

Overview of Food Safety Issues for Growers and Food Entrepreneurs

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Why Do We Care About Food Safety?

The Centers for Disease Control and Prevention (CDC) estimates each year:

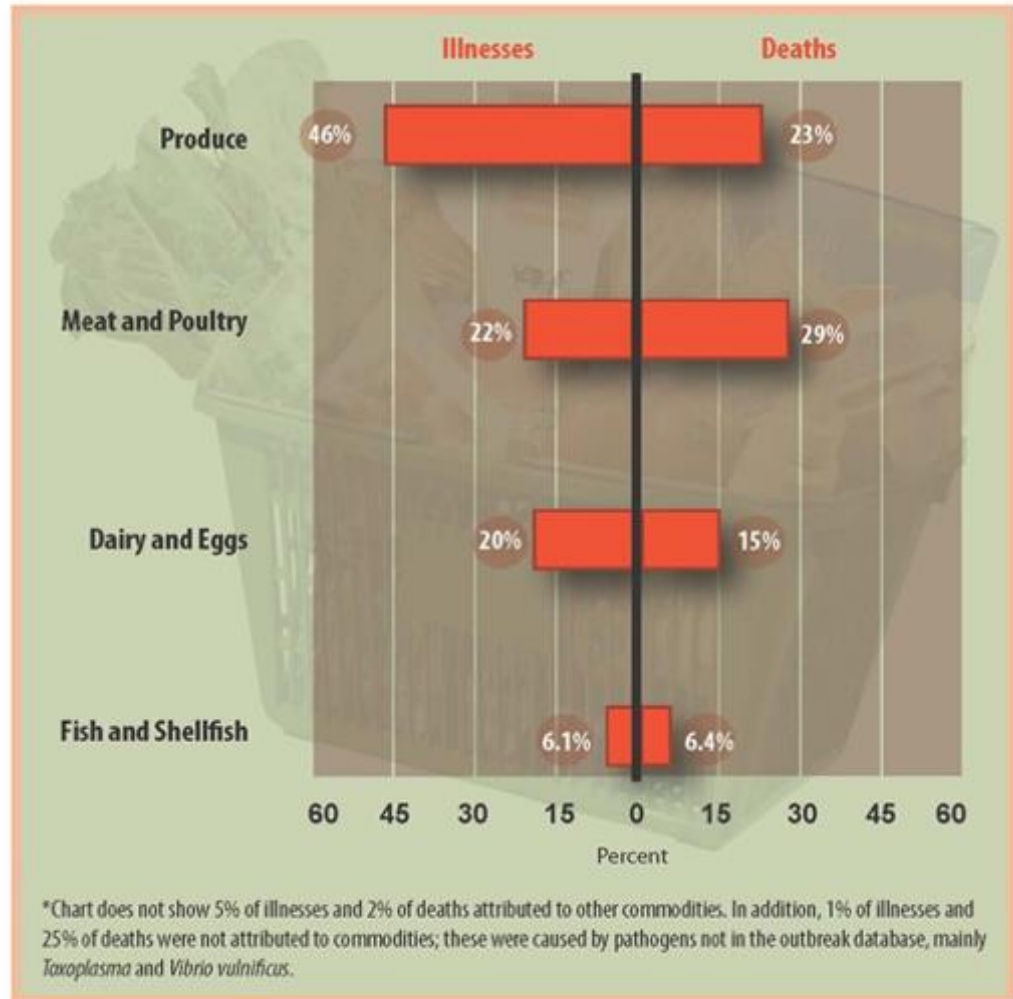
- 48 million people get sick
- 128,000 are hospitalized
- 3,000 die

From foodborne diseases



Which Foods Make Us Sick?

Figure 1. Contribution of different food categories to estimated domestically-acquired illnesses and deaths, 1998-2008*



Source: Painter JA, Hoekstra RM, Ayers T, Tauxe RV, Braden CR, Angulo FJ, Griffin PM. Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. *Emerg Infect Dis* [Internet]. 2013 Mar [date cited]. <http://dx.doi.org/10.3201/eid1903.111866>

Food Spoilage vs. Fermentation

Food Spoilage

- Microorganisms (M/O) use nutrients in food to further their own growth
- High numbers of M/O required
- **Undesirable outcome**

Fermentation

- Microorganisms use nutrients (carbohydrates) in food to further their own growth
- High numbers of M/O required
- **Desirable outcome!**



Foodborne Disease

- Occurs via consumption of food contaminated with pathogenic bacteria, their toxins, or pathogenic viruses
- Requirements for disease: At risk consumer, pathogenic organism, adequate infective dose



Who are the players?



Yeasts

- Food production
- Food spoilage
- Pathogenic



Molds

- Food production
- Food spoilage
- Pathogenic



Bacteria

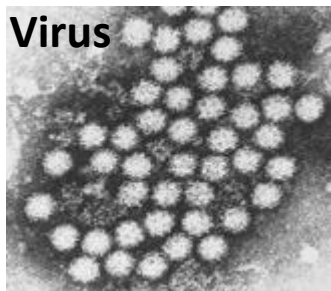
- Food production
- Food spoilage
- Pathogenic



Protozoa

- Pathogenic

Fig. 2.1, Ray and Bhunia

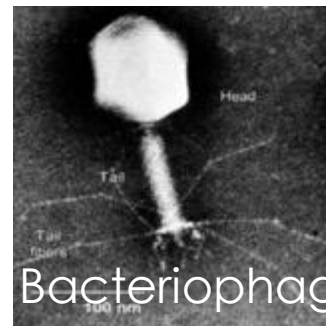


Viruses

- Pathogenic

<http://en.academic.ru/dic.nsf/enwiki/13699>

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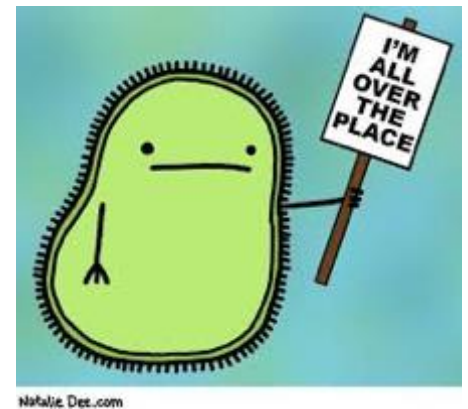
Bacteriophage

- Bacterial pathogens
- Food production

<http://www.bio.davidson.edu/Courses/Molbio/MolStudents/spring2003/Keogh/plasmids.html>

Sources of Microorganisms in Foods

- M/O are everywhere
 - Human/mammalian body: Microbial cells outnumber human cells by 10:1
 - Food (e.g.)
 - Raw milk, pasteurized milk
 - Raw ground beef
 - Leafy greens and nuts
- So how do M/O get into foods?
 - “Farm-to-fork” contamination events
 - Natural and external sources of microorganisms

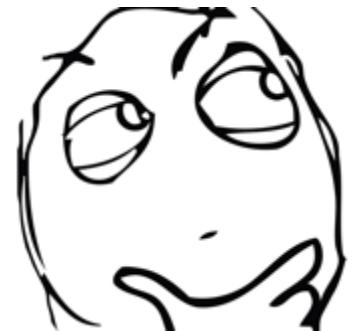


Food Production: Farm-to-Fork

Where can contamination happen?



Think about the ingredients that you use in your product and what could be a source of contamination....

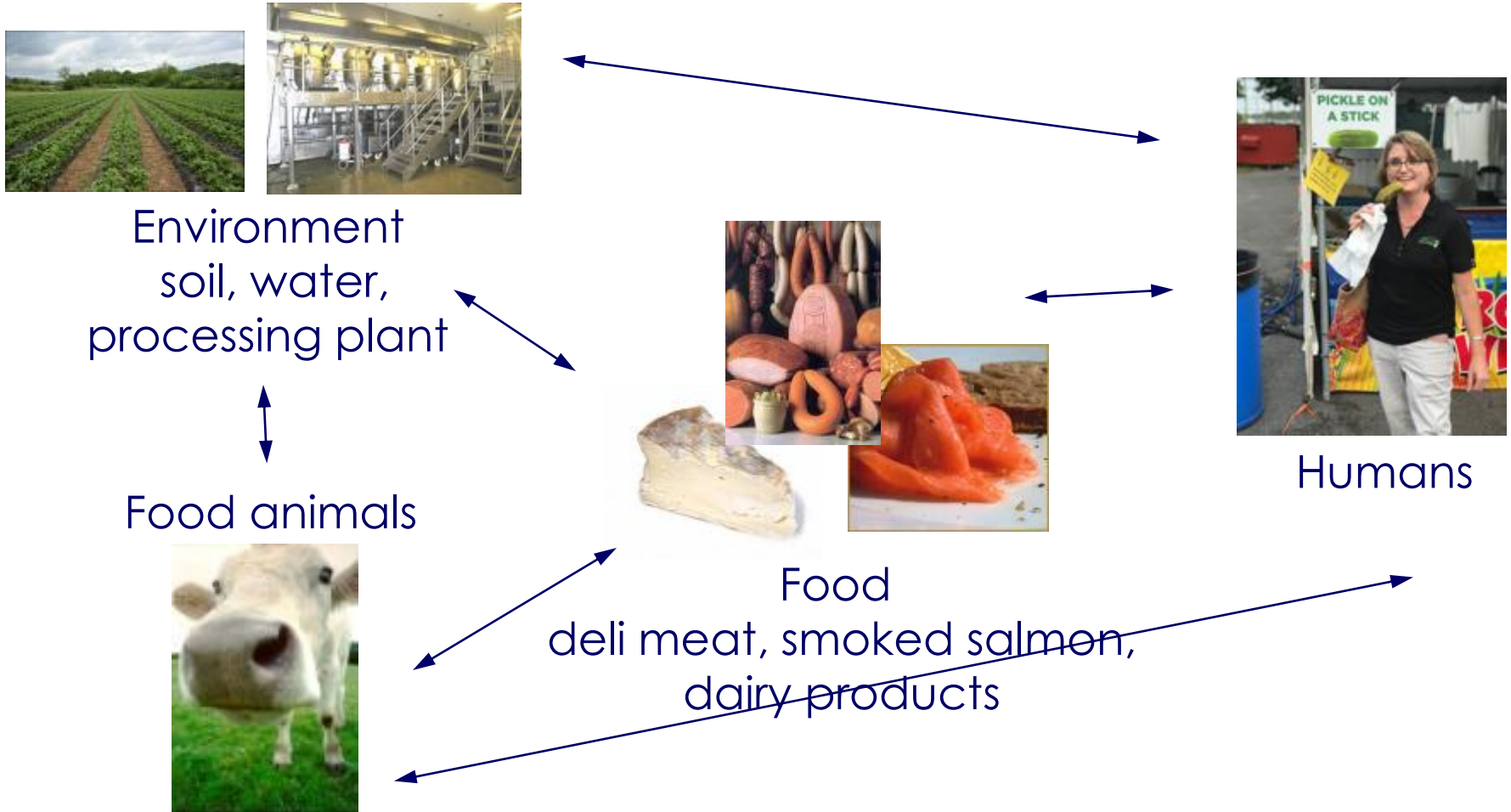


Natural Sources of Microorganisms in Foods

- Plant products (fruits/vegetables)
 - Surface contamination – from microorganisms in soil, water, manure/fertilizer
 - Molds, yeasts, bacteria – both nonpathogenic and pathogenic.
- Animal products (meat, poultry, fish, dairy)
 - Muscle tissue of animals and fish is sterile
 - Contamination from: gastrointestinal tract, skin, hair, feathers, scales, urogenital tract, respiratory tract
 - Raw milk – not sterile
 - Contamination from: inside milk ducts, skin on outside of udder



Transmission of Microorganisms



pH of a Food Product

- Most M/O can grow over wide range of pH, but optimal growth usually occurs at more narrow range
- Yeasts and molds most problematic

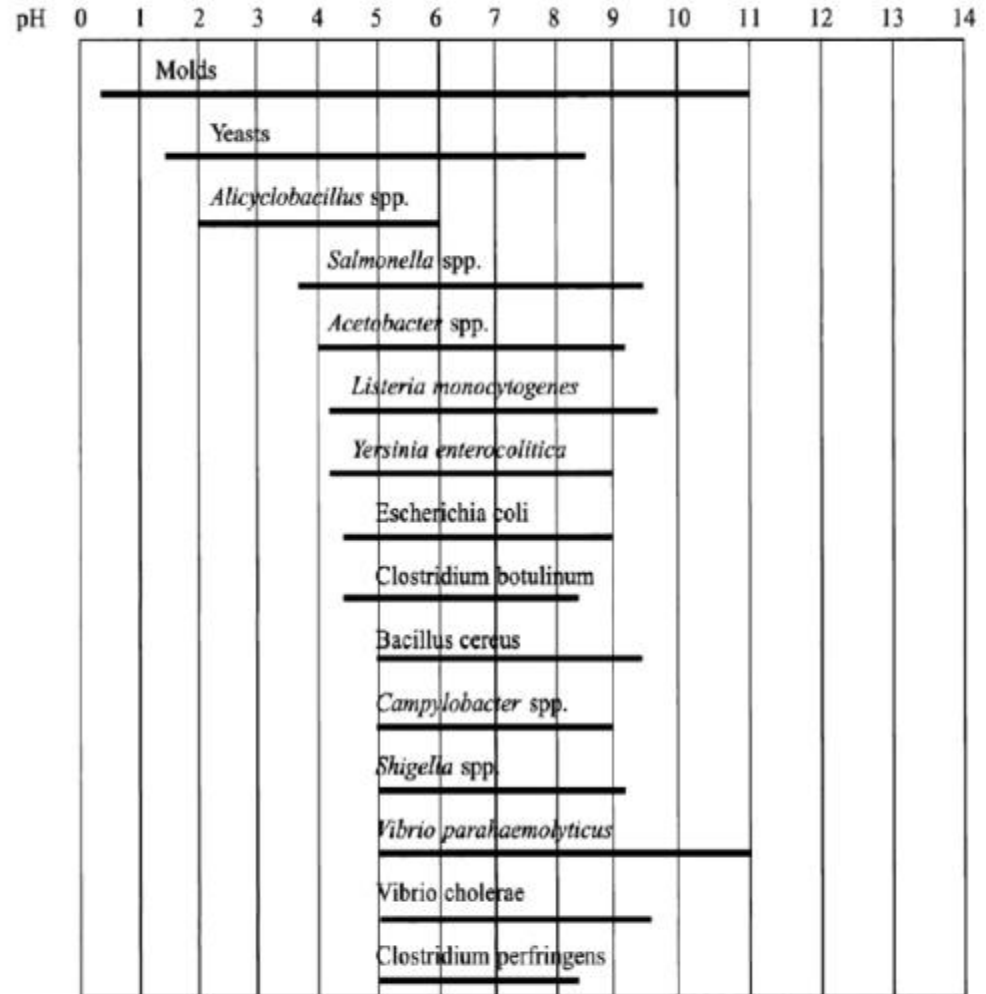


Figure 3-1 Approximate pH growth ranges for some foodborne organisms. The pH ranges for *L. monocytogenes* and *S. aureus* are similar.

pH of Various Food Products

Table : pH values of some food products

Food type	Range of pH values
Beef	5.1 - 6.2
Chicken	6.2 – 6.4
Milk	6.3 – 6.8
Cheese	4.9 - 5.9
Fish	6.6 - 6.8
Oyster	4.8 - 6.3
Fruits	< 4.5 (most < 3.5)
Vegetables	3.0 – 6.1

Disease-causing bacteria grow at a pH of more than 4.6

Water Activity (a_w)

- a_w – water in foods that is available for metabolic purposes
- Total water in food = Bound + free water
 - Bound water = fraction used to hydrate hydrophilic molecules and dissolve solutes in food matrix
 - Free water = unbound
- **Free water is essential for growth of M/O**



a_w Requirements of M/O

Microbe	Minimum a_w
Most Gram-negative bacteria	0.95
Most Gram-positive bacteria	0.90
Most Yeasts	0.85
Most Molds	0.70 - 0.80
<i>Staphylococcus aureus</i>	0.86
Halophilic microorganisms	0.75
Xerophilic Microorganisms	0.61
Osmophilic microorganisms	0.60

a_w of Food Ranges from ~0.1-0.99

Food	a_w
Fresh foods (meat, fish, vegetables, milk, eggs), canned fruits and vegetables	0.98-0.99
Some bakery products and bread, medium-aged cheeses (cheddar, swiss), processed cheese, evaporated milk, tomato paste, bread, fruit juices, sausage	0.93-0.98
Fermented sausage, dry cured meats, sweetened condensed milk, maple syrup	0.85-0.93
Jelly, dried fruits, parmesan cheese, nuts	0.60-0.85
Noodles, honey, chocolate, dried egg	<0.60
Cereals, crackers, sugar, salt, dry milk	0.10-0.20

Testing pH and a_w

- Commercial testing labs can do this test
- This can also be done at Purdue Food Science – Food Manufacturing Entrepreneur Institute (FEMI)

<https://ag.purdue.edu/departments/foodsci/femi/index.html>

Questions?

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