Food Microbiology 101

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Summary

• Microbiological contamination of food
• Routes of contamination by pathogens
• Overview on emerging risks
• Solutions
Basics of Food Microbiology

• Not all microorganisms are ‘bad’
  • Used to ferment products
  • Necessary for composting organic materials
• Some cause spoilage
  • Decomposition of foods ➔ economic losses
• Some cause illnesses and diseases
  • Pathogens

Types of foodborne illnesses

• Infections
  • Caused by swallowing living pathogens, which grow within the body and cause illness
• Intoxications
  • Caused by swallowing toxin (poison) that has been formed in food as pathogens grow
• Reactions usually occur within hours or days of consumption
• Secondary conditions attributed to some of these illnesses
Historical perspective 1900-1950’s

- *Clostridium botulinum*
- *Salmonella spp.*
- *Staphylococcus aureus*

Worked hard to figure out how they grew, how they caused illnesses, etc.

**Growth needs**
- Food
- Acid
- Temperature
- Time
- Oxygen
- Moisture

**Survival skills**
- Sporeformers
  - High temperatures
  - Unpleasant conditions
  - Sanitizer chemicals
  - Low pH
- Vegetative pathogens
  - Low water activity
  - Low pH
  - Low temperatures

**Some produce toxins**
1950’s to 2000’s and beyond

• *E. coli* (many strains and serotypes)
  • *E. coli* O157:H7 Enterohemorrhagic (EHEC)
  • Enterotoxigenic *E. coli* (ETEC)
  • Shiga (or Shiga-like) Toxin *E. coli* (STEC)
• *Shigella* spp.
• *Clostridium perfringens*
• *Vibrio vulnificus*
• *Listeria monocytogenes*
• *Campylobacter jejuni*
• *Bacillus cereus*
• *Cronobacter sakazakii*
• *Yersinia enterocolitica*
• Parasites: *Cryptosporidium, Cyclospora*
• Viruses: *Hepatitis A, Norovirus* 

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<td>Cause</td>
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<td><em>Norovirus</em></td>
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<td><em>Salmonella</em> spp.</td>
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<td><em>Clostridium perfringens</em></td>
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<td><em>Campylobacter</em></td>
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<td><em>Toxoplasma gondii</em></td>
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<td><em>Listeria monocytogenes</em></td>
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What happened?

• Are there ‘more’ microorganisms?

• Has technology improved so we can detect them?

• Are we providing ‘better’ environments for them to flourish?

What has changed?

• Technology
  • Improvements in testing and identification methods
  • To detect pathogens in the plant environment, in finished products and ingredients
  • To trace back foodborne illness outbreaks
    • Whole Genome Sequencing (WGS)
  • Some are becoming resistant to antimicrobial agents
What has changed?

• Consumers
  • Population of sensitive consumers
  • More convenient foods
  • More ‘healthy’ foods
  • Less knowledge about food safety

Population of sensitive consumers

> 30 million people in the U.S.
• Elderly
• Infants and children
• Pregnant women
• Those with weakened immune systems
More convenient foods

• Fast
• Convenient
• Ready-to-Eat
• Minimal heating

• More eating out / Less home cooking
• Delivered foods for preparing

More ‘healthy’ foods

• Want less ‘process’ (fresher)
• Less ‘chemicals’ (clean labels)
• Healthy
  • Less salt, less sugar, less preservatives
Less knowledge about food safety

• Assume food is ‘safe’
• Don’t think about food safety (much)
• Don’t read instructions (much)

• Product Development
  • New, innovative ‘foods’

So the industry responds

• Clean labels
• Minimal processes
• ‘Fresh’ foods
• ‘Ready to Eat’ foods

• But they need to make a profit as well
Global sourcing of ingredients

- Different standards and specifications
  - Global Food Safety Initiative
- Some ingredients may be cheaper, but may be contaminated
  - Need to know your specifications and make sure your suppliers meet them

Processors

- Profits = Time = Costs
- Automation
- Many facilities are older, harder to clean or maintain properly
How different foods can get contaminated with microorganisms

- Raw materials
- Poor production practices
- Poor employee practices
- Dirty equipment
- Environmental contamination
- Inadequate temperature controls
- Recontamination after process

Recalls and Regulations

- Used to recall foods AFTER a foodborne illness outbreak, after epidemiological studies identified the ‘source’
- Now, recall if there is a ‘suspicion’ of contamination
  - Finished product testing
  - Review of processing procedures
  - Suspect ingredients
  - Environmental testing
Issues with emerging pathogens

• Growth is important
  • Dosage
  • Toxin production
• Survival may be even more important
  • Minimal processed foods may not ‘kill’ the pathogens
  • Low pH, Aw or temperature may not ‘control’ the pathogens as well as we suspected

Issues with emerging pathogens

• Contaminated foods may look, smell and taste normal
• Consumers may not behave as expected

• Response
  • Avoid contamination in the first place!
  • Know what you’re doing and why you’re doing it!!