

# Pasteurization of Genuine Dill Pickles\*†

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## Introduction

THE manufacture of genuine dill pickles is beset with many difficulties. Frequently, however, the greatest loss through spoilage is encountered during the storage period following completion of the curing process. This spoilage is characterized by a progressive softening of the tissue of the pickles. Such gradual loss of firmness of the cucumber tissue may occur rather rapidly but often takes place slowly, that is, over a period of from three to six months.

In connection with other studies on the manufacture of genuine dill pickles, the practicability of pasteurization of this product has been investigated.

Pasteurization is an important procedure in the processing of many types of pickles. However, until the present time there has been no reference in the literature to the pasteurization of genuine dill pickles. Campbell<sup>1</sup> suggested that heating the brine, used in the canning of dills, to a temperature of about 170° F. would destroy the activity of the bacteria and yeasts present.

The purpose of pasteurization is to bring about destruction of the microorganisms or their accumulated by-products, which cause deterioration and other undesirable changes in the product. Pasteurization is accomplished by exposing the product to a sufficiently high temperature for an adequately long period of time. Care must be exercised to avoid imparting a cooked flavor to food products by means of prolonged exposure at elevated temperatures or by the use of excessively high temperatures. The temperature and time period which will produce a cooked flavor during pasteurization differs for various food products. However, temperatures above from 170° to 190° F. generally favor the rapid development of flavor changes.

The studies reported here were conducted over the period, 1938 through 1940. The genuine dill pickles were cured in barrels according to the method outlined in a previous paper.<sup>2</sup> They were pasteurized in one-gallon lacquered cans and stored for differing periods of time at unheated room temperatures. In the locality in which these experiments were conducted the average temperature of the storage room was between 60 and 80 degrees Fahrenheit.

Observations were made upon the pasteurized product at intervals during prolonged storage periods. These included bacteriological analyses which were conducted as outlined in an earlier report.<sup>3</sup> Also the observations included an estimation of quality based upon the firmness and crispness of the dill pickle. The firmness was determined by means of the U.S.D.A. Fruit Pressure-tester as described previously.<sup>4</sup> Crispness was determined by means of biting or eating.

## Experimental

IN THESE studies the dills were pasteurized after active fermentation was over. The brine used to fill the cans was the same brine employed in the curing process. The pasteurization procedure consisted of packing the dills in one-gallon cans, covering with hot brine which had been heated at 170° F. for 15 minutes, sealing the can and submerging in water maintained at the desired temperature. In the unpasteurized or control lots, both the brine and the pickles were unheated.

An outline of the pasteurization procedure is shown in Table I. Following pasteurization proper, the cans were cooled quickly by submerging in cold running water.

Table I  
Dill Pasteurization Processing Schedule.

Treatment Designation	Processing Procedure
Control	Unheated or unpasteurized
140°	Brine temperature in can raised to and held at 140° for 15 minutes. Cooled in water.
165°	Brine temperature in can raised to and held at 165° for 15 minutes. Cooled in water.
180°	Brine temperature in can raised to 180°. Cooled immediately in water.

Temperature changes occurring within the cans during the pasteurization process were measured by fitting a can with a thermometer and checking the brine temperatures at short intervals. In addition, the bulb of a maximum registering thermometer was carefully placed in the interior of a cucumber at the center of the can. This can was opened after the heating and cooling process and a record obtained of the maximum temperature attained by the cucumbers in the innermost part of the can.

Periodic inspections of the pasteurized and unpasteurized dills were made during storage. At such times bacteriological plate counts were made to determine the

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**Table II**  
Pressure Test Values of Pasteurized Dills at Intervals During Storage. 800 Count Size Dills, 1938 Studies. Values Expressed in Terms of Pounds Resistance to Puncture by 5/16" Tip.

Observation Date and Treatment No.	Processing Treatment			
	Unpasteurized	Pasteurized at temp. indicated		
		140° F.	165° F.	180° F.
7 months after pasteurization				
*D 2	6.4	9.9	12.5	12.9
**D 4	7.4	11.0	11.5	10.6
9 months after pasteurization				
D 2	5.0	11.2	11.1	12.0
D 4	9.0	11.9	12.9	11.5

\* Curing treatment, no vinegar at start.  
\*\* Curing treatment, 1/2 gal. 110 grain vinegar at start.

**Table III**  
Pressure Test Values of Pasteurized Dills at Date of Pasteurization and at Intervals During Storage. 1800 Count Size Dills—1939 Studies. Values Expressed in Terms of Pounds Resistance to Puncture by 3/16" Tip.

Observation Date and Treatment No.	Processing Treatment			
	Unpasteurized	Pasteurized at temp. indicated		
		140° F.	165° F.	180° F.
Immediately before pasteurization				
*D 10	13.8	...	...	...
**D 34	17.0	...	...	...
***D 38	16.7	...	...	...
9 months after pasteurization				
D 10	5.7	10.3	10.9	11.3
D 34	7.6	12.3	13.6	12.3
D 38	6.9	13.4	13.6	13.7
16 months after pasteurization				
D 10	5.6	8.8	9.5	9.7
D 34	5.1	11.2	12.1	12.4
D 38	5.2	11.7	12.8	11.9

\* Curing treatment, no vinegar added at start.  
\*\* Curing treatment, 1/2 gal. 110 grain vinegar added at start.  
\*\*\* Curing treatment, 1 gal. 110 grain vinegar added at start.

predominating types of organisms present. Brine samples for these analyses were taken through a small opening made in the top of the can prior to the removal of the can top. Quality evaluation was estimated by means of tasting the dills and testing from 12 to 20 cucumbers from each can by means of the U.S.D.A. Fruit Pressure-tester.

### Results and Discussion

A COMPARISON of changes in the firmness of pasteurized and unpasteurized lots occurring over various periods of time are presented in summarized form in Tables II to IV. These results indicate the following:

(1) The pasteurized lots retained their firmness during the storage periods investigated in contrast to the unpasteurized lots, which rapidly became soft.

(2) Lots which differed distinctly in firmness prior to pasteurization were correspondingly different after pasteurization. This is indicated in Tables III and IV.

(3) All lots which were sufficiently firm prior to pasteurization to be commercially marketable retained a

**Table IV**

Pressure Test Values of Pasteurized Dills at Date of Pasteurization and at Intervals During Storage. 3,000 Count Size Dills—1940 Studies. Values Expressed in Terms of Pounds Resistance to Puncture by 5/16" Tip.

Observation Date and Treatment No.	Processing Treatment			
	Unpasteurized	Pasteurized at temp. indicated		
		140° F.	165° F.	180° F.
Immediately before pasteurization				
2 A	13.8	...	...	...
2 B	9.7	...	...	...
5 months after pasteurization				
2 A	5.1	13.0	11.6	11.1
2 B	...	9.2	9.2	8.9
6 A	...	13.1	14.6	13.9
6 B	6.5	13.1	14.6	13.3
9 months after pasteurization				
2 A	Soft	11.1	11.6	11.4
2 B	"	8.9	9.3	9.1
6 A	"	12.8	14.4	13.6
6 B	"	12.2	14.9	13.1

Curing treatment included addition of 1/2-gallon 100 grain vinegar at start.

**Table V**

Maximum Temperature Attained in Brine and Interior of Cucumber During Pasteurization. (Each Value Is Average of Four Experiments)

Temperature of Treatment	Brine Temperature		Maximum temperature attained in cucumber
	Maximum	Time brine at max.	
140° F.	140° F.	15 min.	139° F.
165° F.	165° F.	15 min.	160° F.
180° F.	180° F.	Flash	167° F.

**Table VI**

Incidence of Microorganisms in Pasteurized Dills at Intervals During Storage

Lot No.	Elapsed Period of Time	Plate count per cc. at different elapsed periods after pasteurization			
		Processing treatment			
		Control or Unpasteurized	140° F.	165° F.	180° F.
1938					
†D 2	3 mo.	190,000	0*	0*	0*
"	7 mo.	1,000	20	20	0*
"	9 mo.	2,000	10	20	0*
‡D 4	3 mo.	2,000	0*	0*	0*
"	7 mo.	3,000	0*	0*	0*
"	9 mo.	6,600	0*	0*	0*
1939					
D 10	9 mo.	24,000	20	0*	0*
"	16 mo.	170,000	130	20	0*
D 34	9 mo.	34,000	20	0*	0*
"	16 mo.	70,000	0*	0*	0*
D 38.	9 mo.	30,000	10	0*	0*
"	16 mo.	90,000	15	0*	0*

† Initial count 10,500 per cc.  
‡ Initial count 14,000 per cc.  
\* Less than 10 per cc.

satisfactory degree of firmness during the pasteurization process and during the storage periods investigated.

(4) In lots cured by the same treatment but pasteurized at different temperatures, slight variations were observed; however, these were neither consistent nor large.

From the standpoint of quality as determined by eating, the unpasteurized lots were all unsatisfactory at the periods of observation following the pasteurization date. These observations were made after five to 16 months storage, as indicated in Tables II to IV. This inferiority was principally a lack of firmness of the cucumber tissue. Moreover, the flavor was frequently somewhat poor. A cooked flavor was not detected in any of the pasteurized dill pickles. In the opinion of certain judges, the pasteurized lots processed at 165° or 180° possessed a better flavor than those processed at 140°.

Table V summarizes the temperature observations made on brine and cucumbers within the cans during pasteurization at the different temperatures. From this table it would appear that the cucumber temperature probably never exceeded 170° F. during processing even in the 180° F. treatment.

Bacteriological analyses of the pasteurization experiments are summarized in Table VI. Two principal facts are brought out by the data. These are: (a) an appreciable number of microorganisms persisted in the unpasteurized or control lots over the entire storage period, and (b) the incidence of microorganisms in all pasteurized lots was exceedingly low.

These observations may be further amplified. The predominating types of microorganisms which are found in fermenting dill brines are acid-forming bacteria and yeasts. The organisms found in the control or unpasteurized lots were one group of the acid-forming bacteria which are frequently encountered in dill fermentations. This group of organisms is not necessarily typical of a dill fermentation but is frequently encountered. In the pasteurized lots neither the acid-forming bacteria nor the yeasts survived the pasteurization treatment. The counts which have been indicated in the pasteurized lots in Table VI represent chiefly resistant spore-forming organisms.

In view of the data presented in Table VI and in consideration of this information along with that presented in Tables II to IV, dealing with firmness of the pasteurized lot, it would seem that the pasteurization treatment has effectively reduced the microbial population to the extent that little or no change occurred during the storage period subsequent to pasteurization.

It is well to mention at this time that a loss of firmness of dill pickles during storage may not be wholly

the result of the action of microbial activity but also may occur through the action of products previously formed by the microorganisms. In other words, enzyme activity may be responsible for the softening of the dills in storage. This factor has not been investigated in these studies. In light of general information concerning enzyme activity the authors have considered that the temperatures employed in the pasteurization treatments were sufficiently high to inactivate enzymes which may have been present in the brine.

Accordingly, it is concluded that microorganisms or enzymes present have been inactivated by the pasteurization treatments outlined. From the practical standpoint the pasteurization process has been effective in preventing gradual loss of firmness of the dill pickles during the storage period investigated in this study.

No attempt was made to study the commercial or semi-commercial scale pasteurization of genuine dill pickles. The packer must make the necessary adaptations required to accomplish this. However, the following suggestions are made to those wishing to investigate the commercial pasteurization of dill pickles.

(1) Maintain careful temperature control during pasteurization and cooling. If processing is carried out in batches, the cans should be so stacked that heating or cooling is uniform at all points in the processing tank. (2) If a continuous pasteurizer is used, this problem is somewhat eliminated. Control cans fitted with thermometers should be situated at different places in the tank or pasteurizer and frequently checked to assure that pasteurization is taking place at the desired temperature and for the desired length of time.

(2) The packer who is equipped with an exhaust sealer might find that satisfactory results can be obtained by filling the can with cold, unpasteurized brine, exhausting, sealing and pasteurizing, as previously described, rather than heating the brine prior to filling the can, as indicated in this report. This variation of pasteurization procedure was not studied in this investigation.

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