THESIS
DOMESTIC CANNING OF FRUIT

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by

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Diligent care in the domestic canning of fruit is frequently neglected by housekeepers, who, as a result, experience many failures. Experiments have been undertaken to find out the cause of this trouble.

In this day there is no need of housekeepers losing such a large proportion of their canned goods. While the canning of fruit should not be considered as a difficult process, it requires care and attention.

With the idea of obtaining various methods of preserving fruit, letters were addressed to people prominent in culinary arts, asking for their methods and results.

One sent the following method: "Select the very best fruit, have it thoroughly cooked and sweetened to taste. Rinse out the jars in hot water, then in cold water. Place a cold cloth beneath the can and pour in the hot fruit. Slip the rubber on and wipe out the lid with a cloth, and screw the cover down on the can. If there is not enough fruit to fill the jar set it aside until more is ready."

In this method cold water has been used to rinse out the jars. Cold water should not be put into the jars just before filling with hot fruit. To do this is to contaminate the jars. Water is full of living forms, to pour it into the jars means

the pouring in of micro-organisms, which will work a change in the fruit. The wiping out of the lid means another contamination. Furthermore fruit should not be left exposed to the air, for reasons which will be given later in the work.

It is customary for some, when the jars are empty the season before, to have them thoroughly washed and the tops screwed on tight. To fill the next season they merely rinse them with warm water and pour in the hot fruit.

It does not matter how well the jars are washed the season before, they should before filling be washed out with scalding water and allowed to stand in boiling water before putting in the hot fruit.

One recognized authority on "household arts" gives the following: "Only perfectly sound and fresh fruits should be used for canning. It is false economy to purchase fruits on the verge of decay, as they are liable to ferment and will require greater care in sterilization. Large fruits, such as peaches and pears, after paring, should be thrown immediately into cold water to prevent discoloration. They may then be boiled in clear water until tender and reheated in a syrup made from a quarter of a pound of sugar to each pound of fruit. Large mouthed glass jars only should be used. Rubbers should be in good condition or new. Do not put the fruit on to cook until you have everything in readiness - the jars heated, the rubbers adjusted, the tops boiled, and spoons, funnel and towels on the table near the stove. To prevent breakage, slip the jars sidewise into a kettle of hot water, rolling them so that every part may be quickly and uniformly heated. Fold a damp towel, place it in the bottom of a pan, stand a jar on the towel and, if the fruit is small, adjust the funnel, fill

quickly to overflowing. Run a heated silver knife around the inside of the jar to break any air-bubbles that may have been caught with the fruit, and adjust the rubbers, then lift the lid from the hot water and place it at once. After sealing, stand the jars out of a draught and over night. The glass by that time will have contracted and the lid will in consequence be loose. Wipe each jar carefully and give the top an extra turn. Put away in a cool, not cold, dark closet."

The next method I took from a book on "Canning and Preserving," written by Mrs. Mary J. Lincoln, a widely known teacher of cooking: "Clean and scald the jars and their covers. Even if cleansed when put away they should be scalded just before using. See that each one is in perfect condition and that the rubbers fit perfectly. Use new rubbers every season. Stand the jar in a shallow pan of water on the back of the stove, where the water will keep hot. If the fruit is to be cooked in water first, have a pan on boiling. Pare only enough fruit to fill one can at a time, drop into the boiling water. Take out each piece as soon as soft and put on a large plate. Do not pile one piece on another for the lower ones would be crushed. When all the fruit has been cooked strain the water and use it for the syrup. In this way none of the flavor is lost. Boil the syrup and remove the scum. If the fruit is to be cooked again, put it in the syrup very carefully and boil according to special recipe. When ready to fill the jar see that the water in the pan is hot and the jars hot. Place the funnel in the jar and with a silver nut pick or fork put each piece in the jar so that the best part of it will be next to the glass. Fill the jars

nearly full, then pour in the syrup with a tea-cup. Run a silver knife or spoon handle around the inside and up and down the jar to let any bubbles of air escape; then wipe off the top, put on the rubber, fill to overflowing with boiling syrup, put on the cap and screw it down, being careful to see that the rubber bears evenly on the glass. Remove from the water and invert on the table. As the jars cool the caps will bear screwing down. The next morning examine the jars to see if there be any leakage. If the covers are tight, wrap each in paper and put away in a cool, dry, dark closet. A little mould or foam on the top is not always an unfavorable condition, if the cover is tight."

The last two methods show careful study on the subject. Both are methods which could be highly recommended. The utensils, however, have not been heated, and unless this is done there would be a source of danger.

The last method mentions mould as not an unfavorable indication. While some moulds exist only on the top of the fruit, yet there are some which penetrate throughout all the fruit and all of them will probably exert more or less influence upon the canned fruit.

In talking with housekeepers in regard to this subject particular stress was given regarding the care that the cans should receive before filling with fruit. Most of them had the cans thoroughly washed and heated before filling. With the exception of a very few instances, this was done merely to prevent the cans from breaking as the hot fruit was poured in them. A few had the cans washed and tops screwed on when they were emptied the season before, and thought it only

necessary to rinse them out at the next filling. Many used new rubbers every year, while others were not as particular.

Another point which received emphasis was the attention given to the tops. One writer says: "If they are of glass heat them," thus conveying the idea if they are not glass they need not be heated. Many were not particular with the lids, merely wiping them out; others poured boiling water or them. All seemed to realize the necessity of getting the tops on tight.

There seemed to be no one who attached any importance to the washing off of all particles of fruit on the outside of the can. If any is left on, it serves as food for bacterial growth.

It was interesting to notice in the course of conversation how particular most of them were about storing the fruit in a dry place. Some seemed to think it made no difference regarding the care the canning received; if the fruit was stored in a damp place if would certainly be changed. Others seemed to think it essential that fresh air should be circulating around the cans, and that the fruit kept better if placed on a shelf in the cellar instead of on the floor.

After reviewing the various methods, experiments were begun on fermented or changed canned goods of domestic preparation, to ascertain what had caused the fermentation or change in the fruit, vegetables or pickles, as the sample happened to be.

Sample No. 1. Can of Grapes.

The person who canned this fruit washed the can and top in hot water, poured in the fruit and sealed it. The can of fruit when received was undergoing considerable fermentation

producing gas in such abundance as to force the lid. It was evident that the rubber was not new from the condition in which it was found. There was no appearance of any mould on top.

Gelatin plates were made from this can, and at the end of two days colonies appeared.

Colonies:- They were round, with a smooth border, the outline of which was clear and distinct. The contents of the colony were granular and of a light yellow color.

Hanging Drop:

Hanging Drop:- Small oval cells, sometimes three and four in a chain.

Motion:- None.

Staining Reaction: Stains readily.

Gelatin tube culture:- Growth not along line of inoculation, but spreading out over the surface. Does not liquefy the gelatin.

Agar, inclined tube culture:- White dots along the line of inoculation.

Bouillon cultures:- There was a heavy white sediment at the bottom, which, on shaking, separated into granules, giving the solution a cloudy appearance.

Milk Cultures:- Milk coagulated and lactic acid formed.

Potato tube cultures:- Small white dots, of granular appearance. At first the growth was moist, but finally became quite dry.

Lactose bouillon:- Heavy sediment of granular appearance, giving a cloudiness to the solution.

Temperature:- Thermal death point between 50 ° and 55 ° C for ten minutes.

Gas Formation:- Considerable gas produced, but not determined.

Behavior to gelatin:- Does not liquefy.

Growth:- Rather slow.

Chemistry:- Lactic acid in milk

Sample No. 2. Can of Squash.

The person who canned this squash did so to save it, as some of the squash had commenced to decay. The squash had been cut into small pieces, a large quantity cooked at one time and mashed before putting into the can. The can was well filled with the squash, the lid was difficult to remove, the rubber was in good condition, but there was a crack in the porcelain of the lid. The squash had a very peculiar odor about it. While the squash had been mashed after cooking there were hard lumps throughout it, showing that it had not been thoroughly cooked.

Colonies:- The border was escalloped. The outline was clear, of a light yellow color. Contents were of a fine granular material.

Hanging Drop:- Small oval cells.

Motion:- None.

Staining reaction:- Stains readily.

Gelatin tube culture:- Growth does not follow line of inoculation, but spreads over the surface in white dots.

Agar inclined tube culture:- A growth of white dots along line of inoculation.

Bouillon cultures:- The color of the solution not changed, but a white sediment formed at the bottom.

Milk Cultures:- Coagulated, lactic acid formed.

Potato tube cultures:- A growth of white dots. After a time the potato dries up and changes to a dark color, yet the growth remains very white.

Lactose bouillon:- The solution remains clear, but a sediment formed at the bottom. On shaking the tube the sediment separates into granules.

Temperature:- Thermal death point between 50° and 55° C. at ten minutes.

Behavior to gelatin: Does not liquefy.

Growth:- Slow.

Chemistry:- Forms lactic acid in milk.

Sample No. 3. Can of Pickles.

When the can was obtained the vinegar had run out over the sides of the jar and then dried, leaving a white

crust-like deposit. The lid was on tight, the rubber was in good condition. The pickles had a white deposit on them; the vinegar had a cloudy appearance.

Colonies:- They were round in shape and clear in outline. The contents were of very fine granular material and of a light yellow color.

Hanging drop:- Long bacilli with rounded ends. They were very many times longer than broad.

Motion:- very mobile. A progressive darting motion.

Staining reaction: Stains readily.

Gelatin tube culture:- At first following line of inoculation, spreading in a funnel shape growth. The growth soon spread and the gelatin entirely liquefied.

Agar inclined tube cultures:- A slimy white growth, spreading over the entire surface.

Bouillon cultures A dirty white scum formed on the surface. Also a sediment of the same color. This growth gives to the bouillon the same appearance as the vinegar of the pickles.

Potato tube culture:- A slimy growth, spreading over the surface which looks like the growth on the pickles.

Growth:- Very rapid.

Behavior to gelatin:- Liquefies it very rapidly.

Sample No. 4. Can of Tomatoes.

The lid of this can was or very tight, but the rubber was in very poor condition. On opening the can there was a rotten odor to the tomatoes.

No. I.

Colonies:-	Were quite large. They were elevated, to the naked eye appearing white, but under the microscope a faint yellow. They were round in shape. Outline clear and distinct. Contents granular.
Hanging drop:-	Micro-cocci. No particular arrangement but often two would be seen together.
Motion:-	Browian.
Staining reaction:-	Stains very readily.
Gelatin tube culture:-	The growth first appeared along the line of inoculation, then readily liquefied the gelatin.
Agar inclined tube culture:-	A moist yellowish growth.
Bouillon culture:-	Cloudy appearance, with fine sediment at the bottom.
Milk cultures:-	Milk coagulated and lactic acid formed.
Potato tube culture:-	A moist yellowish growth over the surface.

Behavior to gelatin:- Liquefies it very rapidly.

Growth:- Rapid.

Chemistry:- Forms lactic acid in milk.

No. II.

Colonies:- They are small, round, somewhat elevated, moist and of a decided pink color. The center of the colony was of a deep color, and in the shape of a triangle.

Hanging drop:- Small oval cells.

Motion:- None.

Staining reaction:- Quite readily.

Gelatin tube culture:- Not along the line of inoculation, but spreads over the surface in small white dots.

Agar inclined tube culture:- A moist growth of a pink color, spreads over the surface.

Bouillon culture:- A pink scum at top, also sediment of same color.

Potato tube cultures:- Small red dots over the surface.

Milk cultures:- Red sediment at the bottom, also red ring at the top. Milk curdled and lactic acid present.

Behavior to gelatin:- Does not liquefy it.

Growth:- Quite rapid.

Chemistry:- Lactic acid formed in milk.

No. III Same can of tomatoes.

Colonies:- Quite large, moist and elevated, of a lemon color. Had a slimy appearance.

Hanging drop:- Micro-cocci.

Motion:- Quite rapid, sliding movement.

Gelatin tube culture:- Growth at first along line of inoculation, then spreading throughout the gelatin and liquefying it.

Agar inclined tube:- A slimy growth of yellow color over the surface.

Bouillon culture:- A lemon-colored ring at top; sediment of same.

Milk culture:- A ring of lemon color at the top; milk curdled.

Potato culture:- A slimy yellow colored growth over the surface.

Growth:- Rapid.

Behavior to gelatin:- Liquefies it.

Another source of annoyance in preserving fruit is mould. Mould spores are always in the air, and unless careful attention be given in handling the fruit there is danger of mould forming. The most abundant mould on canned fruit is the

Penicillium Glaucum, or the common green mould. This mould is very widely distributed in the fermentation industries. It forms a felt-like mass over the surface, is at first white then greenish or bluish grey and spreads with great rapidity. The mycelium consists of transparent branched filaments, which when immersed in liquid swell. From these filaments the conidiophores are thrown up perpendicularly. Penicillium posesses the power of secreting an invertive ferment which is able to convert cane sugar into other sugars.

Aspergillus Glaucus was obtained from the top of jelly. It was a leathery like layer about one inch in thickness. Microscopical examination showed jointed filaments. The upper ends were of flask shaped heads, from these papillae of oblong form projected.

Mucor Mucedo was obtained from a can of citron. You could notice no appearance of mould on the fruit, but the citron had a peculiar taste. Microscopical examination showed single branches. On the end of the filaments were large round bodies, filled with a granular material of a yellow color.

From experiments with changed canned goods of domestic preparation it would seem that this trouble was caused by ignorance and carelessness. If housekeepers could realize the fact that the air is filled with living floating matter, which coming in contact with the fruit causes fermentation, they would no doubt see the necessity of having everything hot to kill any living forms.

Too many fail to see the importance of heating jars. It is not only to prevent their breaking but to kill any micro-organism that may be present.

Investigations with canned goods of domestic preparation have led me to the formulation of a method, which, if strictly followed, there would be little if any loss of fruit.

Look over your jars and see that the tops fit perfectly. Very often there is a dent in the lid or some imperfection with the jar which prevents a perfect fit. Be sure that there are no cracks in the lid, either in the metal or porcelain part, for if there are they furnish passage for mould spores and other living forms. After thoroughly washing the cans and tops, lay the cans sidewise in a pan of cold water, also place in this pan the tops and whatever other utensils you are to use. Place this pan on the stove and let it come to a boil. This is to kill any life which may be present. While this is boiling you can prepare the fruit. Whatever receipt is used the general rules and method should be strictly followed. Have the best fruit possible, for then you will have fewer organisms to kill. Observe the utmost cleanliness in every part of the work. Clean your finger nails, wash the hands with soap and water. Rinse them in water which has been boiled. Do not wipe them. This may seem a little thing, but it is important for the cleaner the hands the fewer micro-organisms on them. The same with the utensils. Wash the outside of the fruit. After paring do not allow it to stand exposed to the air for any length of time, as the floating matter in the air is very likely to find a lodging place there. Exposure to the air also changes the color of the fruit. Cook only enough fruit to fill one or two jars at a time. In this way all can be thoroughly cooked. Bring the fruit to a boil; this will kill any living forms present. When you are ready to fill the jar draw the preserving kettle close to the

pan of jars, empty the boiling water from the jars, and with the funnel taken from the boiling water pour in the fruit. Don't tough the inside of the funnel with the hands. It avails little even if you are particular about the jars but neglect to have all utensils thoroughly scalded. Now dip the rubber in the hot water, thus killing any life which may be on it, slip this over the jar, being sure that your hands are clean. Fill the jar to overflowing with boiling syrup. Run the handle of the spoon, which has been kept in the boiling water, around the inside of the jar to break any air bubbles which may be present. While the few germs in one or two bubbles of air would, in all probabilities, be killed in coming in contact with the hot syrup, yet it is always best to take all precautions. After the rubber is on pick up the lid from the boiling water. It will have a few drops of water clinging to it, but don't wipe this off. The water will not hurt the fruit. If you use a cloth to wipe it off you will contaminate the lid. Never allow fruit to stand a second in the jar without the cover. If you do life will fall on the fruit. Invert the jar on the table and let stand over night. You will then be able to tell whether there is any leakage in the can. The next morn wipe off the outside of the can to remove any remains of the fruit. If any is left on, it serves as food for the growth of mould spores, and also micro-organisms. As mould developes on the outside of the can its fine filaments will run in under the lid and penetrate down to the fruit. Wrap the jar of fruit in paper so as to exclude the light, as it will fade the fruit and perhaps cause some chemical change in the fruit.

It does not matter where the fruit is stored, if it has been put up properly; dampness will have no effect on it. A cool place is more desirable from the fact that if any living forms are present they will not grow so abundantly as when stored in a warm place.

Perhaps it would be well to give a summary of the method:

Carefully look over the cans and lids, being sure that no cracks are in any part of the jar or lid. Thoroughly wash the cans and lids. Place them with the utensils that are to be used in a pan of cold water. Place this pan on the stove and let it come to a boil. While this is boiling take care of the fruit. Rinse the fruit off in several waters. Do not pare it until you are sure that your hands are clean. Do not allow the fruit to stand for any length of time exposed to the air. Cook only enough for one or two jars at a time. Be sure to bring the fruit to a boil, when it is ready for the can. Bring the preserving kettle close to the pan of jars. Pour the water from the can. Insert the funnel, which has been taken from boiling water, into the jar and quickly pour in the fruit. Dip the rubber in the boiling water and slip on the can. Fill the jar with boiling syrup. Lift the lid from the boiling water and quickly screw in place. Invert the jar on the table and let stand over night. In the morning, wipe off outside of the jar, wrap in paper and store in a cool closet.