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PROCEDURE FOR PASTEURIZING PICKLE PRODUCTS

By

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PROCEDURE FOR PASTEURIZING PICKLE PRODUCTS*

Pasteurization of pickles may be done by various methods as described in this article but pasteurization must be a part of the process to prevent spoilage. Experiments show the proper methods. By JOHN L. ETCHELLS** and IVAN D. JONES†

In a recent article,¹ the authors called attention to the importance of care in the pasteurization of pickle products and discussed some of the reasons for failure experienced by pickle packers. The response to the article by a number of packers indicated that they desired more specific information on the actual pasteurizing treatment itself. These details were published^{2,3} several years ago but are no longer available for distribution.

In general, pasteurization is required for all pickle products that do not contain sufficient amounts of added vinegar and sugar to stop fermentation by certain microorganisms which are responsible for spoilage. It is important to point out that the final product must not only remain free from spoilage, but also be free from undesirable texture and flavor changes which may result from improper pasteurization, such as overheating. The correct procedure for pickle products has been arrived at by carefully conducted bacteriological and chemical determinations, carried out under commercial conditions. According to this developed procedure, the products in cans or jars are sealed and heated in water until the temperature *at the center of the container* reaches 165 deg. F. This temperature is maintained in the container for 15 minutes, after which it is rapidly lowered to 100 deg. F. by cooling with water.

Types of Pasteurized Pickle

There are probably a dozen or more different types of pickle made from fresh or partially fermented cucumbers that require pasteurization during their manufacture. No doubt the bulk of the pasteurized pickles packed is composed of the well known sliced fresh cucumber pickle (also known as old-fashioned or bread-and-butter pickle), and the fresh dill pickle.

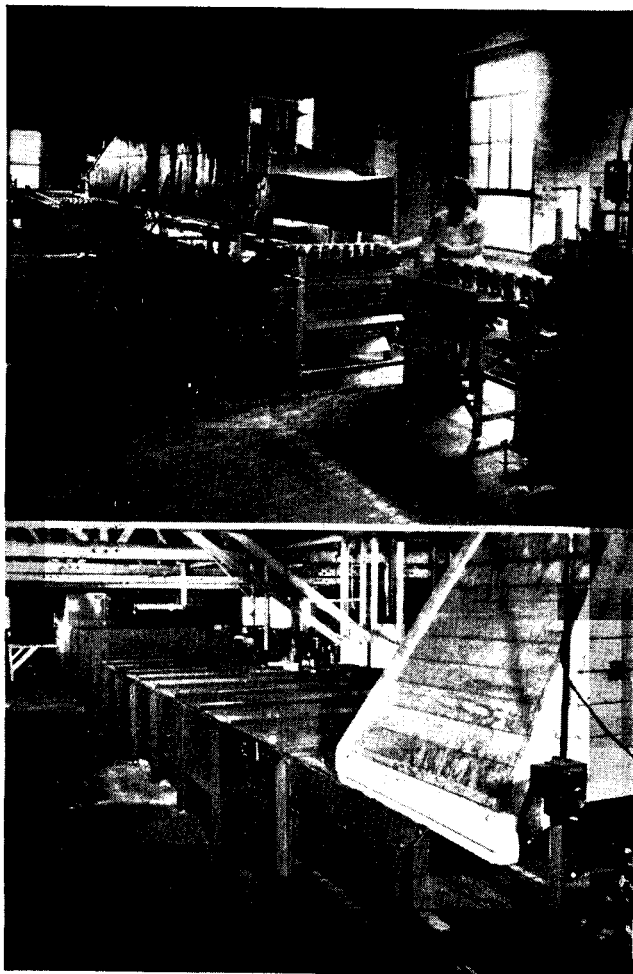
There are also a number of closely related types of dills packed that require pasteurization. These vary chiefly as to length of natural fermentation period allowed prior to packaging, or as to the amount of acid, salt and spice used during preparation. Quite often, partially fermented dills are referred to as Polish, Hungarian, overnight, or fresh-fermented dill pickles.⁴ Also, the addition of garlic and more spicing may be sufficient reason for the packer to label any one of the various types of

dills as a Kosher-style product. Ordinarily, a Kosher-style dill is relatively low in acid and salt content, and is rather highly seasoned, particularly with garlic.

In addition to being a necessity in the manufacture of fresh or partially fermented cucumber pickle products, pasteurization is an advantage in the packing of genuine dill pickles. It has been demonstrated⁵ that this treatment makes cured dill pickles retain most of their original firmness over a storage period of many months.

Pasteurization is also required for the sweet pickle made from salt stock but differing from the usual sweet pickle in that it contains less vinegar and sugar. Many non-cucumber products can be placed in the pasteurized group, such as fresh or partially fermented dilled tomatoes, fresh vegetable relish, and similar vegetable pickle prepared from uncured stock.

Accordingly, for the purpose of this article it is pos-

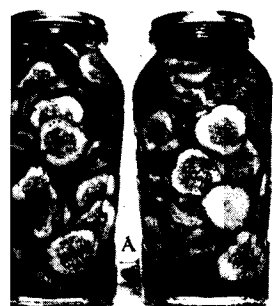
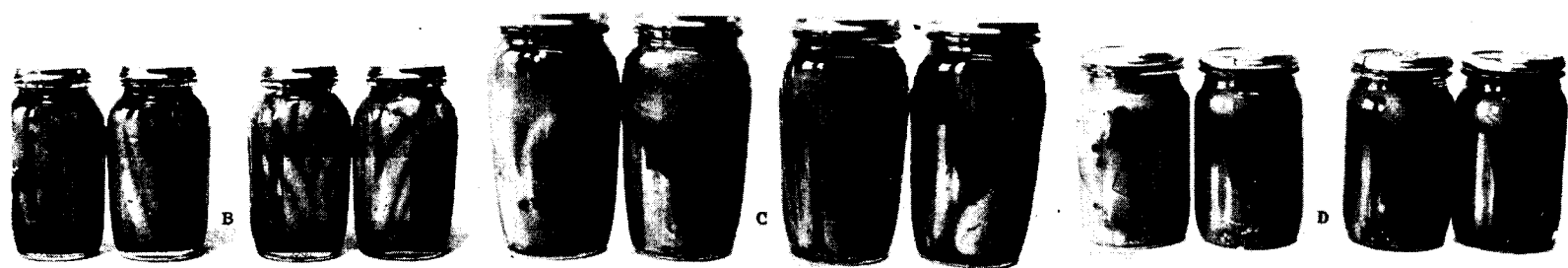


● Fig. 1. Continuous pasteurizers used in pickle products.

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- A. Sliced fresh cucumber pickles in 25-oz. glass.
 B. "Sens Gherkins" or ripe, fresh cucumber pickle in 12½-oz. glass. Ripe produce cucumbers were used in jars at the left and ripe pickling cucumbers for those at the right.
 C. Genuine dills made in a vat. Jars—20-oz.—at left have original cloudy brine. With those at the right the brine has been clarified.
 D. Genuine dills in 16-oz. glass. Original cloudy brine at left; clarified brine at the right.
 E. Experimental jars of whole fresh cucumber pickle, 20-oz., made according to the fresh sliced cucumber pickle formula.
 F. Kosher style, partly fermented dills in 16-oz. glass with original cloudy brine.

sible to class the various pickle products requiring pasteurization as: 1. Fresh or unfermented, 2. partially fermented, or 3. fully fermented. Pasteurization is required for the first group to prevent fermentation from taking place; in the second, to stop the fermentation under way; and in the third, to protect the product against further growth of organisms or from the action of fermentation by-products that may reduce the firmness of the pickle during storage (such as occurs with genuine dills).

Preparation of the Pickle

No attempt will be made to give all the details of preparation for the various types of pickle requiring pasteurization. Commercial formulas vary, depending both upon the individual manufacturer and the customer preference in a given area. However, some general points on preparation of the pickle can be discussed briefly.

Washing: Vegetables such as cucumbers and green tomatoes which are to be prepared as fresh types of pasteurized pickle should be thoroughly washed. This can be done with a rotary vegetable washer. If they are particularly dirty, or if the dirt has dried, a pre-soaking is helpful. The hardened or caked dirt can be loosened by soaking the vegetable in water in two large wooden tubs or other suitable containers. These may be made from an olive cask cut in two. After a period of soaking in the first tub, the vegetable is removed to the second, and then into the rotary washer. The water should be changed frequently in both tubs. This treatment makes the rotary washer more effective.

Fresh Slices: For making fresh, sliced cucumber pickle, cucumbers of 1200-1800 count size* are suitable. They are sliced by machine and placed in tanks of about 40-bushel capacity. They are then covered with a 30 deg. salometer brine (7.9 per cent), containing tumeric for color, and allowed to remain several hours. Usually it is convenient to cut in the afternoon and allow the slices to remain in the brine overnight. The slices are then packed into containers with about a level teaspoonful (for 25-oz. jars) of a mixture of 2 parts mustard seed and 1 part celery seed. Hot liquor at approximately 160-170 deg. F. is then poured on the slices. The liquor should contain sufficient vinegar and sugar to make it test about

14-15 grains* acetic acid and 16-18 deg. Bé. (29-33 deg. Brix) when drained from the finished pickle. The final ratio of slices to liquor is usually about 5 to 3 by volume. A uniform pack can be maintained by putting a measured amount of hot liquor in the jars first, and then adding sliced cucumbers until the liquor comes up to the top of the jar. The hot jars are immediately capped with a rubber-type closure and are ready for the pasteurizing treatment (165 deg. F. for 15 min.).

Fresh Dills: The cucumbers (or green tomatoes) for this product are first thoroughly washed as previously described. Then they are held for several hours in tanks or barrels containing about 30 deg. salometer brine, after which they are packed tightly into containers with the desired whole spices and covered with a hot dill liquor (160-170 deg. F.) containing sufficient vinegar to finish at about 6 to 8 grains acetic acid. The final salt content should be about 2.5 to 3 per cent. The packed containers are then capped and pasteurized (165 deg. F. for 15 min.).

It is well to point out that a sprig of dill weed is usually placed in each jar for appearance. However, the dill flavor is commonly added with the hot liquor in the form of emulsified oil of dill. Kosher-style fresh dills usually contain garlic cloves or fresh garlic juice in addition to the spices.

Fermented Dills: In general, products such as overnight dills and Polish-style dills are prepared from cucumbers, spices, and dill weed covered with about a 20 deg. salometer brine and allowed to ferment in barrels a short time prior to packaging. In addition to the mixed spices and dill weed, onions or garlic can be added at the time of preparation. Green tomatoes can be used for this pickle instead of cucumbers. The acid content should be allowed to reach about 4 to 6 grains acetic acid and the final salt content should be about 2.5 to 3 per cent. The partially fermented stock should be sorted free from bloaters and packed into jars. The pickles are then cov-

*Equivalent to 1.4 to 1.5 per cent acetic acid.



Fig. 2. Pasteurizing tank showing "V" circulation baffle in front.

*Number per 45-gallon cask.



Fig. 3. Preparing Control Jars or Cans

ered with the original curing brine after it has been heated to 160 to 170 deg. F. and the jars are capped and pasteurized at 165 deg. F. for 15 min.

Genuine Dills: Genuine dills of satisfactory quality can be made in barrels or tanks by any reliable commercial formula. The problem during the manufacture of genuine dills does not concern the choice of the formula so much as the proper handling of the cured stock. Packers frequently encounter serious loss through spoilage of the cured dills during storage. This is characterized by a gradual softening of the pickles to the point where they are unmarketable. As mentioned earlier, a marked improvement in the retention of firmness by genuine dills during storage can be obtained by pasteurizing the cured product in sealed containers.

To be genuine, the dill pickles must be covered with the original brine from the fermentation process, which should test about 8 to 10 grains of acetic acid and read 17 to 20 deg. on the salometer. If there is objection to the cloudiness of the original brine, it can be removed by filtration. The fully-cured stock should be carefully graded to remove the bloaters prior to packing. The original brine is then heated to 160 to 170 deg. F. and poured over the packed pickles. After capping, the sealed containers are ready for pasteurization (165 deg. F. for 15 min.).

Types of Pasteurizers

In general, pasteurizers may be classified into continuous and batch types. In either type, the pasteurization procedure should be conducted so as to heat the product throughout to 165 deg. F. and to hold it at that temperature for 15 minutes. The choice of equipment depends to a great extent on the resources and facilities of the company and the extent of operations to be undertaken.

By careful attention to details, discussed below, it is possible to obtain high-quality products with almost any kind of equipment designed for pasteurizing. Equally satisfying results can be obtained in batch operations with large wooden pasteurizing tanks, small wooden tanks or metal tanks. The same is true for continuous pasteurizers of different kinds and sizes (see Fig. 1).

Batch Pasteurization

Pasteurizing Tank: Good results in batch pasteurization have been obtained with the wooden tank shown in Fig. 2 which is eight feet in diameter, has a capacity of about 1,500 gallons, and holds approximately 100 crates (24 jars per crate) of pickle.

With this particular tank, the water is heated by direct steam. A one-inch open-end pipe is run down the inside of the tank and across the bottom to within about two feet of a wooden circulation baffle directly opposite. The baffle is made of two boards each, 1 inch thick and 12

1. The lid is centered, edge down, over the wooden block and a hole punched out. A punch can be made from a 10-inch piece of standard $\frac{3}{8}$ -inch pipe, reamed out at one end to a cutting edge.

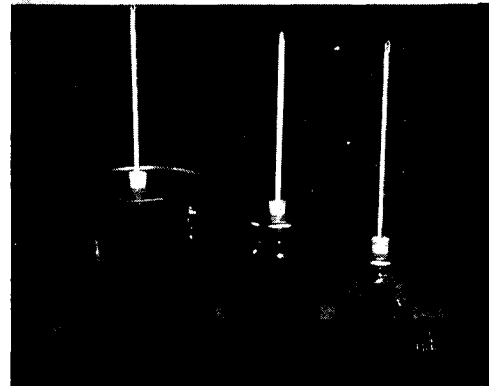
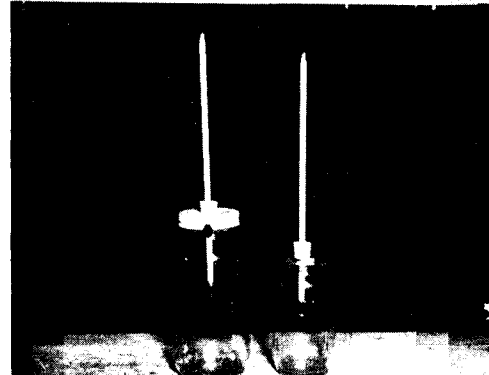
2. A No. 7 regular-length cork stopper is bored to fit a mercury thermometer. To do this, select a borer from the set with the same diameter as the thermometer. Center the borer on the small end of the cork stopper and twist through. A suitable thermometer to use is one that has graduations from 0 to 220 deg. F. marked on stem.

3. The cork with thermometer in place is pushed firmly into the punched cap. Note: When cans are used, the lid is first punched and sealed on the can of pickle. Then the cork with thermometer in place is inserted into lid.

4. The assembled cap (with thermometer in place) is then put on the jar tightly by hand. The bulb end of the thermometer should extend half way into the jar can. The correct position of thermometers in jars is shown at right.

5. Finished control jars or cans are now ready for placing in the batch to be pasteurized. Use new jars or cans of pickle each time a batch is run. A stout cord attached to jar neck is convenient to remove them from the hot water. A wire basket can be made for removing the more bulky gallon cans.

Note: Thermometers, corks, and a set of cork borers can be ordered from wholesale drug or laboratory supply companies.



inches wide, set at an angle of 45-deg. and mounted securely to the side of the tank. The steam emerging from the pipe forces the water against the "V" and provides adequate circulation. The "V" baffle is notched where it comes in contact with the bottom of the tank so as to allow introduction of water for cooling through a hose or a fixed pipe run down the inside of the baffle. Two holes are bored in opposite sides of the tank for draining and are supplied with long plugs that can be reached from the top of the tank.

On the bottom of the tank, pine (2 x 4's) are put down parallel to the steam pipe. They form channels for the water during pasteurization and cooling, and also serve to keep the crates on the bottom tier from too close contact with the steam pipe.

Loading the Tank: The tank is loaded in the following manner: The first tier of crates is arranged on the edges of the parallel 2 x 4's in such a manner as to allow free circulation of water. The subsequent tiers are then added. The tank when loaded holds approximately 100 crates in five tiers, the top tier coming to within about six inches of the top of the tank.

Control Jars: During loading, control jars (or cans) are placed in the top and bottom areas of the tank, the bottom control jar being lowered with a cord between the crates and the side of the tank. These are equipped with thermometers inserted through holes punched in the metal lids and held in place by corks of proper size bored to carry the thermometers (see Fig. 3) for prepara-

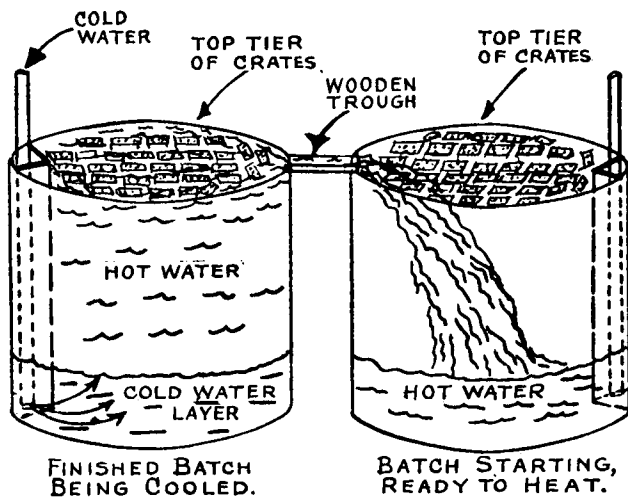


Fig. 4. Arrangement for re-use of hot water with batch pasteurization tanks. Steam siphon can be used in place of wooden trough.

tion of control jars or cans. A stout cord attached to the jars serves to remove them from the hot water.

After the crates of pickle and the control jars are properly placed in the tank, the draining holes are plugged and the tank is filled with water. Steam is allowed to enter as soon as the bottom of the tank is covered with a few inches of water and continues to flow while the tank is being filled.

Temperature Record: Temperature readings are made on the control jars at 10-minute intervals until the pasteurizing temperature (165 deg. F.) is reached, and then at 5-minute intervals during the 15-minute holding period. The water temperature is also taken at each time interval.

This is necessary to avoid heating the water much above 165 deg. F. Overheating the water may cause certain types of caps to blow off with the usual amount of head space.

Cooling the Pickle: At the conclusion of the pasteurizing period, the jars are cooled rapidly to 100 deg. F. by water from a hose or a fixed pipe run down inside the baffle to within about six inches of the bottom of the tank.

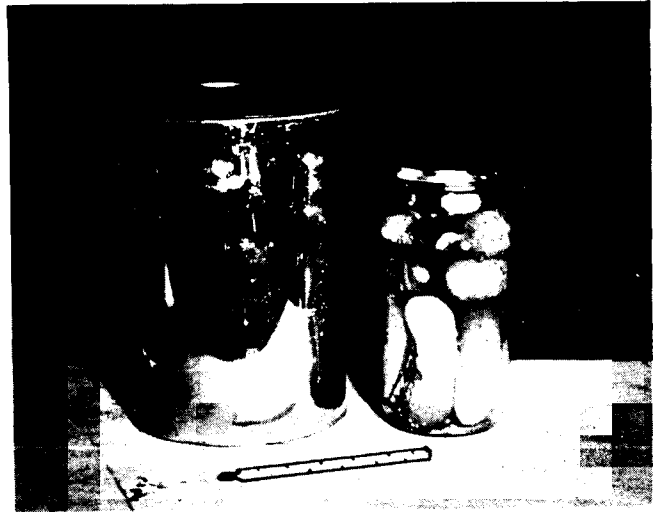


Fig. 5. Pasteurizing equipment not allowing use of control jars or cans can have max.-indicating thermometer placed in marked jar.

The cold water is added slowly at first to form a layer, and the jars are cooled by the upward displacement of the hot water by the cold water. Prompt cooling will prevent undesirable flavor and texture changes that would occur in uncooled lots of pickle.

Re-use of Hot Water: In order to save time, conserve heat and thus reduce expense, the pasteurizing tanks should be arranged so that the hot water from the tank being cooled can be transferred to a batch just starting to heat. This can be accomplished very simply by the introduction of cooling water into the bottom of the tank which causes the hot water to rise and pass through an overflow trough or siphon into an adjacent tank ready to be pasteurized. This method of transferring the hot water is illustrated in Fig. 4.

Continuous Pasteurizers

In cases where pasteurizing equipment (see Fig. 1) does not allow the use of control jars, or cans equipped with thermometers for frequent temperature observations, it may be possible to obtain the information as to the course of heating in the following manner. Test runs can be conducted with small maximum-indicating thermometers* reading up to 220 deg. F. placed inside marked jars or cans of the pickle (see Fig. 4) so the bulb end of the thermometer is as near the center as possible. The thermometers, removed when the test run is finished, show the maximum temperature reached in the jar or can in the area around the thermometer bulb. When the thermometers show that the contents of the jars or cans are at 165 deg. F. when emerging from the

*Directions for use of maximum-indicating thermometers are the same as for ordinary clinical thermometers. The column of mercury must be shaken down each time before using.

pasteurizer, the operating conditions should be maintained.

Several general suggestions and precautions with respect to plant procedure are presented with the view to helping the plant operator.

1. *Cleanliness and Sanitation:* Care must be taken at all times to keep equipment clean during manufacture. Guard against the introduction of large numbers of microorganisms into the pickles by improper plant sanitation. Inspect whole spices and other raw materials to make sure that they are clean and of good quality. Control insects and rodents at all times.

2. *Fresh Materials:* Use freshly harvested, carefully graded green stock. Cucumbers showing even slight evidence of mold growth, resulting from improper handling or shipping, are unsuitable for the fresh types of pasteurized pickle because the final product will have a "woody" or "earthy" taste due to the mold growth in the cucumber tissue.

Check the incoming green stock for the presence of the pickle worm. This is particularly important during the latter part of the receiving period and during an extended growing season. A few bushels of cucumbers, sliced and inspected for worms may well be worth the time and effort in future sales.

3. *Handling Fresh Slices:* Fresh cucumber slices should be handled in enameled ware or suitable metal containers. Rough wooden boxes are unsatisfactory because they cannot be cleaned and heavy mold growth may take place during the week-end shutdown. The same is true for wooden packing tables or similar equipment coming in contact with the sweet liquor or juice from the slices.

4. *Correct Closures:* Rubber-lined jar closures are essential for pasteurized pickle products. They can be of either the venting or non-venting type. Pulp-and-oil lined caps are not satisfactory.

Allow adequate head space in jars fitted with vacuum closures. Failure to do this may result in the caps blowing off during pasteurization. This difficulty increases if the water temperature is permitted to rise 10 or 15 deg. above 165 deg. F. The packer should consult the company supplying his closures for information regarding head space required and the maximum temperature to which the jar can be subjected without causing closure failure.

5. *Vacuum Required:* Jars of pasteurized fresh cucumber slices, or whole fresh dills with a final vacuum reading somewhat in excess of 10 inches of mercury on the testing gauge, lose their attractive, fresh white appearance within a very short time after being opened (see Fig. 6). Also, excessive final vacuum may affect the crispness of the opened product unfavorably.

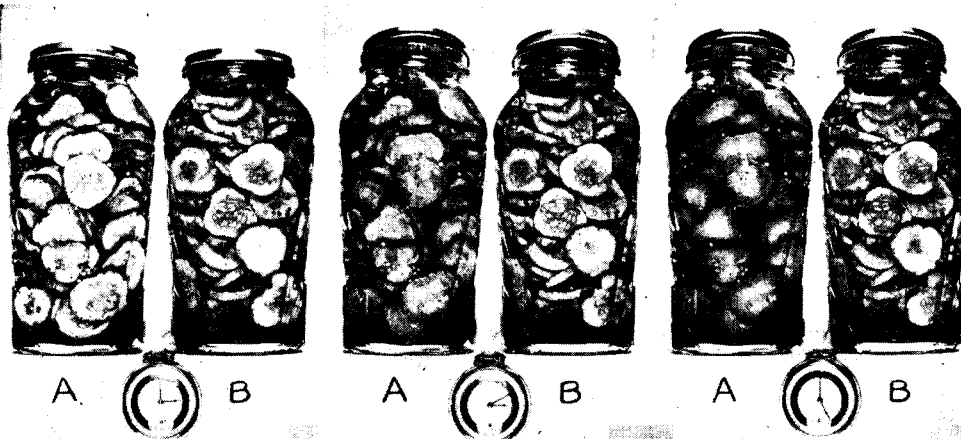


Fig. 6. The effect of final vacuum on the appearance of opened fresh cucumber pickle. Jar "A" of each set tested 15 inches of vacuum, and Jar "B" 9 inches. LEFT TO RIGHT: No. 1 at the start, unopened; No. 2, opened 10 minutes; No. 3, opened 2 hours. Note the loss of whiteness in jar "A" after opening as compared to jar "B". The pickles have lost their crispness and appear soggy.

It is felt that for pasteurized products such as the fresh slices or fresh dills, where maximum crispness and fresh, attractive appearance are of prime importance, the final vacuum of the product should not be in excess of 10 inches. If possible, machines applying closures by direct vacuum or steam vapor should be regulated so as to obtain a vacuum in the jar sufficient only for positive assurance of closure of the jar during the pasteurization treatment. Here again the closure company should be consulted for the necessary information.

6. *Keep Records:* A major portion of the losses due to improper pasteurization by pickle packers can be overcome simply by using the correct pasteurizing treatment and keeping a record of each batch pasteurization. A record sheet for this purpose is easily prepared showing: (a) Batch number; (b) time of starting; (c) jar and water temperatures at 10-minute intervals during heating the jars to 165 deg. F., and (d) jar and water temperatures at 5-minute intervals during the 15-minute holding period. The time that the holding period is to end should be recorded on the sheet, and the course of cooling likewise should be followed by temperature and time readings.

All too frequently the operator doesn't know what has gone on in his pasteurizer. Keeping careful records takes the guesswork out of the operation and pays dividends. Packers having continuous pasteurizers likewise cannot afford to neglect constant checking of the course of heating. The loss through spoilage of an occasional batch will greatly exceed the cost of regular inspection of the process being used.

7. *Container Variation:* The packer should realize that a change in the container size, or in the amount of pickle packed in a given container may decidedly influence the rate of heat penetration to the center of the jar. There will also be a difference in rate of heating between metal and glass containers. However, by keeping records as previously suggested and by making test runs these differences will be easily recognized and the processing schedule can be adjusted accordingly.

8. *Circulation and Cooling:* The importance of adequate circulation during the heating, and the prompt cooling of the product at the conclusion of the pasteuriz-

ing process cannot be over-emphasized. For batch pasteurizers, circulation can be obtained by use of steam pressure directed against the "V" baffle as previously discussed or the water can be circulated by a motor-driven propeller attached to the side of the tank. The pickle should be cooled rapidly to at least 100 deg. F. to prevent continued "cooking" which results in undesirable flavor and texture changes.

9. *Evidence of Spoilage:* It has been shown^{3,6} that spoilage of improperly pasteurized pickles is due chiefly to yeasts and acid-forming bacteria. These organisms occur naturally on the cucumbers and are carried over during the preparation of the fresh pickle. Usually both types survive the application of hot liquor. Therefore, if adequately controlled pasteurization at 165 deg. F. for 15 minutes is not carried out, spoilage will result through fermentation by these organisms.

The spoilage is usually characterized by vigorous gas production so that the liquor becomes highly charged with gas and possesses a stinging taste. Gas production is usually sufficient to blow off the lids of jars having vacuum-type closures; to break jars having screw-type caps; or to burst sealed cans. The acid content of some products, such as the fresh dills, is increased by the fermentation. Frequently, all the whole pickles in a jar of fresh dills become bloaters due to fermentation caused by gas-producing types of acid-forming bacteria or yeasts.

Unfortunately, spoilage of improperly pasteurized products does not always show up early enough to be spotted before the pickle leaves the plant. Sometimes it does not appear until weeks later, when the merchandise is on

the store shelf. Nothing short of careful bacteriological examination can reveal the immediate presence of the few organisms that may survive in lots of improperly heated pickle and bring about spoilage. However, carefully conducted pasteurization at 165 deg. F., with a holding period of 15 minutes, followed by prompt cooling, will eliminate the possibility of spoilage.

ACKNOWLEDGMENT

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