Just Can It!
Food Preservation Basics

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Extension Associate
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The Basics
• Food safety and sanitation
• Bacteria and how they grow
• Research-based home canning techniques
  • principles of home canning
  • ingredients
  • recipes
  • equipment
  • high- and low-acid foods
  • using a boiling water bath canner (Lunch!)
  • using a pressure canner
  • food spoilage
  • What's new?
• Drying foods at home
• Home freezing basics
• Where to go for research-based answers

FOOD SAFETY AND SANITATION
**Food Safety & Sanitation**

**PUT FOOD SAFETY FIRST!**

- Growers should use fertilizers and pesticides correctly—read the label!
- Growers should reduce the risks of potential contamination
  - minimize exposure to animal waste
  - use potable water for irrigation
  - do not use fields for dumping trash
- Food handlers should practice good personal hygiene

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**The Safe Food Handler**

Most important to prevent the contamination of food products:

- HAND WASHING!  
- HAND WASHING!  
- HAND WASHING!

Also:

- Keep yourself neat, clean and healthy
- Protect food from open cuts or sores
- Avoid smoking, eating or drinking
- Keep all equipment and surfaces clean

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**The Sanitary Kitchen**

- Washed, rinsed and sanitized
- **Clean** means free of visible soil
- Wash cutting boards, utensils and counters with hot, soapy water
- **Sanitary** means free of harmful levels of disease-causing bacteria
- Sanitize with hot water or chemical sanitizer/bleach
BACTERIA ~ HOW THEY GROW

Requirements for Bacteria to Grow
- Food
- Acidity (pH)
- Time
- Temperature
- Oxygen
- Moisture ($A_w$ = water activity)

Food
Food for us = Food for bacteria
**Acidity: pH of Common Foods**

- **High Acid Foods**
  - Tomatoes: 4.4 – 4.6
  - Cucumbers: 5.1 – 5.8
  - String beans: 5.6
  - Beets: 5.3 – 6.6
  - Cabbage: 5.2 – 6.8
  - Corn: 5.9 – 7.3

- **Low Acid Foods**
  - Grapes: 2.8 – 3.8
  - Apples: 3.4 – 4.0
  - Peaches: 3.3 – 4.0

Bacteria will not grow well at pH below 4.6

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**Time: Bacterial Reproduction**

- **Psychotrophic**
  - Grow best at 58 – 68 °F
  - Can grow slowly at refrigerator temperatures

- **Mesophilic**
  - Grow best at 86 – 98 °F
  - Most of the microorganisms that affect food safety grow within this range
  - *Clostridium botulinum* of special concern

- **Thermophilic**
  - Grow best at 122 – 150 °F
  - Spoilage bacteria—most affect food quality, not food safety

The result of this kind of growth is a tremendous increase in the numbers of bacteria over a relatively short period of time.

Compliments of National Restaurant Association

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**Temperature Requirements**

- Psychotrophic
- Mesophilic
- Thermophilic
**Temperature: Food Danger Zone**

- DANGER ZONE
- Bacteria survive and grow
- 40°F - 140°F

**Oxygen Requirements**

- **Aerobic**
  - with oxygen
  - out in the air

- **Anaerobic**
  - without oxygen
  - canned foods
  - *Clostridium botulinum*

- **Facultative**
  - either with or without oxygen
  - cause most foodborne illness

**Moisture Requirements**

Water Activity ($A_w$) = measure of water available for bacterial growth

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</tbody>
</table>

Most fresh and canned fruits, vegetables, meat and fish have $A_w > 0.95$.
**Requirements for Bacteria to Grow**

- Food
- Acidity (pH)
- Time
- Temperature
- Oxygen
- Moisture (\(A_w = \text{water activity}\))

**Bacteria**

**Vegetative Cells**
- Able to grow and reproduce
- May be killed by high temperatures
- May survive freezing

**With Spores**
- Spore: a thick-walled formation within the bacterial cell
- Does not reproduce
- Resistant to heat, cold and chemicals
- Can become a vegetative cell when conditions become favorable
- *Clostridium botulinum*

**Clostridium botulinum**

- Bacterium of chief concern in home canning—produces the toxin that causes botulism
- Spores are found in soil and on surface of fruits and vegetables; oxygen in the air prevents them from growing
- Spores will not germinate and grow (producing botulism toxin) until conditions are favorable:
  - low oxygen (as in canned foods)
  - low acidity (pH > 4.6)
- Cannot grow in high acid foods (pH ≤ 4.6)
- Spores can survive boiling water bath processing
HOME CANNING BASICS

Principles of Home Canning

- Select fresh, good quality ingredients
- Wash hands, produce, equipment and work surfaces as needed
- Use good sanitation procedures
- Use research-based recipes
- Use appropriate equipment and supplies
- Apply enough heat to:
  - destroy harmful bacteria and spoilage microorganisms
  - inactivate enzymes
  - drive air from jars, to produce vacuum seal on cooling

Ingredients

- Produce
  - start with fresh, top-quality produce
  - choose varieties best suited for canning
  - wash produce well
  - can as soon as possible after harvesting
Ingredients

- Salt
  - adds flavor to canned fruits, vegetables and meats; can be reduced or omitted in these products
  - needed for safety in fermented pickles and sauerkraut; should not be reduced
  - pickling or canning salt is the best choice
    - table salt may cause cloudiness
    - iodized salt may darken pickles and cause unusual colors in vegetables

- Sugar
  - acts as a sweetener; usually not needed for safety
  - can be reduced in many recipes
  - can have a preservative effect

- Vinegar
  - increases acidity; acts as a preservative
  - adds tart flavor
  - use commercial (5% acidity) vinegar only
  - never reduce or dilute in a recipe; add sugar if a less sour product is desired
  - use white distilled vinegar for light color

- Lemon juice
  - increases acidity; acts as a preservative
  - adds flavor

- Spices
  - add flavor

Home Canning Recipes

- Always use current, research-based recipes
- Avoid the advice of untrained celebrities, old cookbooks, “back to nature” publications, and out-of-date home canning leaflets (even those from Extension!)
- Follow recipes closely; modify only when suggested in the recipe
**Home Canning Recipes**

**Sources for research-based recipes:**

- USDA Complete Guide to Home Canning
- So Easy to Preserve (University of Georgia)
- National Center for Home Food Preservation website [http://nchfp.uga.edu/index.html](http://nchfp.uga.edu/index.html)
- Ball Blue Book Guide to Preserving
- UK Cooperative Extension home canning publications—new!

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**Headspace**

- The amount of space from the top of the food or liquid to the top of the jar
- Allows the food to expand as the jar is heated during processing, and a vacuum seal to form as the jar is cooled
- Different foods require a different amount of headspace
- Follow recipe for correct headspace, usually:
  - ¼ inch for jams, jellies and juices
  - ½ inch for fruits, tomatoes and pickles
  - 1 to 1¼ inches for low acid, pressure-canned foods

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**Methods of Pack**

- Raw Pack
  - Raw, unheated food is put directly into jars
  - Boiling hot water, juice or syrup is poured over the food to obtain proper headspace
- Hot Pack
  - Food is preheated or cooked for a specified length of time
  - Hot food and liquid are packed into jars
- Always use the type of pack specified in the recipe
- Hot pack generally yields better color and flavor, especially in a boiling water canner
**Jars and Lids**

- Use only Mason-type jars designed for canning; can be reused; inspect each year for cracks and nicks
- Do not reuse commercial single-use jars (e.g. mayonnaise, peanut butter)
- USDA recommends two-piece screw-on caps (lids and screw bands)
- Lids are used only once; check new lids for dents or uneven sealing compound
- Screw bands (rings) may be reused if not rusty or damaged

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**Preparing Jars and Lids**

- Wash jars, lids and screw bands in hot, soapy water; rinse in hot water
- Dry screw bands and set aside
- Prepare lids as directed by manufacturer
  - new Ball/Kerr lids do not need preheating—just wash, rinse and keep at room temperature until ready to use; preheating will not harm
  - do not boil lids—can result in seal failure
- Heat jars before filling to help prevent breakage
  - submerge jars in enough water to cover
  - bring water to simmer (180°F) and keep jars in hot water until ready to use

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**Additional Canning Utensils**

- Jar funnel
- Headspace tool
- Bubble freer—not metal!
- Magnetic lid wand
- Jar lifter
- Clean cloths
- Timer
- Other utensils and equipment needed to prepare recipe (knives, cutting board, saucepans, hot pads)
Two Types of Canners

**Boiling Water Canner**
- 212°F

**Pressure Canner**
- 240°F @ 10 pounds pressure

Which Canner to Use?

- **Bacteria will not grow well at pH below 4.6**

<table>
<thead>
<tr>
<th>pH</th>
<th>High Acid Foods</th>
<th>Low Acid Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Boiling Water Canner</td>
<td>Pressure Canner</td>
</tr>
<tr>
<td>2-3</td>
<td>Limes</td>
<td>Tomatoes</td>
</tr>
<tr>
<td>3.3-4</td>
<td>Mayonnaise</td>
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<tr>
<td>4.4-4.6</td>
<td>Grapes</td>
<td>Apples</td>
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<td>4.7-7.3</td>
<td>Corn</td>
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<td>5.1-5.8</td>
<td>Beet</td>
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<td>5.3-6.6</td>
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<td>Apples</td>
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<tr>
<td>5.9-7.3</td>
<td>Corn</td>
<td>Peaches</td>
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</tbody>
</table>

High Acid vs. Low Acid Canned Foods

- High acid (or acidified)
  - pH ≤ 4.6
  - depend on the pH of the food to prevent the growth of *Clostridium botulinum*
  - May use boiling water canner
- Low acid
  - pH > 4.6
  - depend on heat processes under pressure to destroy the spores of *Clostridium botulinum*
  - Must use pressure canner
Steps to Safe Home Canning

- Follow research-based recipes
- Place the food in hot, prepared jars, leaving the correct headspace; remove air bubbles
- Wipe jar rims; adjust two-piece caps; tighten lids until fingertip tight only
- Heat the filled jars to the specified temperature for the food, **using the right type of canner**
- Process jars for the specified time to inactivate enzymes and destroy harmful bacteria and spoilage microorganisms
- Altitude affects processing times and pressures
- Cool jars properly so a vacuum seal forms

Two Types of Canners

**Boiling Water Canner**

- Fill canner half full of clean warm water; place rack in bottom; preheat water to simmering (180°F)
- Prepare recipe and fill jars
- Using a jar lifter, load jars into canner one at a time, keeping them upright at all times
- Add more boiling water if needed so that water level is 1-2 inches above jar tops
- Place lid on canner; turn up heat
- When water returns to a boil, begin timing; adjust heat to maintain a gentle but complete boil for entire processing time
- At end of processing time, turn off heat and remove canner lid; wait 5 minutes before removing jars from canner
- Using a jar lifter, remove jars from canner, keeping them upright
- Set jars on a towel on counter to cool; leave undisturbed for 12-24 hours (as jars cool, vacuum seal forms)

**Pressure Canner**

- 240°F @ 10 pounds pressure
- High acid foods: Fruits, jams, jellies, pickled fruits or vegetables, acidified tomatoes, salsa, barbecue sauce
- Low acid foods: All vegetables, meat, poultry and fish

Boiling Water Canner
Hands-on Canning Activity: Corn Relish

- Recipe adapted from Ball Blue Book, page 53 (half recipe)
- Vinegar used to increase acidity to level safe for boiling water canning ($\text{pH} \leq 4.6$)
- Using half-pint jars in place of pints; processing time cannot be reduced; use full pint jar processing time
- Read through entire recipe before beginning

Pressure Canner

- Fill canner with 1-2 inches of water, following the manufacturer's instructions
- Prepare recipe and fill jars; load jars into canner and secure canner lid; leave weight off vent port
- Turn up heat and vent canner for 10 minutes to remove trapped air; place counterweight or weighted gauge over vent port to begin building pressure in the canner
- Bring pressure up to that specified in recipe
- Begin timing process as indicated in recipe; adjust heat to maintain steady pressure for entire processing time
- At end of processing time, turn off heat and allow canner to cool naturally to return to zero pressure; then remove weight from vent port (Canner and contents are still very hot!)
- Wait 10 minutes; remove lid carefully; remove jars
- Set jars on a towel on counter to cool; leave undisturbed for 12-24 hours (as jars cool, vacuum seal forms)

After Processing

- Allow jars to cool, undisturbed, for 12-24 hours to allow vacuum to form
- After 24 hours, test to be sure that jars are sealed
  - most two-piece lids will seal with a “pop” while they’re cooling
  - sealed lid will be curved downward and should not move when pressed with finger
- Remove screw bands to prevent them from rusting on during storage
- Wash outside of jars and lid surfaces
- Date and label jars and store in cool, dry place for up to two years
Unsealed Jars

- If a jar is not sealed, refrigerate and use within two to three days
- Freeze the food for longer storage
- Unsealed jars can be reprocessed within 24 hours
  - remove lid and check jar rims for nicks
  - change jar if necessary
  - add new, properly prepared lids
  - reprocess for the full processing time specified in the recipe

Sources of Bacterial Spoilage

- Incipient spoilage
  - food held too long before canning
  - allows spoilage to start before canning occurs
- Inadequate heat processing
  - insufficient time or temperature to kill all bacteria and/or spores present in the food
  - bacterial growth continues after processing
- Contamination after processing
  - before vacuum seal is complete
- Thermophilic bacterial spoilage
  - improper cooling
  - storage above 95°F

Signs of Bacterial Spoilage

Do not taste any foods that show the following signs:

- Unsealed jar or bulging lid
- Dried food on outside of jar, indicating seepage
- Rising air bubbles
- Cloudiness
- Spurting liquid when opened
- Disagreeable odor
- Mold growth on food surface or underside of lid

Remember that harmful bacteria can be present without any signs of spoilage, if the home-canned product was improperly processed!
One More Time...

High acid foods
- pH ≤ 4.6
- Fruit, pickles, relishes, jams, jellies, fruit butters, salsa, tomatoes acidified with lemon juice or citric acid
- Process at 212°F for specified time
- Boiling water canner

Low acid foods
- pH > 4.6
- All fresh vegetables, red meats, seafood, poultry, eggs, milk, soups and stews
- Process at 240°F for specified time
- Pressure canner

What’s New in Home Canning?
- Ball® FreshTECH Automatic Home Canning System
- Ball® FreshTECH Automatic Jam & Jelly Maker
- Ball® FreshTECH Electric Water Bath Canner and Multi-Cooker
- Ball® Sure Tight™ Band Tool

DRYING FOODS AT HOME
Food Drying/Dehydrating

- One of the oldest methods of food preservation
- Preserves food by removing the moisture that bacteria and other microorganisms (yeasts, molds) need to grow
- Enzyme action is slowed (but not stopped); helps maintain color, texture and quality

What Can You Dry?

- Fruits
- Vegetables
- Leathers
- Herbs
- Nuts and seeds
- Meat jerkies

Drying Methods ~ Outdoor

- Sun drying
  - fruits; a few vegetables
  - needs hot, dry, breezy weather
- Solar drying
  - fruits; a few vegetables
  - dryer magnifies sun's heat
- Vine drying
  - beans, lentils and soybeans
  - leave pods on vines until they rattle
- Pasteurization required to kill insects and eggs
  - freezer (0°F for 48 hours or longer)
  - oven (160°F for 30 minutes)
Drying Methods ~ Indoor

- **Room drying**
  - herbs, nuts, chili peppers
  - sunny room, low humidity, air movement

- **Oven drying**
  - most foods
  - need low temperature (140 - 150°F)
  - oven door open, fan for air movement; high energy use

- **Dehydrator drying**
  - most foods
  - high quality, sanitary, fast

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Drying Fruits

- Uniform pieces; peeled and thinly sliced dry fastest
- Pretreat to prevent darkening
  - burning sulfur; no longer recommended
  - sulfite or ascorbic acid dip
  - fruit juice or honey dip; adds flavor and calories
  - blanching in syrup or steam
- Dry in single layer for recommended time at 135°F
- When dried (20% moisture)
  - no visible moisture
  - may remain pliable, but not sticky
  - cool 30 – 60 minutes before packaging
- Condition 7 – 10 days to evenly distribute moisture

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Drying Vegetables

- Uniform pieces
- Pretreat to inactivate enzymes and set color
  - water blanching
  - steam blanching
- Dry in single layer for recommended time at 130°F
- When dried (10% moisture)
  - most will be brittle or crisp (beans, corn, onions, celery)
  - some will be leathery (tomatoes, carrots, mushrooms)
  - cool before packaging
- No need to condition (very low moisture)
Fruit & Vegetable Leathers

- Use fresh, frozen or drained canned fruit
- Use tomatoes, pumpkin puree, or mixed vegetables (tomato, onion, celery)
- Combine fruits or vegetables to mix flavors
- Puree fruits or vegetables until smooth
- Add lemon juice or ascorbic acid to prevent browning (light-colored fruit)
- Sweeten if desired (sugar, honey or corn syrup)
- Pour $\frac{1}{8}$ to $\frac{1}{4}$ inch thick layer; dry at 140°F
- When dried
  - no indentation when touched
  - peel from tray when warm to prevent sticking

Drying Herbs

- Harvest before flowers open
- Room drying
  - bundle and tie; hang in warm, dry well-ventilated room
  - hang tender herbs inside paper bags with holes in sides
- Dehydrator drying
  - dry in single layer at 95 – 115°F
- Oven drying
  - leaves only (mint, sage, bay leaf)
  - up to 5 layers between paper towels in very cool oven
- When dried
  - leaves crumble
  - stems break when bent

Storing Dried Foods

- Cool completely before packaging
- Seal out air and moisture
  - clean, dry canning jars
  - plastic freezer containers with tight-fitting lids
  - plastic freezer bags
  - vacuum packaging
- Store in cool, dry, dark area
- Recommended storage time: 4 months to 1 year, depending on the food
HOME FREEZING BASICS

Freezing Food
- One of the easiest methods of home food preservation
- Preserves food by using low temperatures to prevent the growth of bacteria and other microorganisms; also lowers \( A_w \) (FAT TOM)
- Slows down chemical changes that affect quality or cause food spoilage
- Does not kill bacteria or other microorganisms—on thawing, any bacteria present will begin to grow and may cause spoilage or illness
- Does not destroy enzymes that cause color and flavor changes—just slows them down

What Can You Freeze?
- Fruits
- Most vegetables
- Meats, poultry and seafood
- Dairy foods
- Eggs
- Nuts
- Prepared or cooked foods
Foods That Don’t Freeze Well

- Some vegetables (e.g. cabbage, celery, lettuce, cucumbers, radishes)
- Some dairy foods (e.g. sour cream, meringue, custards, milk sauces)
- Cooked macaroni, spaghetti or rice
- Mayonnaise or salad dressing
- Gelatin
- Spices, herbs and seasonings
- Most fried foods

Freezing Basics

- Start with top quality foods
  - freezing will not improve flavor or texture
- Work under sanitary conditions
- Follow directions for each individual food
- Package to keep air out, moisture in
  - helps maintain flavor and nutritive value
- Label and date each package
- Freeze foods quickly
  - cool all foods before packaging
  - don’t overload freezer with unfrozen food
  - allow space between packages for air circulation
- Freeze foods to 0°F or lower

Containers for Freezing

- Freezer is a dry climate
- Choose containers or packaging that will protect the flavor, color, moisture content and nutritive value of food
- Look for:
  - moisture-, vapor-, oil- and water-resistant materials
  - durable and leak-proof
  - will not crack at low temperatures
  - easy to seal
  - easy to mark
  - half-gallon size or less, for quicker freezing
Types of Containers/Packaging

- Rigid containers
  - plastic or tempered glass
  - tight-fitting lids
  - straight sides desirable
  - headspace allows for expansion of food during freezing
- Flexible bags or wrappings
  - plastic bags or wrap, freezer paper, or heavy-weight aluminum foil
  - press to remove as much air as possible before closing (except for headspace)
- Vacuum packaging
  - keep food frozen until ready to use (risk of botulism from some vacuum-packaged foods)

Freezing Fruits

- Select fruit of best quality (firm, ripe, at peak of freshness)
- Enzymes can cause browning and loss of vitamin C
  - controlled by chemical compounds (ascorbic acid most effective)
- Follow specific directions for each type of fruit
- Types of packs
  - syrup pack—better texture and flavor for most fruits
  - sugar pack—better texture and flavor for most fruits
  - dry pack or tray pack—good for small whole fruits such as berries
  - unsweetened packs—water, unsweetened juice, or pectin syrup; may use sugar substitutes

Freezing Vegetables

- Select vegetables of best quality (fresh, young, tender)
- Enzymes can cause loss of flavor, color and texture
  - controlled by blanching in boiling water or steam, followed by rapid cooling
  - blanching is a must for almost all vegetables
  - blanching cleans surface, brightens color, helps slow loss of vitamins, softens hard veggies for easier packaging
  - blanching time is crucial and varies with the vegetable and size
- Follow specific directions for each type of vegetable
- Dry pack or tray pack
### Freezing Meat, Poultry and Seafood
- Select only high quality, fresh products
- Follow directions for specific products
- Package meats in moisture-proof freezer paper or wrap, wrapping tightly and sealing well
- If packaging in store wrap, overwrap with suitable freezer wrap
- Package in meal-size portions
- Label and freeze immediately
- Do not stuff poultry before freezing
- Package shellfish in rigid containers or freezer bags

### Storing Frozen Foods
- Freezer temperature: 0°F or lower
  - check temperature periodically with thermometer
  - avoid temperature fluctuations
- For best quality, observe recommended storage times for frozen foods
  - after these times, food should still be safe—just lower in quality
- Arrange foods so that food frozen longer can be used first
- Keep a frozen food inventory up to date

### Thawing Foods for Serving
- Fruits
  - thaw in refrigerator, in microwave oven, at room temperature, or in a pan of cool water
- Vegetables
  - most should be cooked without thawing first
- Meat, fish and poultry
  - can be cooked frozen or thawed
  - best thawed in refrigerator in original wrapping
  - can be thawed in cold water
  - can be thawed in microwave, if cooked immediately after thawing
- Butter, eggs, milk, cheese and cream
  - thaw in refrigerator
WHERE DO I GO FOR ANSWERS?

Research-based Information on Home Food Preservation

- So Easy to Preserve (University of Georgia)
- National Center for Home Food Preservation website http://nchfp.uga.edu/index.html
- Ball Blue Book Guide to Preserving
- UK Cooperative Extension publications
  - Home Canning series
  - Drying Food at Home
  - Home Freezing series

Questions?

- References
  - National Center for Home Food Preservation website http://nchfp.uga.edu/index.html

- Images from
  - Microsoft Office Clip Art
  - 123RF Stock Images
  - National Center for Home Food Preservation

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