

Good Agricultural Practices Food Safety and Foodborne Illnesses: How safe is what I eat?

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<http://sickcrops.tamu.edu>

Texas AgriLife Research
& Extension Center at **AMARILLO**

Plant Pathology Extension

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Welcome to **SICK CROPS**



- Citrus
- Corn
- Potato
- Sorghum
- Bean/Soybean
- Vegetables
- Wheat
- Other Crops
- Homeowner/Gardeners
- **Contact Information**
- Wheat Disease Fact Sheets
- Plant Diagnostic Form
- Texas Plant Diagnostic Clinic (THPPDL)

Wheat in Rio Grande Valley of Texas



Tomato (Greenhouse)



Tomato (Outdoors)



Good Agricultural Practices

Fruit and Vegetable Microbial Safety Issues



Fruit and Vegetable Consumption

Between 1970 - 1997, the U.S. per capita consumption of fruits and vegetables increased 24 % !



577 lbs to 718 lbs per year

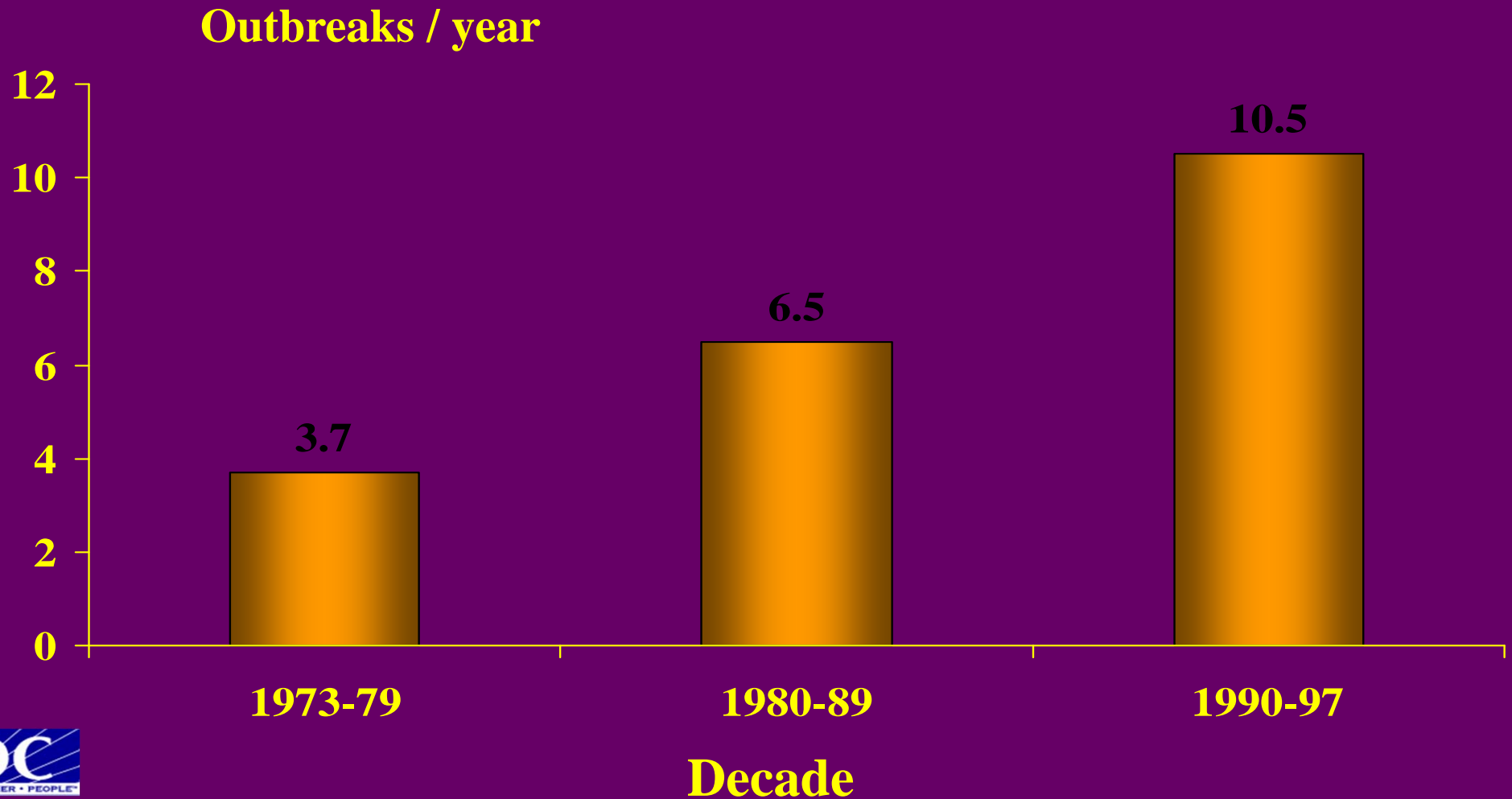


Fruits and Vegetables

- **Significant increases in the number of produce associated foodborne disease outbreaks in the U.S.**
- **Produce associated outbreaks per year more than doubled from 1973-1987 and 1988-1998.**



Number of Produce Associated Outbreaks by Decade, 1973 - 1997

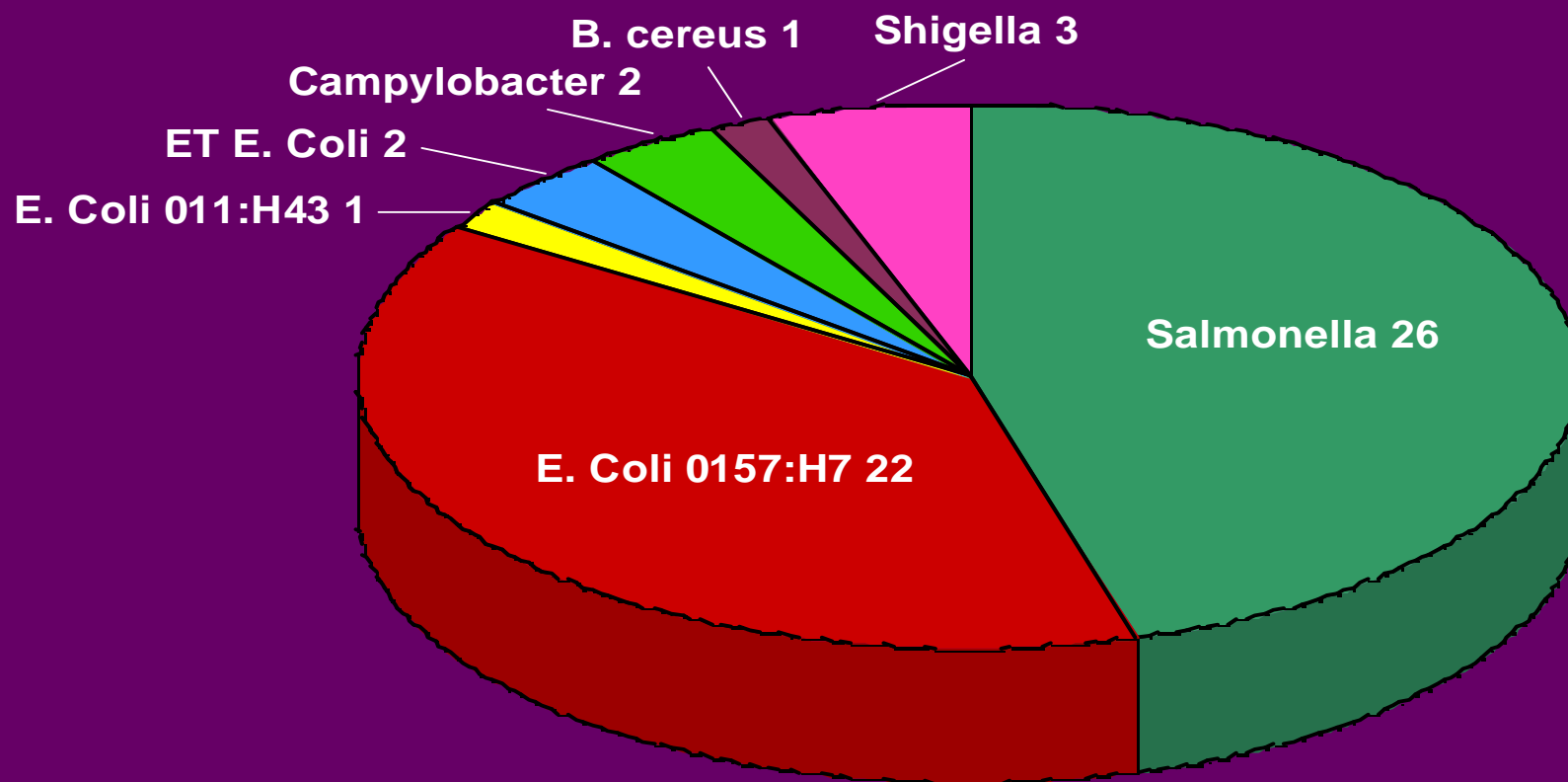


Fruit & Vegetable Outbreaks by Specific Agent, 1973 - 1998

	<u>1973-87</u>	<u>1988-98</u>
Bacterial	24	57
Parasitic	1	8
Viral	4	7
Unknown	35 (55%)	41 (37%)
Total Outbreaks	64	112
Outbreaks/year	4.3	10.2

Source: CDC Foodborne outbreak surveillance system

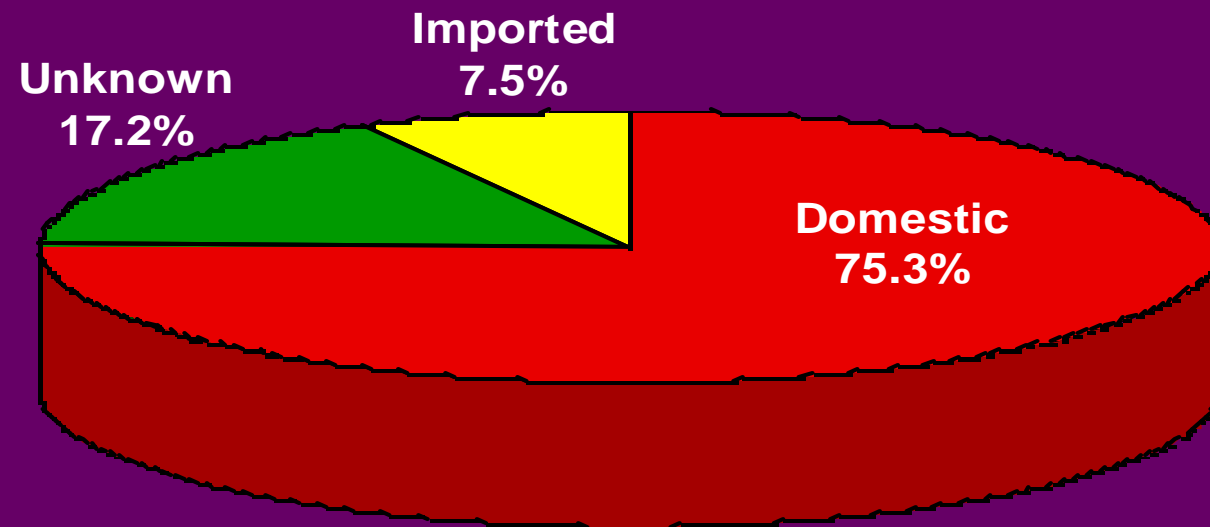
Fruit and Vegetable Bacterial Outbreaks: 1988 - 1998



Source: CDC Foodborne outbreak surveillance system



Fruit and Vegetable Outbreaks by Origin of Produce: 1990 - 1998



Source: CDC Foodborne outbreak surveillance system



E. coli O157:H7 Lettuce Outbreak

- A multistate Outbreak of *Escherichia coli* O157:H7 Infections Associated with Consumption of Mesclun Lettuce
- By Elizabeth D. Hilborn, et.al.
- Archives of Internal Medicine, Vol. 159, August 9/23, 1999.



E. coli O157:H7 Lettuce Outbreak

- Occurred during May & June, 1996
- 49 Cases
- Two separate outbreaks reported in:
 - Connecticut - mesclun mix
 - Illinois - red leaf lettuce
- Patients had similar demographics



E. coli O157:H7 Lettuce Outbreak

- Were these two outbreaks related?
- Case-control studies conducted.
- Molecular subtyping by pulsed field gel electrophoresis (PFGE) showed they were indistinguishable.



E. coli O157:H7 Lettuce Outbreak

- **49 Cases of Infection**
 - **Connecticut 21**
 - **Illinois 28**
- **21 Patients (49%) were hospitalized**
- **3 Patients (7%) developed HUS (Hemolytic uremic syndrome)**
- **Patients age from 2 - 87 years**



E. coli O157:H7 Lettuce Outbreak

Results of the Investigation

- **Lettuce traced back to one California grower.**
- **Lettuce grown near beef cattle ranch.**
- **A dirt track separated the two operations.**
- **Free range chickens had access to cattle and lettuce fields.**

E. coli O157:H7 Lettuce Outbreak

- **Unchlorinated well water used for cattle husbandry, lettuce culture and processing.**
- **The processing shed was open to the environment; there was no mechanism to exclude dust, insects, birds or rodents.**
- **No handwashing facilities were available.**

E. coli O157:H7 Lettuce Outbreak

- **Gloves were not worn during processing.**
- **Recirculated wash water was used.**
- **The recirculating and filtration systems failed in May and the water was changed 3X a day.**
- **Lettuce was crisped in reused plastic baskets.**

Why Should We Care?

Foodborne illness outbreaks are a major cause of:

- **Personal distress**
- **Preventable death**
- **Avoidable economic burden**



Why Should We Care?

Every year foodborne illnesses result in an estimated:

- **76 million cases of foodborne illness.**
- **325,000 people hospitalized for foodborne illness.**
- **5,200 needless deaths each year.**
- **Economic losses between 10-83 billion dollars.**



Contamination With Microbial Pathogens: Where Can It Occur?

- In fields or orchards
- During harvesting and transport
- During packing or processing
- In distribution and marketing
- In restaurants and food service facilities
- In the home

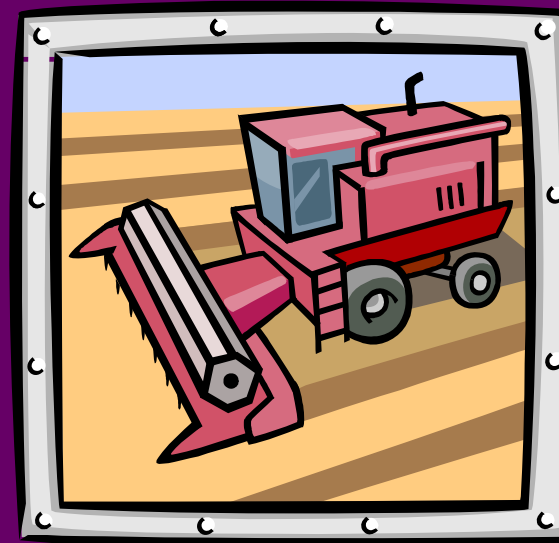
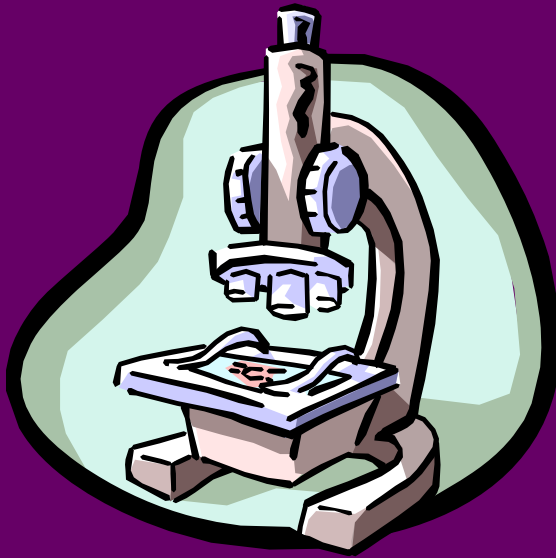
FARM to FORK



Cattle meets food crops



Microorganisms of Concern in Production Agriculture

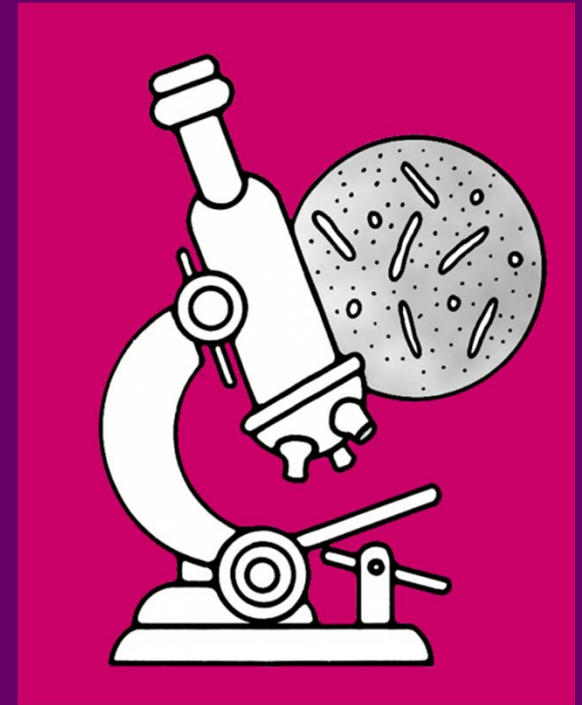






Practical Food Microbiology

- 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!



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.



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.



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.



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.



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* 0157:H7.



Harmful Microorganisms & Outbreaks Associated with Produce

Pathogen

Produce

E. coli O157:H7

Iceberg lettuce, radish sprouts,
unpasteurized apple cider/juice

Salmonella spp.

Tomatoes, bean sprouts, sliced
watermelon, sliced cantaloupe, coleslaw
& onions, alfalfa sprouts, root vegetables,
dried seaweed

L monocytogenes

Cabbage

B. cereus

Sprouts

Hepatitis A virus

Iceberg lettuce, raspberries, strawberries

Cryptosporidium

Apple cider

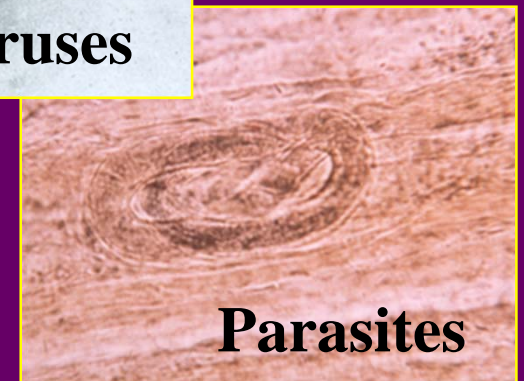
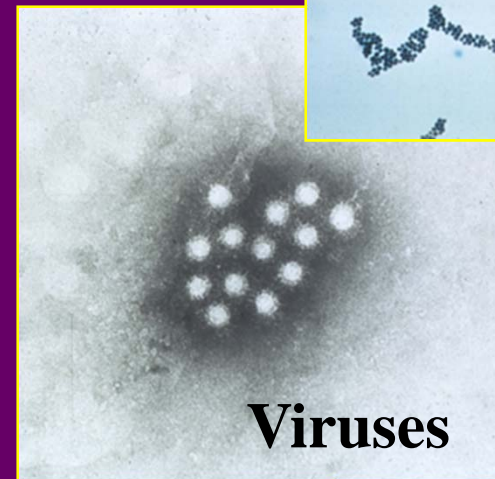
Cyclospora

Raspberries



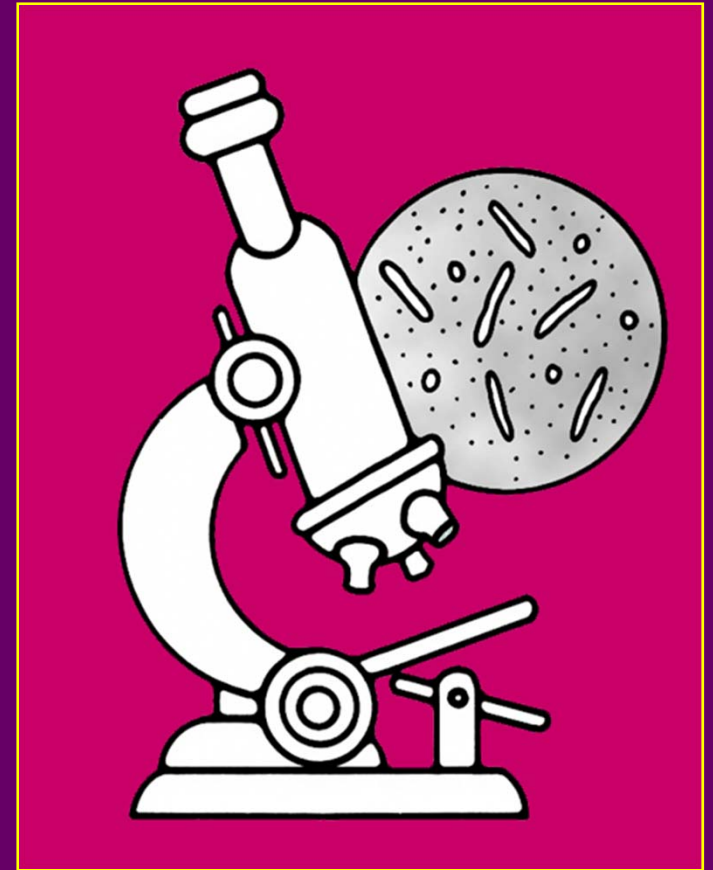
Microbes That Cause Foodborne Illness

- **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.



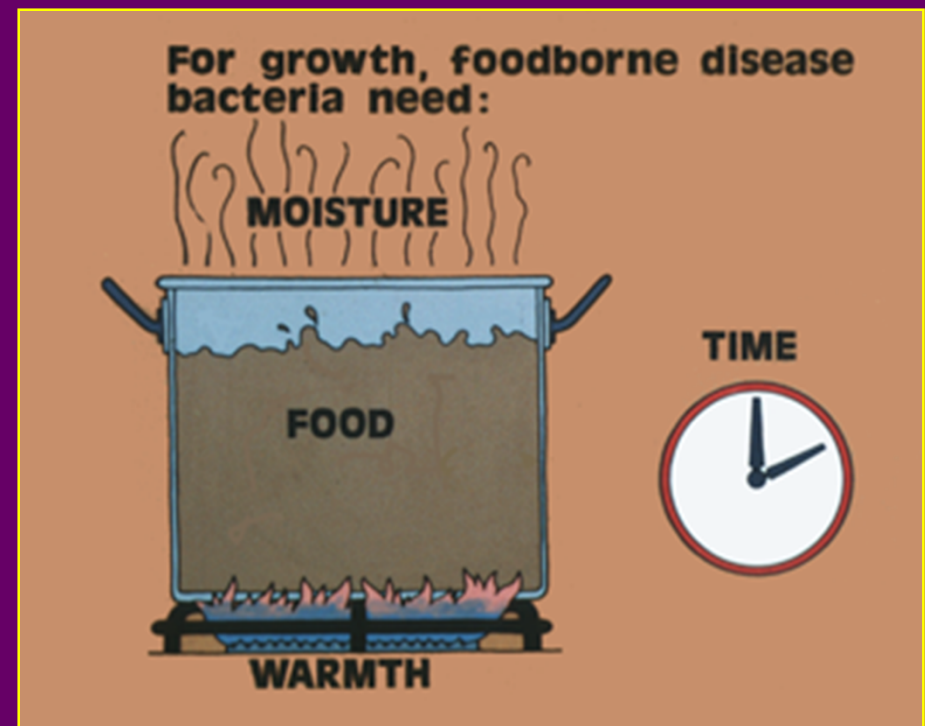
Bacteria...

- 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.



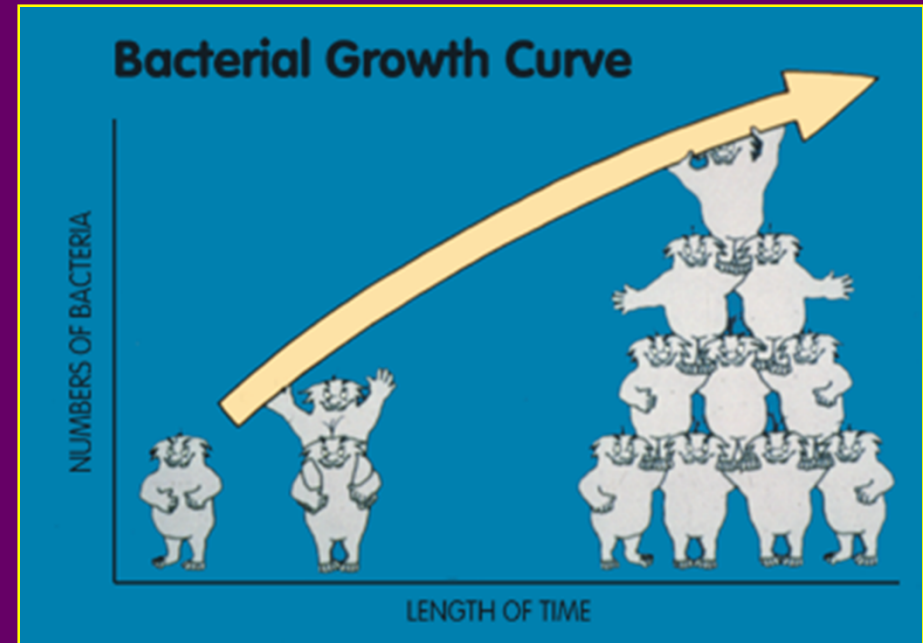
To Grow & Cause Illness, Bacteria Need:

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

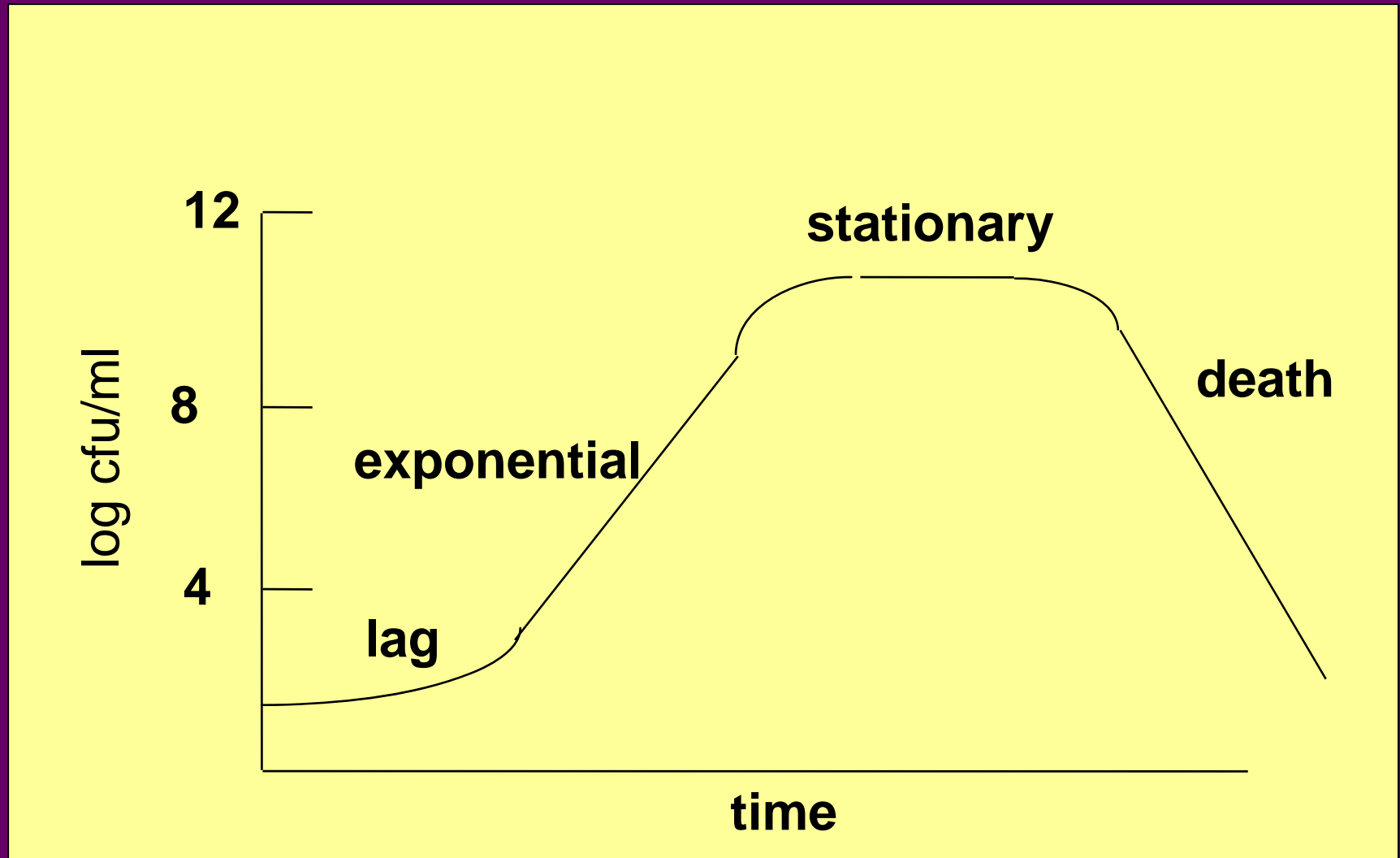


Bacteria Increase in Number by Dividing in Two

- 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.



The Bacterial Growth Cycle has Four Phases



Bacteria Are Found Everywhere

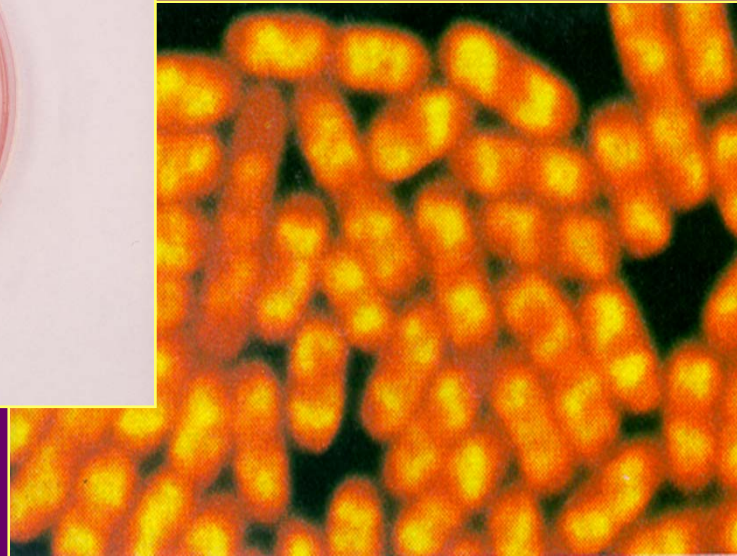
- In air, soil, and water
- In intestines of animals & humans
- On skins of fruits & vegetables
- On raw meat, poultry, & seafood
- On shells of nuts
- On insects & rodents
- On hand, skin, hair, & clothing of people



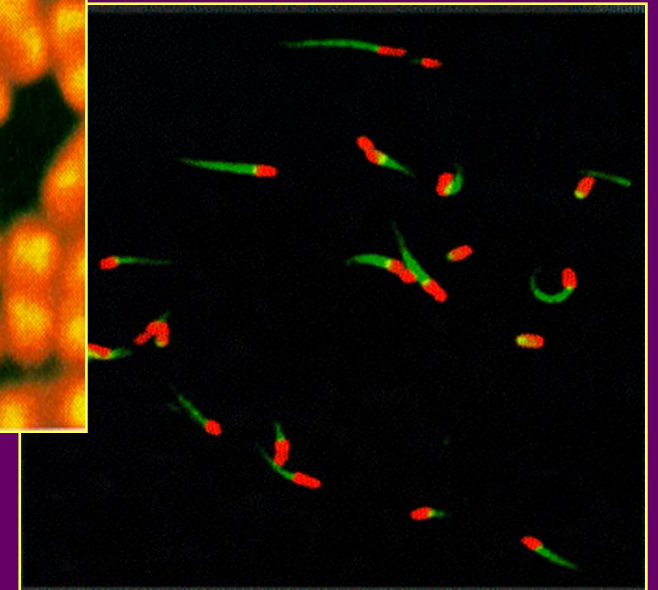
3 Harmful Foodborne Bacteria



E. coli O157:H7



Salmonella

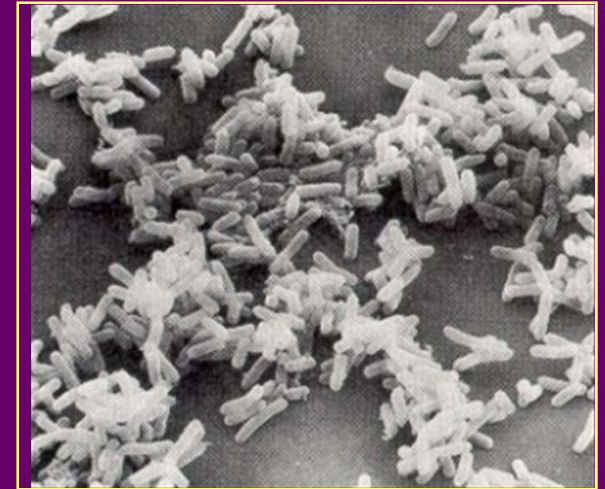


Listeria



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

- *Escherichia 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.



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.



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



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.

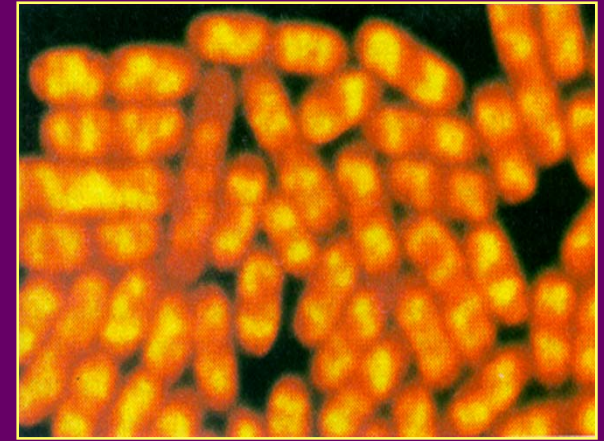


Foodborne Illness Caused by *E. coli* O157:H7

- 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.



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.



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



Salmonella enterica

- About 142,000 Americans infected each year (about 30 deaths) with Salmonellosis (diarrhea, fever, vomiting, abdominal cramps). Most recover without treatment.
- Fecal matter on egg shell.
- Related subspecies *S. enterica*
enterica serovar Typhi causes Typhoid (slow fever up to 104 F, sweating, gastroneuritis)



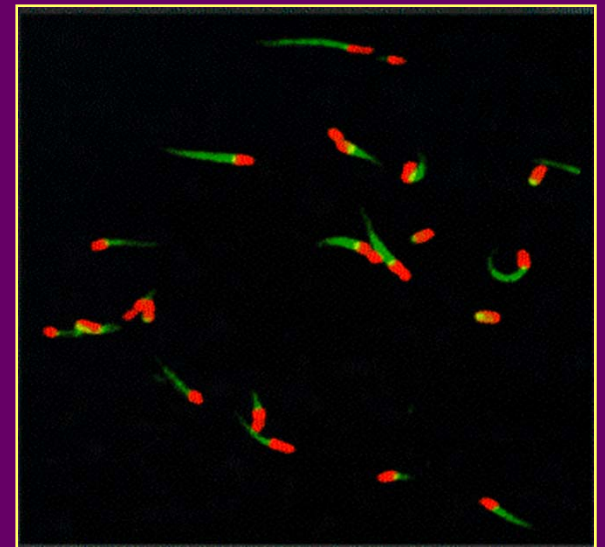
Foodborne Illnesses Caused by *Salmonella* species

- 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.



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.



Listeria monocytogenes

- Listeriosis: symptoms last 7-10 days
- Fever, muscle aches, vomiting (sometimes nausea and diarrhea).
- If infections spreads to brain/spinal cord, can cause meningitis (headache, stiff neck, confusion, loss of balance, and convulsions)



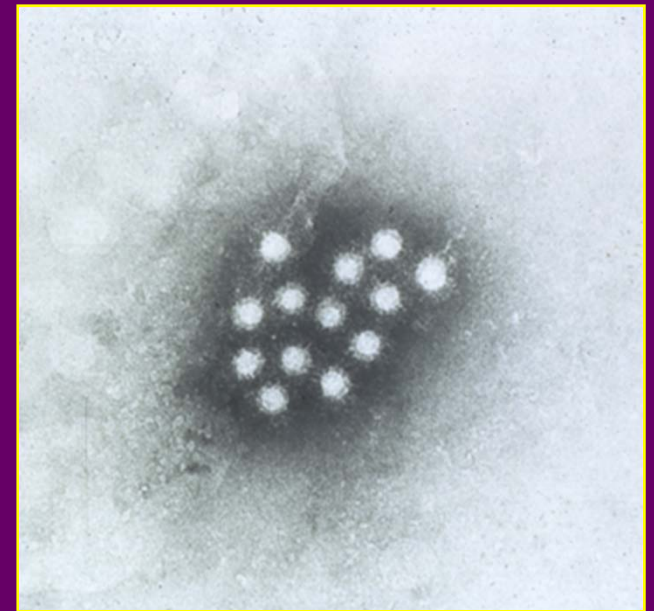
Foodborne Illness Caused by *Listeria monocytogenes*

- 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.



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.



One Virus of Concern: Hepatitis A

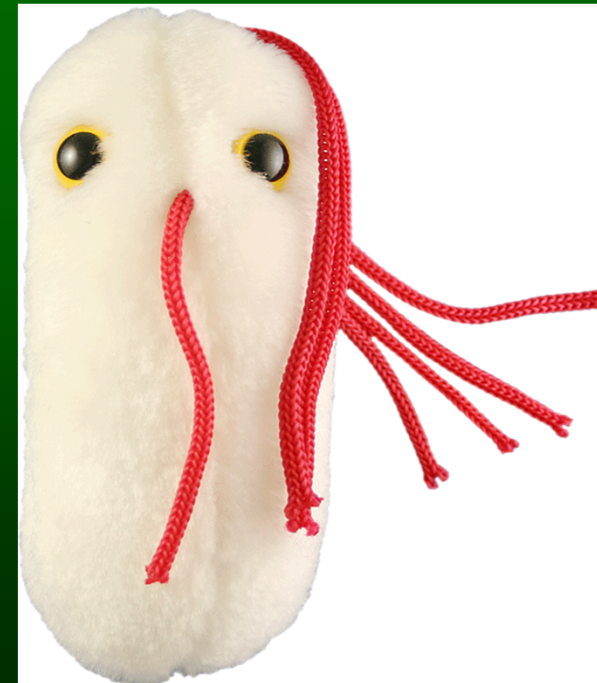
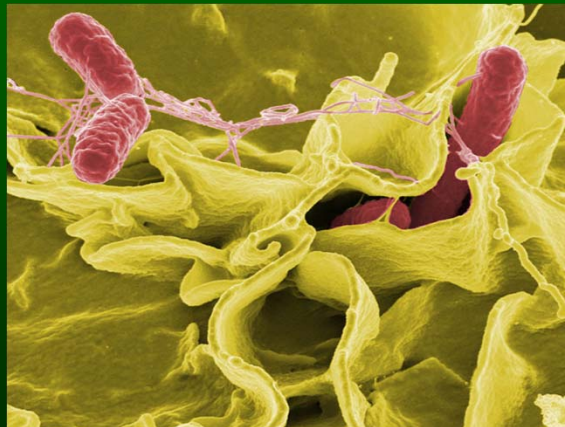
- An infected person can spread the disease to others well before the symptoms of Hepatitis A are present.
- It is primarily transmitted by person-to-person contact through fecal contamination, but can also be spread through food and water.
- Causes fever, nausea, vomiting, abdominal cramps, extreme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



Streptococcus pyogenes

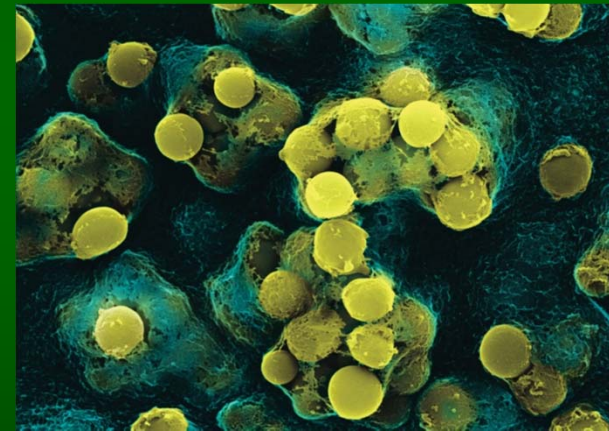


Salmonella enterica/bongori



Streptococcus pyogenes

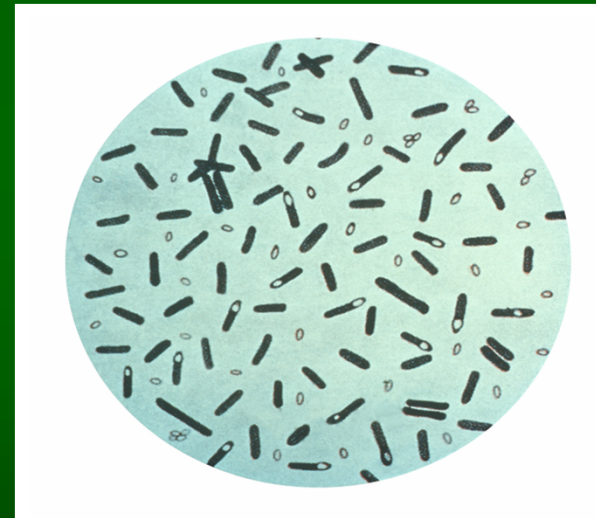
- Responsible for Streptococcal infections Group A.
- Throat or skin infections.
- Bacterium may produce toxins.
- Treated with penicillin.



Britannica.com

Botulinum toxin

- *Protein produced by Clostridium botulinum.*
- Causal agent of botulism (paralysis, respiratory failure)
- Initially for treatment of strabismus (crossed-eyes) and blepharospasm (uncontrollable blinking)
- BTX-A for muscle pain disorders.
- Also used for cosmetic surgery



Food Safety for Seniors

- Raw foods are risky
- Microbes/Germs are tougher to get rid off
- Avoid raw meat: Raw fish, raw shellfish, raw beef, raw poultry, unpasteurized cheese or milk.
- Avoid soft cheeses (brie, blue)
- Raw/lightly cooked eggs.
- Untreated fruit/vegetable juice

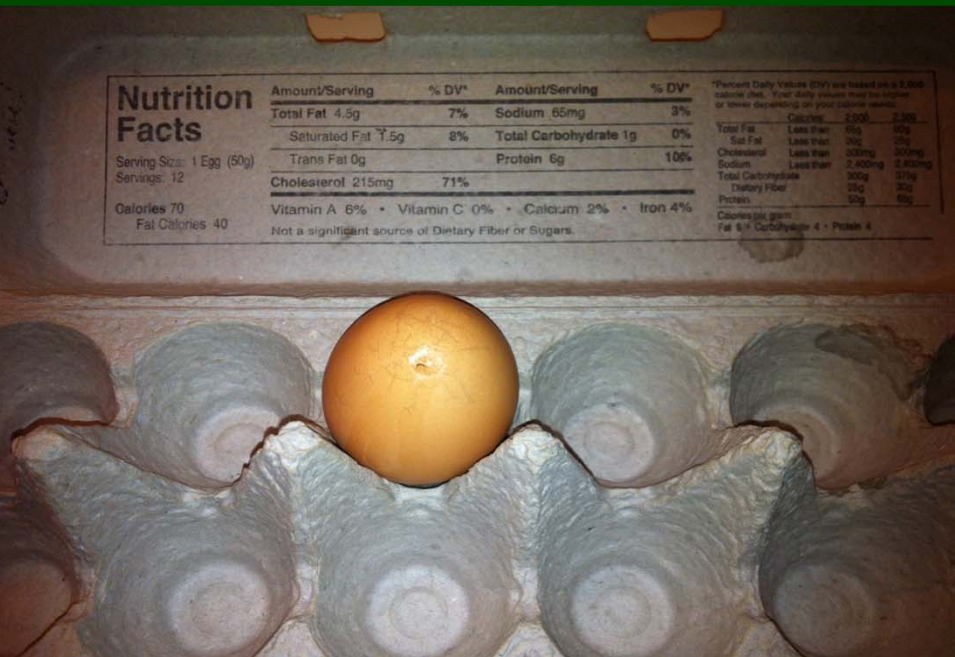
Ceviche



What's wrong with this picture?

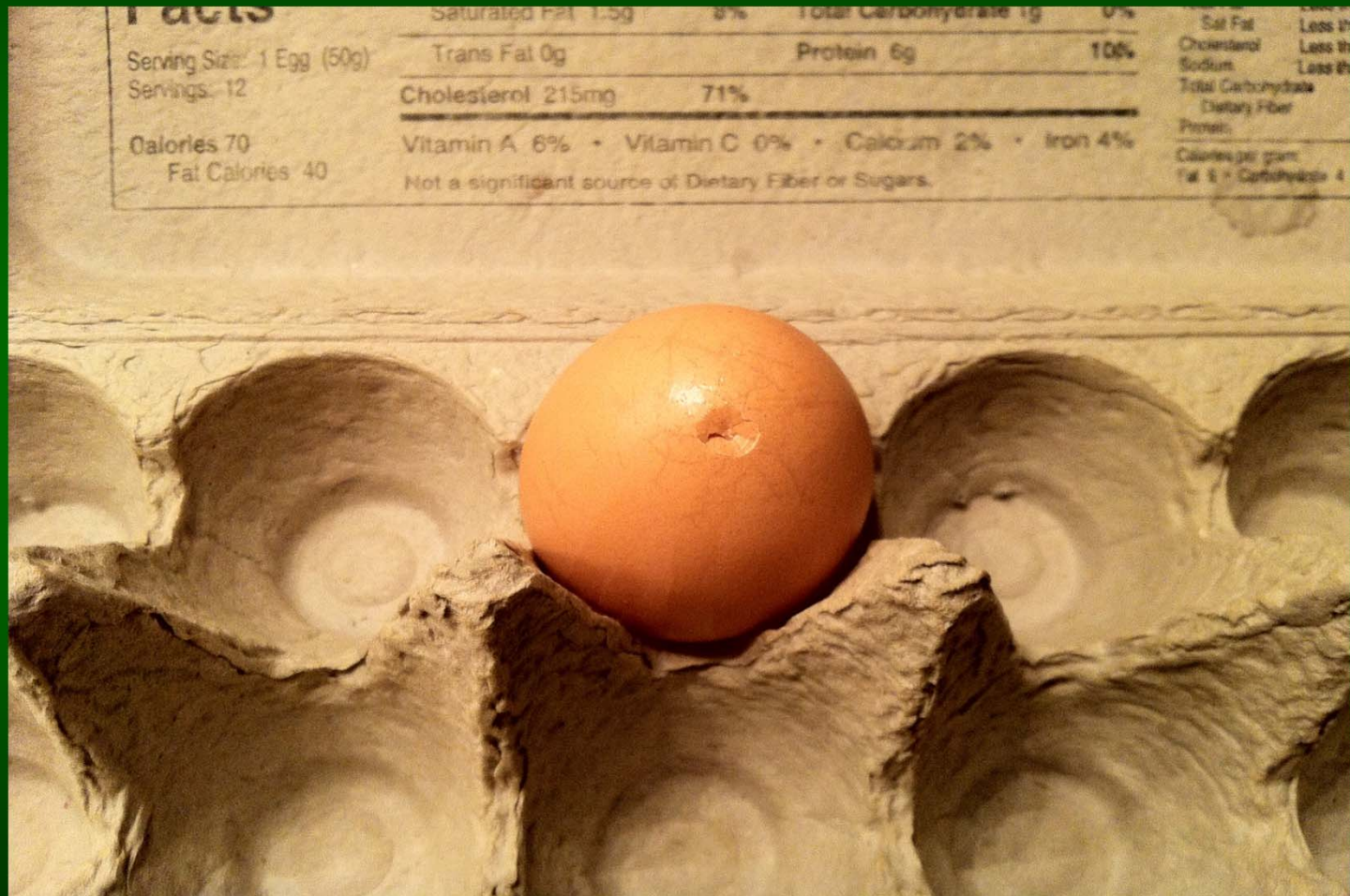


What's wrong with this picture?



Saturated Fat 1.5g 8% Total Carbohydrate 1g 0%
Trans Fat 0g Protein 6g 100%
Cholesterol 215mg 71%
Vitamin A 6% • Vitamin C 0% • Calcium 2% • Iron 4%
Not a significant source of Dietary Fiber or Sugars.





Facts

Serving Size: 1 Egg (50g)
Servings: 12

Calories 70
Fat Calories 40

Saturated Fat 1.5g	3%	Total Carbohydrate 1g	0%
Trans Fat 0g		Protein 6g	100%
Cholesterol 215mg	71%		
Vitamin A 6% • Vitamin C 0% • Calcium 2% • Iron 4%			
Not a significant source of Dietary Fiber or Sugars.			

Salt Fat	Less th
Cholesterol	Less th
Sodium	Less th
Total Carbohydrate	
Dietary Fiber	
Protein	
Calories per gram	
Fat 9 • Carbohydrate 4	

Food Safety: Cooking Outdoors?

- Choose fresh meat; refrigerate within 30 min
- Cook / freeze within 1 to 2 days
- If thawing, do it in the fridge!
- If marinating, do it to add flavor not microbes.
- Wrap meat (prevent “contamination” of foods)
- Wash hands, cutting boards (don't mix meat with veggies).
- Cook to a safe temperature (160-165° F)



Food Safety at Home

- Spoiled food can make you sick (don't trust smell)
- Keep food viable: clean, cook, chill, separate
- Wash hands and counters.
- Use plastic cutting boards.
- Use paper towels; cloths need to be washed.
- Separate raw foods.
- Cook at adequate temperature.
- Chill right away.



Reduce Your Risk of Foodborne Illness

- One out of every 4 (~25%) get it yearly.
- Usually caused by bacteria.
- Buy food from reliable source.
- Perishable foods need to be stored or cooked.
- Check your refrigerator temperature.
- Thaw foods safely.
- Keep cutting boards clean.
- Wash hands (reduce FB illness 50%)



Washing Vegetables?



Thank You!