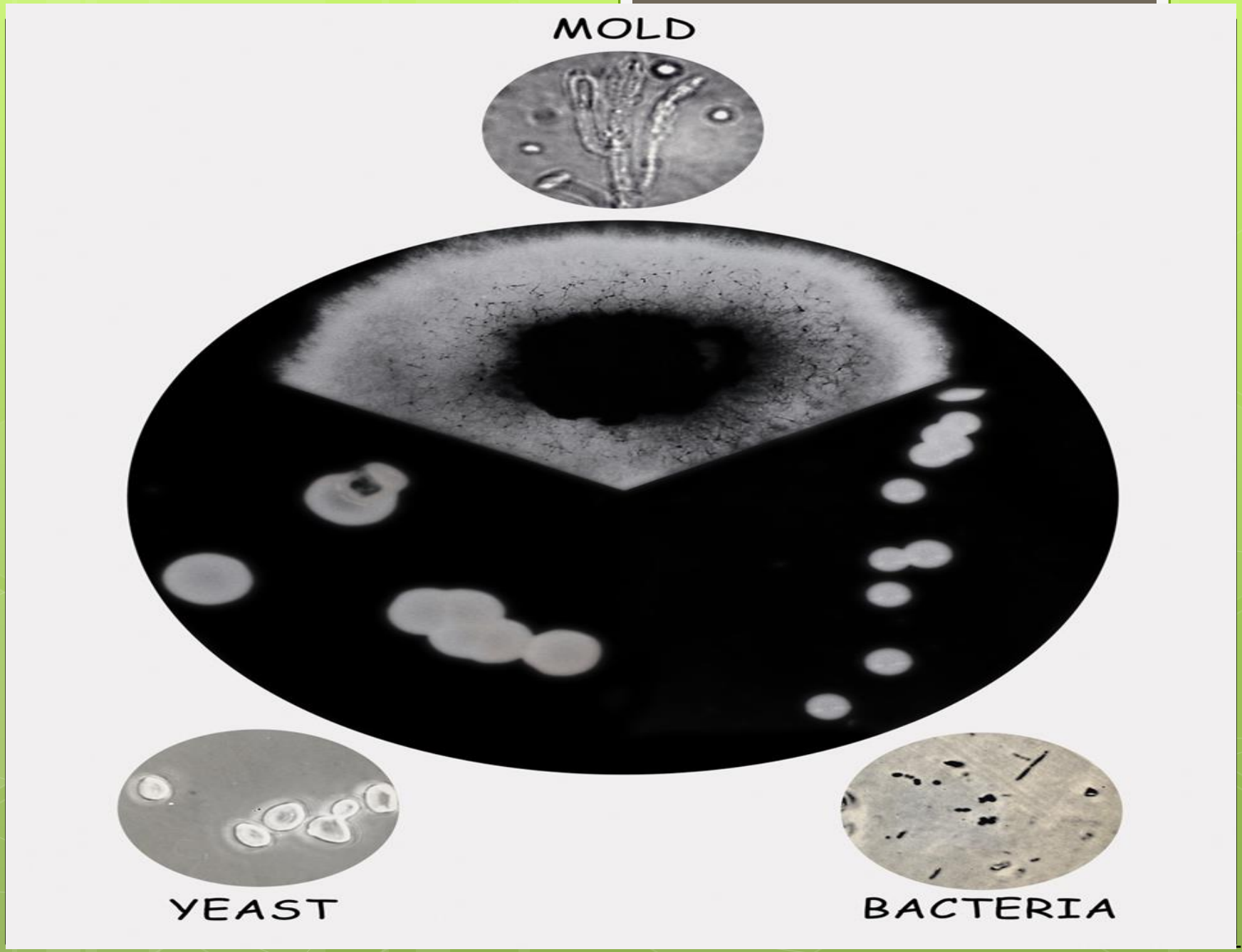
Lets learn about most common biological hazards- Big 6 +

Characteristics
FATTOM

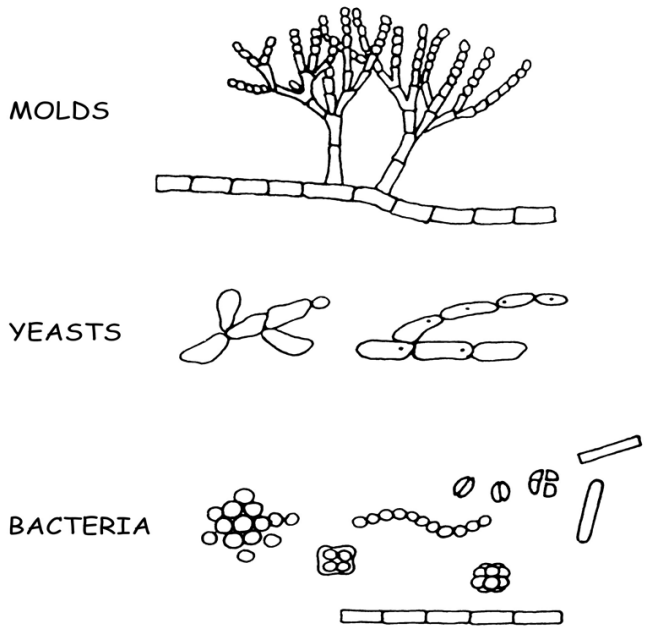
Biological hazards

- Microorganisms are the principal cause of foodborne diseases
- Bacteria and viruses are responsible for more cases of foodborne diseases than any other hazard.
- They are so small that can not be seen without the use of a microscope




MOLD
YEAST
BACTERIA

Microorganisms have different forms and shape



- They have different form
- Some are sporeformers
- Some are round, bacillus,
- Some have

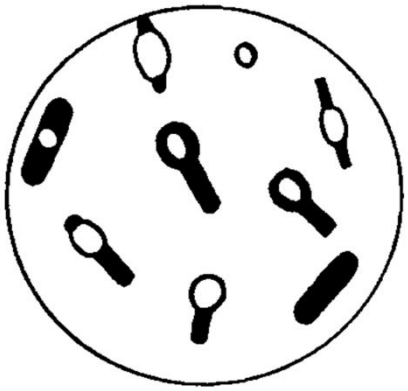
Are all microorganisms bad? NO !!!

- Not all are bad
- Some are used to produce food such as bread, wine, beer, yogurt, sauerkraut
- Others affect the quality but do not make us sick
  - Affect color, texture, flavor, ferment them
- Pathogens – Microorganisms that make us sick
  - Although there are more than 30 pathogens, the FC 2013 focus in the Big 6

Bacteria, Sporeforming vs. Non-Sporeforming

Bacteria are classified as sporeforming and non-sporeforming.

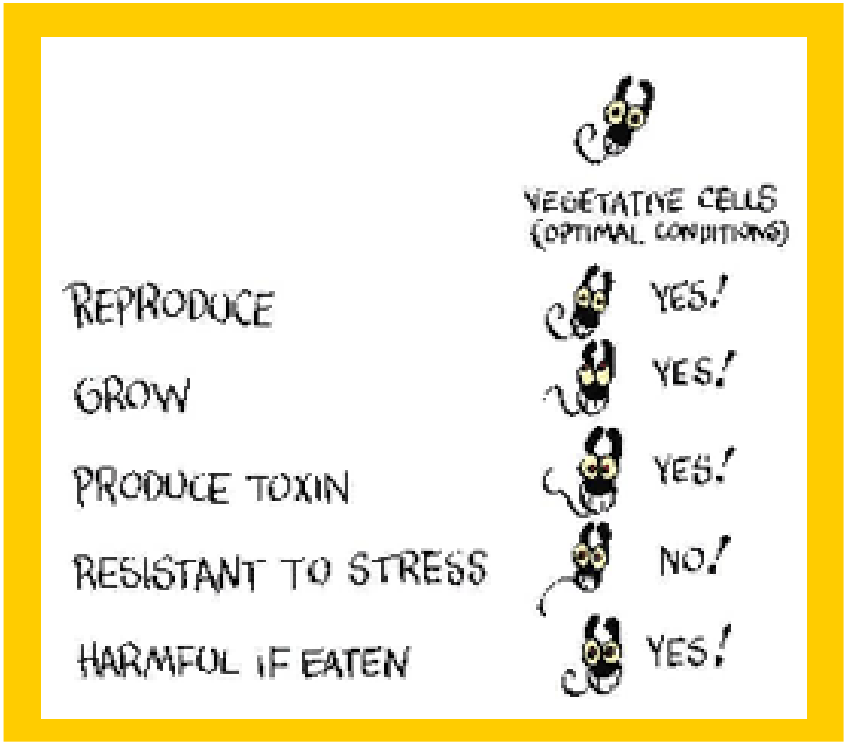
Spore formers



- More resistant to heat, dry, and chemicals.
- Which means they can survive stress as heat, dryness and chemicals and grow when stress is removed.

Bacteria — Characteristics

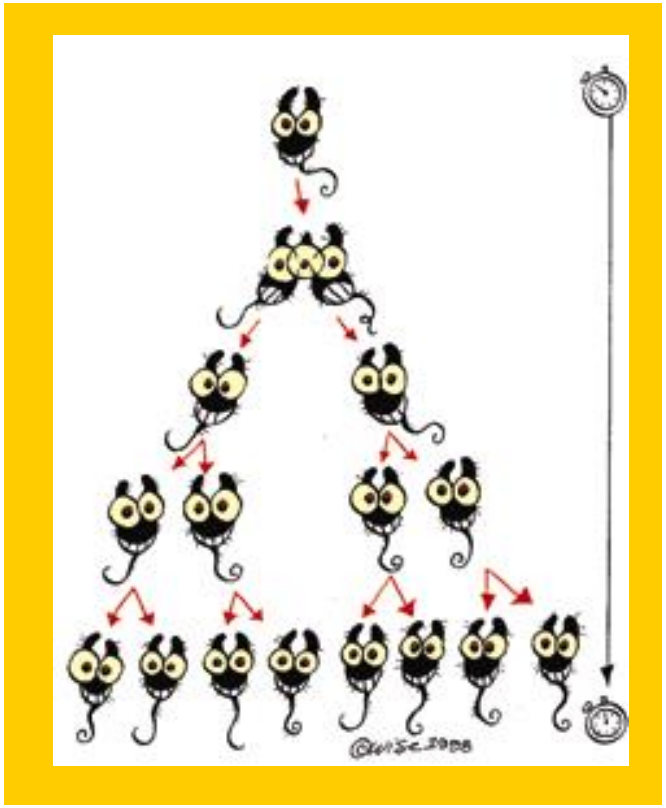
- Bacteria that are spore formers, developed the spore to help them survive adverse conditions: heat, dry, chemicals
- Only bacteria in the vegetative stage can cause a foodborne disease if conditions are favorable for their reproduction



Vegetative cells

Bacterial Growth

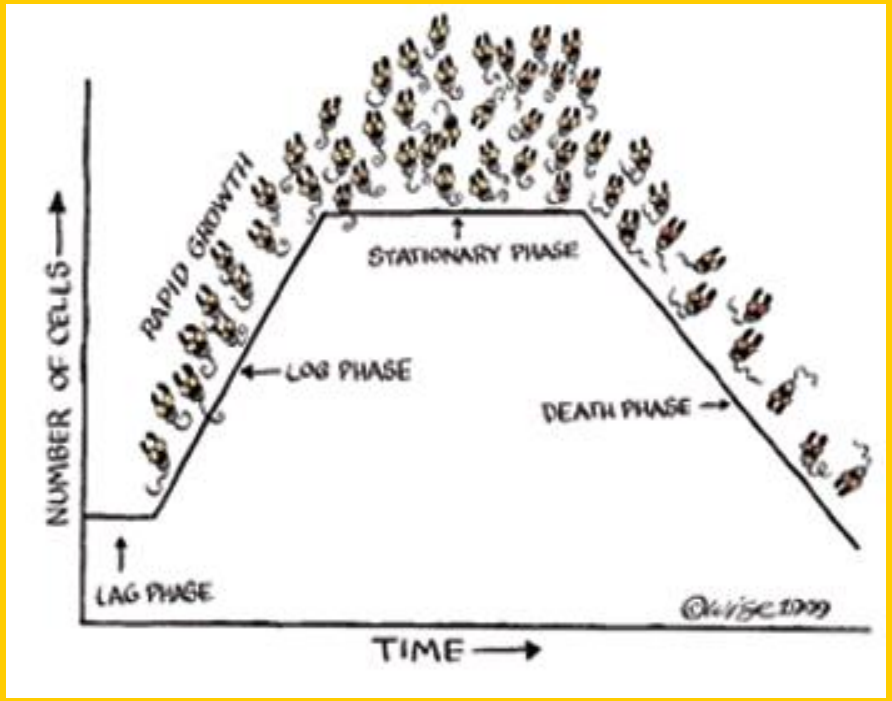
Vegetative bacteria reproduce through binary fission – each cell divides to form two new cells.



Bacterial Growth Curve

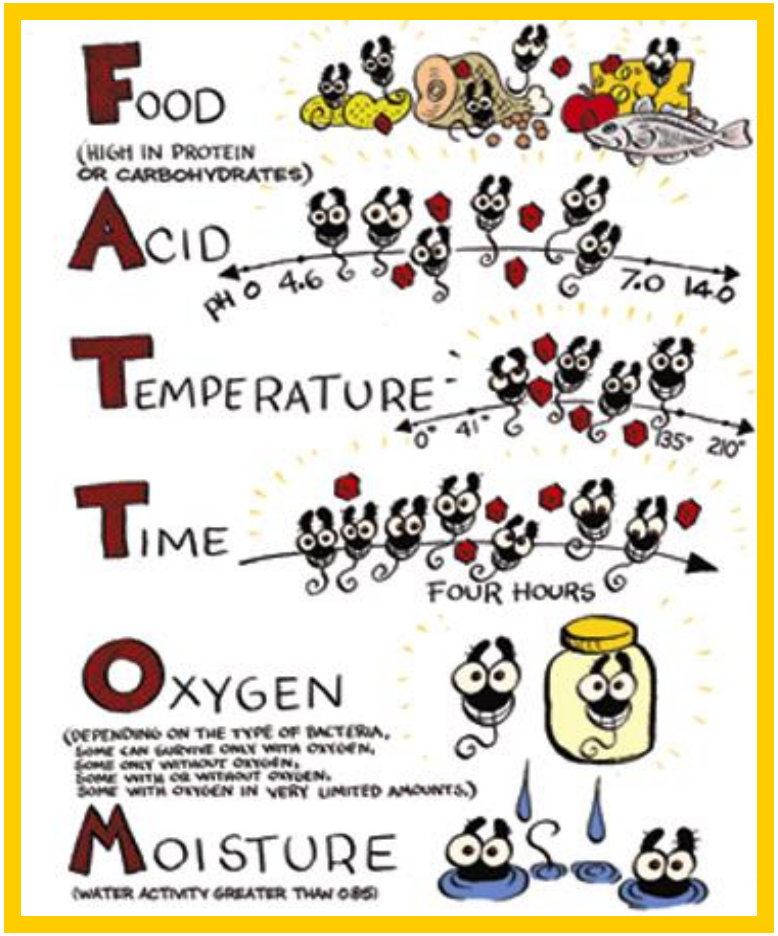
Bacteria life cycle

1. Lag phase.
2. Log phase.
3. Stationary phase.
4. Death phase.



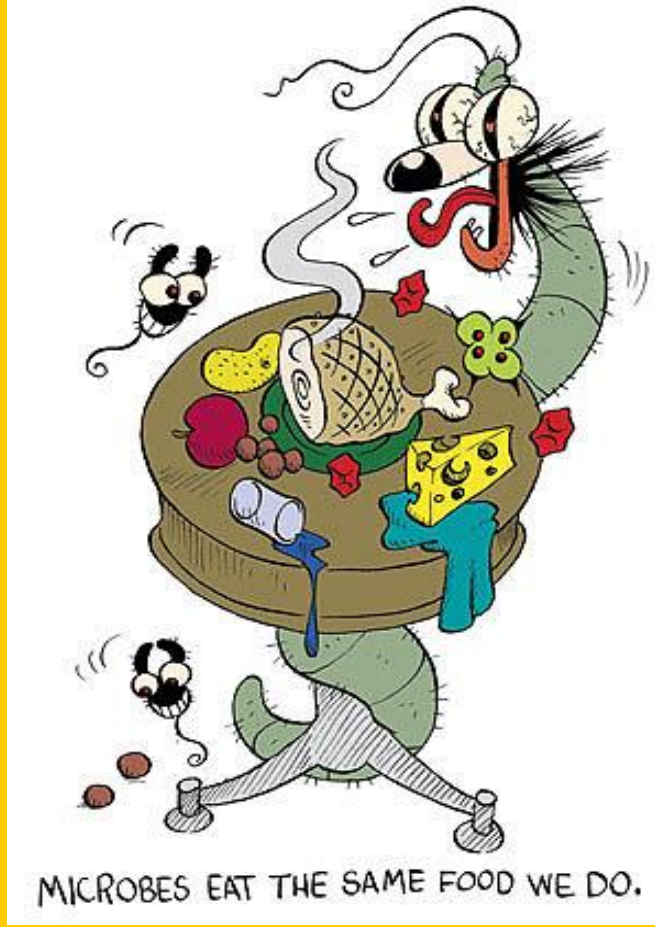
Bacterial Growth: *FATTOM*

What bacteria need to grow?



Bacterial Growth: *Food*

Bacteria prefer foods that are high in proteins or carbohydrates!



Ready-To-Eat Foods

Ready-to-eat foods can become contaminated if they are not handled properly.

Ready to eat food

- Food that can eaten without further preparation, washing, cooking
- Examples are:

Food that require Time/temperature Control for Safety - TCS

- Available water (aw), acidity (pH), redox potential (Eh). etc.
- Epidemiological evidence associates TCS food with foodborne outbreaks
- Additional information of TCS food is included separately

- Milk and dairy products

- Shell eggs (except those treated to eliminate *Salmonella* spp.)

- Meat: beef, pork and lamb

- Poultry

- Fish

- Shellfish and crustaceans

- Baked potatoes

- Heat-treated plant food, such as cooked rice, beans and vegetables

- Tofu or other soy protein
- Synthetic ingredients, such as textured soy protein in meat alternatives

- Sprouts and sprout seeds

- Sliced melons
- Cut tomatoes
- Cut leafy greens

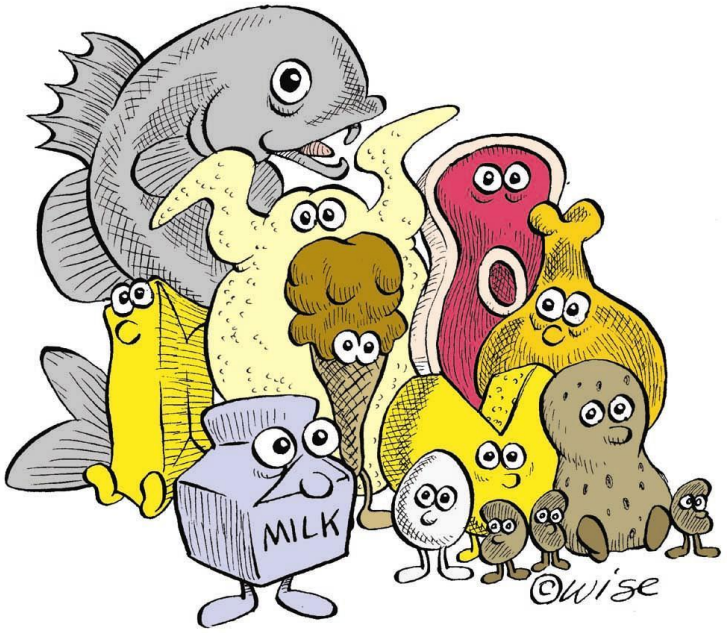
- Untreated garlic-and-oil mixtures

http://www.restaurant.org/Restaurant/media/Restaurant/SiteImages/MMR/Food%20and%20Nutrition/TCFfoods.jpg

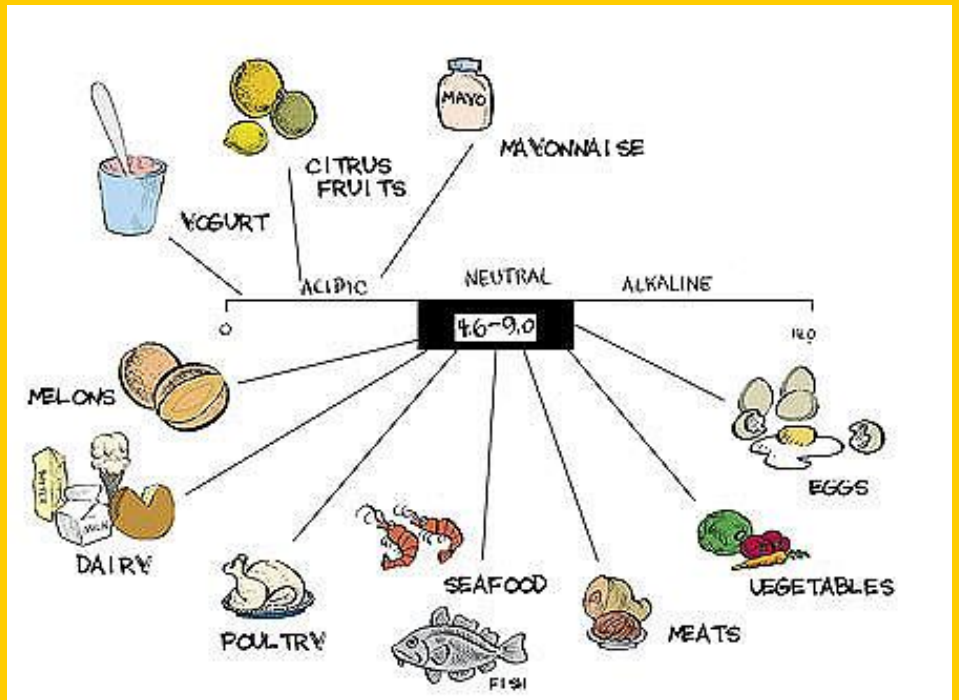
TCS Foods are

Time/Tempertature Control for Safety Foods are:

- High in protein or carbohydrates
- High in moisture
- Low in acidity.



Bacterial Growth: *Acid*



pH levels of food vary.

Disease-causing bacteria grow best in a mildly acidic environment (pH level of 4.6 to 7.0).

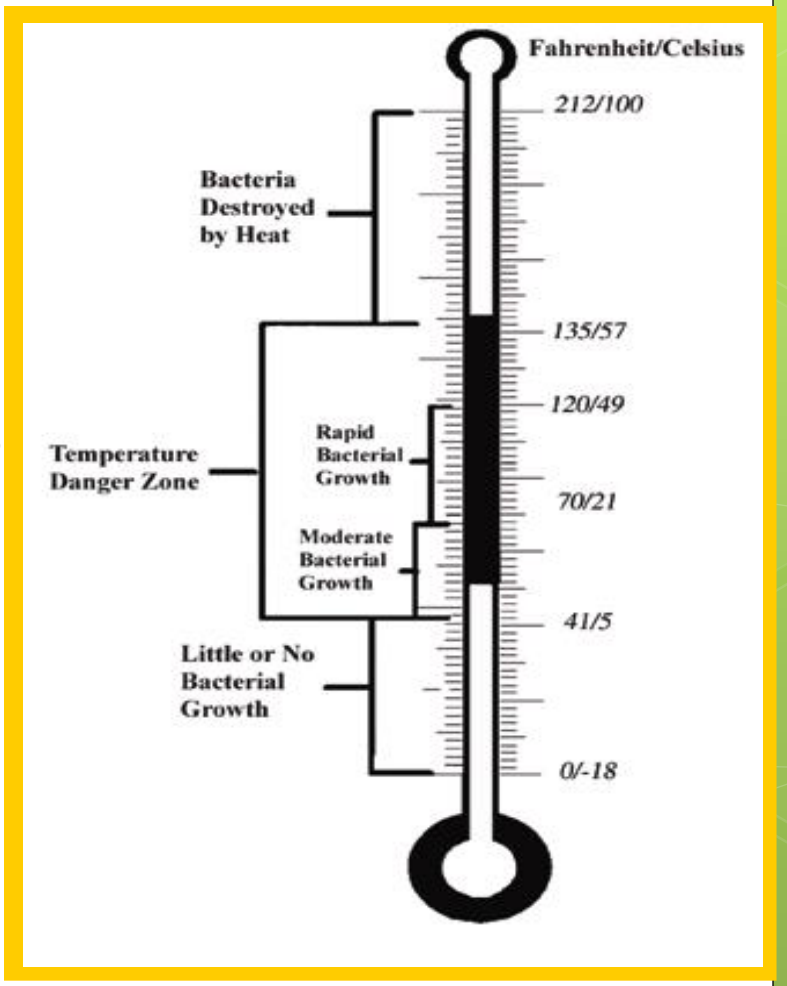
Approximate pH for several foods

Lemon Juice	2.0 - 2.6
Apples	3.1 - 4.0
Blueberries	3.1 - 3.3
Sauerkraut	3.3 - 3.6
Orange Juice	3.3 - 4.2
Pineapple, canned	3.4 - 4.1
Apricots	3.3 - 4.0
Tomatoes, canned	3.5 - 4.7
Peaches, canned	3.7 - 4.2
Pears, canned	4.0 - 4.1
Bananas	4.5 - 5.2
Beets, canned	4.9 - 5.8
Asparagus, canned	5.0 - 6.0
Beef	5.1 - 7.0
Carrots	4.9 - 5.2
Peppers, green	5.2 - 5.9
Papaya	5.2 - 6.0
Tuna	5.2 - 6.1
Sweet Potatoes	5.3 - 5.6
Onions	5.3 - 5.8
White Potatoes	5.4 - 5.9
Spinach	5.5 - 6.8
Beans	5.6 - 6.5
Peas, canned	5.7 - 6.0
Corn, canned	5.9 - 6.5
Soy Beans	6.0 - 6.6
Mushrooms	6.0 - 6.7
Clams	6.0 - 7.1
Salmon	6.1 - 6.3
Coconut milk	6.1 - 7.0
Milk	6.4 - 6.8
Garbanzo Beans	6.4 - 6.8
Chicken	6.5 - 6.7
Eggs, whole	7.1 - 7.9

Bacterial Growth:
Temperature

Bacteria grow best between 41°F (5°C) and 135°F (57°C).

To keep foods safe, keep them out of this "Temperature Danger Zone!"



Bacterial Growth: *Time*

Under ideal conditions, bacterial cells can double every 15 to 30 minutes.

Time	0	15 min.	30 min.	60 min.	3 hrs.	5 hrs.
						
# of cells	1	2	4	16	>1000	>1 million

Bacteria need about four hours to grow to high enough levels to cause illness.

Bacterial Growth: *Oxygen*

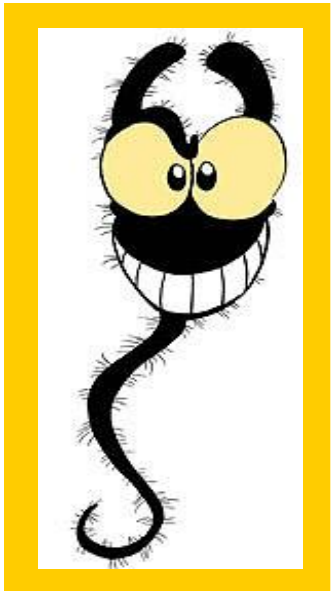
Regardless of available oxygen, some disease-causing bacteria will find the conditions suitable for growth.

Aerobic – requires oxygen to grow

Anaerobic – grow in the absence of oxygen. Can grow in ROP

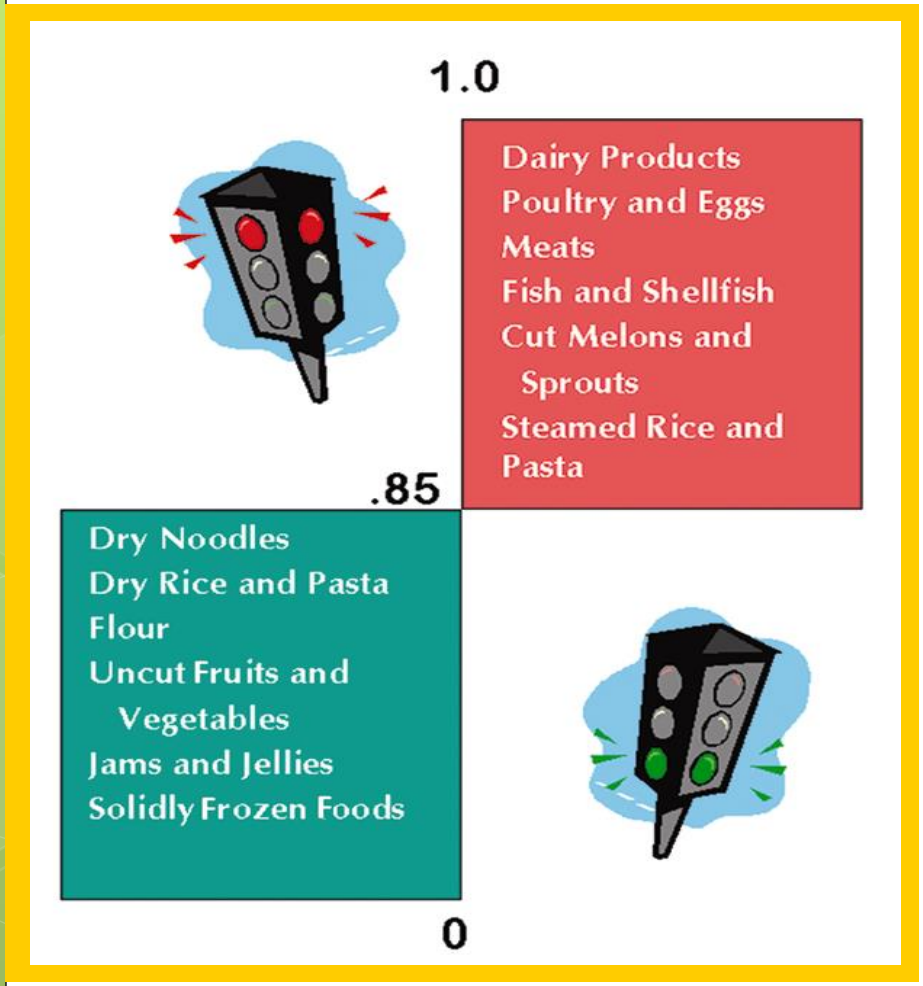
Facultative anaerobic

can grow in either conditions



- **Aerobic**
- **Anaerobic**
- **Facultative anaerobic**

Bacterial Growth: *Moisture*

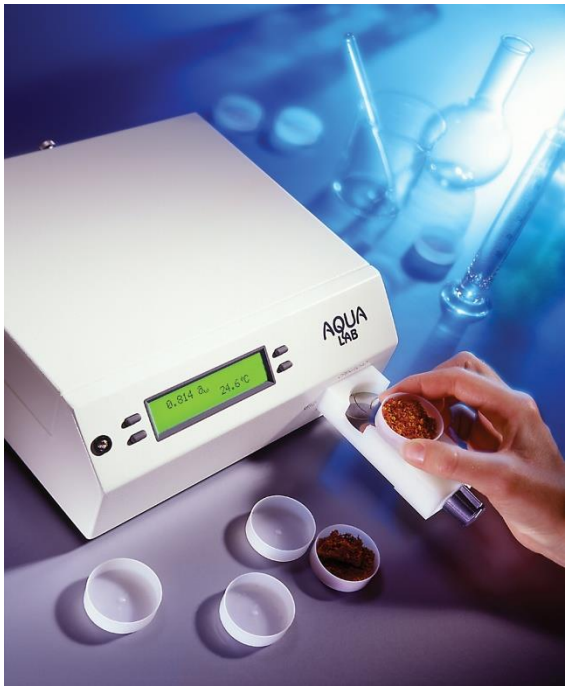


Water activity A_W

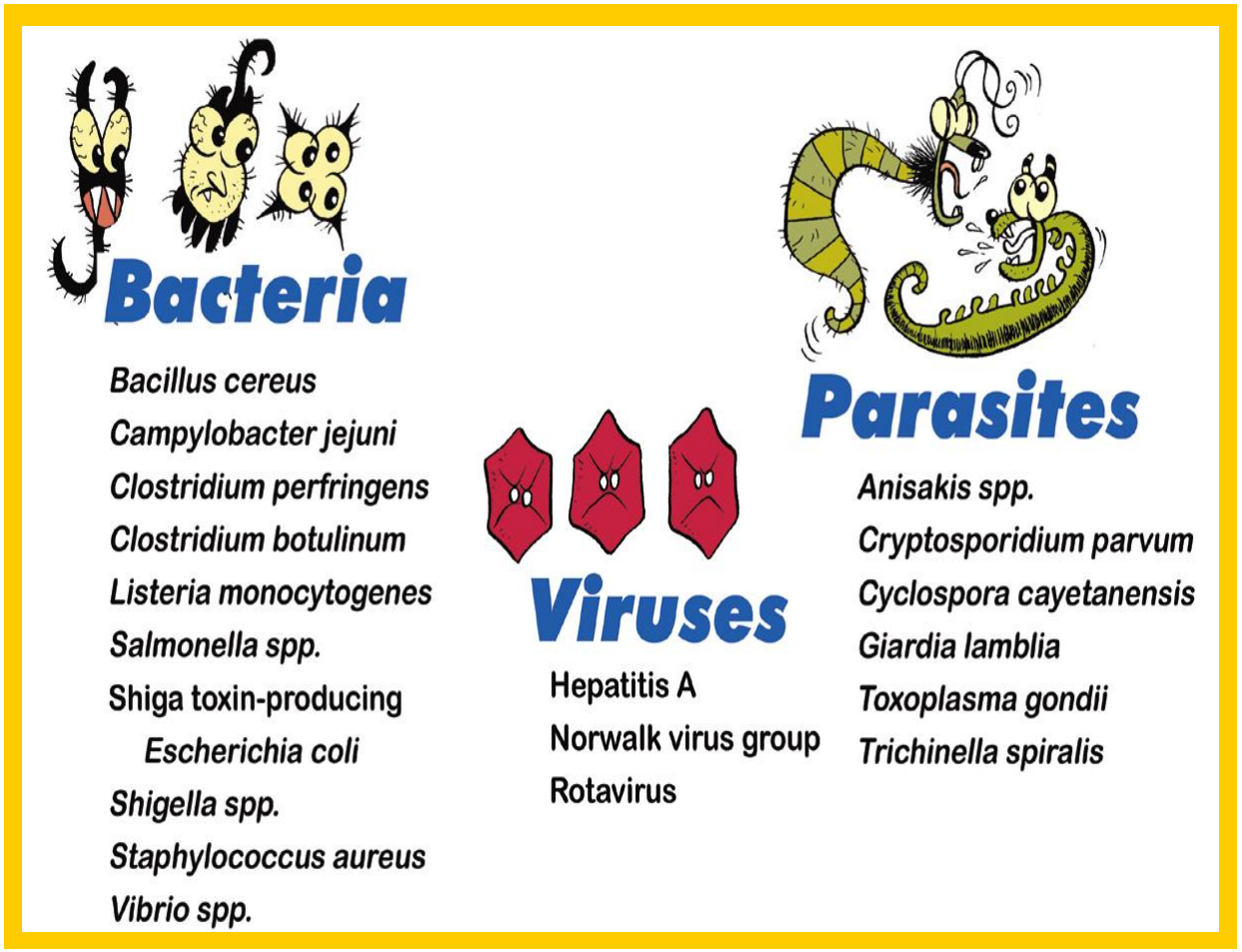
Disease-causing bacteria can only grow in foods that have a water activity (A_w) higher than .85.

A water activitiy meter is used to measure aw in foods

- To learn more about water activity go to resources / references



Biological Hazards



Types of biological hazards

Common biological hazards include:

- Bacteria
- Viruses
- Parasites
- Fungi.

According to FDA and Food Code 2013

Six pathogens (the Big six) have been distinguished as highly contagious and can cause severe illness:

- *Shigella* spp.
- *Salmonella* Typhi
- NonTyphoidal Salmonella *(NTS)*
- *Shiga Toxin Producing Escherichia coli (STEC)*
- *Hepatitis A*
- *Norovirus*

Lets discuss the Big Six and prevention actions

Then additional discussion on additional pathogens that causes foodborne diseases

FDA Identified….

- Four bacteria as highly contagious and can cause severe illness
  - *Salmonella* Typhi
  - Nontyphoideal *Salmonella* *(NTS)*
  - *Shigella* spp.
  - Shiga toxin-producing *E. coli* (STEC)

FOOD HANDLERS diagnosed with illness from any of these bacteria can never work in food service operation while they are sick

Shiga toxin-producing *Escherichia coli -STEC*

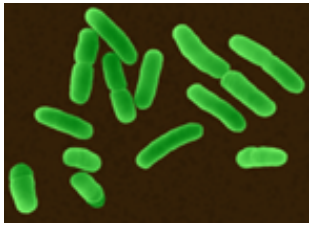
Source: Commonly found in intestine of cattle and infected people. Can be in persons feces for weeks with symptoms

Food associated: Ground beef (raw or undercooked), contaminated produce

Prevention:

- Exclude food handlers who have diarrhea or diagnosed with disease
- Cook to minimum temperature
- Purchase from approved supplier
- Prevent cross contamination

Unpasteurized apple cider



Shigella spp.

Ready-to-eat salads

Accounts for about 10% of foodborne illnesses in the United States and are commonly found in:

Source: Intestines of humans with the disease

Food Associated: Food in contact with contaminated water Ready-to-eat salads, Food easily contaminated with hands

Prevention: Exclude food handlers who have diarrhea or diagnosed with *Shigella*, Hand washing,

Control or flies in and out the operation

Salmonella Typhi

- **Source:** Bacteria only lives in humans
  - People with typhoid fever carry the in their bloodstream and intestinal tract
  - Can be present in feces for weeks without symptoms
- **Food Associated**: Ready to eat food and beverages
- **Prevention:**
  - Exclude food handlers who have been diagnosed with disease caused by Salmonella Typhi
  - Hand washing
  - Cook food to internal temperatures

Non Typhi *Salmonella*

Source: Commonly found in:
Intestinal tracts of farm animals and humans. The bacteria can be in persons' feces for weeks with symptoms.

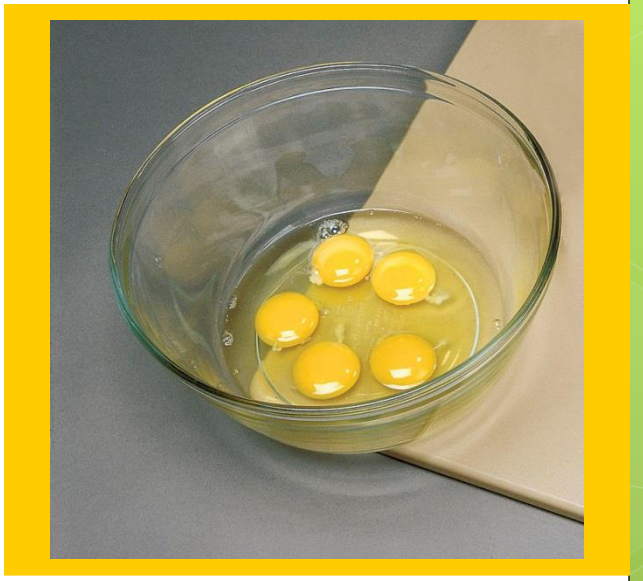
Food Linked: Poultry, eggs. Milk, dairy, tomatoes, peppers, cantaloupes

Prevention:

Exclude food handlers that have been diagnosed with NTS.

Prevent cross contamination

Cook at minimum temperature



Viruses Differ from Bacteria

Foodborne Diseases Caused by Viruses

Hepatitis A virus

Norwalk virus

Rotavirus

Viruses

- The viruses that cause foodborne disease are much smaller than bacteria,
- They require a living host (animal or plant) to grow multiply.
- Can be transferred by food and remain infectious in food

Sources

- Norovirus can be transmitted by airborne vomit particles
- Fecal-oral routes.
- Food, water and any contaminated surface

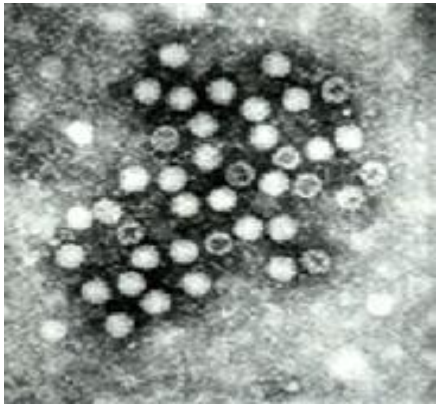
Viruses

- Viruses differ from bacteria.
  - Are smaller than bacteria
  - Do not grow on foods
  - Can cause illness with only a few viral particles
  - Most foodborne illness are caused by virus and bacteria
  - FDA identified Hepatitis A virus and Norovirus that are highly contagious and cause severe illness
  - FOOD HANDLERS diagnosed with illness from any of these viruses can never work in food service operation while they are sick

Hepatitis A virus

Sources are:

- Contaminated or polluted water
- Infected food employees.
  - May not show symptoms for weeks but can be very infectious

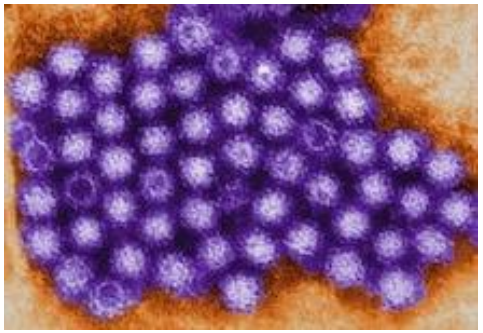


Do not handle food if you are infected with Hepatitis A virus.

Hepatitis A

- Preventive measures
- Exclude food handlers who have Hep A or have had jaundice for 7 days or less
- Wash hands correctly
- Avoid bare hand contact with RTE food
- Purchase shellfish from approved supplier

Norwalk Virus & Rotavirus



Clams

Sources Norovirus

Transfer by infected food handler that touches food or equipment

Very contagious

Eating small amount can make you sick

Commonly found in raw and undercooked seafood from contaminated water

Ready to eat

Prevention actions for Norovirus

- Exclude employees that are vomiting, or have diarrhea or were diagnosed with Norovirus
- Wash hands correctly
- Avoid bare-hands contact with RTE food
- Purchase shellfish from approved, reputable supplier.

Other important pathogens include

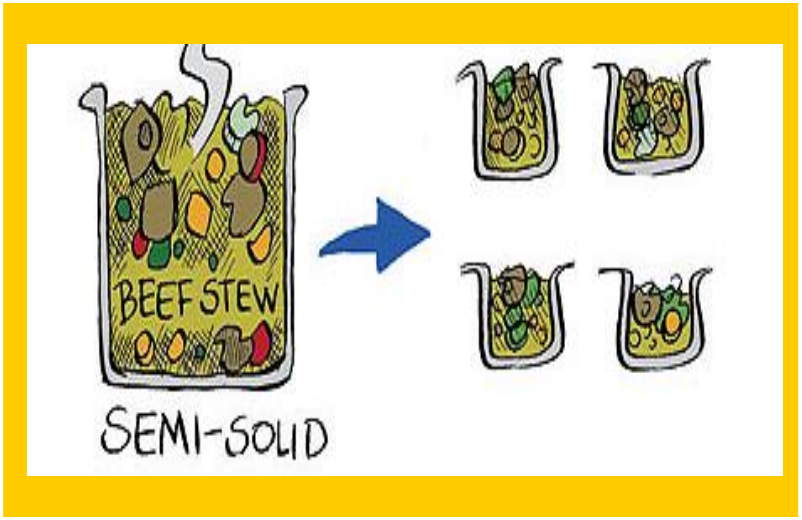
Bacillus cereus

Bacillus cereus is commonly found in:

- Rice
- Pasta
- Potatoes
- Meats and fish
- Milk
- Vegetables.

Cooked rice

Clostridium perfringens



Cool foods properly.

Clostridium perfringens can be commonly found in:

- Gravy
- Foods commonly grown in soil
- Vegetables
- Meats
- Spices.

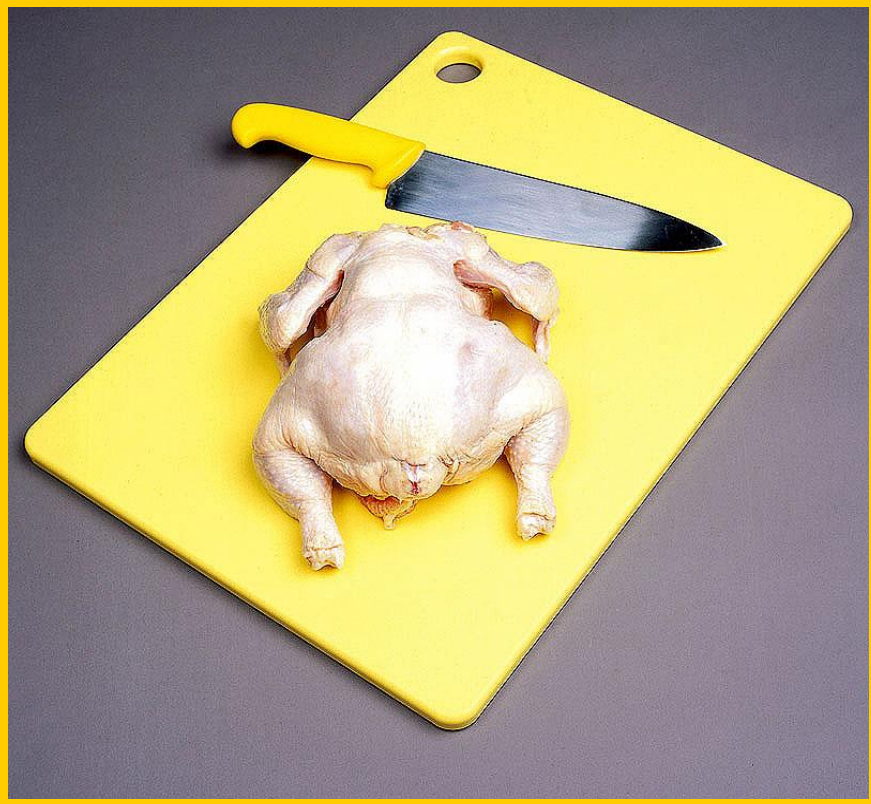
Clostridium botulinum

Clostridium botulinum can commonly be found in:

- Improperly home-canned foods
- Vacuum-packed refrigerated foods
- Garlic or onions stored in oil.
- Temperature abused baked potatoes

Campylobacter jejuni

It is estimated that 100% of raw poultry is infected with *Campylobacter jejuni.*



Raw poultry

Listeria monocytogenes

Hot dogs

is commonly found in:

- Ready-to-eat meats (luncheon meats and hot dogs)
- Raw meats
- Raw poultry
- Dairy products
- Raw vegetables
- Raw seafood
- Seafood salads.

Staphylococcus aureus

Pre-cooked, ready-to-eat foods

Can commonly be found in:

- Pre-cooked, ready-to-eat foods that have been re-contaminated by food employees
- Vegetable and egg salads
- Milk and dairy products
- Foods that require considerable food preparation and handling
- Food Handler

Vibrio spp.

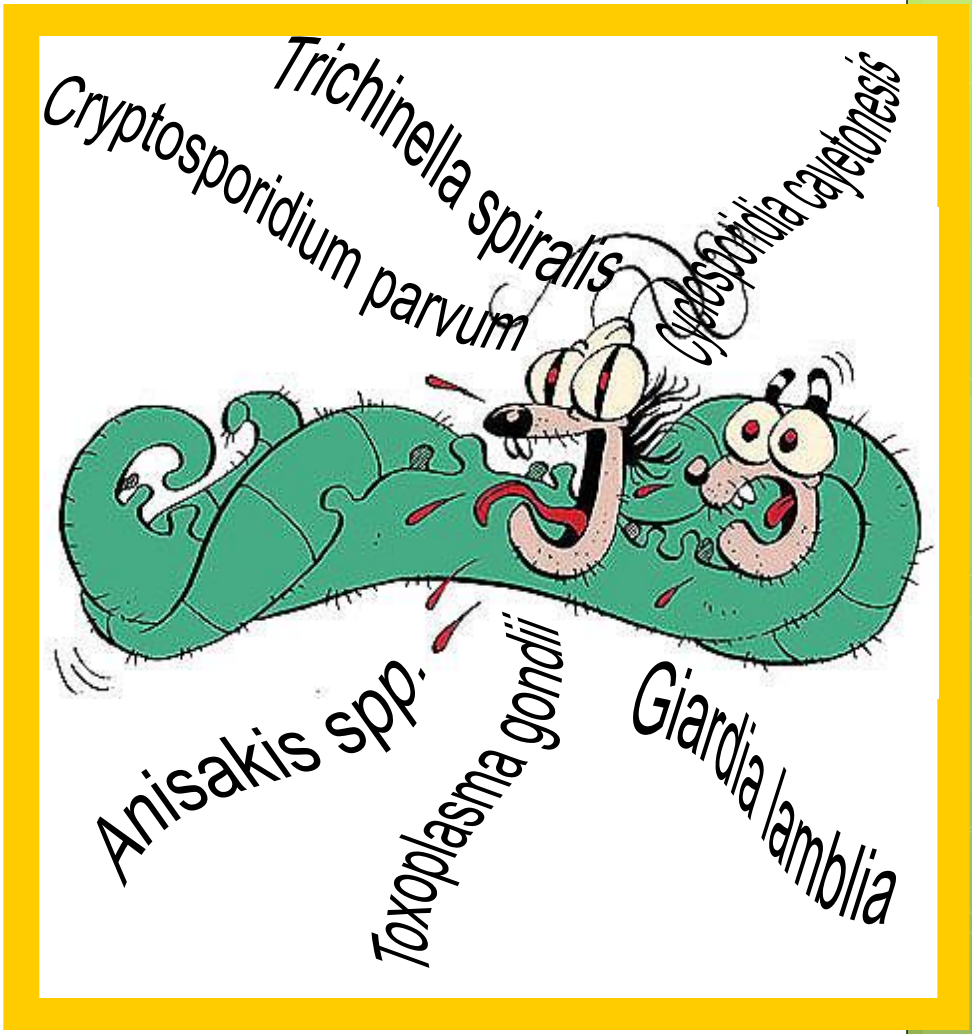
Vibrio spp. is commonly found in seafood such as:

- Fish
- Oysters
- Crabs
- Shrimp
- Clams
- Lobster.

Handle seafood carefully.

Parasites

Parasites are small or microscopic creatures that need to live on or in another living organism to survive.



Parasites

Anisakis spp.

Salmon

Anisakis spp. is commonly found in bottom-feeding fish such as:

- Salmon
- Cod
- Haddock.

Cyclospora cayetanensis

Strawberries and raspberries

is commonly found in contaminated:

- Water
- Raspberries
- Strawberries
- Fresh produce.

Cryptosporidium parvum & Giardia lamblia

Are transferred by:

- Contaminated water
- Infected employees.

Employees need to be clean.

Toxoplasma gondii

Is commonly found in:

- Red Meats, especially:
  - Pork
  - Lamb
  - Venison

Trichinella spiralis

Trichinella spiralis is commonly found in:

- Pork
- Wild game meats.

Pork

Prevention measures for parasites

- Purchase from approved, reputable supplier
- Cook to required minimum temperature
- Frozen correctly by manufacturer

FOOD SAFETY PROGRESS REPORT FOR 2013

Disease Agents	Percentage change in 2013 compared with 2006–2008	2013 rate per 100,000 Population	2020 target rate per 100,000 Population	CDC estimates that...
Campylobacter	13% increase	13.82	8.5	For every *Campylobacter* case reported, there are 30 cases not diagnosed
Escherichia coli O157	No change	1.15	0.6	For every *E. coli* O157 case reported, there are 26 cases not diagnosed
Listeria	No change	0.26	0.2	For every *Listeria* case reported, there are 2 cases not diagnosed
Salmonella	No change	15.19	11.4	For every *Salmonella* case reported, there are 29 cases not diagnosed
Vibrio	75% increase	0.51	0.2	For every *Vibrio parahaemolyticus* case reported, there are 142 cases not diagnosed
Yersinia	No change	0.36	0.3	For every *Yersinia* case reported, there are 123 cases not diagnosed

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

For more information, see http://www.cdc.gov/foodnet/

Preliminary FoodNet 2013 Data

April 2014

CS246920

Fungi: Molds, yeast and mushrooms

- Fungi
  - Spoilage organisms that can cause food to spoil
  - Many produce toxins (mycotoxins) that may be carcinogenic, cause acute illness or even death.

Biological Toxins

- Natural origins – like poison mushrooms, plants and seafood.
- Some toxins are part of some fish
- Histamine is produced by pathogens on the fish when temperature abuse
- Ciguatoxin – Fish eat smaller fish that have eaten a toxin
- Oyster can be contaminated by eaten marine algae that contain toxin
- Cooking will not destroy them

Symptoms of illness

- Usually occur in minutes
- Can include:
  - Vomiting
  - Diarrhea
  - Tingling of extremities, hot or cold
  - Reverse hot and cold sensations – ciguatera
  - Flushing of face, hive, difficulty breathing, burning of mouth and heart palpitations

Prevention of biological toxins

- Purchase plants, mushrooms, fish and seafood from reputable supplier
- Check at receiving any signs of temperature abuse
- Avoid known sources of the toxin
- Toxins can not be destroyed by cooking or freezing
- Control of time and temperature when handling raw fish.

"Concepts to remember!"

- Some bacteria can survive in the Temperature Danger Zone.
- Biological hazards can be prevented when proper procedures are followed:
  - Proper Time and Temperature Controls
  - Proper Personal Hygiene and Hand-washing
  - Proper Cleaning and Sanitizing
  - Avoiding Cross Contamination
  - Purchasing from Reputable Suppliers.