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CIPHI Ontario Seminar Series
Safety Considerations for Home-Canned Food

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Outline

- Introduction
- Illnesses and outbreaks associated with home-canned food
- Favorable condition for growth of foodborne pathogens
- Home canning methods
- Validated recipe
- Recorded errors during the canning process
- Case study

Canning

- Nicolas Appert developed the first commercial canning process in the 18th century.
- Canning is a method of food preservation: food is treated by the application of heat alone, or in combination with pH and water activity, then stored in hermetically sealed containers.
- Home canning is the preservation of foods by packing them into glass jars and heating the jars to eliminate organisms that would create spoilage.

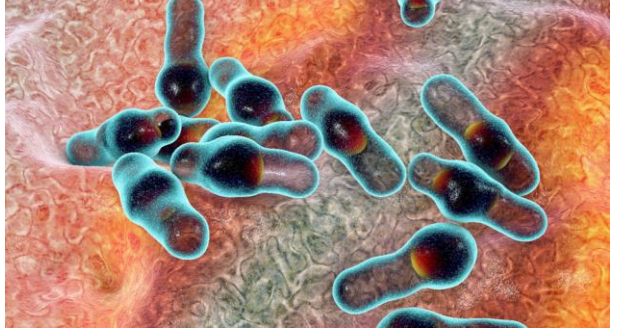
Ontario Agency for Health Protection and Promotion (Public Health Ontario). Home canning: literature review. Toronto, ON: Queen's Printer for Ontario; 2014. Available from: https://www.publichealthontario.ca/-/media/documents/h/2014/home-canning.pdf
Source: Wikimedia. Appert Nicolas [Internet]. San Francisco, CA: Wikimedia Foundation, Inc.; 2020 [cited 2021 Oct 07]. Available from: https://upload.wikimedia.org/wikipedia/commons/a/ad/Appert_Nicolas.jpg

Illnesses and Outbreaks

- Canning can be a safe way of preserving and storing food for a prolonged period of time. However, if not done properly, it can cause illnesses.
- Shelf-stable home-canned products containing low acid foods such as vegetables and meat dishes are often implicated in botulism illnesses and outbreaks.
- In Canada and internationally, there are number of published reports of foodborne illnesses and outbreaks associated with improperly canned food.

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Home canning: literature review. Toronto, ON: Queen's Printer for Ontario; 2014. Available from: https://www.publichealthontario.ca/-/media/documents/h/2014/home-canning.pdf

Botulism



Spore-forming bacteria Clostridium

- Botulism is a paralytic disease caused by a toxin that by the bacterium *Clostridium botulinum*.
- Symptoms include double or blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, and muscle weakness. If untreated, these symptoms may progress to cause paralysis of the respiratory muscles, arms, legs, and trunk, and ultimately death.
- *C. botulinum* spores and toxins are resistant to freezing temperatures. The spores can germinate and produce toxins in low acid food with an equilibrium pH ≥ 4.6, in an anaerobic environment of less than 2% oxygen, between 4°–50°C.

Examples of Reported Illnesses and Outbreaks of Foodborne Botulism Associated with Home-Canned Food

Year of Event	Location	# of cases	Most Likely Source(s)	Contributing Risk Factor(s)
1999	Canada-Ontario	3	Home-canned tomatoes	Inadequate pH of the final product
1980-2002	Georgia	565	Home preserved vegetables (implicated food for 80% of botulism cases)	Inadequate sterilization equipment and temperature treatment, canned food stored for too long and preserved vegetables eaten uncooked
2004	Italy	28	canned green olives, produced in a restaurant	Inadequate pH of the final product
2006	Thailand	163	Home-canned bamboo shoots	Inadequate temperature treatment
2008-2009	United States - Ohio and Washington	12	Home-canned vegetables (blend of carrots, beans, green beans, asparagus) Home-canned vegetables accounted for 56% of botulism outbreaks in the United States between 2008 and 2009	Inadequate temperature treatment
1985-2005	Canada	18	Home-canned mushrooms; home-canned vegetables (mushrooms and asparagus); beef and vegetable soup; and sausage produced in a restaurant	Not reported

Reference:

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Home canning: literature review. Toronto, ON: Queen's Printer for Ontario; 2014. Available from: https://www.publichealthontario.ca/-/media/documents/h/2014/home-canning.pdf

FAT TOM

Characteristics that influence foodborne pathogens growth:

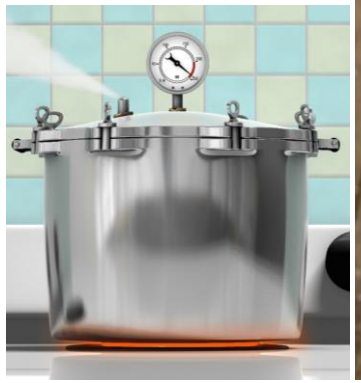
- **F**ood: available nutrients
- **A**cidity: pH level suitable for growth
- **T**ime: how long food can stay at certain temperatures
- **T**emperature: temperatures pathogens grow best in
- **O**xygen: aerobic vs. anaerobic pathogens
- **M**oisture: available water (Aw) in food

What Microbial Growth Conditions are Controlled to Produce Kimchi?

a. Temperature, acidity, and oxygen
b. Food, temperature and oxygen
c. Food, acidity and oxygen
d. Temperature, moisture and time
e. Acidity, food and time
f. None of the above

Home-Canning Methods

- Boiling in water bath (100°C /212° F @ sea level)
  - Used for high-acid or acidified foods—foods that have a natural equilibrium pH ≤ 4.6
- Pressure canning (116° to 121°C /240° to 250°F)
  - Must be used for low-acid foods with a finished equilibrium pH > 4.6 and water activity > 0.85.
  - The canning process is often used to obtain commercial sterility.
  - It is not recommended for inexperienced canners.

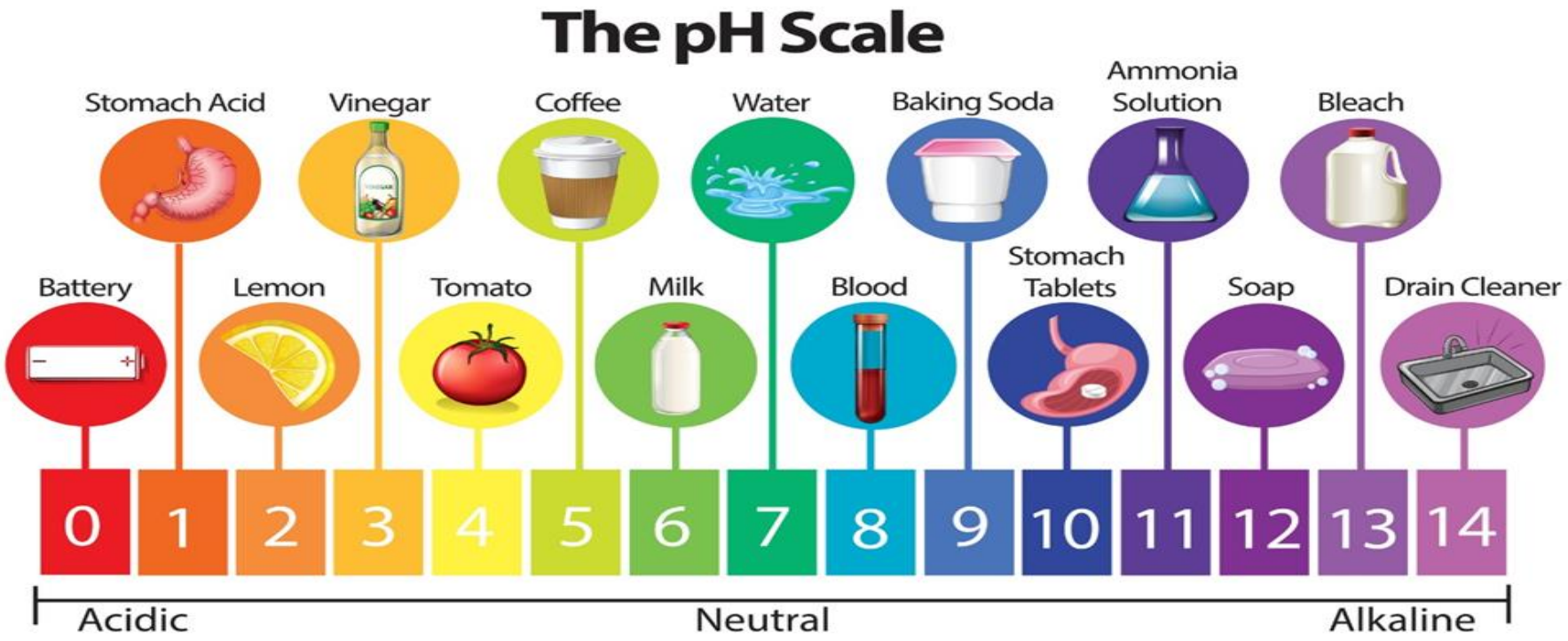


Acidic/Acidified Food vs. Low-Acid Food

- Acidic food is food that naturally has a pH ≤ 4.6.
  - Most fruit have low acidity
- Acidified food is food to which acidulant(s) or acid food(s) are added, and has a finished equilibrium pH ≤ 4.6 and Aw > 0.85.
  - Pickled beans
  - Acidulants - vinegar, lemon juice, citric acid
- Low-acid food is any food (other than alcoholic beverages) having a finished equilibrium pH > 4.6 and Aw > 0.85.
  - Butternut squash soup - low acid food, no acidulant added

pH

- pH is a measure of the acidity or alkalinity of a food
- The lower the value, the greater the acidity
- pH meter is used for measurement



High-Acid/Acidified (pH ≤ 4.6)

Low Acid (pH > 4.6)

Equilibrium pH

3.0

4.6

7.0

Jams, Jellies

Relishes, salsas

Veg purées, soups

Pickled vegetables

Equilibrium pH is the pH of a food product after the added acid has reached throughout the food; the pH of the acid brine and the food have equilibrated.

Hu X. The food safety of resurgent food technologies: a workshop on canning, fermentation, raw meat dishes and sous vide cooking. Presented at: The Ontario Public Health Convention 2017. 2017 Mar 29-31; Toronto, ON.

Are the Following Canned Products

a) Acidic
b) Acidified or
c) Low Acid Food?

Chicken soup

Pickled eggs

Apple Sauce

Water Activity (Aw)

- A measure of the availability of water to support microbial growth
- Is the ratio of the vapor pressure of water in a food to the vapor pressure of pure water at the same temperature
- Scale ranges from 0 to 1; pure water has a water activity of 1.0
- Water activity meter is used to measure Aw
- It is different from moisture content and is a better food safety indicator.
- Most canned foods have Aw of over 0.85

What Does Commercial Sterility Mean in Home Canning?

a) Using sterile utensils to process food

b) Using approved chemical sterilizers for canning

c) Applying conditions that reduces microorganisms capable of growing during storage in canned food.

d) None of the above

e) All of the above.

Commercial Sterility

- The definition for commercially sterile products according to Codex Alimentarius is:

  "The conditions achieved by application of heat which renders such food free from microorganisms capable of growing in the food at temperatures at which the food is likely to be held during distribution and storage."[1]

- The heat process required to make low-acid canned foods commercially sterile depends on the microbial load, storage temperature, the presence of various preservatives, water activity, composition of the products and container size and type.

Food and Agriculture Organization of the United Nations. Code of hygienic practice for low-acid and acidified low-acid canned foods [Internet]. Rome: Food and Agriculture Organization; 2011 [cited 2021 Nov 09]. Available from: http://www.fao.org/input/download/standards/24/CXP_023e.pdf

Validated Recipes

- A formulation and accompanying scheduled process that has been scientifically determined to be adequate in ensuring a shelf-stable product that is free from pathogens and controls the risk of spoilage. Requires extensive experimentation and analysis using specific equipment.
- It takes into account:
  - food composition
  - preparation procedure and
  - container dimensions
- It establish a scheduled process specific to the recipe.

Validated Recipes

Examples of sources include:

- National Center for Home Food Preservation; USDA Complete Guide to Home Canning
- Ball Corporation canning guides - https://www.freshpreserving.com/
- Bernardin Home Canning - https://www.bernardin.ca/

Validating a Canning Recipe

- Validation of thermal processes:
  - Heat penetration studies are used to scientifically determine safe processing times by establishing time-temperature requirements at the slowest heating point of the food (“cold spot”) in a specified container type, size and shape.
  - If a specific thermal process is not calculated for the specific food formulation, style of pack and container dimensions, the heating may not be adequate and the food may be under-processed.

Scheduled Process

- The length of time that a food must be processed at a specific temperature and pressure to achieve commercial sterility.
- Factors influencing the scheduled process:
  - pH of the food;
  - Composition of the food
    - e.g., types and amounts of particulate and liquid, size of particulates, product viscosity, tightness of pack, presence of ingredients such as fats, starches, hydrocolloids
  - Convective vs. conductive transfer of heat
  - Initial temperature of food as it is filled into jar
  - Process temperature and pressure; and
  - Size and shape of container/jar

Examples of Errors During the Canning Process

- A validated process is not used
- A change in the formulation and viscosity of the product
- Equipment errors – e.g., temperature, processing time, pressure, failure to calibrate, wrong container size, change in headspace (the unfilled space from the top of the jar to the food or liquid in the jar)
- Failure to follow written instructions/HACCP
- Failure to review records
- Failure to act on adverse records

Case Study

Canned Crushed Tomatoes

You received a call from a resident in a rural area, advising that she is planning to sell canned crushed tomatoes online and at the local farmers market. Ms. Kannit has been making this product for many years and has been getting compliments from friends and family members. Now that she is retired, she is trying to supplement her income with this product, made from her grandmother's recipe. If the business picks up, she is planning on providing more products. She is checking with the health unit to see if there are any food safety requirements she needs to meet.

What Do You Do?

a) Wish her good luck and ask her to send a few jars of crushed tomato to the health unit.

b) Tell her this is a small production business and needs to get licensed by OMAFRA.

c) Ask for the recipe, the source of the recipe, food safety plan and any other information regarding the processing that she has.

d) Make an arrangement to visit Ms. Kannit and review the process.

e) A and B

f) C and D

Upon visiting the resident you find out that:

- Ms. Kannit has been using family recipes (passed on for generations) for canning tomatoes and vegetables for years.
- Does not have an understanding of HACCP/food safety plans or the potential risks associated with canning.
- She has never had any problems with her home canned tomatoes. She uses her canned crushed tomatoes in her pasta and other cooked dishes; the canned tomatoes are cooked and heat treated before it is served.

Grandmother K's Classic Canned Crushed Tomato Recipe

Ingredients

- 12 pounds ripe tomatoes
- 4 teaspoons Kosher salt
- Basil leaves
- 4 tablespoons bottled lemon juice
- 4 sterilized quart jars with lids and rims

Equipment

- Pot for boiling water
- Large pot of tomatoes
- Wooden mallet or spoon
- ½ Liter (1 Pint) Glass jars and lids
- Boiling water canner
- Weighted-gauge or dial-gauge pressure canner (optional)
- pH meter

Instructions

1. Cut an X into the bottom of each tomato, which will make peeling easier. Boil a large stockpot or lobster pot of water and add all tomatoes. When their skins begin to retract after a minute or so, remove the tomatoes from the water and plunge into cold water to stop the cooking and loosen the skins.
2. Peel the tomato skins off, and cut out the stems. Press the peeled and cored tomatoes firmly into the sterilized jars until there is only 1/2-inch remaining at the top.
3. Once the jars are filled, add a teaspoon of Kosher salt and a tablespoon of bottled lemon juice and a few basil leaves to each quart. Place the lids and rims on the jars, and tighten.
4. Prepare a large boiling water bath in a stockpot or lobster pot, making sure the water is deep enough to completely cover the jars. Once the water has come to a boil, arrange the jars on a wire jar rack, and lower into water. Allow the jars to process in the water bath for 20 minutes.
5. When the processing is complete, carefully remove the rack and place on a heatproof surface. Cover the jars with a clean dishtowel, and allow them to cool at room temperature for a few hours.
6. Test the seals to ensure proper processing, label the jars with the date, and store in a cool, dark place (like a pantry) for up to 3 years.

What are some of the concerns with this recipe?

a) No concern, she has been making this for years and she had no problem.

b) She is using wrong pH strips

c) Using different size jars

d) Types of tomatoes she uses

e) It is not a validated recipe

Ms. Kannit has identified 4 recipes for crushed tomato to replace her recipe. Which one would be acceptable?

a) Crushed Tomatoes Recipe For Home Canning: https://allshecooks.com/crushed-tomatoes-recipe-for-home-canning/

b) Crushed Tomatoes (Canning): https://www.food.com/recipe/crushed-tomatoes-canning-252833#activity-feed

c) Canning Crushed Tomatoes: https://mountainmamacooks.com/canning-crushed-tomatoes-2-ways/

d) Tomatoes – Crushed, Quartered, Hot Pack (No Added Liquid): https://richland.extension.wisc.edu/files/2015/06/B2605-Tomatoes-Tart-Tasty.pdf

Tomatoes — Crushed, quartered, hot pack (no added liquid)

1. Wash high-quality, firm, ripe tomatoes.
2. Dip in boiling water for 30 to 60 seconds or until skin splits. Then dip in cold water, slip off skins, remove cores, and cut into quarters.
3. Crush some of the quartered tomatoes in a large kettle while heating rapidly. Gradually add remaining quartered tomatoes, stirring constantly. After all tomatoes are added, boil gently for 5 minutes.
4. **Add 1/2 teaspoon citric acid or 2 tablespoons bottled lemon juice to each quart jar; add 1/4 teaspoon citric acid or 1 tablespoon bottled lemon juice to each pint.** Add 1 teaspoon salt and 1 teaspoon sugar per quart, if desired. Fill clean, hot canning jars with hot tomatoes, leaving 1/2-inch headspace.
5. Remove excess air from the jar by running a spatula or bubble freer between the tomatoes and the side of the jar in several places.
6. Wipe jar rims, and cap with properly pretreated lids. Adjust lids. Process using one of the three methods below.

Hot pack crushed tomatoes

Boiling water canner—process time

Jar size	0-1000 ft	1001-3000 ft
pints	35 min.	40 min.
quarts	45 min.	50 min.

Dial gauge canner—process time

Jar size	process time	canner pressure (psi) 0-2000 ft
pints	20 min.	6 lb.
quarts	15 min.	11 lb.

Weighted gauge canner—process time

Jar size	process time	canner pressure (psi) 0-1000 ft	canner pressure (psi) above 1000 ft
pints	20 min.	5 lb.	10 lb.
quarts	15 min.	10 lb.	15 lb.

Source: Ingham BH, University of Wisconsin-Extension Cooperative Extension. Wisconsin safe food preservation series: tomatoes tart and tasty [Internet]. Madison, WI: Board of Regents of the University of Wisconsin System; 2009 [cited 2021 Nov 09]. Available from: https://richland.extension.wisc.edu/files/2015/06/B2605-Tomatoes-Tart-Tasty.pdf. Used with permission.

Ms. Kannit wants to ensure she is meeting the health unit requirements. She has put together the following process flow, and want to know what are the critical control points.

1. Tomatoes: Inspect for damage/wash. Clean and sterilize jars
2. Dip in boil water for 60C then cold water: remove skin/core and quarter
3. Heat 1/6 of tomatoes while crushing, add the rest and boil for 5 minutes.
4. Hot fill jars with tomatoes, 2tbsp of lemon juice and 1tsp of salt. (1/2 inch head space
5. Remove excess air, cap and place in canner
6. Process in boiling water for 35 minutes, ensure final pH is less than 4.6

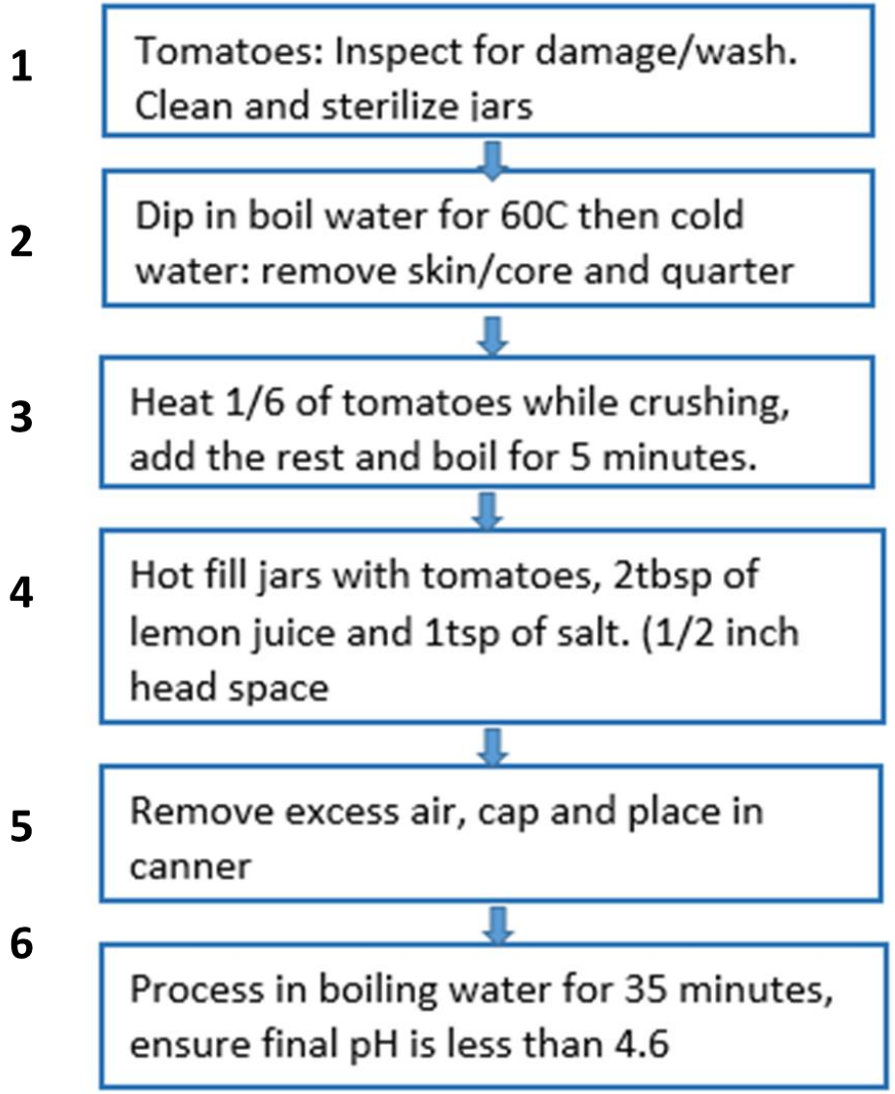
Which steps are the Critical Control Points?

a) 1, 3, 5 & 6

b) 1 to 6

c) 2,4, 6

d) 2,3, 5, 6



Review of the Critical Control Points

1. Tomatoes: Inspect for damage/wash. Clean and sterilize jars

- Critical control points:
  - Inspect for soiling or insect damage
  - Use potable water
  - Ensure clean utensils are used
  - Jars/lids could be contaminated with pathogens, need to wash and simmer

Review of the Critical Control Points

3. Heat 1/6 of tomatoes while crushing, add the rest and boil for 5 minutes.

- Critical control point:
  - Heat treatment is needed to reduce microbial load.

5. Remove excess air, cap and place in canner

- Critical control point:
  - Apply appropriate amount of force to seal jars.

Review of the Critical Control Points

6. Process in boiling water for 35 minutes, ensure final pH < 4.6

- Critical control point:
  - Ensure boiling temperature and adequate time and pH is obtained.

In Summary

Producing safe home-canned food

- Start with a validated recipe
- Design a HACCP-based food safety plan that includes:
  - achieving the required temperature, water activity and acidity
- Ensure adequate implementation of this process
  - verify and record the critical control points in the processing

Acknowledgments

- Robert Blenkinsop, OMAFRA

Further information on Home-canning:

- Ontario Agency for Health Protection and Promotion (Public Health Ontario). Home canning: literature review. Toronto, ON: Queen's Printer for Ontario; 2014. Available from: https://www.publichealthontario.ca/-/media/documents/h/2014/home-canning.pdf
- Government of Canada. Home canning safety [Internet]. Ottawa, ON: Government of Canada; [modified 2013 Feb 08; cited 2021 Nov 09]. Available from: https://www.canada.ca/en/health-canada/services/general-food-safety-tips/home-canning-safety.html

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