

### Food Microbiology 101

Food Sanitation Workshop Nov. 8, 2011  
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- Microorganisms are small, living unicellular or multicellular.
- They include bacteria, viruses, yeasts, molds, and parasites.
- They can be . . .
  - The good
  - The bad, and
  - The ugly!



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### Kinds of Microorganisms

- The Good (or helpful):
  - Add them to foods or they are there naturally.
  - They ferment foods to preserve them and/or create unique flavors and textures.
  - Examples: cheese, yogurt, sour cream, bread, sauerkraut and pickles.



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### Kinds of Microorganisms

- The Bad (or spoilage)
  - Change foods and cause them to “go bad” or spoil.
  - Examples: Discolored, mushy, or fuzzy vegetables; sour milk; and slimy, putrid meat.



FOOD SPOILAGE

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## Kinds of Microorganisms

- The Ugly (disease-causing, pathogenic):

- Illness can range from mild to life-threatening.

- Examples include foods contaminated with *Salmonella* or *E. coli* O157:H7. Common signs and symptoms include nausea, vomiting, and diarrhea.



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## Microorganisms that cause...

### Food spoilage -

- Affect aroma, texture and/or appearance of food

### Foodborne illness -

- May or may not affect sensory characteristics of the food.

**Only laboratory testing can tell if harmful microorganisms or toxins are present – some are difficult to detect or cannot be detected.**

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## Current Problems With Harmful Microbes

- Some people are more vulnerable to foodborne illness:
  - Young children or elderly people.
  - Immuno-compromised individuals.
- New ways of transmitting organisms:
  - Widespread food distribution system.
  - New food formulations and handling practices.
  - Changes in food choices.
- New or evolving pathogens:
  - Example - *E. coli* O157:H7.

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### Where Microbial Pathogens Live

Common in soils...

- Listeria monocytogenes*
- Bacillus cereus*
- Clostridium botulinum*
- Clostridium perfringens*

Residents of human and animal intestinal tracts...

- *Salmonella* species
- *E. coli* O157:H7
- *Shigella* species
- *Campylobacter jejuni*
- Viruses and parasites

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### Microbes That Cause Foodborne Illness

- **Bacteria** – Single-celled organisms that live independently.
- **Viruses** - small particles that live and replicate in a host.
- **Parasites** - intestinal worms or protozoa that live in a host animal or human.



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### Bacteria...

- Cause the greatest number of foodborne illnesses.
- Single-celled organisms that live independently.
- Invisible to the naked eye: Must be magnified 1,000 times to be seen.
- 400 million bacteria are equal to a grain of sugar in size.



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### To Grow & Cause Illness, Bacteria Need:

- Moisture, found in most foods, including fruits and vegetables.
- Nutrients, provided by most foods.
- Warmth, especially room temperature or a little higher.
- Time



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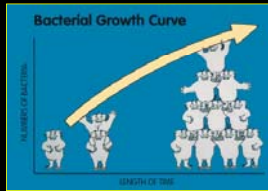
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### Bacteria Increase in Number by Dividing in Two

- With ideal conditions, they double every half hour.
- 1 becomes 2, 2 become 4, 4 become 8, and so on...
- In 12 hours, 1 cell could multiply into 33 million cells!
- Usually you start with many bacterial cells, not just one.



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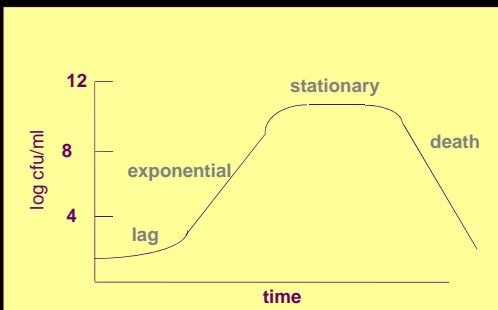
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### The Bacterial Growth Cycle has Four Phases



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### Food Joke # 1

How does the man in the moon eat his food?

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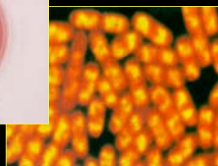
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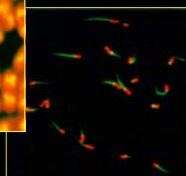
### 3 Harmful Foodborne Bacteria



*E. coli* O157:H7



*Salmonella*



*Listeria*

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### *E. coli* / *E. coli* O157:H7

- *E. coli*: common microbe in animal and human intestinal tracts. →
- Most strains of *E. coli* are not harmful.
- But harmful strains, such as *E. coli* O157:H7, cause severe illness. →



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***E. coli* O157:H7**

- First recognized as human pathogen in 1982.
- Outbreaks often associated with undercooked ground beef.
- Produce associated outbreaks have involved lettuce, unpasteurized apple cider & juice, radish sprouts, and alfalfa sprouts.

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***E. coli* O157:H7**

- Naturally exists in animals without symptoms
  - cattle, sheep, deer, dogs, cats, other animals
- Can contaminate/grow on fresh produce:
  - minimally processed cantaloupe
  - watermelon cubes
  - shredded lettuce
  - sliced cucumbers
  - mesclun lettuce



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**Contamination of Fruits and Vegetables  
by *E. coli* O157:H7**

- Wild or domestic animals.
- Improperly composted animal manure.
- Fruits and vegetables dropped on the ground have a higher chance of being contaminated by manure.
- Water may carry and spread organisms.
- Farm and packing house workers, as well as any food handlers, may also contaminate produce.

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**Foodborne Illness Caused by  
*E. coli* O157:H7**

- Causes severe cramps, bloody diarrhea, vomiting, dehydration.
- Severe complications can include kidney failure, strokes, seizures, and sometimes painful death.
- Onset 3 - 9 days; lasts 2 - 9 days, unless there are complications.

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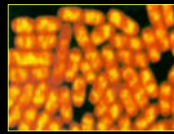
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***Salmonella* species**



- More than 2300 types.
- About 200 types cause human illness.
- Comes from intestinal tracts of poultry, pigs, birds, and insects.
- Also can be carried by humans.
- Infective dose – a few cells to millions.

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***Salmonella* species**

- Isolated from many types of raw fruits and vegetables – not a frequent event.
- Outbreaks linked to:
  - tomatoes
  - bean sprouts
  - melons
  - unpasteurized orange juice and apple juice

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### Foodborne Illnesses Caused by *Salmonella* species

- Illness causes nausea, vomiting, abdominal cramps, diarrhea, fever, and headache.
- Symptoms occur in 12 - 48 hours and last 2 - 6 days in otherwise healthy people.
- May last weeks in immuno-compromised people.
- Secondary problems such as reactive arthritis or pericarditis may result in some patients.

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### Food Joke #2

Why did the man stare at the can of orange juice?

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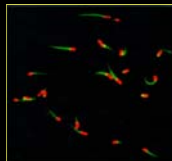
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### *Listeria monocytogenes*

- Widely distributed in nature.
  - In soil, sewage, fresh water sediments.
  - In silage, decaying plant matter.
  - In animal intestinal tracts.
- Animal carriers may not be sick.
- Found in raw foods.
  - Meats, unpasteurized milk.
  - Vegetables.



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### Foodborne Illness Caused by *Listeria monocytogenes*

- Causes flu-like symptoms in healthy people.
- May progress to meningitis, blood poisoning, abortion in pregnant women, or death.
- Symptoms appear within 1 day to 3 weeks.
- Duration depends on treatment.
- High fatality rate in immune-compromised individuals.

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### Other Microbial Hazards: Viruses

- Excreted in feces by infected individuals.
- Can be carried by raw produce, uncooked food.
- Persists for weeks or months on crops or in soils.
- Examples
  - Hepatitis A on lettuce, raspberries, and strawberries.



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### Virus Transmission

- Viruses can be transmitted to plants and fresh fruits and vegetables by:
  - People.
  - Tractors, equipment, clippers.
  - Insects.
- Viruses can also cause plant and animal diseases.
- By preventing virus transmission, plant diseases can be decreased and produce safety can be increased.

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### Food joke # 3

What did the mayonnaise say to the refrigerator?

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### One Virus of Concern: Hepatitis A

- An infected person can spread the disease to others well before the symptoms of Hepatitis A are present.
- It is primarily transmitted by person-to-person contact through fecal contamination, but can also be spread through food and water.
- Causes fever, nausea, vomiting, abdominal cramps, extreme fatigue, jaundice (affects the liver).
- Onset 15 - 50 days after ingestion.
- Lasts 1-2 weeks to months in severe cases.

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### Other Microbial Hazards: Parasites

- Single-celled microorganisms.
- Exist as cysts outside animals; require animal or human intestinal tract to multiply and spread.
- Spread by fecal contamination of water or fresh produce.
- Examples of outbreaks:
  - Giardia: raw vegetables, fruits.
  - Cryptosporidium: unpasteurized apple juice.
  - Cyclospora: imported raspberries, basil, mesclun lettuce.

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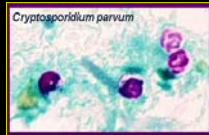
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### Parasites: Cryptosporidium

- Cysts in water or food infect intestinal cells.
- Infection causes illness and allows the parasite to reproduce.
- Causes watery diarrhea, stomach cramps, nausea, and fever.
- Symptoms 2 -10 days after ingestion; can last 4 days to 4 weeks.



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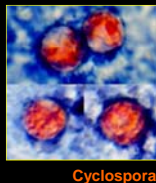
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### Parasites: Cyclospora

- Cyclospora parasites infect the small intestine.
- Causes watery diarrhea (sometimes explosive), loss of appetite, bloating, stomach cramps, nausea, vomiting, muscle aches, low-grade fever, weight loss, and fatigue.
- Some cases are without symptoms.
- Symptoms 1 week after consuming contaminated food or water, can last more than a month and can return later.



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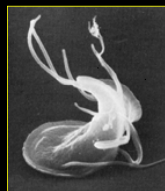
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### Parasites: Giardia

- Common parasite that infects animal and human intestines.
- Causes diarrhea, abdominal cramps, nausea, and vomiting.
- Symptoms 1 -2 weeks after ingestion of cysts in contaminated food or water.
- Lasts 4 - 6 weeks in healthy people, but can last years in some cases.



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### Bottom line

- Prevent cross contamination
- Proper processing procedures must be used
- Personal hygiene

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### Food Joke #4

What's the worst thing about being an octopus?

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### Acknowledgements

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