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## **A study of the suitability of native citron melon and watermelon for preserves, pickles and candied fruit.**

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A STUDY OF THE SUITABILITY OF  
NATIVE CITRON MELON AND WATERMELON  
FOR PRESERVES, PICKLES AND CANDIED FRUIT

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A STUDY OF THE SUITABILITY OF NATIVE CITRON MELON  
AND WATERMELON FOR PRESERVES, PICKLES AND  
CANDIED FRUIT

Lavada Katherine Curtis

Thesis submitted for the degree

of

Master of Science

MASSACHUSETTS STATE COLLEGE, AMHERST

May 11, 1938

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## HISTORY OF RAW PRODUCTS

### Watermelon

Webster's definition of watermelon (*Citrullus vulgaris*) is:  
"A large oblong or roundish fruit of a vine of many varieties. It has a green or white rind with copious sweet watery juice and many seed. It is a native of tropical Africa but widely cultivated."

The watermelon is the most valuable vine grown crop in the United States. They are grown for the market over a wide range or territory, and are grown extensively in the southern section of the United States. The six states producing the bulk of the commercial crop, in the order of their importance, are: Texas, Georgia, Florida, Indiana, Mississippi, and California. According to statistics contained in Crops and Markets covering the ten year period from 1924 to 1933, inclusive, there was an average yearly shipment of 50,000 carloads from the sixteen principal producing states, valued at \$5,286,988.

Georgia, Florida, Texas, North Carolina, South Carolina, Virginia, Missouri, and California are noted for their heavy watermelon production. The area planted to watermelons in the sixteen principal producing states in 1935 are reported in Crops and Markets, Report of the United States Department of Agriculture (11), as 185,950 acres.

A yield of 350 to 400 marketable melons per acre is good. A melon weighing 32 to 34 pounds is the most desirable or adopted standard for shipping. There are approximately 1600 standard melons per car load.

Watermelons are profitably grown in many sections but in some localities good yields are obtained only where the crop is grown on new land that is being conditioned for other crops, while in other sections watermelons are a standard crop which is grown in regular rotation.

Over-production is one of the chief causes that governs the sale of melons for the market. Cool rainy weather will cause breaks of the market, while hot weather will invariably stimulate the demand. Losses are also caused by diseases which originate on the farm but develop during transit.

Shipments from southern Florida and southern Texas begin in April, and the season gradually moves northward. After the northern-grown watermelons are gone, California and Colorado continue to supply the market with special varieties, known as winter watermelons, which are available until December.

A fertile sandy loam is a preferable soil type. It must be well drained and free from alkali. Some of the heaviest yields are produced in the sandy river-bottom of southeastern Missouri.

The seed are planted in hills from 7 to 12 feet apart. The 12 foot planting gives approximately 300 hills per acre.

The Tom Watson variety is widely grown throughout the southeastern United States. This variety is splendid for shipping, uniform in shape and size, and is a good eating quality. The Irish Grey variety is grown to some extent in Georgia and sometimes brings a little higher

price on certain markets than the Tom Watson. In California the varieties known as Excel, White-Seeded Angelino, Black-Seeded Angelino, Florida Favorite, and Klondike are most important. Stone Mountain or Dixie Belle is very popular in the South. For home use and local marketing, Tom Watson, Kleckly Sweet, Dixie Belle, Florida Favorite, Excel, and Irish Grey are extensively planted.

The 1937 acreage of watermelons (12) in the states of Florida, Georgia, North Carolina, and South Carolina was six percent higher than 1936. This increase was reported by the Crop Reporting Board of the Department of Agriculture.

A summary of this situation in a recent report from the Bureau of Agricultural Economics showed that growers increased 1937 watermelon plantings in Georgia by five percent, in South Carolina by five percent, and in Florida by twenty-two percent.

In terms of acres planted, Georgia growers planted 63,000 acres, an increase of 3,000 acres over last year's plantings. South Carolina farmers planted 21,000 acres, an increase of 1,000 acres from last year. Florida growers reported they planted 19,500 acres, or 3,500 more acres of watermelons than were planted in the state last year. North Carolina reported 12,800 acres, the same as last year. Thompson (7), gives general growing directions for both watermelons and citron melons.

The increase in acreage in 1937, as explained by the General Crops Section, U. S. Department of Agriculture, was due largely to the favor-

able prices which prevailed for the 1936 watermelon crop. Prices were higher than at any time during the six previous seasons. The prices were increased primarily because of a light crop, and better distribution of shipments to terminal markets.

The average composition of watermelon, as reported by Chatfield and McLaughlin (5), is as follows:

	Percent
Water	92.10
Protein (N x 6.25)	0.50
Fat	0.20
Ash	0.27
Total carbohydrates (by difference)	6.30
Crude fiber	0.60
Calories per pound	140

According to Tibbles (10) the inedible portion comprises approximately 59.4 percent of the melon by weight. He states that the melons contain 6.7 percent carbohydrates, 0.4 percent protein, 0.3 percent ash and 0.2 percent fat.

Citron Melon

Webster's definition of citron melon is: "One of the race of watermelon having a small fruit, the hard flesh of which is used like the citron. Referred to as the round preserving melon or citron. More hardy and more disease resistant, stronger grower and more productive. Not edible raw. Its chief use being as a base for preserves after boiling in a syrup strongly flavored with lemon or ginger or both."

The citron melon belongs to the same botanical species as the watermelon, i.e. *Citrullus vulgaris*, with which it readily crosses. However, the citron melon is inedible and distinctly different as to fruit characteristics. The citron melon is used mainly for making home prepared preserves. It has been but little used commercially.

The plant is very hardy, and is grown in nearly all parts of the United States. In California it has escaped from cultivation and grows wild. It is cultivated to a limited extent in the north for making preserves. In other sections the rind is used for making conserves, pickles, and is sometimes fed to stock. It is also known as "stock-melon." The citron melon has about the same cultural requirements as the watermelon, and has been used in breeding a wilt-resistant watermelon.

The composition of preserved citron melon is as follows (7):

	Percent
Water	19
Protein	0.5
Nitrogen free extract	78.1
Fat	1.5
Ash	0.0

An interesting feature of the citron melon is the high content of pectin, which is sometimes extracted and used to bring about a jell formation in fruits which lack pectin.

Studies of the citron melon showed more than six times as much total pectin substance as in the watermelon, with over half of the pectin substance occurring as pectin. The pectin acid content is much lower than in watermelon.

At the Sandhill Experiment Station (7) a test was undertaken to determine the palatability of citron melon and to compare them with soaked beet pulp in a dairy ration. They found that apparently the melons were quite palatable, for one cow consumed an average of 108 pounds daily for ten days and another cow ate 100 pounds daily for a similar period. Neither animal seemed to tire of the feed. The melons contained only 4.8 pounds of nutrients per 100 pounds and it required 3.7 pounds of melons to equal one pound of beet pulp. Over a 10 day period milk production was lower when melons were fed than when beet pulp was used.

There is apparently little data on the citron melon. No record was found as to the extent of cultivation, yield and value of the crop.

General data on pickling have been reported by Chenoweth (6), Campbell (4), Fabrian (1, 2), Lefevre (3), Cruess (5), and Tanner and Eagle (9). Home pickling directions are also described in numerous State Agricultural Experiment Station and Extension Service bulletins.

## THE RAW PRODUCTS

### Watermelon Pickles

"The term pickle applies to any food that is preserved in brine or vinegar, either with or without bacterial fermentation and either with or without the addition of spices and sugar."

A number of tests were made with watermelon rind to determine the most desirable process of making pickles from the raw product.

The watermelon rind was cut into pieces and the green rind and pink center removed. The white part of the rind was cut into half inch cubes. Various methods of treatment and precooking were used in testing the rind for pickles. One pound of rind was used in each test. Pickle solution of different amounts of vinegar, water, sugar, spices, lemon and orange were used in determining the best amount to use for flavor and texture.

The finished product was filled into eight-ounce glass containers and processed in a water bath for ten minutes. After three months the product was examined.

Representative tests and the results obtained are as follows:

#### TEST NO. 1

##### Method:

The rind was soaked in lime water (1 ounce to 4 quarts of water) for 12 hours. It was freshened in clear water for one hour, and boiled in three changes of water. The

drained product was added to the pickle solution and cooked for two hours.

Result:

The water turned brown each time it was changed. The pickles were a dark, muddy color, and did not cook clear. The product was very poor.

TEST NO. 2

Method:

The rind was soaked in lime water (1/3 ounce lime to 1 quart of water) for 12 hours. It was freshened in clear water for three hours and boiled in clear water until tender. The drained product was added to the pickle solution and boiled two hours and ten minutes.

Result:

In this test the pickles were firm and crisp, but did not cook clear. This test made a very poor product.

TEST NO. 3

Method:

The rind was placed in a 40 percent salometer brine for 24 hours. The fruit was drained and freshened by par-boiling for five minutes in two changes of clear water.

The spices were added to the vinegar, simmered for twenty minutes and 1/2 pound of sugar added. The cooked rind was added to the syrup and heated to boiling; after two

days the syrup was drained from the pickles and 1/2 pound of sugar added. The syrup was heated to boiling and returned to the pickles.

Result:

The pickles were firm, crisp, of good color and flavor. This method made a very good product.

#### Citron Melon Pickles

The citron melon was cut into 1/2 inch slices, the center and green rind removed. The hard white remaining rind was cut into 1/2 inch cubes.

One pound of rind was used in each test. Various methods of treatment and precooking were used in testing the citron rind for pickles. Cider vinegar was used in making the pickle solution. Pickle solutions of different amounts of sugar, vinegar, water, spices, lemon and orange were used in determining the best amount to use for flavor and texture.

The finished product was filled into eight-ounce glass containers and processed in a water bath for ten minutes. After three months the product was examined.

Representative tests and results obtained are as follows:

##### TEST NO. 1

Method:

With no previous treatment the rind was added to the pickle solution and boiled for two hours.

Result:

The pickles were soft and did not cook clear. They were classed as a very poor product. There was a very poor yield in this test.

TEST NO. 2

Method:

With no previous treatment the rind was added to the pickle solution and boiled two hours and twenty minutes.

Result:

The pickles were soft, did not hold their shape nor cook clear. They were classed as a very poor product.

TEST NO. 3

Method:

The rind was soaked in lime water (1/5 ounce of lime to 1 quart of water) for 12 hours. It was freshened in running water for two hours. The rind was added to a light syrup made of 2 quarts of water and 3 cups of sugar and boiled for thirty minutes. The drained product was added to the pickle solution and boiled for one and one-half hours.

Result:

The center of the cubes became hollow and collapsed at the end of the cooking period.

The pickles were shriveled and did not cook clear. They were light in color, crisp and well flavored but were a poor product.

TEST NO. 4

Method:

The rind was soaked in lime water (1/3 ounce to 1 quart of water) for 12 hours. It was freshened in clear water for three hours, then boiled in clear water until tender.

The drained product was added to the pickle solution and boiled two hours and ten minutes.

Result:

The pickles did not cook clear, were shriveled and had a dark color. The cubes were crisp outside and soft in the center. The pickles were a very poor product.

TEST NO. 5

Method:

The rind was soaked in lime water (1/3 ounce to 1 quart of water) for 12 hours. It was freshened in running water for two hours and boiled in three changes of water. The drained product was added to the pickle solution and boiled for two hours.

Result:

The pickles were firm, crisp and held their shape. They did not cook clear and were of a medium color. The pickles were classed as a fair product.

TEST NO. 6

Method:

The prepared fruit was boiled in the water until tender, then sugar and vinegar were added and boiled for one hour. Spices and lemon were added the last thirty minutes of the cooking period.

Result:

The pickles were firm and crisp. The product was a light color, well flavored and of a very good quality.

Watermelon Preserves

"Fruit preserves are whole fruits or pieces of large fruit preserved in a heavy syrup."

The watermelons were small with very thin rinds, and many of them over-ripe. They were washed, cut into pieces, and the green rind and pink centers removed. The white part of the rind was cut into 1/2 inch cubes.

Two pounds of fruit were used in each test. Various methods of treatment and precooking were used in testing the rind for preserves. Each time a 20 percent syrup was used (made by boiling 2 pounds of sugar and 4 quarts of water). Lemon, orange, pineapple, ginger and spices were used for flavor.

The finished product was filled into eight-ounce glass containers and processed ten minutes. After two months the results were determined.

Representative tests and results obtained are as follows:

TEST NO. 1

Method:

The watermelon rind was boiled for ten minutes in clear water, drained and added to the 20 percent syrup solution. One-half of a lemon was sliced and added to the syrup. The rind was cooked until tender and clear, which required two hours and twenty minutes. The finishing point of the syrup registered 220° F.

Result:

A very mild flavored product, which was tender and clear, was obtained. The fruit showed a slight shrinkage and did not hold its shape. The amount yielded 16 ounces of preserves.

TEST NO. 2

Method:

The rind was soaked in lime water (1/5 ounce of lime to 1 quart of water) for two and one-half hours. After soaking the rind in the lime solution, it was drained and freshened for two hours in clear water. After draining, the product was covered with fresh water and boiled for two hours. Then drained again and added gradually to a 20 percent syrup solution. One ounce of ginger and 1/2 of a lemon were added to the syrup. The finishing point was 220° F.

Result:

The preserves were translucent, crisp and held their shape. They had a very good flavor and were classed as a good product. The test yielded 16 ounces of preserves.

TEST NO. 3

Method:

No previous treatment was given to the product. The fruit was added to a 20 percent syrup solution and boiled. One-half lemon was added to 1/2 of the product, and lemon and ginger to the other half. The preserves were finished at 221° F.

Result:

The preserves had a mild watery flavor, were tough, and did not hold their shape. The product did not boil clear and was classed as a very poor product. The test yielded 12 ounces of preserves.

TEST NO. 4

Method:

The product was soaked overnight in lime water (1/2 ounce of lime to 1 quart of water). It was freshened in cold water for one hour, drained, covered with cold water and cooked until tender, which required one and one-half hours.

The product was then drained and boiled in a 20 percent syrup solution for thirty-five minutes, and let stand overnight in this same syrup. The next morning the cooking was

continued, with 1 cup of pineapple juice and 2 slices of pineapple added. Finishing point was 222° F.

Result:

The product was brown and had a strong alkali odor. The preserves were crisp, clear and very sweet. This test yielded 16 ounces of preserves.

### Citron Melon Preserves

The citron melons were cut into pieces, the centers and green rind removed. The hard white remaining rind was cut into 1/2 inch cubes.

One pound of fruit was used in each test. Various methods of treatment and precooking were used in testing the rind for preserves. Each time a 20 percent syrup was used, made by boiling 1 pound of sugar and 2 quarts of water. Lemon, orange, pineapple, ginger and spices were used for flavor.

The finished product was filled into eight-ounce glass containers and processed ten minutes in boiling water. After two months the product was examined.

Representative tests and results obtained are as follows:

#### TEST NO. 1

Method:

The prepared fruit was soaked in lime water (1/2 ounce lime to 1 quart of water) for 12 hours. It was then freshened for one-half hour in clear water, and boiled twenty minutes to

remove lime. The drained product was added to a 20 percent syrup solution. One cup of pineapple juice and 1/2 lemon were added to this syrup. The boiling continued until 222° F.

Result:

The preserves were shriveled and tough. The center of the cubes were soft. The test yielded 16 ounces of preserves.

TEST NO. 2

Method:

To this lot no previous treatment was given. The fruit was added to a 20 percent syrup solution and boiled twenty minutes before adding 2 slices of pineapple. The rind was cooked until clear and tender, the syrup testing 221° F.

Result:

The preserves were slightly shriveled, but tender and clear. They were classed as a good product. The test yielded 17 ounces of preserves.

TEST NO. 3

Method:

The citron rind was left in lime water (1/2 ounce of lime to 1 quart of water) for 16 hours. (The lime did not penetrate to center of cubes, which left a small white center). After freshening for two and one-half hours, the rind was boiled in 3 changes of water, drained and added to a 20 percent syrup solution. One-half lemon and 2 slices of pineapple were added

the last thirty minutes of the cooking period. The syrup registered 223° F. when finished.

Result:

The preserves were slightly shriveled, but tender and crisp. They did not cook clear. They were classed as a good product. The test yielded 16 ounces of preserves.

TEST NO. 4

Method:

In this method the citron rind was boiled in clear water until tender, drained and soaked in lime water for three hours. The product was freshened by boiling in 3 changes of water and was then added to a 20 percent syrup solution. The syrup tested 220° F.

Result:

The preserves held their shape and did not shrink. Upon boiling in syrup the product turned brown and had a strong odor of lye. The test yielded 16 ounces of preserves.

TEST NO. 5

Method:

The fruit was boiled in 1 1/2 quarts of water until tender, or twenty-five minutes. Three-fourths pound of sugar was then added and the product continued to boil for one hour. One-half lemon, thinly sliced, was then added, and allowed to boil until the drop sheeted off. The syrup tested 221° F.

Result:

The product in this test was firm and crisp. The cubes held their shape, and had a good flavor and color. The test yielded 14 ounces of preserves.

Candied Watermelon

TEST NO. 1

Method:

Two pounds of watermelon rind was used in the test. The fruit was soaked in lime water (1/3 ounce of lime to 1 quart of water) for four hours, drained and boiled in two changes of clear water.

A syrup was made, using 1/2 pound of sugar, 3/4 cup of Karo and 1 quart of water. The prepared fruit was placed in the syrup and heated to boiling. Strong ginger tea was made by using 1 ounce of ginger and 1 pint of water, boiled ten minutes, and added to the syrup. The fruit was set aside for one day.

The syrup was tested every day for four days and the density raised approximately 10 percent by using 1 part Karo and 2 parts sugar. At intervals thereafter the syrup was tested until it remained constant around 70 percent.

Result:

When the density of the syrup reached 67 1/2 percent,

sugar crystals were found in the jar. One-half cup of Karo was added and the fruit heated to boiling.

Again when the syrup tested 70 percent sugar, a few crystals were noticed. One-half cup of Karo was added.

The product was very crisp and held its form.

After the addition of the last amount of Karo the fruit remained in the syrup for four days and then 1/4 pound was put aside to dry. Within ten days the dried product had started crystallizing.

The fruit was heated to boiling twice. Each time a portion was dried, it became coated with crystals.

#### TEST NO. 2

##### Method:

Two pounds of watermelon rind was cooked in water until tender, then added to a 28 percent syrup, using pineapple juice as part of liquid in syrup. The subsequent treatment was the same as in No. 1.

When the syrup remained constant around 70 percent a small portion was taken from syrup, drained well and spread on waxed paper to dry.

##### Result:

Crystals did not form in the syrup at any time during the process. The dried fruit was in good condition six months later.

Candied Citron

TEST NO. 1

Method:

Two pounds of citron rind was used in this test. The fruit was soaked in lime water (1/3 ounce of lime to 1 quart of water) for four hours. It was then drained and boiled in two changes of water.

A syrup was made using 1/2 pound of sugar, 3/4 cup of Karo syrup and 1 quart of water. The prepared fruit was placed in the syrup and heated to boiling. Strong ginger tea was made by using 1 ounce of ginger and 1 pint of water, boiled ten minutes, and added to the syrup. The fruit was set aside for one day.

The syrup was tested for four consecutive days and the density raised approximately 10 percent by using 1 part of Karo syrup and 2 parts of sugar. At intervals thereafter the syrup was tested until it remained constant around 70 percent.

Result:

When the density of syrup reached 67 1/2 percent, sugar crystals were found in the jar. One-half cup of Karo syrup was added and the fruit heated to boiling.

Again when the syrup tested 70 percent, a few crystals had formed. One-half cup of Karo syrup was again added and the fruit heated to boiling. The product was very crisp and held its shape.

After the addition of the last amount of Karo, the fruit remained in the syrup for four days, and then 1/4 pound was put aside to dry. Within ten days the dried product had started crystallizing.

The fruit was heated to boiling for three consecutive days, and each time the portion put aside to dry became coated with crystals.

#### TEST NO. 2

##### Method:

Two pounds of citron rind was boiled in water until tender, then added to a 28 percent syrup, using 1 cup of pineapple juice and 2 slices of pineapple as a part of the liquid. The subsequent treatment was the same as in No. 1.

When the syrup tested 60, 65, 67 and 70 percent, a small portion was drained well and spread on waxed paper to dry.

##### Result:

Crystals did not form in the syrup at any time during the process. The dried product taken from syrup testing 60 and 65 percent became coated with crystals after ten days. The dried product taken from syrup testing 70 percent, kept in good condition for six months.

## SALTING

The process of preserving fruits and vegetables by the addition of salt has long been practiced by commercial people when the product was to be kept for any length of time. By salting the raw product, either in a weak or strong solution until it has undergone certain chemical and physical changes which preserve it, the product can be kept indefinitely. The amount and manner of using salt varies according to the type of fruit or vegetable.

It is a well known fact that bacteria play an important part in the fermentation of fruits and vegetables. The number and kind of bacteria vary according to the degree of salometer brine. There are more peptonizing bacteria for the first few days and less acid producing bacteria; as the salt increases, the peptonizing bacteria practically disappear.

As shown by Fabian (1), three factors are responsible for the reduction of the acid producing bacteria: the concentration of the salt, the presence of available food, and the acidity produced by the bacteria themselves.

Too, it is shown that low salt curing permits a very rapid curing product. The product is less firm than curing at high salt concentration, and there is a greater chance of undesirable bacteria growing in the brine.

The high salt curing will cure more slowly and produce a firmer and better product. There is less undesirable bacteria growing in the brine.

Watermelon Salt Stock

The next series of experiments were set up in order to determine the influence and amount of salt needed in curing watermelon rind.

Six different lots were used with various degrees of salt and vinegar.

The watermelon rind was cut into narrow strips. The inner ripe pulp and outer green peel were removed. The remaining clear white rind was cut into 1/2 inch cubes. Four pounds of rind was used in each test for curing the rind.

The following table was used in determining the amount of salt for brines of different densities.

Salometer Reading	:	Salt Per Quart of Water
Percent	:	Ounces
20	:	2
40	:	4
60	:	6
80	:	8
100	:	10

Table No. 1

TEST NO. 1

Method:

The prepared fruit was placed in a 20 percent salometer brine. This brine was tested at intervals. When the brine was tested sufficient salt was added to restore the proper density to 20 percent salometer reading. The scum of yeast and molds that formed was removed every few days.

Result:

Within ten days active fermentation was completed. The pickles were not as firm as those cured at a higher salt concentration.

The product was left in the 20 percent salometer brine and observed at intervals. Within 31 days it had become dark, mushy, and had a putrefactive odor. The lot was discarded.

TEST NO. 2

Method:

In this method the rind was placed in a 40 percent salometer brine. The brine was tested weekly and sufficient salt added to restore the density to 40 percent salometer reading.

Result:

Five weeks were required to complete fermentation, which was slower than in the low salt curing. It produced a firm product. The rind was cream color, rubbery and transparent.

TEST NO. 3

Method:

The watermelon rind was placed in a 60 percent salometer brine. When the brine was tested at intervals, sufficient salt was added to restore the proper density to 60 percent salometer reading.

Result:

The product was very slow curing and fermenting. There

was less yeast and mold formed than in the previous methods of salting. In comparing the finished product with No. 2 it was found to be firmer and darker in color than the 40 percent brine.

TEST NO. 4

Method:

In this test the watermelon rind was packed with 1 pound of salt, which was 1/4 their weight in salt. Two days later the brine tested 80 percent salometer. Salt was added to raise the density to 100 percent. No more salt was added during the test.

Result:

There was sufficient brine to cover the product. The shape and color remained the same in appearance as the product.

TEST NO. 5

Method:

The product was covered with 2 percent vinegar solution. The liquid was tested at intervals and the acidity raised to 2 percent solution.

Result:

Within ten days a putrefactive odor was noticed. The product became soft and translucent.

TEST NO. 6

Method:

The prepared fruit was placed in a 2.5 percent vinegar and 20 percent salometer brine. The product was tested at

intervals for acidity and salometer reading. The vinegar and salt were added to bring it up to the original reading.

Result:

The rind was not firm, it had a bubble appearance and a dark muddy, uneven color. It was not as firm as the citron of the same percent salt stock. The brine had a putrefactive odor.

#### Citron Melon Salt Stock

A series of experiments were made to determine the best method of curing citron melon rind. Various amounts of salt and vinegar were used.

The citron melon was cut into narrow strips. The inner ripe pulp and outer green peel were removed. The remaining clear rind was cut into 3/4 inch cubes. Four pounds of rind were used in each test.

Table No. 1 was used in determining the amount of salt for brines of different densities.

#### TEST NO. 1

Method:

The prepared fruit was placed in a 20 percent salometer brine, and tested at intervals. Each time the brine was tested, sufficient salt was added to restore the proper density of 20 percent salometer reading. The scum of yeast

and molds that formed was removed every few days.

Result:

A pink mold growth was noted the seventh day of fermentation. The mold was removed and no other signs were shown.

Within four weeks active fermentation was completed. The product was clear, and light cream in color.

The brine continued at 20 percent salometer reading. Softening was noticed at the beginning of the sixth week.

TEST NO. 2

Method:

In this method the rind was placed in a 40 percent salometer brine. The brine was tested weekly and sufficient stock was added to restore the density to 60 percent salometer reading.

Result:

The product was very slow in curing and fermenting. Seven weeks were required to complete the fermentation. The rind was light cream color, firm and transparent.

TEST NO. 4

Method:

The product was covered with a 2 percent vinegar solution. The liquid was tested at intervals and the acidity raised to a 2 percent solution.

Result:

Within twelve days from the time the test was made the rind became soft and mushy. The odor was not as offensive as the same experiment with watermelon. The rind was a light cream color and clear.

TEST NO. 5

Method:

The prepared fruit was placed in a 2 1/2 percent vinegar solution and a 20 percent salometer brine. The product was tested at intervals for acidity and salometer reading. Vinegar and salt were added to bring the solution up to the original reading.

Result:

The solution had a clean vinegar odor. The product was firm, clear, and somewhat darker than the other products.

TEST NO. 6

Method:

In this test the citron rind was packed with 1/4 of its weight in salt. The liquid was tested at intervals for density.

Result:

Salt had to be added one time to bring the density to 90 percent salometer reading. There was sufficient brine to cover the product. No change was noted in appearance or shape of product. It remained firm and white in appearance as the fresh product.

TABLE SHOWING SALOMETER READING AND DATE TESTED

Watermelon

Salometer Reading	Date	Oct. 31	Nov. 6	Nov. 14	Nov. 21	Dec. 2	Dec. 8	Dec. 15	Final Reading
No. 1 20% Brine	Oct. 27	10	20	20	20	20	20	20	23
No. 2 40% Brine	Oct. 28	20	30	30	35	40	40	40	42
No. 3 60% Brine	Oct. 28	30	46	50	55	60	59	60	65
No. 4 1 lb. Salt	Oct. 28	80	90	90	90	90	90	90	98
No. 5 2% Vinegar	Oct. 28	.4	.9	1.1	.6	.9	1	2	2.1
No. 6 2 1/2% Vinegar	Oct. 28	.4 acidity: 10% brine	1.1 acidity: 11% brine	1.1 acidity: 15% brine	1.5 acidity: 15% brine	1.4 acidity: 20% brine	2.6 acidity: 20% brine	2.5 acidity: 20% brine	2.5 acidity: 20% brine

TABLE SHOWING SALOMETER READING AND DATE TESTED

Citron Melon

Salometer Reading	Date Stored	Oct. 27	Oct. 28	Oct. 31	Nov. 6	Nov. 14	Nov. 21	Dec. 2	Dec. 8	Dec. 20
No. 1 20% brine	Oct. 20	10		15	17	19	20	20	20	20
No. 2 40% brine	Oct. 20	20		25	30	35	37	38	40	40
No. 3 60% brine	Oct. 20	30		40	45	55	55	58	60	60
No. 4 2% vinegar	Oct. 20		.48	.54	2.2	.7	2	.6	2.1	2.1
No. 5 2.5% vinegar 20% brine	Oct. 20	.15		.62	:2.3 acidity: :13% brine	:1.9 acidity: :18% brine	:2% acidity: :19% brine	:1.9 acidity: :20% brine	:2.2 acidity: :20% brine	:2.5 acidity: :20% brine
No. 6 1½ lbs. salt	Oct. 20			75	90	90	90	90	90	90

## MANUFACTURE OF SALT STOCK

### Preserves

The tests in this study were confined to the principles of making preserves from the previous salted stock. Various methods of treatment and precooking were used in testing the salt stock for preserves. In each test the watermelon and citron melon stock was desalted in running tap water for twelve hours.

One pound of fruit was used in each test. Each time a 20 percent syrup was used, made by boiling 1 pound of sugar and 2 quarts of water. Lemon, orange, pineapple, ginger, and spices were used for flavor. The finished product was filled into eight-ounce glass containers and processed in a water bath for ten minutes. After two months the product was examined.

Representative tests and results obtained are as follows:

### Watermelon Preserves

#### TEST NO. 1 - 40 percent Salt Stock

##### Method:

The desalted stock was boiled in the 20 percent syrup. After boiling for one hour 2 slices of pineapple were added and the preserves continued to boil for one and one-half hours. The syrup registered 221° F.

##### Result:

The preserves were very firm and tender. They held their shape and did not show any shrinkage. They were clear

and had a light color, and were classed as very good preserves.

TEST NO. 2 - 90 percent Salt Stock

Method:

Ten ounces of salt stock was boiled in clear water forty-five minutes, drained and added to a 20 percent syrup. The preserves were boiled in the syrup for one hour.

Result:

The melon rind remained firm in the boiling water and became clear in the boiling syrup. The preserves were crisp, clear and did not shrink. They were classed as good preserves.

Citron Melon Preserves

TEST NO. 1 - 40 percent Brine Stock

Method:

A syrup was made using 2 quarts of water and 1 pound of sugar. After boiling one hour the syrup continued thin and 14 ounces of sugar were added. Two slices of orange and 2 slices of pineapple were added the last thirty minutes. The preserves were finished at 219° F.

Result:

All the syrup was not used for covering the preserves. The preserves were firm, crisp, very clear, and a light color. They were classed as good preserves.

TEST NO. 2 - 20 percent Salt, 2.5 Vinegar

Method:

The fruit was boiled in 1 1/2 quarts of water for twenty-five minutes, or until tender. One pound of sugar was added and continued to boil for one hour. One-half lemon, thinly sliced, was added and continued to boil until the drops sheeted off. The syrup tested 221° F.

Result:

The preserves were firm, crisp, and tender. They were darker in color than test No. 1, which was due to darker salt stock. They were classed as good preserves.

TEST NO. 3 - 90 percent Salt Stock

Method:

The salt stock was boiled in clear water for fifteen minutes, drained and added to a syrup made of 1 pound of sugar and 2 quarts of water. Three-fourths of a lemon was added the last thirty minutes. The preserves finished at 220° F.

Result:

The product became soft in the boiling water and quite foamy in the syrup. The preserves were soft and mushy. They were classed as a very poor product.

## Pickles

The discussion in this study is confined to the principles of making pickles from the previous salted stock. Various methods of treatment and precooking were used in testing the salt stock for pickles. In each test the watermelon and citron melon stock was desalted in running water for twelve hours.

Cider vinegar was used in making the pickles because of its aromatic qualities, and mellow acid taste. This had a tendency to discolor the pickles slightly. One pound of salt stock was used in each test.

Pickle solutions of different amounts of vinegar, water, sugar, spices, orange, and lemon were used in determining the best amount to use for flavor and texture.

The finished product was filled into eight-ounce glass containers and processed in a water bath for ten minutes. After two months the results were determined.

Representative tests and results obtained are as follows:

### Watermelon Pickles

#### TEST NO. 1 - 40 percent Salt Stock

##### Method:

A syrup was made of vinegar, sugar, spices and lemon, and was allowed to simmer for five minutes. One pound of rind was added to the syrup and boiled for one hour and twenty-five minutes.

Result:

The fruit was firm and medium crisp. No shriveling was noticed. The pickles were light in color, well flavored, and a good quality product.

TEST NO. 2 - 40 percent Salt Stock

Method:

The fruit was stored in strong unsweetened vinegar for one week. The vinegar, sugar and spices were simmered together for five minutes and allowed to stand overnight. The liquid was heated, poured over the rind and brought to a boil. This was repeated every day for three days.

Result:

The pickles were dark in color, and slightly crisp. Softness was probably due to the long period of boiling. They were clear and considered good pickles.

TEST NO. 3 - 60 percent Salt Stock

Method:

The rind was covered with a 3 percent vinegar solution. After three days the vinegar was tested and made up to the original acid strength. The pickles were allowed to stand in the solution for five days. The vinegar was tested and made up to 3 percent acid by adding standard vinegar. At this time 1/2 pound of sugar was added. The acidity was tested at intervals and the sugar increased gradually. One

and one-half pounds of sugar was used to the 1 quart of vinegar.

One ounce of spices was placed in the vinegar and heated at simmering temperature for ten minutes. It was allowed to cool and poured over the pickles. After three weeks the product was examined.

Result:

The fruit was firm and crisp. The pickles were of medium color, well flavored, and a high quality product.

TEST NO. 4 - 60 percent Salt Stock

Method:

The rind was boiled in water until tender. A syrup was made of vinegar, water, sugar, spices and lemon, and allowed to simmer for five minutes. The syrup was added to the rind and boiled for one hour.

Result:

The pickles were firm and crisp, of good texture and color. The off flavor of the rind was noticed in the flavor of the pickles.

TEST NO. 5 - 90 percent Salt Stock

Method:

The rind was boiled in water for twenty minutes and added to the syrup made of vinegar, water and sugar. The spices were tied in a bag and added to the syrup. The rind was added to the syrup and boiled one hour.

Result:

The rind was firm after boiling in water, and remained firm in the syrup. It was not clear, but of very good texture and a good quality product.

TEST NO. 6 - 90 percent Salt Stock

Method:

The product was boiled in clear water for fifteen minutes, drained and soaked in lime water (1 tablespoon of lime to 1 quart of water) for two and one-half hours. It was drained and freshened in clear water for thirty minutes. It was then boiled in a pickle solution for one and one-half hours.

Results:

The pickles were very firm and crisp. No shriveling was noticed. The color compared with other results and made a very good product. The off flavor of the rind was noticed in the flavor of the pickle.

TEST NO. 7 - 25 percent Vinegar, 20 percent Salt Stock

Method:

The rind was boiled in clear water for one hour, drained and covered with a 3 percent vinegar solution for twelve hours. The fruit was added to the pickle solution and cooked one hour.

Result:

The pickles were crisp, but were not clear and had a muddy color.

Citron Melon Pickles

TEST NO. 1 - 20 percent Salt Stock

Method:

One and one-half pounds of salt stock from the 60 percent salometer brine was covered with 3 percent vinegar. After three days the vinegar was tested and made up to the original acid strength. The pickles were allowed to stand in the solution for five days. The vinegar was tested and made up to 3 percent acid by adding standard vinegar. At this time 1/2 pound of sugar was added. The acidity was tested at intervals and the sugar increased gradually. One and one-half pounds of sugar was used to the 1 quart of vinegar.

One-fourth ounce of spices was placed in the vinegar and heated at simmering temperature for ten minutes. This was allowed to cool and then poured over the pickles. After three weeks the product was examined.

Result:

The fruit was firm, crisp, and the color was characteristic of this kind of pickles. The pickles were well flavored and a high quality product.

TEST NO. 2 - 60 percent Salt Stock

Method:

The fruit was boiled in water for twenty minutes and added to the syrup made of vinegar, sugar and water. The

spices were tied in a piece of cheesecloth and added to the syrup. The fruit was added to the syrup and boiled one hour.

Result:

The pickles were firm and very crisp. The color was darker than in test No. 1, but they were well flavored and a good quality product.

TEST NO. 3 - 40 percent Salt Stock

Method:

A syrup was made of vinegar, sugar, spices and lemon, and allowed to simmer for five minutes. One pound of citron was added to the syrup and boiled for one hour and twenty-five minutes.

Result:

The fruit became shriveled during the first part of the cooking, but returned to the original size before the end of the cooking period. The fruit was firm, but not as crisp as in test No. 1. The product was very light in color, well flavored and a fair quality product. It was considered a very good product for quick process pickles.

TEST NO. 4 - 40 percent Salt Stock

Method:

The fruit was stored in strong unsweetened vinegar for one week. A syrup was prepared of 1 1/2 pints of vinegar, 1 lemon sliced, 1 stick of cinnamon, 1 1/2 pounds of sugar,

and 1 teaspoon each of mace, ginger root and whole cloves.

The vinegar, sugar, spices and lemon were simmered together for five minutes, then allowed to stand overnight.

The hot liquid was poured over the citron rind and brought to a boil. This was repeated each day for three days.

Result:

The fruit was softer after heating, and became firmer before repeating the process. The pickles were crisp, tender and well flavored, and a fair quality product.

TEST NO. 5 - 20 percent Brine and 25 percent Vinegar Stock

Method:

The rind was boiled in clear water for one hour, drained and covered with a 3 percent vinegar solution for twelve hours. The fruit was then added to the pickle solution and cooked one hour.

Result:

The brine stock was darker than in the other tests, resulting in a darker pickle. The pickles were firm, crisp and well flavored. They were classed as good pickles.

TEST NO. 6 - 90 percent Salt Stock

Method:

The rind was boiled in clear water for fifteen minutes, drained and added to the pickle solution. The pickles cooked for one and one-half hours.

Result:

The citron became soft while boiling in the water and much softer in the pickle solution. The syrup was quite foamy. The pickles were classed as a very poor product.

TEST NO. 7 - 90 percent Salt Stock

Method:

Since test No. 6 became softened while precooking, the product was boiled in clear water for fifteen minutes, drained and soaked in lime water (1 tablespoon lime to 1 quart of water) for two and one-half hours. It was drained and freshened in clear water for thirty minutes. The product was boiled in the pickle solution for one and one-half hours.

Result:

The pickles were very firm, brittle, and a few pieces were shriveled. They were well flavored and classed as fair pickles.

SUMMARY OF CITRON AND MELON STUDY

1. Raw Products:

Watermelon preserves and pickles made from the raw product, with no previous treatment, will not retain the form of the original fruit. Citron preserves and pickles are much softer and have greater shrinkage than watermelon. Citron preserves and pickles yield a better product without the treatment with lime.

Lime water does not penetrate citron rind as readily as watermelon rind. If the citron remains in lime water long enough to penetrate the center of rind, the finished product will have a strong lye odor.

Watermelon and citron melon preserves require orange or lemon peel and pineapple or ginger for flavor.

The pickle solution giving the best flavored product consisted of 1 pint of vinegar, 1 1/2 quarts of water, 3/4 lemon sliced, 1 tablespoon mixed spices, and 3/4 pound of sugar.

Watermelon and citron may be candied successfully from the raw product. The addition of ginger made a better flavored product. Rind treated with lime water, then candied, will become coated with sugar crystals. Candied citron is more translucent than candied watermelon.

2. Salt Stock:

Fermentation is completed in 20 percent brine within four weeks; 40 percent, six weeks; 60 percent, seven weeks; 20 percent brine and 2 1/2 percent acid requires four weeks. No fermentation will occur in stock if 1/4 salt by weight is used. Melon stock will desalt in less time than citron salt stock.

3. Procedure of Manufacturing Salt Stock:

Pickles and preserves made from salt stock retain form of the original fruit, are more translucent, firmer, more crisp, and have a better yield. Preserves need to be strongly flavored with lemon or ginger, or both.

The best texture and flavor for watermelon and citron pickles are made by building up the acid and sugar content gradually. If stored in strong unsweetened vinegar for one week, then hot syrup added, the rind is crisp, tender and well flavored.

A very good quality product may be made from salt stock by quick process. The pickles are not as crisp, but are very well flavored.

Preserves made from salt stock are crisp, tender and show little shrinkage, if fruit is placed in a syrup of approximately 30 percent sugar and boiled slowly to the desired concentration.

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