

## Food Microbiology

**The Good:** better taste or texture/production of food products

**The Bad:** food borne illness: infection with live organisms  
Intoxication with toxins from bacteria

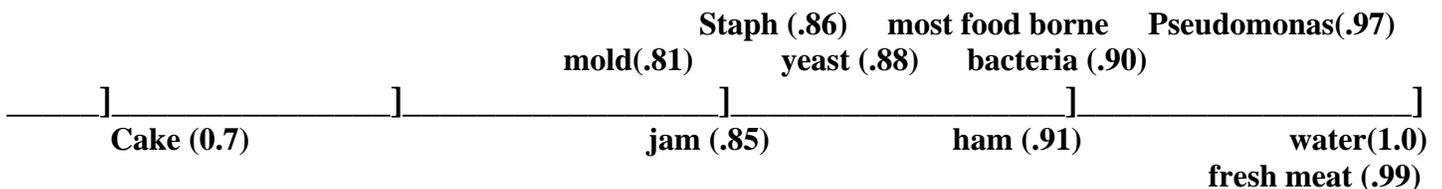
**The Ugly:** food spoilage of undesirable changes

**Factors affecting microbial growth in food:**

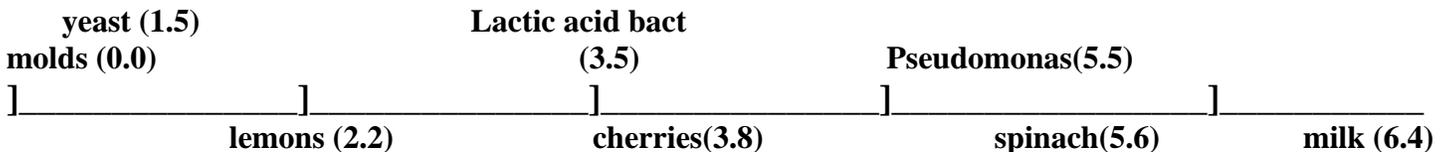
**Intrinsic: conditions naturally present in food**

**Water Availability (a w):** amount of water in food (pure water = 1.0)

Most fresh foods have a w > 0.98 (most bacteria require > .90)



**pH:** most pathogens not grow at pH < 4.5 (except Lactic acid bacteria)



**Nutrients:** Bacteria (eg. Pseudomonas) can grow if able to synthesize essential nutrients

**Extrinsic:**

**Storage Temperature:** < 0 C no growth/water crystallize and not available  
Slightly above 0 C enzyme reactions very slow or non-existent (refrigerator temps. 4 C-10 C)

**Atmosphere:** availability of O<sub>2</sub>

**Natural Food Protectants:**

**Antimicrobial chemicals:** produce naturally (eg. Egg white-rich in lysozyme)

**Biological Barriers:** rinds, shells, other coverings

## **Microorganisms in food and beverage production:**

### **Lactic Acid fermentation:**

**Glucose → pyruvic acid → lactic acid**

#### **Fermented milk products:**

**Cheese: Lactococcus sp.**

**Yogurt: Lactobacillus sp.**

**Pickled vegetables: sauerkraut: Leuconostoc sp., Lactobacillus sp.**

**Fermented meats**

### **Alcoholic fermentations by yeast (Saccharomyces):**

**Glucose → pyruvic acid → alcohol + CO<sub>2</sub>**

**Wine/beer/distilled spirits**

**Bread**

### **Mold growth:**

**Soy sauce; bleu cheese**

## **Food Spoilage: Undesirable changes**

**Repugnant taste, odors, appearance---Usually not harmful**

**Still best not to eat because pathogens may also be present**

### **Common food spoilage bacteria:**

**Pseudomonas**

**Erwinia**

**Acetobacter (transfer alcohol to vinegar/problem in wine)**

**Alcaligenes (glycocalyx slime in milk)**

**Lactobacillus/Streptococcus: produce lactic acid in milk**

**Leuconostoc/Lactobacillus: greening of meat**

### **Fungi:**

**Rhizopus**

**Penicillium**

**Aspergillus grain and peanuts; produce aflatoxin**

**Claviceps purpurea grain; ergot poisoning**

## **Food Preservation:**

**Kill organisms: canning Pasteurization/cooking/irradiation**

**Inhibit growth: refrigerate, freeze, dehydrate (reduce a w), lower pH, high salt, add chemicals**

## **Food Borne Intoxication: ingestion of toxins**

**Toxins: Exotoxins—produced inside bacteria as part of growth and secreted:**

**Enterotoxin**

**Cardiotoxin**

**Neurotoxin**

**Super Antigen: Type I** intense immune response → cytokines → fever, nausea, vomiting, shock (Staph aureus)

**Membrane Disrupting Toxins: Type II** lyse cells by disrupting membrane

**A-B toxins: Type III**—two parts

**A**—active enzyme toxin—inhibits protein synthesis and kills cell

**B**—binding to surface so toxin transported across plasma membrane (Clostridium)

**Clostridium botulinum:** gram pos, anaerobic rod, spore forming

**Botulism**—neurotoxin

**Staph aureus:** gram pos cocci in clusters, facultative

**Food borne Illnesses:** infection by ingestion of living organisms

**Campylobacter jejuni:** gram neg curved rod, microaerophilic, culture at 42 C

**Salmonella spp:** gram neg rod, facultative, lactose negative, H<sub>2</sub>S positive

**Salmonella typhi:** enteric fever (thypoid)

**Salmonella enterica**

**Salmonella typhimurium**

**Shigella spp.** Gram neg rod, facultative, lactose negative, non-motile

**Shigella sonnei**

**Shigella dysenteriae:** dysentery

**Shigella flexneri**

**Shigella boydii**

**Vibrio cholerae:** cholera: curved gram neg rod, facultative, motile

**Non-cholera vibrios:** **Vibrio parahaemolyticus**

**Vibrio vulnificus**

**Escherichia coli:** gram neg rod, facultative, lactose positive

**Enterotoxigenic (ETEC)**

**Enteropathogenic (EPEC)**

**Enterohemorrhagic (EHEC): O157:H7/sorbitol negative**

**Enteroinvasive (EIEC)**

**Listeria monocytogenes:** gram positive rod, non-spore forming, facultative

**Bacillus cereus:** gram positive rod, spore forming

**Yersinia enterocolitica:** gram neg rod, lactose negative

