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Causes And Prevention of Spoilage In Home Canned Food

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MONTANA STATE COLLEGE AGRICULTURAL EXTENSION SERVICE BOZEMAN, MONTANA

Table of Contents

	3
Signs of spoilage in canned foods	3
Causes of spoilage in canned foods	2
Molds	- 4
Yeasts	4
Bacteria	5
Why canned foods spoil	5
Improper handling	5
Faulty seals or leaky cans	6
Underprocessing	e
How to prevent spoilage of canned foods	0
What to do with food that has spoiled	1
Table I-Common types of spoilage and changes in canned fruits,	
fruit juices, and tomatoes	8
Fruit fruit juice, tomatoes—Mold	8
Fruit, fruit juice, tomatoes—Gas swells	8
Prunes, berries, apples, kraut in plain tin cans—Hydrogen springers	8
Kraut-Brown discoloration	8
Red cherries and berries in plain tin cans-Loss of color	9
Fruit and fruit juice—Fermentation	- 9
Pears, peaches, apricots, apples—Brownish discoloration	9
Tomatoes and tomato juice-Flat sour	9
Fruit and tomatoes-Botulinus poison	9
Table II Common types of spoilage and changes in canned meats	
Table 11-Common types of sponage and enables in Common sectors	10
Meste and vegetables—Mold	10
Meats and vegetables—Putrefaction	10
Meats and vegetables - Botulinum	10
Meats and vegetables	12
Boultry and other mests-Pink rusty or red discoloration	12
Wests corn mature beans and peas greens in plain tin cans or	
iars with metal lids—Gray or black discoloration	12
Corn mature hears and neas greens-Swells	12
Corn mature beans and neas—Sulfide spoilage	13
Mature beans and peas Cloudy liquid or white sediment	13
Corn—Yellow or brown discoloration	13
Vegetables_Flat sour	13
Vegetables Toughness or hardness	14
Asparagus—Vellow deposits	. 14
Spinach, Swiss chard, beet greens—White deposit on leaves	14
Beets-Black	. 14
Table III Common types of spoilage and defects in pickles	16
Cuambar nichles_Tough and shriveled	16
Cucumber pickles_Soft slippery	16
Cucumber pickles—Bleached or faded	16
Culdumber pickles (canad) White source in top of iar	16
Dioklas Dark color	17
Dicklee_Ritter flavor	17
Formented nickles_Scum	17
Dill nickles-Cloudy liquid	17
A alwayi provide otoury inquite	10
ACKIIO WIEGBIIIEII	. 10

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Causes and Prevention of Spoilage In Home Canned Foods

By

BESSIE E. McCLELLAND Extension Nutritionist

Signs of Spoilage in Canned Foods

- 1. Gas in the jar or can
- 2. Bad odor when jar is opened or food is heated
- 3. Soft or slimy texture
- 4. Unusual appearance such as:
 - a. Mold on fruit, vegetables or meat
 - b. Liquid cloudy or frothy
 - c. Unusual change in color, either badly discolored or unnaturally bright.

Food showing any of these signs of change should be destroyed without tasting. A possible exception would be change in color of fruit such as peaches, pears, apples, and apricots. These may change color from overcooking or pieces in the top of the jar may turn dark from under-processing or not enough liquid. Such discolored fruit is still usable if there is no odor, gas, or cloudiness. Such fruit should be boiled 10 minutes before it is used.

It is hard to lay a hard and fast rule for detecting spoilage. Botulinus poisoning has been known to occur from food that showed none of these signs. On the other hand, some changes may affect the quality but not actually spoil the food. These will be discussed under the individual products later in this bulletin.

Causes of Spoilage in Canned Foods

There are three groups of living organisms that can spoil food. They are molds, yeasts, and bacteria.

Molds form a threadlike growth through foods. Some of the threads extend to the surface and produce spores that serve as seeds. These spores can be scattered by the air and start new mold on other foods. Jars of food thoroughly processed and with good seals should never mold. Molds require moisture and some air for growth and are easily destroyed by heat. They often grow in jams, jellies, and preserves, in jars that have been canned open kettle, or in jars with faulty seals. Molds on jams and jellies do not ruin the product unless there is enough to spoil the flavor. Canned meats and vegetables should not be used if moldy since, if mold spores are present, other spoilage organisms may be there also. Mold does not produce gas but it will make foods easier for other spoilage organisms to work in because it tends to make them less acid.

Yeasts also are likely to grow in canned foods that are underprocessed or in jars with faulty seals. Yeasts are not dangerous but they can cause waste and loss of products. They break down sugar to form alcohol and gas and can work in sealed jars as well as those with faulty seals. This type of spoilage is easily detected because of the gas and the alcoholic odor that is usually present. Yeasts are easily killed by heat and should never be present in well processed food with tight seals. Open kettle canned fruits may develop yeast spoilage if there is air space in the top of the jar.

Bacteria are the most serious enemy to home canning. Some are easily destroyed by heat while others form spores that can live through hours of boiling. Some require air, others grow in perfectly sealed cans without air unless they are destroyed by heat. Fairly large amounts of salt, sugar, or acid as in brined foods, preserves, and pickles prevent growth of most bacteria. That is why fruits and tomatoes can be canned safely with less processing than vegetables and meats. Fat protects bacteria and makes them harder to kill. Warmth speeds their growth.

Most spoilage bacteria are not destroyed by freezing but their growth and activity are slowed down greatly or stopped. No serious bacterial changes occur in frozen foods held at zero temperature. Properly dehydrated foods, kept dry, do not contain enough moisture for spoilage organisms to work. Foods that are held too long before canning or that are badly contaminated with spoilage organisms stand a poorer chance of keeping than clean, fresh products that are cared for promptly. Flat sour and botulinus poisoning are two of the most common types of spoilage caused by bacteria.

Why Canned Foods Spoil

There are three common reasons for spoilage in home canned foods:

- 1. Improper handling
- 2. Faulty seals or leaky cans
- 3. Underprocessing

Improper handling may include many things. Foods should be *fresh*, *cool* and in *prime condition* when canned. If kept too long or in a warm place, spoilage organisms grow and multiply rapidly. Two hours from garden to can is a good rule for vegetables and most fruits. Corn and peas spoil very quickly if kept a few hours in a warm place.

Food should be *clean*. The more organisms present the harder it will be to kill them all. Wash fruits and vegetables thoroughly. Keep meat clean and wipe with damp cloth if necessary. Have jars, lids, and all utensils clean. Cutting boards, dish cloths, and other equipment can harbor spoilage organisms. Jars for open kettle and water bath canning and used jars, especially if they may have contained spoiled food, should be sterilized by boiling 20 minutes just before they are used. New jars should be thoroughly scalded, at least. Pressure processing sterilizes the jars along with the food.

Processed food should *cool quickly*. Jars should be removed from cooker or water bath as soon as processing is complete. Avoid a draft but do not cover with a cloth. When cool, 12 to 24 hours later, examine seals. Label and store in a *cool*, *dry*, *dark place*. Some very hardy spores might still be in the food and would be more apt to grow if stored in a warm place.

Faulty seals or leaky cans are the greatest single cause of spoilage. Even a small amount of air entering the jar after it is processed may carry molds, yeasts, and bacteria. Lids should be used according to the directions of the manufacturer. Food or grease on the jar rim or rubber may prevent a seal or cause it to loosen later. Liquid that boils out during processing can do the same thing. Turning a self-seal jar upside down may break the seal. This type of lid should be screwed firmly into place before processing and not tightened afterward. It will form its own seal and trying to tighten it afterward may pull it loose from the jar rim. Test the seal by tapping the lid with a spoon after the jar has cooled. It should have a ringing sound quite different from the dull thud of an unsealed jar. A piece of food sticking to the lid will cause the sound to be somewhat different. Tip jars with other types of lid to see if juice leaks out. Tin cans should be tested after processing by dropping them into cold water while they are still hot. A leak should cause bubbles to rise.

Food that has spoiled because of a leaky seal will usually have gas, possibly bubbles, and may even ooze out around the leak. It will usually smell sour and the food may become soft or slimy. Signs of spoilage occur within a few days after the jar begins to leak or from the time it was canned if the jar or can did not seal properly.

Underprocessing will allow food to spoil. Several things can affect the processing. Heat travels more quickly through liquid than through solid food. A tight solid pack or much grease may keep the center of the jar from getting enough heat. A pressure cooker gauge that is not accurate or a water bath that has not been kept boiling during the entire processing may also keep the food from being heated enough to destroy the organisms. All air must be exhausted from a pressure cooker before the petcock is closed. This requires from 7 to 10 minutes. Pressure must be increased one pound for each two thousand feet of altitude. Reliable time tables should be used and followed accurately.

Processing time should be counted when the pressure gauge registers the necessary pressure or in a water bath when the water actually comes to a good boil. A pressure cooker is necessary for meat and vegetables because it can furnish the amount of heat necessary to kill bacteria in such non-acid products. There is danger of food being underprocessed in oven canning because of the slow transfer of heat from the dry air to the food. No temperature greater than that of boiling water can be obtained in the jar unless it seals and steam forms pressure. In that case it is very likely to explode.

How To Prevent Spoilage of Canned Foods

- 1. Use frseh products of good quality, picked while cool if possible.
- 2. If products must be held, keep in a refrigerator or spread out in a cool place.

- 3. Have food as clean as possible.
- 4. Have jars and equipment clean and in good condition. Use new rubbers or self-seal lids. Discard jars with cracks and nicks. Sterilize jars for open kettle and water bath canning.
- 5. Work rapidly. Do not try to can large quantities at one time. Do not fill more jars than can be processed at once.
- 6. Seal food hot, either preheated or steamed in the cans. (Possible exceptions would be fruits packed raw with hot syrup added and cold pack tomatoes.)
- 7. Use good rubbers or lids and jars with no nicks on the rims. Wipe rim of filled jar with clean cloth. Seal according to manufacturer's directions.
- 8. Process according to reliable time tables, making necessary adjustments for altitude.
- 9. Count processing time in pressure cooker when gauge registers the proper pressure and try to keep the pressure even.
- 10. Count processing time in water bath from the time water actually begins to boil. Keep water boiling the entire time.
- 11. Remove from processing promptly and cool carefully.
- 12. Test seals within 12 to 24 hours. Handle carefully and avoid tipping while hot.
- 13. Wipe jars, label, and store in cool, dry, dark place.

What To Do With Spoiled Food

If a jar or can of food shows any signs of spoilage, destroy it without tasting. Spoiled food should never be fed to chickens or animals because, if botulinus poison is present it could kill them. Mix several spoonfuls of lye to the jar or can, allow to stand for 24 hours (out of reach of children or animals) and then bury or burn the food and all parts of the container.

All home-canned non-acid vegetables should be thoroughly boiled for 15 minutes before using, unless they have been canned by recommended methods and processed in a pressure cooker that is operating accurately. The same rule applies to homecanned meat. It should be boiled or heated thoroughly for 15 minutes or longer, depending on size of pieces.

Table I											
Common	Types	of	Spoilage and	Changes	In	Canned	Fruits,	Fruit	Juices	and	Tomatoes

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Food	Spoilage	Prevention
Fruit, Fruit Juices and Tomatoes	Mold: Bluish gray or white fuzzy growth on the sur- face and threads of mold may extend into the fruit. Food may be slimy and usually has musty odor. No gas. If only a small amount of mold is present it may be removed along with the fruit it is on. The rest of the fruit may be boiled 10 minutes in an open kettle and used. Larger amounts of mold may make the fruit less acid and permit botulinus spores to grow. If much mold is present the food should be destroyed. Jelly and pickles may be used without reheating after the mold is removed.	 Process fruit in boil- ing water bath instead of canning open kettle because air sealed in jars and not processed may contain mold spores. Have a good seal. Store in cool, dry place.
Fruit, Fruit Juices, and Tomatoes	Gas Swells: This is caused by bacteria and spoilage occurs within a few days after the product is canned. There is a bad odor, gas, and usually froth or foamy bubbles. The food is not good to eat but it is not pois- onous.	 Use fresh, clean fruit. Have containers and equipment clean. Process thoroughly in water bath.
Prunes, Berries, Apples, and Kraut in Plain Tin Cans	Hydrogen Springers: Acid in the food reacts with the metal can to form gas which causes can to bulge. If no other change has occcurred the food is harmless and may be used. If there is a change in color, the liquid is cloudy or there is an odor, bacteria have been working and the food should not be used.	 Use lacquered can. Have food hot when sealed. Fill container full. Process correctly. Cool quickly and store in cool place.
Kraut	Brown Discoloration: Brown coloring with no gas. This is caused by oxidation from air within the kraut or jar and not enough heating.	 Pack jar with hot kraut. Cover with hot brine. Process in boiling water bath.
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Red Cherries and Berries in Plain Tin Cans	Loss of Color: If no gas is formed and no bad odor, the food is safe to use.	1. Can in R-enamel cans.
Fruit and Fruit Juice (not toma- toes)	Fermentation: Carbon-dioxide gas forms bubbles and may break the seal or bulge the can. Gas and liquid usually spurt out when jar is opened. There is an alcoholic odor and sour taste. This spoilage is caused by yeast that should have been killed during proces- sing. It usually occurs soon after canning, is not dan- gerous, but spoils the food for eating.	 Process in water bath. Have good seal.
Pears, Peaches, Apricots and Apples	Brownish Discoloration: Usually in top of jar due to presence of air and lack of sufficient processing. It is due to oxidation and the action of natural enzymes within the fruit. Over-cooking may give a pinkish color. If the liquid is clear and there is no gas, no off odor or flavor, the fruit may be boiled 10 minutes and used.	 Work quickly and do not leave peeled or cut fruit exposed to air. The pieces of fruit may be allowed to stand 10 minutes in a solution of one teaspoon salt to one quart of cold water. Process fully but do not over-cook.
Tomatoes and Tomato Juice (not fruits)	Flat Sour: Disagreeable sour or bitter flavor, a sour odor, and sometimes a brighter color. No gas forms. The spoilage is caused by a spore-forming bacteria. It ruins food for use but is not poisonous.	 Use clean, fresh, sound tomatoes, free from cracks and decayed spots. Can immediately or keep in cool place. Process correctly. Cool quickly and store in cool dark place.
Fruit and Tomatoes	Botulinus Poison: Fruits are generally considered safe from botulism because of the acid they contain. A few cases of botulism have been reported from fruits and tomatoes but in every instance except for canned figs, mold or yeast had also developed in the fruit.	1. Destroy fruit that is very moldy or has fer- mented from action of yeast spores.

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PREVENTION OF SPOILAGE IN FOODS

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Table II

Common Types of Spoilage and Changes in Canned Meats and Vegetables

Food	Spoilage	Prevention
Meats and Vegetables	Mold: Bluish gray or white fuzzy growth on the sur- face and sometimes extending down into the food. Stale, musty odor. Mold in canned meat or vegetables usually means a leaky seal. More serious spoilage, even botulinum may be present. Destroy the food by by burning or mix it with lye and bury it. Do not taste.	 Seal hot. Have a good seal. Process meats and vegetables in pressure cooker. Use a recommended timetable and adjust for altitude if necessary.
Meats and Vegetables	Putrefaction: Caused by a spore forming bacteria. Gas is always present and the food is usually discolored, soft and slimy. It has a very bad odor. The food is <i>dangerous</i> and <i>should be destroyed</i> . Underprocessing per- mits this type of spoilage to occur. Meat canned with vegetables is usually underprocessed and often develops this spoilage.	 Process meats and vegetables in a pressure cooker. Use a recommended timetable and adjust for altitude if necessary. Avoid too much fat in canning meat.
Meats and Vegetables	Botulinum: The spores of these bacteria form a toxin that is a <i>deadly poison</i> . Death has resulted from merely tasting the spoiled food. The spores are found in the soil and are harmless when eaten in freshly cooked food. They work without air so when sealed in a jar of canned food they can grow and make the deadly toxin unless the heat of processing destroys them. Ordinary processing is sufficient to kill spores in fruit	 Seal while hot. Do not make too tight a pack. Process meats and vegetables in a pressure cooker.

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and tomatoes because of the acid but for non-acid 4. Use a recommended vegetables and meat, heat, greater than that of boiling timetable and adjust for water, is required. This extra heat can only be obtained altitude if necessary. in home canning by the use of a pressure cooker. Food 5. Can fresh, clean proprocessed by reliable timetables in a pressure cooker ducts in prime condithat is working accurately should be perfectly safe. tion. Meats or vegetables canned by any other method 6. Have should not be tasted until they have been boiled thor- clean. oughly for 15 minutes and stirred frequently. This boiling will not kill the spores but it should destroy the toxin. Snap beans, greens, and pork are the most common offenders although any non-acid product might be contaminated. Canned fruits should be safe unless mold or yeast have reduced their activity. Food containing botulinus poison usually has a rancid, cheesy odor that is more noticeable when the food is heated. Gas may or may not be present. The food may be soft or slimy or discolored and the liquid cloudy or it may not show any of these signs, not even an odor. Death has resulted from such food that showed no signs of spoilage. Never taste home canned meat or vegetables before boiling 15 minutes unless you are sure they have been properly canned. Large pieces of meat will need longer cooking.

Burn or mix with lye and bury the spoiled food and its jar or can. If such food has been tasted or eaten notify a physician or health official immediately and furnish him with a sample of the food. Botulinus poisoning can be treated with an antitoxin if taken in time.

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	TABLE II (Continued)	
Meat	Jellied Juice Liquifies: Liquid on canned meat does not need to jell to be safe. However, if it does jell it should stay that way unless moved to a warm place. Heat will melt the jelly but it should jell again if chilled. If the jelly changes to liquid and will not jell again it means that meat has spoiled and should be discarded. Bacteria cause this spoilage.	 Can meat that is clean and in good con- dition. Wipe grease and li- quid from top of jar be- fore sealing. Process correctly in a pressure cooker. Store in a cool place.
Poultry and Other Meats	Pink, Rusty, or Red Discoloration: Heat usually causes the coloring matter in the juice of chicken and other meats to turn somewhat brown. Sometimes it changes to a pink, rusty, or bright red color. This is a harmless product and safe to use.	No way known to pre- vent it.
Meat, Corn, Ma- ture Beans and Peas, Greens, in Plain Tin Cans or Jars with Metal Lids	Gray or Black Discoloration: Sulphur compounds from the protein of the food react with iron in the metal can, lid or on iron or copper utensils and form this discolor- ation in the food, usually along the seam and on top. The tin may have dark spots on it also. It looks un- attractive but if no unusual odor is present the food may be boiled 15 minutes and used.	 Avoid iron or copper utensils and use stainless steel knives. Avoid water with iron or sulphur in it. Have food hot when sealed. Avoid too much fat. Fill tin cans full.
Corn, Mature Beans and Peas, Greens	Swells: This is caused by spore forming bacteria. <i>Gas</i> forms and may burst the jar seal or bulge the tin can. The food is unfit for use but not poisonous.	 Can freshly picked vegetables that have been kept cool. Pick while cool if possible. Process thoroughly. Store in cool place.

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Corn, Mature Beans and Peas	Sulfide Spoilage: Gray or black discoloration but <i>no</i> gas. There is an odor of rotten eggs from the hydrogen sulfide. This is caused by bacteria that act on the protein of the food. Food is unfit for use but not poisonous.	Same as above.
Mature Beans and Peas	Cloudy Liquid or White Sediment: Mature beans and peas may have enough starch to cook out and thicken the liquid slightly or make a sediment in the bottom of the jar. There is no odor. It is harmless. White sediment may be caused by hard water.	 Use fresh foods that have been kept cool. Cool promptly after processing. Use soft water that is non-alkaline for canning if possible.
Corn	Yellow or Brown Discoloration: The heat of processing may caramelize the sugar in young sweet corn. It is not harmful but affects the appearance and sometimes the flavor.	 Avoid overprocessing. Select corn in right stage for canning.
Vegetables	Flat Sour: Caused by bacteria with spores that are very hard to kill. These bacteria work rapidly in a warm place. If vegetables stand several hours in a warm place before being canned, many spores may form and not all get destroyed during processing. Slow cooling after processing or storage in a warm place will allow them to grow and cause flat sour. It causes a sour flavor and odor. The liquid is usually, but not always, cloudy. No gas forms. The color is often brighter. This is not a poison but the food is unfit for use.	 Pick vegetables while they are cool, if possible, especially corn and peas. Keep them cool and can immediately. Do not leave jars or cans in pressure cooker after processing is com- pleted. Cool immediate- ly.
		4. Store in cool place.

PREVENTION OF SPOILAGE IN FOODS

TABLE II (Continued)						
Vegetables	Toughness or Hardness: Hard water sometimes causes vegetables, especially green beans, to become hard or tough.	 Can fresh, tender, vegetables in prime con- dition. Use soft non-alkaline water in canning. 				
Asparagus	Yellow Deposit: Little yellow specks are sometimes caused by a chemical reaction and no way is known to prevent them. The green color is not affected, there is no odor. It is not spoilage and will disappear with shaking or heating.	No way known to pre- vent it.				
Spinach, Swiss Chard, and Beet Greens	White Deposit on Leaves: Oxalic acid in the leaves may react with calcium of the leaves or water to form a harmless white deposit of calcium oxalate crystals on cut edges of the leaves. It disappeares on shaking. No other signs of spoilage should be present.	No way known to pre- vent it.				
Beets	Black: Beets turn black but no odor or gas is formed. It is caused by bacteria that act when iron is present	 Avoid contact with iron. Do not use water with iron in it. 				

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PREVENTION OF SPOILAGE IN FOODS

Table III							
Common	Types	of	Defects	and	Spoilage	in	Pickles

Food	Spoilage	Prevention
Cucumber Pickles	Tough and Shriveled: May be caused by too much salt, too much sugar, or too strong vinegar. Hard water may prevent proper acid formation and keep pickles from curing normally.	 Use reliable recipe. Use 40 to 60-grain vinegar. This contains to 6 percent acetic acid. Use soft, non-alkaline water.
Cucumber Pickles	Soft, Slippery: Soft pickles may be caused by overcooking or by vinegar that is too weak. Bacteria may act on pickles that extend above the brine or vinegar and cause them to become soft and slippery. Such pickles should be discarded.	 Same as above. Keep pickles com- pletely covered with brine or vinegar.
Cucumber Pickles	Bleached or Faded: May be caused by too strong vine- gar.	 Use 40 to 60-grain vinegar. Use reliable recipe.
Cucumber Pickles (canned)	White Scum in Top of Jar: This is caused by yeast. It cannot grow without air so jar should be filled com- pletely with vinegar. This will require use of glass lids since vinegar would react with metal.	1. Fill jars completely before sealing.

Pickles	Dark Color: This may be caused by too much spice or cooking too long with the spice. Iron in the water may also cause discoloration.	 Avoid water with iron in it. Whole spice tied in cloth bag may be re- moved before pickles are canned.
Pickles	Bitter Flavor: Caused by too much spice or cooking too long with spice.	Same as above.
Fermented Pickles	Scum: Yeasts, molds, and bacteria may form a scum on top of vegetables that are fermenting in brine. This scum should be removed frequently or it may weaken the acidity of the brine and spoil the entire jar of vegetables.	 Remove scum frequently from top of the brine. Renew strength of brine by adding more salt if necessary.
Dill Pickles	Cloudy Liquid: This is caused by the growth of bacteria and is harmless unless the quality of the pickles is affected. If it develops to the extent that pickles be- come soft they should not be used.	 Use reliable recipe. Use fresh, firm cu- cumbers. Store in cool place.
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Acknowledgment

Credit is given the following publications for some of the information included in this bulletin.

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- "Spoilage Problems in Home-Preserved Foods," Hilda Faust, K. F. Meyer, J. R. Esty, C. T. Townsend, W. V. Cruess, R. H. Vaughn, E. M. Mrak, Hazel F. Friar, Betty M. Watts, A. E. Michelbacher, University of California, 1944.
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- 5. "Pickles In Wartime Meals," Jessie E. Richardson and Helen L. Mayfield, Montana State College Agricultural Experiment Station, 1943.
- 6. Unpublished notes of Jessie E. Richardson, Montana State College Experiment Station.
- 7. "Making Fermented Pickles," Farmers Bulletin No. 1438, United States Department of Agriculture.