

## Food Safety: Growing, Harvesting, and Using Olives

Linda J. Harris,  
Department of Food Science and Technology  
University of California, C Davis

### Outline

- + Good Growing Practices
- + Good Harvesting Practices
- + Food Preservation and Food Microbiology
- + Olive Oil
- + Curing Olives
  - + Basic Principles
    - + Water, brine
    - + Dry Salt
    - + Lye
  - + History

### Growing and Harvesting

- + Good Growing Practices
  - + Water
  - + Inputs
  - + Wildlife
  - + People
- + Good Harvest Practices
  - + Equipment
  - + Food grade
  - + Clean
  - + Hygiene
- + Goal
  - + REDUCE CONTAMINATION



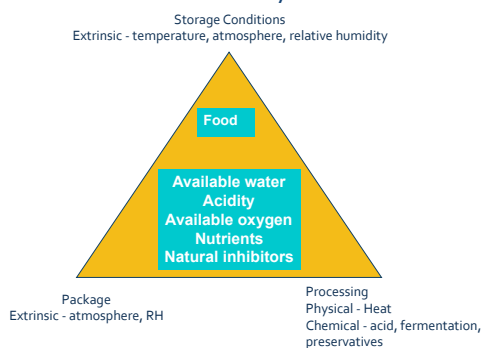
### Microbiology 101

- + Microorganisms
  - + Spoilage
  - + Pathogens
  - + Beneficial
- + Food preservation is based on techniques that
  - + Reduce, control, or eliminate (spoilage and pathogens)
  - + Control (beneficial)
- + Preservation techniques
  - + Food (modification), Process, Package, Storage Conditions



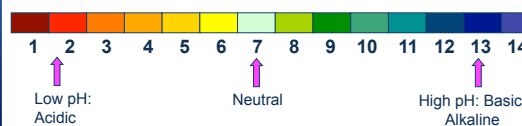
SEM images ©Dennis Kunkel, [www.pbrc.hawaii.edu/kunkel/gallery](http://www.pbrc.hawaii.edu/kunkel/gallery)

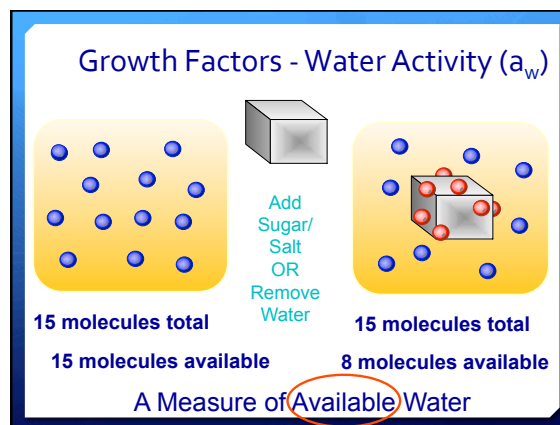
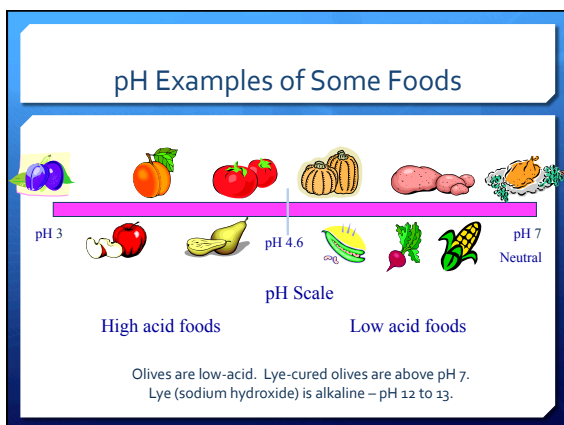
### The Food System



### What is pH?

- pH is a measure of acidity
- $\text{pH} = -\log [\text{H}^+ \text{ ions}]$
- Scale ranges from 0 to 14





### Determining Water Activity $a_w$

- + Electric hygrometer measures “equilibrium relative humidity”
- + Water activity results between 0 and 1
- + E.g., 0.98, 0.65, 0.47

Tests take 5 to 10 minutes

### *Clostridium botulinum*

- + Contained in soil and water worldwide
- + Spore-former
  - + (heat resistant)
- + Produces a deadly toxin
  - + When growing in food
- + Needs
  - + Moisture, low acidity, anaerobic conditions, warmth (in most cases)

### Botulism

- + Symptoms
  - + Muscular weakness
  - + double vision
  - + difficulty swallowing
  - + respiratory paralysis - stop breathing

### Effect of pH on *C. botulinum*

- + Spores of *C. botulinum* will not germinate and grow below pH 4.8
- + pH 4.6 (safety factor built in) is the legal dividing line between commercial foods canned by pressure canning and those by water bath or steam
- + The same applies for home canning but methods are more conservative because controls are variable

## Water Activity ( $a_w$ )

- Most foods greater than 0.95 allow microorganisms to grow
- *C. botulinum* prevented from growing  
✓  $a_w$  less than 0.93
- All pathogens inhibited  
✓  $a_w$  less than or equal to 0.85

## Salt and $a_w$

10% salt is a water activity of about 0.93.

## Microbiology 101 – olive oil

- + Oils, in general a low risks for microbial food safety
- + Refined oils (canola, sunflower, peanut, etc.) have no water, no place for microorganisms to "hang out"
- + Olive oils, especially extra virgin do carry small numbers of microorganisms within tiny water droplets
- + Yeasts may be involved in some flavor development
- + Extra virgin olive oils also carry broad range of antimicrobials
  - + Levels vary in composition and amount
    - + Variety, production practices, maturity, extraction method, storage condition, time

UC Davis Olive Center Report, Microbiological Food Safety of Olive Oil: A review of the literature. 2011

## Olive Oil

Environment (ambient or refrigerated)

Olive Oil  
Minimal water  
Reduced pH  
Antimicrobials

Olive Oil

Process  
Extraction

Package (excludes light, air)

## Flavored olive oil

- + Botulism risk
  - + Garlic-in-oil mixtures
  - + Stored at room temperature
- + Prevention
  - + Flavor with dry herbs and spices
    - + Low water activity
  - + If moist ingredients are added
    - + Store refrigerated short time (7 days)
    - + Freeze

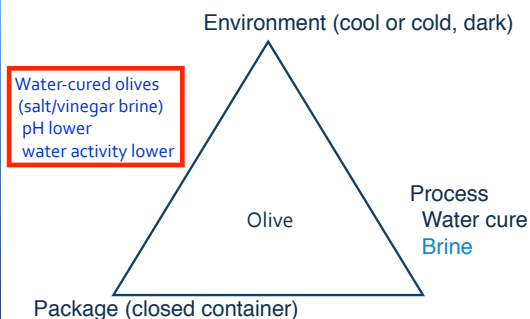
## Curing Olives

- + Preservation principles
- + Preventing microbial growth
  - + Increasing acidity, decreasing available water or water activity (increasing salt or drying)
- + Killing microorganisms
  - + Thermal processing (canning)

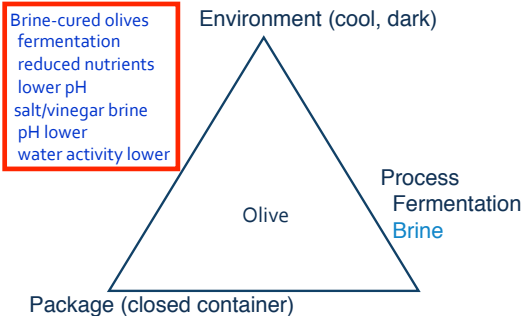
## Curing

- + A method to remove oleuropein
- + Water cured
- + Brine cured
  - + Natural fermentation
  - + pH lowered
- + Dry salt cured
  - + Reduced water activity
- + Lye cured

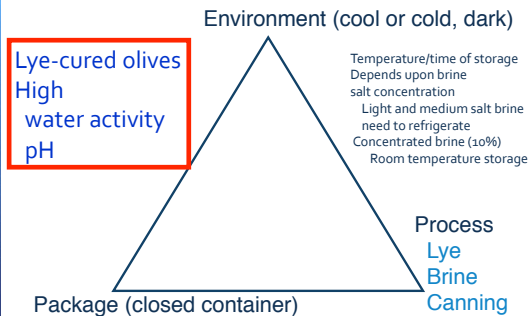
## Water-Cured Olives



## Brine-Cured Olives

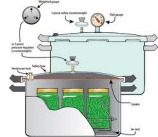


## Lye-cured Olives



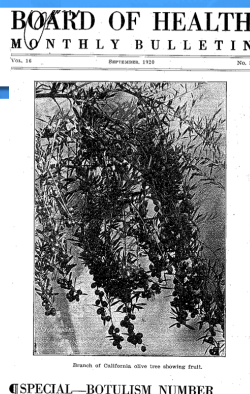
## Canning Lye-cured Olives

- + Lye-cured and unfermented olives
- + Low-acid (pH 7 or 8)
- + Water activity high
- + CANNING MUST BE DONE IN A PRESSURE CANNER
- + Follow times and pressures indicated in instructions for your local elevation



## Olives and botulism

- + Canned lye-cured olives were marketed across the US
- + Scientific understanding of thermal processing was limited
- + Several outbreaks occurred in 1919, 1921, 1924
- + Lead to National Canners' Association and significant research in this area
  - + Some done at UC Davis
- + Initial canning-inspection program





## Olive Spoilage

- + Preservation is also designed to prevent spoilage
- + Often spoilage microorganisms are more pH and water activity tolerant than the pathogens
- + Softening
  - + Multiple causes - breakdown of pectin
    - + Microbial causes
      - + Molds and bacteria that produce pectin-degrading enzymes
      - + Keep covered, appropriate brine concentration, refrigeration
    - + Chemical causes
      - + Lye too strong or too hot
    - + Olives
      - + Variety, too ripe, overly large
- + Gas Pockets
  - + Bacterial growth and gas formation
    - + Frequent water changes during the lye washing phase

## www.ucfoodsafety.ucdavis.edu

University of California  
UC Food Safety

SKIP TO CONTENT SITE MAP Enter Search Terms



Home  
Consumer Advice  
Food Industry Contacts  
Retail and Food Service  
Processing Foods  
Process Validation  
Produce - Preharvest  
Produce - Postharvest  
Low Moisture Foods  
UC Publications  
Food Safety Links  
Gemp Info  
ASNR Links

UC Food Safety Home

Welcome to the University of California Food Safety website. Research and Extension faculty at UC Davis (Drs. Linda Harris and Trevor Suslow) are the hosts for this site but current information from any UC campus will be included. From here link to presentations, publications, and other websites with information related to the production, harvest, and processing of foods. The emphasis is on microbial food safety but many other subjects related to food such as biotechnology, food quality and food security are also addressed.

Event Name	Date	UC Food Blog
Your Sustainable Backyard: Olive Curing	9/24/2011	<a href="#">Alternatives to fumigation and improving fumigant efficacy</a>
Basic HACCP - A Food Safety System	10/24/2011	Posted 9/22/2011 - Synthetic soil fumigants such as chloropicrin and 1,3-D are used by some commercial growers to control soilborne pathogens, weeds and nematodes
Advanced HACCP: Verification: Implementation and Other Challenges	10/27/2011	