

Minn. 3.3
#413

NOV 27 1978

Extension Bulletin 413
Revised September 1978

UNIV. OF HAWAII
LIBRARY
Dec 11 1978
GOV'T DOCUMENTS
COLLECTION

Home Canning- Fruits, Vegetables, and Meats

Isabel D. Wolf and Edmund A. Zottola

AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

This archival publication may not reflect current scientific knowledge or recommendations.
Current information available from University of Minnesota Extension: <http://www.extension.umn.edu>.

Home Canning- Fruits, Vegetables, and Meats

Isabel D. Wolf and Edmund A. Zottola*

FOOD PRESERVATION BY CANNING

All food begins as a living plant or animal which begins to deteriorate immediately after harvest or slaughter. Deterioration can be caused by 1) cellular respiration and enzyme activity continuing, 2) natural chemicals in the food reacting with the oxygen in the air, or 3) microorganisms like yeasts, molds, and bacteria which begin to grow on and within the raw foodstuff. Depending on the nature of the microorganism, this growth will spoil the food or make it unsafe unless it is stopped or drastically slowed down.

The primary objective of canning, whether done at home or in a commercial cannery, is to preserve the food by the application of heat so that it can be safely eaten later. In canning, preservation takes place by the application of heat which destroys most of the microorganisms and halts respiration and enzyme activity.

SAFETY DEPENDS ON TIME AND TEMPERATURE

Canning depends for its effectiveness on the combined effect of time and high temperature on microorganisms. As the temperature is raised to the lethal point the microorganisms die. If the food is held at this lethal temperature a sufficiently long time, it becomes essentially sterile in that it contains very few living disease-producing or spoilage microorganisms.

The ideal heat treatment would sterilize the food by killing all the microorganisms present. To achieve such sterilization, every particle of food in the jar would have to reach or exceed the lethal temperature and be held there long enough to destroy all microorganisms.

This sounds simple enough, but other factors must also be considered. For example, what effect does this heat treatment have on the quality of the food, on its flavor, texture, appearance, palatability, and nutritional value? When developing a canning process for home or commercial use, the food scientist selects a time-temperature combination that has a maximum destructive effect on microorganisms and a minimum effect on the quality of the food. A combination time and temperature schedule is chosen which will lead to what is called

*extension specialist, food science and nutrition, and extension food microbiologist

“acceptable” sterility. This will not necessarily destroy every last microbe present, but it will guarantee a safe food with a long storage life. The specific combination will differ with each type of food, the growth state of the microorganism, and other factors.

If a food-spoilage bacterial cell is actively growing, for example, it can be destroyed by heating to 212° F (100° C) for just a few minutes. However, some bacteria can also exist in a dormant, spore state. These spores are very heat resistant and, depending on the acidity of the food, may require temperatures above the boiling point of water for significant lengths of time before they are destroyed. The higher the temperature above boiling, the shorter the time needed to kill the spore forms. A pressure canner must be used to reach temperatures above the boiling point of water in home canning.

The spore-forming bacteria of greatest concern is one called *Clostridium botulinum*. This organism produces a toxin or poison which causes botulism, an often fatal food poisoning. Home-canning methods for low-acid foods are such that when the time and temperature instructions are followed, *Clostridium botulinum* and its spores will be destroyed.

The length of processing time needed to achieve acceptable sterility depends on the type and number of microorganisms present in the unprocessed food. It also depends on the rate at which heat will reach the coolest or innermost portion of the container, to bring it up to a killing temperature.

HISTORY OF SCIENTIFIC METHODS FOR HOME CANNING

The first instructions for home canning were printed in the United States in the nineteenth century. Most of these instructions, developed through hit or miss techniques, incorporated the procedures developed by Nicholas Appert, a French chef in Napoleon's time. Many cookbooks of the Victorian era contained home canning instructions as well as descriptions of the difficulty of preserving some foods using these methods.

During World War I, the first United States government publications on home canning were printed. These publications were part of a massive campaign to urge citizens to grow and preserve their own food. They contained directions for many extremely dangerous canning methods such as water bath and steam processing of low acid vegetables, as well as oven canning.

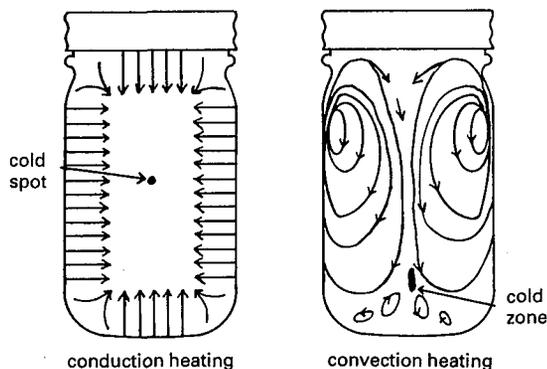
In 1943, the United States Department of Agriculture (USDA) issued a firm statement that pressure canning was the only safe way to can meat and low acid vegetables. In 1946, the USDA published results of the extensive heat penetration and bacteriological studies on home canned foods and established a firm scientific basis for home canning instructions.

The first reexamination of USDA home canning recommendations since 1945 was completed in 1978 at the University of Minnesota. The results of these three-year heat penetration studies at Minnesota are the basis for the times and temperatures presented in this bulletin. While some of the times and temperatures in this bul-

let in are different from those of the USDA, the new times and temperatures combinations are safe and give quite reliable results.

ESTABLISHING A CANNING PROCESS

Establishing safe home canning times and temperatures for a given product depends on the acidity of the product and the rate of heat penetration. Heat is transferred from the outside of the jar through the food by either conduction, convection, or a combination of both. Strained pumpkin and ground meats are examples of foods that heat by conduction; whereas peas, carrots, and string beans are examples of foods that heat by convection currents.



The heat-penetration rate is affected by a number of conditions:

- The size and shape of the container: The rate of heat penetration into the center of the jar is dependent upon the diameter of the jar and to some extent the height of the jar.
- The ratio of solids to liquid: Dry corn kernels (no liquid added) take longer to heat up than corn kernels in brine. Attempts to produce low liquid level canned vegetables at home are potentially dangerous.
- The type and size of the pieces packed in the container: Corn and peas heat up faster than yams or boneless chicken breasts.
- The amount of fat: Fat is a thermal insulator and slows the heat penetration process.
- The type of heating medium being used: Wet steam heats cans faster than dry air. The dry heat of an oven at 250°F does not have the same effect on the heat transfer process as 250°F in a pressure canner.

The number of factors which affect heat penetration rate explains why different products have different process times. The second main factor in determining a canning process relates to the acidity of the food. Most foods naturally contain acids. Depending on the type and amount of acid present, they are called high-acid or low-acid foods. Natural acids have the ability to inhibit or prevent the growth of many of the microorganisms which produce spoilage and disease. The degree of inhibition depends on the type and amount of acid present, which is reflected in a measurement of the pH of the solution. A pH scale from 0 to 14 is used: a pH of 7 is considered neutral, a pH below 7 is called acidic, and a pH above 7 is called alkaline. (Only a few foods such as hominy and egg white have a pH above 7.)

The specific acidity of a food (in terms of its pH) is extremely important in home canning. Many spoilage and disease-producing microorganisms including the toxin-producing *Clostridium botulinum* can grow in the acidity range between pH 4.6 and 7. Foods with a pH in this range must be processed in a pressure canner at temperatures significantly above the boiling point of water for specifically recommended lengths of time to destroy the heat resistant spores of *C. botulinum*. Typical foods in this pH range include most vegetables, meat, poultry, fish, milk products, and soups.

Canned food with a pH below 4.6 (more acid) is sufficiently acid to inhibit the growth of *C. botulinum* and most of the other sporeforming and nonsporeforming bacteria. Therefore, these foods (called "high acid" in spite of the lower pH numbers) can be preserved using a lower heat treatment than low-acid foods; in other words, they do not require pressure canning. Even here, however, the recommended length of processing will vary from food to food. Typical foods in this pH range include almost all fruits, pickles, and tomatoes.

A recent research study at the University of Minnesota evaluated the level of acidity of 107 varieties of tomatoes grown in three locations. The pH of firm, fully colored, ripe tomatoes of each variety was below 4.6. As the fruit became overripe the pH increased and did go above 4.6 in some varieties.

This means that only ripe to slightly underripe tomatoes should be canned in a water bath canner. No overripe tomatoes should be canned as tomatoes or tomato juice. Overripe tomatoes may be used only in products containing significant amounts of added acid, such as catsup which has vinegar added to it.

The most common types of spoilage microorganisms associated with acid foods are yeasts and molds. These organisms can grow in high-acid foods. Processing acid foods at boiling-water temperatures for a specified time will destroy spoilage microorganisms of all three types — yeasts, molds, and bacteria.

Equipment for Home Canning



CANNERS

Boiling Water Bath Canner

The boiling water bath canner is used for processing acid foods such as fruits, tomatoes, pickles, and preserves.

Large boiling water bath canners are readily available in hardware stores and houseware portions of de-

partment stores. This type of canner consists of a very large covered pot containing a metal basket which holds the canning jars in position. The usual capacity of boiling water bath canners is seven pints or quarts. Some larger, 9-quarts-capacity boiling water bath canners are available.

A boiling water bath canner should be deep enough for the level of water to be 1 to 2 inches over the tops of the jars. There should also be room for the water to be actively boiling and not spill out over the range.

It is possible to improvise a boiling water bath canner if you have a very large covered pot. Some kitchen equipment manufactures sell a separate basket portion. It is also possible to fit a large pot with a round metal rack. This rack will prevent the canning jars from being in contact with the metal bottom of the canner.

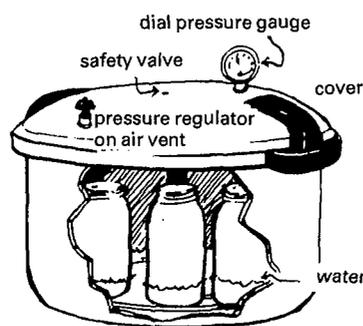
The temperature in the boiling water bath canner never exceeds 212°F (100°C) and therefore can only be used for acid foods. Old timetables for boiling water bath processing of low acid foods are in circulation. These directions can present a very real risk of botulism food poisoning and should **not** be used.

Pressure Canners

The pressure canner must be used for all low-acid vegetables, meat, fish, and poultry.

At the present time, two types of pressure canners are available, the dial gauge type and the weighted gauge or weight control pressure canners.

Large pressure canners, 16 to 22 quart sizes, are available in cast or stamped aluminum. Smaller pressure vessels, 12 quart and smaller, are less expensive. These appliances are often used for cooking foods and can be used for canning small amounts of products.



DIAL GAUGE CANNERS

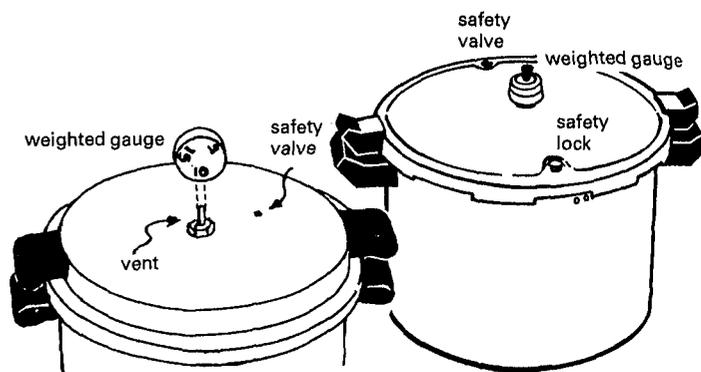
The dial shows the amount of pressure and temperature in the canner. The pressure regulator is removable.

In some old dial gauge canners there is a device which screws over the vent to seal the canner. This device is referred to as the petcock. It is necessary to have insulated gloves when using this old type of dial gauge canner.

The dial gauge needs to be checked for accuracy every two years. It is possible for the dial to read 10 or 15 psi and not be operating at this pressure. This malfunction could result in an under or overprocessed product.

WEIGHTED GAUGE OR WEIGHT CONTROL CANNERS

The weighted gauge allows the pressure to reach 5, 10, or 15 pounds. This weight allows the pressure to reach a certain amount and then release excess steam to keep pressure and temperature from going higher.



The weighted control does not need to be checked for accuracy. There are no mechanical parts to get out or order.

With this type of canner it is most important that the canner be operated exactly according to manufacturers' instructions and that the audible hissing, jiggling, or rocking of the weight be as directed by the manufacturer. If the weighted gauge is not hissing, jiggling, or rocking as directed, the process temperature will be too low.

PARTS OF THE PRESSURE CANNER

A rack is fitted into the bottom to prevent jars from being in direct contact with canner.

Rubber gaskets help seal the canner.

Replacement parts for pressure canners are available from manufacturers.

CHECKING THE DIAL GAUGE

Home canners can send their pressure dial gauge to the Minnesota Department of Agriculture for testing. To send in a pressure dial gauge follow the steps below.

- Remove dial pressure gauge. Wrap tape or cloth around gauge so pliers or wrench will not damage during removal. Do not send top lid of canner.
- Place in small sturdy box and wrap carefully.
- To the package, attach separately addressed envelope with your name and address inside and \$1.25 in stamps for return postage and insurance. (Laboratory cannot accept currency or checks.)
- Insure package. (Allow 2 weeks)
- Mail to: Minnesota Department of Agriculture
Division of Laboratory Services
Room 510, State Office Building
St. Paul, Minnesota 55155

Some county extension officers have purchased pressure canner dial gauge testers and provide this service to clientele on certain days of the year.

PRESSURE SAUCEPANS FOR USE AS PRESSURE CANNERS

Pressure saucepans or pressure cookers of the 4, 6, or 8 quart size can be used for home canning. Because these pressure cookers are smaller in size and contain fewer jars, they will heat up and cool down faster than the larger canners. To compensate for the more rapid heat up and cool down it is necessary to add time to the process period. Add 20 minutes for 10-pound processing and 10 minutes to 15-pound processing directions when using pressure saucepans.

SMOOTH TOP RANGE

To pressure can on a smooth cook top range, the canner bottom must be flat and in contact with the cook

surface. Most heavy cast aluminum canners meet this criteria. Lighter weight stamped aluminum canners have a concave bottom. If the concavity is greater than $\frac{1}{8}$ inch, the canner will not get hot enough to hold 10 or 15 psi. Measure the concavity by placing a flat stick across the canner bottom and measure the distance to the canner bottom with a ruler.

Innovative and Antique Canners

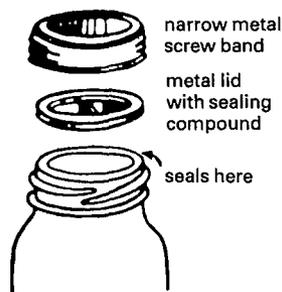
Occasionally queries are received from persons with innovative ideas about canning in the dishwasher, crockpot cookers, electric ovens, the sun or the oven. Such innovations should not be used; they can be extremely dangerous for low acid foods.

Outmoded and potentially unsafe antique canners should not be used for processing home canned items. Some of the most dangerous of these old canners are large range top steamers intended for processing low acid vegetables. Old second hand pressure canners may not be a bargain if replacement parts are no longer manufactured.

CANNING JARS

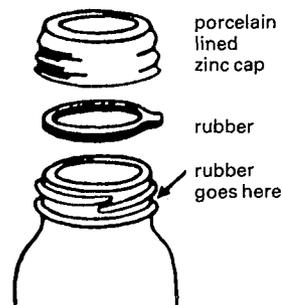
Glass companies produce two types of glass containers: home canning and commercial. Do not use one trip jars in which commercial foods like mayonnaise, peanut butter, and coffee are sold for home canning jars. During World War II such commercial jars were heat tempered for consumers to reuse for home canning. Today, commercial jars are made of thinner glass for use on high speed packing machines. They are not heat tempered. Packers' jars are sealed with caps developed especially for the product being packed.

Canning jars come in a variety of capacities and mouth sizes from half-pint jars to two-quart containers. Pint and quart jars are the most commonly used sizes. These are the sizes for which thermal process times have been developed. While two-quart or half-gallon canning jars are manufactured, no safe heat process times for their use are available.



Lids — Two-Piece Lids

Most of the canning jars sold today have two-piece, self-sealing lids. This type consists of a flat metal disc which has a sealing compound around the outer edge and a separate metal screw band. The lid is used only once; the screw band may be used over and over. The two-piece type of closure is used by over 95 percent of home canners. It is important to follow the directions provided by the manufacturer of the brand of lids being used.

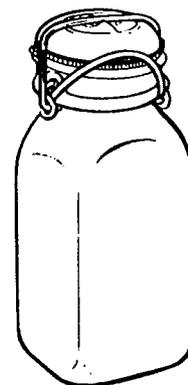


Zinc Lids

Some home canners use porcelain-lined zinc lids. This type of lid is used with a rubber ring. The metal portion of the cap can be used many times. A new rubber ring must be used each time.

To use, wash cap and rubber ring in hot soapy water. Rinse. Keep rubber rings wet until needed. If zinc caps have been used they should be boiled for 15 minutes before reusing since substances can get under the porcelain lining.

Before filling the jar, stretch wet rubber ring just enough to place flat on sealing shoulder. Fill jar, leaving appropriate headspace; wipe top surface of rubber ring and threads of jar with a clean, damp cloth. *Screw cap tight, then loosen about $\frac{1}{4}$ inch.* Process using correct time and method for product being canned. Remove jars from canner. *Slowly screw caps tight.* Let jars cool 12 to 24 hours. Check seal. *If top of cap is low in center, jar is sealed.* Do not tighten cap after jar is sealed.



Bail Type Jars

Some home canners still use the bail type jars. The sealing surface is the ledge about $\frac{1}{4}$ inch below the top of the jar.

Place a wet rubber ring flat on sealing surface of jar, put lid on jar so that it rests on the rubber. Push or pull long bail wire up so it lies on groove on top of lid. Leave the short bail wire up against the jar while jar is in the canner. Process using correct time and method for product being canned. Remove jars from canner and push the short bail wire down against the jar. Let jars stand upright and several inches apart to cool. After 12 hours, test seal by turning a jar upside down and looking for leaks.

When ready to open jar raise lower bail wire, lower upper bail wire and pull rubber ring out with pliers or fingers.

Some new imported bail type canning jars are available in this country. While these jars come with one rubber ring, no replacement rings are available for reuse. These jars are better used for food storage and decorative purposes, than for home canning.

Old antique glass canning jars are prized as collector's items. These jars, often too brittle to withstand the

heat treatment involved in canning, have a great likelihood of breaking during heat processing.

Additional Canning Utensils

The following items are needed for most home canning:

- A jar lifter — essential for easy removal of hot jars from canner.
- A funnel — helps in packing of small food items into canning jar.
- Clean cloths — for wiping jar rims and general cleanup.
- Clean towels
- Knives — for product preparation.
- Cutting board
- Timer or clock — to determine end of process time.

A number of other home canning accessories such as corn cutters, apple slicers, decorative labels, and special canning spoons are available. Some of these items may simplify the procedures but are not essential. Jar lid tighteners and wrenches are better not used.

Home Canning Recipes

The best sources of such instructions are the recently published booklets prepared by the Minnesota Agricultural Extension service, the USDA, major manufacturers of home canning equipment, and reputable test kitchens.

Avoid following the home canning advice of celebrities, old cookbooks, "back to nature" publications, and out of date home canning leaflets. Some potentially dangerous instructions can be found in old official publications, even those of this state!

The Canning Process

GETTING READY TO CAN

Assemble and wash equipment and containers before gathering fruits and vegetables. Examine jars and discard those with nicks, cracks, and rough edges. These defects will not permit an air tight seal on the jar, and food spoilage will result.

Use new metal lids, new rubber jar rings, and standard canning jars. Follow manufacturer's directions for closures.

Gather products early when they are at their peak of quality, and gather or purchase only as much as you can handle within 2 or 3 hours. Wash the product carefully, according to the directions in the chart. The cleaner the raw foods, the more effective the canning process. Do not can decayed or damaged food items.

The following chart indicates the yield of canned goods from fresh produce.

Prepare foods as you would for the table. Keep them cold until you are ready to begin the actual canning.

Scald the washed jars and keep them hot. This may be done in a dishwasher. It is not necessary to sterilize

Yields of Canned Products From Fresh Produce

This table tells you how much fresh food you need to fill quart jars:

<i>Low Acid Foods</i>		
	<i>Pounds per quart</i>	<i>Quarts per bushel</i>
Asparagus	2½ to 4¼	10 to 12
Beans, lima, in pods	3 to 5	6 to 10
Beans, green or wax	1½ to 2½	12 to 20
Beets, without tops	2 to 3⅓	15 to 24
Carrots, without tops	2 to 3	16 to 25
Corn, sweet, in husks	3 to 6	6 to 10
Peas, green, in pods	3 to 6	5 to 10
Pumpkin or winter squash	1½ to 3	—
Spinach & other greens	2 to 6	3 to 8
Squash, summer	2 to 4	10 to 20
<i>Acid Foods</i>		
	<i>Pounds per quart</i>	<i>Quarts per bushel</i>
Apples	2½ to 3	16 to 20
Applesauce	2½ to 3½	15 to 18
Apricots	2 to 2½	20 to 24
Cherries	2 to 2½	22 to 32
Peaches	2 to 3	18 to 24
Pears	2 to 3	20 to 25
Plums	1½ to 2½	24 to 30
Tomatoes	2½ to 3½	15 to 20
Tomato juice	3 to 3½	12 to 16

jars that are to be processed in a boiling water bath or pressure canner. They will be sterilized during the processing.

PACKING THE JARS

Directions are given in the chart as appropriate for each item for hot pack or raw pack. Hot pack is best for fruits like apple slices that tend to discolor during canning. Hot packing fruits also helps to reduce the floating fruit problem.

Packing products raw eliminates one step in the process and for some products — green beans for example — helps retain flavor and food value.

Make sure to leave the recommended amount of headroom or empty space at the top of the jar as indicated in the charts. Some foods, like corn, that expand during processing require extra headroom. Too little headroom, caused by filling the jars too full, will result in the contents bubbling out during head processing. Solids or seeds may be caught under the sealing compound and prevent an airtight seal from forming.

Too much headroom or empty space at the top of the jar also can prevent the jar from sealing if the processing time is not long enough to exhaust all the excess air in the jar.

Cover food pieces with liquid to prevent discoloration or darkening.

Before applying lids, wipe off the rims of the jars with a clean, damp cloth. Any foreign matter such as food particles, seeds, sugar, syrups, or brines on the rims of the jar may prevent an airtight seal from forming. If the jars do not seal, the food will be contaminated by substances carried by entering air and spoil.

SEALING THE JARS

Two-Piece Lids

When putting the lid on a jar of food, pick up the lid with tongs and dip in boiling water — unless the manufacturer's directions state otherwise. Place lid on filled jar, center it carefully, and hold in place with finger. Then screw the band down firmly. Do not use great force or jar tighteners. As the jar cools after processing, a vacuum will form and this creates the airtight seal. Do not tighten the screw band after removing jars from the canner. You may break the seal, prevent a vacuum from forming, and contaminate the contents of the jar. After the jar is cold (12 hours), remove the screw band. Screw bands are unnecessary once the jars are sealed, and may rust if left on the jars. Screw bands may be used over and over but the metal lid may be used only once.

Zinc cap with procelain lining and removable jar ring (sterilize jar caps to remove any hidden soil).

Place wet jar ring on shoulder or jar. Make it lie flat by pressing with side of knife blade. Screw cap down tightly, and turn it back $\frac{1}{4}$ inch. When processing is complete, tighten the cap again as soon as the jar is taken from the canner. The rubber rings should be used only once.

Other Lids

Some new types of two-piece lids and some one-piece canning lids are now being marketed. Follow the manufacturer's instructions for such lids. Check with your county extension office before using unusual types of canning lids.

PROCESSING PROCEDURES FOR ACID FOODS

Boiling Water Bath Method for Acid Foods

(Use only for acid products, such as fruits and tomatoes, and pickled vegetables.)

Any large deep pot with a rack in the bottom and a good fitting cover can be used as a boiling water bath canner. The pot should be deep enough to allow jars standing on a rack to be covered with 1 to 2 inches of briskly boiling water.

Have the water ready in the water bath. Boiling for hot pack — hot for raw pack. Lower the jars quickly. The bubbling around the rim of each jar is caused by air being forced out of the jar. Cover the boiling water bath. Count the process time when the water returns to a boil and keep the water at a rolling boil. Keep the level of the boiling water at least 1 inch over the jars tops. When the process time is complete, remove jars and follow directions under cooling the jars.

Use of Pressure Canner as a Boiling Water Bath Canner

Your pressure canner may be used as a boiling water bath canner if it is deep enough to allow the jars on the rack to be covered by 1 inch of briskly boiling water. Put the cover on the canner but **do not** fasten or lock the lid into place. Leave the petcock wide open so that steam escapes and pressure does not build up inside the canner.

Processing Acid Foods at Temperatures Over 212°F

Pressure canners may be used for processing fruits and tomatoes. These acid foods may be processed at either 5 or 15 pounds of pressure. The times for processing fruits and tomatoes at 5 psi are listed in timetable 2.

A new method for processing tomatoes at 15 pounds of pressure was developed at the University of Minnesota.

For more detailed instructions in this new method see University of Minnesota Food Science and Nutrition Fact Sheet No. 33 — Home Canning Tomatoes.

Pack the tomatoes as directed in table 2. Put jars in canner. Bring canner to 15 pounds of pressure and then turn off burner. Remove canner from heat and allow the pressure to return to zero. Remove the petcock or pressure regulator. After 10 minutes, take the top off the canner and remove the jars.

With this new procedure for acid foods, it is not necessary to exhaust the canner for 10 minutes.

Processing Low Acid Foods — Pressure Canner

Read the equipment section information on the type of pressure canner you have. Also read your canner instruction booklet at the beginning of each canning season.

Get your pressure canner in good condition before the canning season starts. Have pressure gauge and safety valve tested, all parts cleaned, and broken or missing parts replaced.

Have 2 to 3 inches of boiling water in pressure canner. Stand the jars on a rack so they are not touching each other or sides of the canner. Fasten lid to pressure canner.

Turn heat on until steam flows from vent in a steady stream (10 minutes or more after it first appears). At first a mixture of steam and air will be released as a white vapor or cloud. When air is all driven out, the steam from the vent will become nearly invisible for 1 to 2 inches. It is then time to put on or close the petcock or pressure regulator. All air must be exhausted from the canner to make certain the internal temperature of the pressure canner reaches 240°F or 250°F.

Raise pressure rapidly to 2 pounds less than required, reduce heat, and bring up the last 2 pounds slowly to avoid overpressure. Fluctuating pressure is one cause of liquid loss from jars, so hold the pressure steady at 10 or 15 pounds.

When processing time is up, remove the canner from heat and allow the pressure to return to zero. Do not attempt to cool the pressure canner with cold water.

When the pressure registers zero, remove or open the petcock or pressure regulator. Wait 10 minutes before

unfastening the cover. This will help to prevent loss of liquid from the jar. Unfasten the cover and tilt the jar side up so that steam escapes away from you. Remove each jar with the jar tongs or lift them out in the wire basket.

If the canner is not opened in 20 minutes after the pressure has dropped to zero, a vacuum may form inside the cooker. This may draw liquid from the jars and seal the lid to the canner.

Remove jars from canner and follow directions under cooling the jars.

Cooling the Jars

Place the jars upright on a perfectly dry non-metallic surface. Towels, boards, or newspapers may be used. Space the jars for free air circulation.

A ringing metal sound after the jars are removed from the canner is caused by a vacuum inside the jars. This is a sign the jars will seal.

Test for seal after the jars have cooled 12 hours. The "self seal" lids are sealed if the lid is curved down and if the center of the lid is down and will not move when pressed with a finger. Zinc lids are sealed if depressed and the contents do not leak when jar is inverted.

Label the jars with product name and date of pack. Store where cool and dry. Do not allow to freeze. For best nutritive value, use within one year.

CANNING MEAT AND POULTRY

Getting Meats Ready

Use only good-quality meat or poultry — home-produced or purchased from a farm or store.

Chill home-produced meat immediately after slaughter to prevent spoiling. Meat is easier to handle when it is cold. For thorough chilling, keep meat at a temperature below 40°F until time to prepare it for canning. Can it within a few days after slaughter.

If refrigeration is not available and if the maximum daily temperature is above 40°F, process the meat as soon as body heat is gone.

If meat must be held for longer than a few days, freeze it. Store frozen meat at temperatures of 0°F or lower until canning time. Then cut or saw frozen meat into pieces of desired size.

If frozen meat is thawed before canning, thaw it in a refrigerator at a temperature of 40°F or lower until most of the ice crystals have disappeared. Keep all meat clean and sanitary. Rinse poultry thoroughly in cold water, then drain.

Keep all meat as cool as possible during preparation for canning. Handle it rapidly; process it as soon as containers are packed.

To control the bacteria that cause spoilage, keep everything that touches meat as clean as possible.

Processing

As all meat and poultry products are low acid foods with a pH greater than 4.6, they must be processed in a pressure canner. Research done at the University of

Minnesota concluded that meat and poultry can be satisfactorily canned only by the hot pack method.

Precook the meat before packing into glass jars. Pack the meat loosely into clean, hot jars. Keep the precooked meat hot while packing the jars. Cover the meat with boiling liquid such as meat juice, broth or water and leave 1 inch headspace and seal. Process in the pressure canner.

CUBED BEEF

Cut beef into 1½ to 2 inch squares. Trim off fat and gristle. Brown beef cubes in smallest possible amount of fat. Salt to taste. Pack hot into jars, leaving 1 inch headspace. Cover with boiling liquid. Adjust caps. Process.

Canner Size	Pounds Pressure	Pints-minutes	Quarts-minutes
12 qt. and larger	10	60	75
4, 6, 8 qt.	10	80	95
12,13,16,17,21,22 qt.	15	50	50
4,6,8 qt.	15	60	60

POULTRY, HOT PACK WITH BONE

Cut up poultry. Bone breast. Saw drumsticks off short. Leave bone in other meaty pieces. Trim off large lumps of fat. Simmer poultry, covered with water or broth, until medium done. Pack poultry loosely. Place thighs and drumsticks with skin next to glass. Fit breasts into center and small pieces where needed. Leave 1 inch headspace. Add 1 t. salt to quarts and ½ t. salt to pints. Cover with boiling liquid, leaving 1 inch headspace. Adjust lids. Process.

Canner size	Pounds Pressure	Pints-minutes	Quarts-minutes
12 qt. and larger	10	65	75
4,6,8 qt.	10	85	95
12 qt. and larger	15	30	30
4,6,8 qt.	15	40	40

SAFETY PROCEDURES

For added safety, boil home-canned low acid products for 10 to 15 minutes before serving. The heat will destroy any toxin which might have formed in spite of all precautions. The foods most commonly involved in botulism poisonings are beans, corn, spinach, peppers, and asparagus. All should be able to stand this treatment without excess loss of quality.

Do not use canned foods showing any signs of spoilage. Especially **Do Not Taste Doubtful Food** — it could be your last meal. "When in doubt, throw it out" (away from children or pets). If it is a commercially canned food, put it in a safe place and call the food distributor, the public health office, or your local federal food and drug administration official. Your action could save someone else's life.

Although home canning looks simple, attention to every detail is essential for retention of nutrients and for safety.

Syrups for Canning Fruit

type	proportions	yield syrup
very light syrup	1 cup sugar to 4 cups water	4¾ cups
light syrup	2 cups sugar to 4 cups water	5 cups
medium syrup	3 cups sugar to 4 cups water	5½ cups
heavy syrup	4¾ cups sugar to 4 cups water	6½ cups

Boil sugar and water together for five minutes. Skim if needed.

Substitutions for Sugar

Honey may be substituted for part of the sugar in the preparation of the syrups. Consider ¾ cup honey to be equal in sweetening to 1 cup or sugar. It is best to use a

mild flavor honey for canning fruit because the flavor of fruit can be overcome by the use of too much honey or too strong a honey.

Light corn syrup may also be used for part of the sugar in syrup. Use 1 cup corn syrup for 1 cup sugar.

Timetable 1 — Processing Low-Acid Vegetables

PRODUCT	Work rapidly. Raw pack or hot pack foods following directions, if desired add ½ teaspoon salt for pints and 1 teaspoon for quarts. Place jars on rack in pressure cooker containing 2 to 3 inches of boiling water. Follow directions under pressure canner.	PRESSURE CANNER		
		Glass Jars		
		10 psi		15 psi
		Pts	Qts	Pts & Qts
Asparagus	Raw Pack: Wash asparagus; trim off scales and tough ends and wash again. Cut in 1-inch pieces. Pack asparagus tightly as possible without crushing to ½ inch of top. Cover with boiling water leaving ½ inch at top.	min. 25	min. 30	min. 15
	Hot Pack: Prepare as for raw pack; then cover with boiling water. Boil 2 or 3 minutes. Pack asparagus loosely to ½ inch of top. Cover with boiling water leaving ½ inch at top.	25	30	15
Beans, fresh lima	Raw Pack: Shell and wash beans. Pack loosely small type to 1 inch of top of jar for pints and 1½ inches for quarts; for large beans fill to ¾ inch of top for pints and 1 inches for quarts. Fill jars to ½ inch of top with boiling water.	40	50	30
	Hot Pack: Shell the beans, then cover with boiling water, and bring to boil. Pack beans loosely in jar to 1 inch of top. Cover with boiling water, leaving ½ inch headspace at top.	40	50	30
Beans, snap	Raw Pack: Wash beans. Trim ends and cut into 1-inch pieces. Pack tightly in jars ½ inch of top. Cover with boiling water, leaving ½ inch at top.	20	25	15
	Hot Pack: Prepare as for raw pack beans. Then cover with boiling water and boil 5 minutes. Pack beans in jars loosely to ½ inch of top. Cover with boiling-hot cooking liquid and water, leaving ½ inch at top.	20	25	15
Beets	Hot Pack: Sort beets for size. Cut off tops, leaving 1-inch stem, also root; and wash. Boil until skins slip easily. Skin, trim, cut, and pack into jars to ½ inch of top. Cover with boiling water, leaving ½ inch at top.	30	35	15
Carrots	Raw Pack: Wash and scrape carrots. Slice, dice, or leave whole. Pack tightly in jars to 1 inch of top. Fill to ½ inch of top with boiling water.	25	30	15
	Hot Pack: Prepare as for raw pack, then cover with boiling water and bring to boil. Pack carrots in jars to ½ inch of top. Cover with boiling-hot cooking liquid and water, leaving ½ inch at top.	25	30	15
Corn — cream style pints only	Raw Pack: Husk corn and remove silk. Wash. Cut from cob at about ⅔ the depth of kernel. Pack corn loosely to 1 inch of top. Do not shake or press down. Fill to ½ inch of top with boiling water.	95	†	80§
	Hot Pack: Prepare as for raw pack. Add 1 pint boiling water to each quart of corn. Heat to boiling. Pack hot corn to 1 inch of top.	85	†	80§

Timetable 1 — Processing Low-Acid Vegetables (continued)

PRODUCT		PRESSURE CANNER		
		Glass Jars		
		10 psi		15 psi
		Pts	Qts	Pts & Qts
Corn — whole kernel	Raw Pack: Husk corn and remove silk. Wash. Cut from cob at about 2/3 the depth of kernel. Pack corn loosely to 1 inch of top and fill to within ½ inch of top with boiling water.	55	85	50
	Hot Pack: Prepare as for raw pack. To each quart of corn add 1 pint of boiling water. Heat to boiling. Pack loosely to 1 inch of top with mixture of corn and liquid.	55	85	50
Peas, green	Raw Pack: Shell and wash peas. Pack peas loosely in jars to 1 inch of top. Cover with boiling water, leaving 1 inch at top.	40	40	30
	Hot Pack: Prepare as for raw pack. Cover with boiling water and bring to boil. Pack peas loosely in jars to 1 inch of top. Cover with boiling water, leaving 1 inch at top.	40	40	30
Pumpkin* or Winter Squash cubed	Hot Pack: Wash pumpkin or winter squash, remove seeds, and pare. Cut into 1-inch cubes. Add just enough water to cover. Bring to boil. Pack cubes in jars to ½ inch of top. Cover with hot cooking liquid and water, leaving ½ inch at top. For strained pumpkin, pour off liquid and mash before using.	55	90	20
Summer Squash including Zucchini	Raw Pack: Wash but do not pare. Trim ends. Cut squash into ½-inch slices; halve or quarter to make uniform pieces. Pack into jars to 1 inch of top. Cover with boiling water, leaving ½ inch at top.	25	30	20
	Hot Pack: Prepare as for raw pack. Add water to cover. Bring to boil. Pack hot squash loosely to ½ inch from top. Cover with boiling-hot cooking liquid. Leave ½ inch space at top.	30	40	20
Spinach and other greens	Hot Pack: Pick over and wash thoroughly. Cut out tough stems and midribs. Place about 2½ pounds of spinach in cheesecloth bag and steam about 10 minutes or until well wilted. Pack loosely to ½ inch of top. Cover with boiling water, leaving ½ inch at top.	70	90	35

§The State Department of Agriculture recommends all corn be canned in pints rather than quarts since processing time required for quarts tends to darken it.
 †not recommended
 *for strained pumpkin, mash before using.

Timetable 2 — Processing Fruits, Tomatoes, Pickled Vegetables

PRODUCT	Raw pack or hot pack foods following directions. Put filled glass jars into canner containing hot or boiling water: For raw pack have water in canner hot but not boiling; for all other packs have water boiling. Add boiling water to bring water 1 inch or two over tops of jars but don't pour boiling water directly on glass jars. Put on cover of canner. Count processing time when water in canner comes to a rolling boil.	BOILING WATER BATH		PRESSURE CANNER 5 LB PRESSURE	
		GLASS JARS Pints Quarts		GLASS JARS Pints Quarts	
Apples	Hot Pack: 1. Pare, core, cut into pieces. To keep from darkening, place in water containing 2 tablespoons each of salt and vinegar per gallon. Drain, then boil 5 minutes in thin syrup or water. Pack apples in jars to ½ inch of top. Cover with hot syrup or water, leaving ½ inch at top.	min. 15	min. 20	min. 8	min. 8
	2. Make apple sauce, sweetened or unsweetened; pack hot to ½ inch of top.	25	25	8	8
Beets, pickled	Hot Pack: Cut off beet tops, leaving 1 inch of stem and root. Wash beets, cover with boiling water and cook until tender. Remove skins and slice. For pickling syrup use 2 cups vinegar to 2 cups sugar. Heat to boiling. Pack beets in jars to ½ inch of top. Add ½ teaspoon salt to pints, 1 teaspoon to quarts. Cover with boiling syrup, leaving ½ inch at top.	30	30		

Timetable 2—Processing Fruits, Tomatoes, Pickled Vegetables (continued)

PRODUCT		BOILING WATER BATH		PRESSURE CANNER 5 LB PRESSURE	
		GLASS JARS Pints	GLASS JARS Quarts	GLASS JARS Pints	GLASS JARS Quarts
Berries, except strawberries	Raw Pack: Wash berries and drain. Fill jars to ½ inch of top, shaking berries down gently. Cover with boiling syrup leaving ½ inch at top.	10	15	8	8
	Hot Pack: Wash berries and drain well. Add ½ cup sugar to each quart fruit. Cover pan and bring to boil. Pack berries to ½ inch of top.	10	15	8	8
Cherries	Raw Pack: Wash; remove pits if desired. Fill jars to ½ inch of top, shaking cherries down gently. Cover with boiling syrup leaving ½ inch at top.	20	25	8	8
	Hot Pack: Wash; remove pits if desired. Add ½ cup sugar to each quart of fruit. Add a little water to unpitted cherries. Cover pan and bring to boil. Pack hot to ½ inch of top.	10	15	8	8
Fruit juice	Hot Pack: Wash; remove pits if desired and crush fruit. Heat to simmering. Strain through cloth bag. Add sugar if desired — about 1 cup to 1 gallon juice. Reheat to simmering and fill jars to ½ inch of top.	10	10	5	5
Peaches or Apricots	Raw Pack: Wash peaches or apricots and remove skins. Remove pits. To keep from darkening place in solution (same as apples). Drain, pack fruit in jars to ½ inch of top. Cover with boiling syrup (light or medium) leaving ½ inch at top.	25	30	8	8
	Hot Pack: Prepare fruit as for raw pack. Heat fruit through in hot syrup. If fruit is very juicy you may heat it with ½ cup of sugar to 1 quart of raw fruit adding no liquid. Pack fruit to ½ inch of top.	20	25	8	8
Pears	Peel, cut in halves, and core. Follow directions for peaches either raw pack or hot pack using same timetables.				
Plums	Raw Pack: Wash. To can whole, prick skins. Freestone varieties may be halved and pitted. Pack fruit in jars to ½ inch of top. Cover with boiling syrup, leaving ½ inch space at top.	20	25	8	8
	Hot Pack: Prepare as for raw pack. Heat to boiling in syrup or juice. If fruit is very juicy, you may heat it with sugar, adding no liquid. Pack hot fruit to ½ inch of top. Cover with boiling syrup, leaving ½ inch at top.	20	25	8	8
Rhubarb	Hot Pack: Wash and cut into ½-inch pieces. Add ½ cup sugar to each quart rhubarb and let stand to draw out juice. Bring to boiling. Pack hot to ½ inch of top.	10	10	5	5
Tomatoes	Raw Pack: Use only slightly underripe to ripe tomatoes. Scald just long enough to loosen skins; plunge into cold water. Drain, peel, and core. Leave tomatoes whole or cut in halves. Pack tomatoes to ½ inch of top, pressing gently to fill spaces. Add ½ teaspoon salt to pints and 1 teaspoon to quarts.	40	50	10	10
	Hot Pack: Quarter peeled tomatoes. Bring to boil and pack to ½ inch of top. Add salt as for raw packed tomatoes.	35	45	8	8
Tomato juice	Hot Pack: Use underripe to ripe tomatoes. Wash, remove stem ends, cut into pieces. Simmer until softened and put through strainer. Add 1 teaspoon salt to each quart juice. Reheat to just boiling. Fill jars with juice to ½ inch of top.	35	35	5	5

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55108. The University of Minnesota, including the Agricultural Extension Service, is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, creed, color, sex, national origin, or handicap.

30¢