

## **MICROBIOLOGY LIKE A FACTOR OF RISK**

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**Of the three main types of hazards (biological, chemical or physical), the micorbiological hazard is the greatest threat to food safety**

**MICROORGANISMS....:**

- are living organisms that are not visible to the naked eye
- can be found anywhere

**TYPE OF MICROORGANISMS**

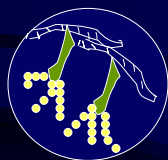
**BACTERIAS**



**MOLDS**

**FUNGI**

**YEAST**



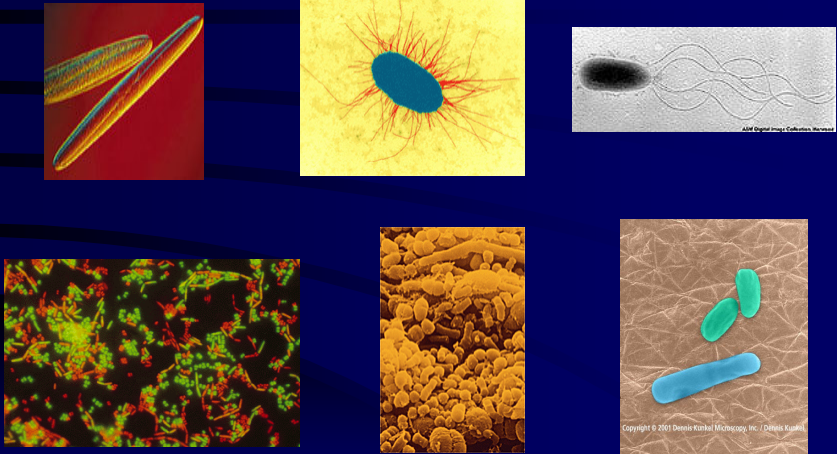
**OTHERS: VIRUSES**

**PROTOZOA**

**ALGA**

### MICROORGANISMS

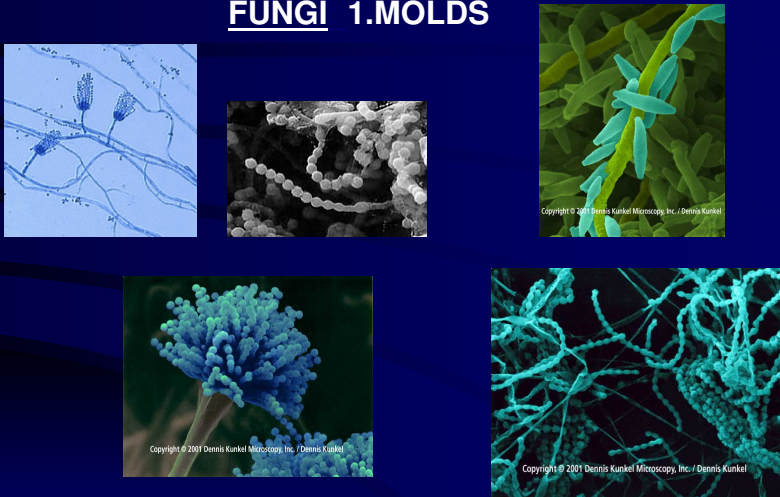
#### BACTERIA



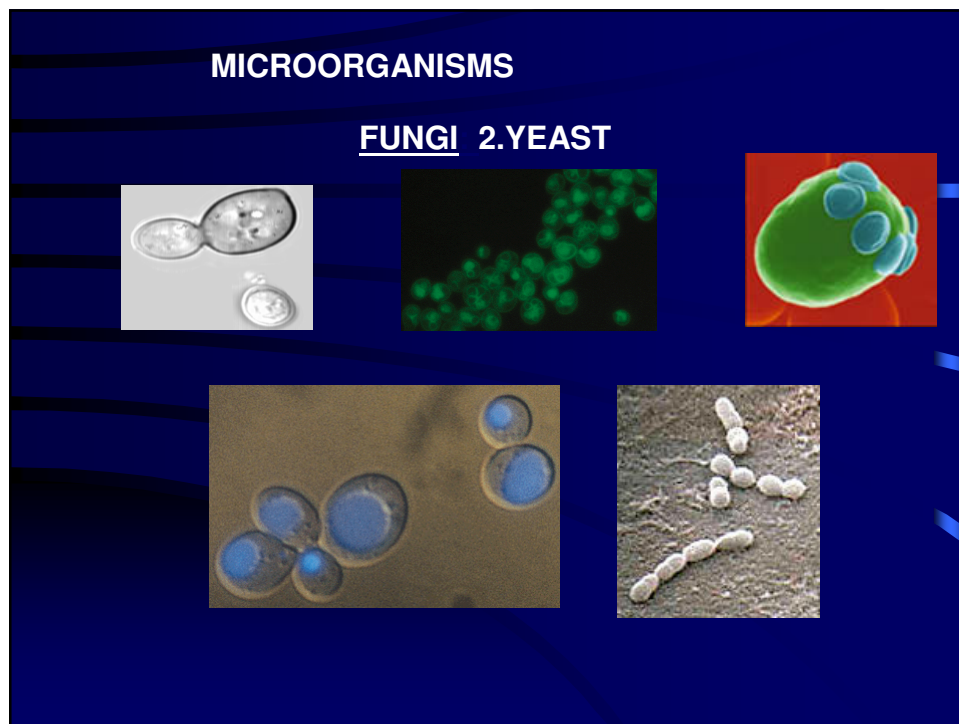
This slide displays six microscopic images of bacteria. The top row features three images: a pair of yellow spirochetes, a blue ciliated bacterium with radiating flagella, and a dark, multi-segmented bacterium with long, thin flagella. The bottom row features three images: a dense field of multi-colored (red, green, blue) Gram-stained bacteria, a yellowish, textured surface of bacterial cells, and two blue-stained rod-shaped bacteria on a brown background. Copyright notices for Dennis Kunkel Microscopy, Inc. are visible in the bottom right of the images.

### MICROORGANISMS

#### FUNGI 1.MOLDS

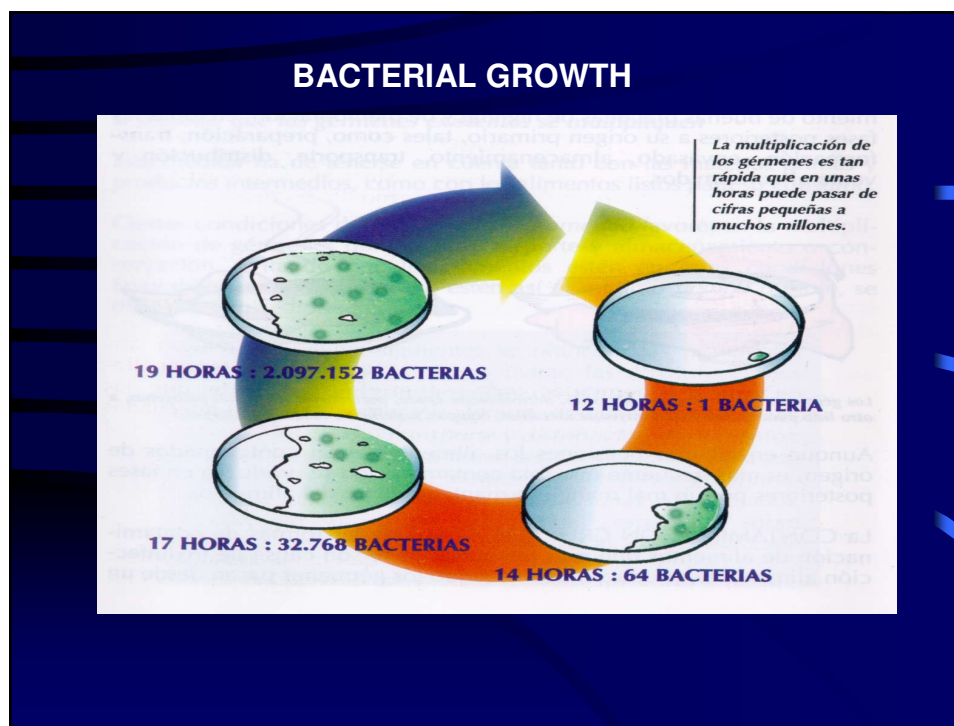


This slide displays five microscopic images of fungi. The top row features three images: blue-stained hyphae with spore-bearing tips, a black and white image of a chain of spores, and a green, textured mold structure. The bottom row features two images: a blue, fuzzy mold structure and a green, branching mold structure. Copyright notices for Dennis Kunkel Microscopy, Inc. are visible in the bottom left of the images.



**The microorganisms are capable of growing (to multiply) rapidly: some bacterial populations can double every 20 min**

**The speed of growth of the microorganisms depends on the type of microorganism and on the environmental conditions**



### FACTORS AFFECTING BACTERIAL GROWTH

- **Intrinsic Factors**: (related to food characteristics)
  - Water Activity ( $A_w$ )
  - Acidity (pH)
  - Oxigen Reduction (Eh)
  - Chemical Composition
  - Presence of natural antimicrobial substances
  - Competitive Flora

## FACTORS AFFECTING BACTERIAL GROWTH

- **Extrinsic Factors** (related to the environment)
  - Temperature
  - Relative humidity
  - Atmosphere composition

## BACTERIA: GENERAL CHARACTERISTICS

- **Temperature**
  - thermophilic 55-75°C (40-90)
  - mesophilic 35-45 °C (5-47)
  - psychrotrophic 20-30°C (-5-20)
  - psychrophilic 15-20 °C (-5-35)
- **Presence of air:**
  - aerobic
  - anaerobic
  - facultative
- **Acidity of food: low**

## BACTERIA: GENERAL CHARACTERISTICS

- Water Activity: high
- Spore-forming

some bacterias have a resistant structure called a spore formed in conditions which would be average to the normal cell. The spores present a great resistant to extreme temperatures, low moisture, low water activity, disinfectan agents,.. When the spores fall in appropriate enviroment, they sprout and form normal cells

## PERFORMANCE OF THE MICROORGANISMS ON THE FOOD

- Certain microorganisms are used in food production to provide a specific function such as fermentation and are thus **BENEFICIAL** to food:

- Yeast → production of beverages, bread , etc.

- Lactic-acid-producing bacteria → production of yogurt, cheese, sausage, etc.

- Others cause the spoilage of food, making it unfit for human consumption . **DETERIORATE** to food.

- Others, can cause illnes or disease in human without deteriorate the food. **PATHOGENIC MICROORGANISMS**

*Staphylococcus aureus*, *Clostridium botulinum* and *E. coli* O157:H7  
release enterotoxin

**Some microorganisms produce toxic substances which are harmful for humans.**

**These substances will be studied as chemical due to their chemical nature.**

Food industries and public health authorities should be particularly concerned about pathogenic microorganisms



Pathogens can be transferred from one food to another, either by direct contact, by food handlers, through common contact with surfaces, or through the air

**FOODBORNE DISEASE:**

**sickness resulting from acquiring a disease that is carried or transmitted to humans by food containing harmful substances**

**FOODBORNE DISEASE** are generally classified as

- **Foodborne INFECTION:** results from ingesting food containing living harmful microorganisms (*salmonella*)
- **Foodborne INTOXICATION:** results when toxins or poisons from bacteria or mold growth are present in the ingested food. These toxins are generally odorless and tasteless, and are capable of causing disease even after microorganisms have been killed. (*botulinum toxin, staphylococcus enterotoxin, mycotoxin*)
- **Foodborne TOXIINFECTION:** results from eating a food containing a large amount of disease causing microorganisms that are capable of producing or discharging toxin once they are ingested. (*clostridium perfringens*)

MICROORGANISMOS PATÓGENOS

**INFECTION:**

*Salmonella*  
*Escherichia coli*  
*Listeria monocytogenes*  
*Yersinia enterocolitica*  
*Vibrio parahaemolyticus*  
*Vibrio vulnificus*  
*Campylobacter*  
Virus entéricos

**INTOXICATION**

*Clostridium botulinum*  
*Clostridium perfringens*  
*Staphylococcus aureus*  
*Bacillus cereus*  
Molds

**The more presence of a pathogen does not necessarily result in foodborne disease**

**In most cases of foodborne illness:**

- 1. The pathogen must be present in high enough quantities to cause an infection or to produce a toxin (exception *E.coli* 0157).**
- 2. The food must be able to support the growth of pathogen**
- 3. The food must remain in the growth temperature danger zone long enough for the organism to multiply and or produce toxin**
- 4. Quantities of the ingested food must exceed the threshold of susceptibility of the individual ingesting the food.**

## ***GRAM -NEGATIVE BACTERIA***

### **SALMONELLA spp.**

**Origin:** Intestinal tract of humans and animals( except for fish, mollusks and crustaceans. Which can become contaminated after being harvested).

**Associated foods :** raw meat, poultry, egg, milk and dairy products, salad dressing.

**Symptoms:** nausea, vomiting, abdominal cramps, diarrhea, fever and headache.

## Salmonella spp

### Control measures:

- Heat food at a temperature sufficient to kill bacteria, from 65 to 74 °C.
- Keep foods at temperatures below 5 °C.
- Prevent cross contamination after cooking.
- Prevent sick handlers or carriers of Samonella from handling food.

## SHIGELLA spp

**Origin :** The organism is frequently found in water contaminated by human waste.

**Associated foods:** salads (potato, tuna, shrimp, macaroni, and chicken), raw vegetables, dairy products, and poultry. Sewage-polluted water and unsanitary habits by food handlers are the most common causes of contamination.

## Shigella spp

**Symptoms** :abdominal pain, cramps, diarrhea, fever, vomiting, blood, pus, mucus in stools and constipation.

**Control measures:**

- avoid contamination of the water supply with human faeces
- personal hygiene
- good hygienic practices
- adequate cleaning and sanitizing in food processing areas.

## ESCHERICHIA COLI

**Origin:** Intestines of all animals.

**Associated foods:**Undercooked or raw ground beef (hamburger), raw milk .

**Symptoms:** severe cramping (abdominal pain) and diarrhea that is initially watery but becomes grossly bloody. Occasionally, vomiting occurs. Fever is either low-grade or absent.

E.coli

•**Control measures:**

- heating foods from 65 to 74°C
- keeping foods in a temperature bellow 5°C
- avoiding cross contamination and
- not permitting infected persons to work with food.

***GRAM - POSITIVE BACTERIA***

## STAPHYLOCOCCUS AUREUS

**Origin:** The presence of this bacteria in animals, especially the milk obtained from animals with mastitis, results in food contamination.

**Associated foods :** meat and meat products; poultry and egg products; salads with egg, tuna, chicken, potato, macaroni, bakery products such as cream-filled pastries, cream pies, chocolate eclairs, sandwich fillings, raw milk and dairy products.

## S. aureus

**Symptoms:** nausea, vomiting, abdominal cramps and prostration.

**Control measures:**

- time and temperature controls, especially after cooking;
- prepare food close to the time it will be served;
- appropriate personal hygiene and adequate cooking foods to destroy microorganisms.



## CLOSTRIDIUM BOTULINUM

**Origin :** Spore-forming rod that produces a potent neurotoxin.

The organism and its spores are widely distributed in nature.

Is a severe type of food poisoning caused by the ingestion of foods containing the potent neurotoxin formed during growth of *Clostridium botulinum*.

## Cl.Botulinum

**Associated food:** any kind of food with pH > 4.6, supports growth and toxin production and, when processed, allows spore survival if not heated before consumption.

**Symptoms:** marked lassitude, weakness and vertigo, usually followed by double vision and progressive difficulty in speaking and swallowing. Paralysis.

The causes of death are respiratory failure and obstruction of air in the throat.

## Cl. Botulinum

### Control measures:

- prevent spore germination; good hygiene practices.
- perform adequate
- thermal processing of canned foods and other processes like salting or drying, fermentation or acidification
- good hygiene practices.

## LISTERIA MONOCYTOGENES

**Origin:** It can be isolated from soil, silage, and other environmental sources.

*L. monocytogenes* is very resistant and may survive freezing, drying, and heat

### L.monocytogenes

**Associated food:** raw milk, inadequately pasteurized milk, cheese (particularly soft-ripened varieties), ice cream, raw vegetables, fermented sausages, raw and cooked poultry, raw meats (all types), and raw and smoked fish .

**Symptoms:** septicemia, meningitis, meningoencephalitis, encephalitis, and intrauterine or cervical infections in pregnant women, which may result in spontaneous abortion.

### L. monocytogenes

#### Control measures:

- cook food completely,
- Keep good hygiene practices during processing
- avoid cross contamination

## BACILLUS CEREUS

**Origin:** soil, dust and intestinal tract of animals and humans.

**Associated food:** meats, milk, vegetables, and fish.

**Symptoms :** watery diarrhea, abdominal cramps, and pain. Nausea may accompany diarrhea, but vomiting (emesis) rarely occurs. Symptoms are similar to those of *Clostridium*.

## B.cereus

### Control measures:

- adopt effective measures to destroy spores
- avoid spore germination in cooked foods by keeping them refrigerated.

### INDICATOR ORGANISMS

- Serve to indicate the presence of a potential health hazard.
- Are used to indicate fecal contamination or lack of cleanliness in food processing. The coliform bacteria and *Escherichia coli* are two indicators commonly used this purpose.
- Their presence would indicate either inadequate processing or recontamination after processing.

### TOTAL COLIFORMS

- Bacteria from the Enterobacteriaceae family are indicator microorganisms Known as total coliforms.
- Genus *Escherichia*, *Enterobacter*, *Citrobacter* and *Klebsiella* form this group.
- The presence of coliform does not necessarily indicate fecal contamination or the presence of enteric pathogens.

## FECAL COLIFORMS

- In the 90% of the cases is E.coli.
- In foods of fresh animal origin, the presence of high numbers of enterobacteriaceae can indicate poor handling practices and/or inadequate storage.

## Fecal coliforms

- In processed foods, a high number of Enterobacteriaceae indicates:
  - Inadequate processing and/or post-processing recontamination.
  - Microbial multiplication that could allow growth of pathogenic and toxigenic microorganisms.

## **DESTRUCTION / ELIMINATION OF MICROORGANISMS**

### **DIRECT METHODS**

- Thermal treatments
- Cleanliness and disinfection
- Filtration
- Irradiation
- Gases
- Thermal - electrical technologies (microwave, warming óhmico ...)
- Not thermal technologies (ultrasounds, discharges press ...)

## **DESTRUCTION / ELIMINATION OF MICROORGANISMS**

### **•INDIRECT METHODS**

- Fermentation
- Dehydration
- Smoked
- Freezing
- Utilization of preserving (classic, bacteriocinas, natives ...)
- Modified atmospheres