and an even higher percentage today. This means those engaged in industries adding value to basic food commodities can look forward to the opportunity to increase the market for their services with the growth of the economy as a whole, as measured by personal income.

This paper has been devoted, in the main, to a discussion of trends in food consumption and factors underlying these trends which was considered necessary as a prelude to the discussion of economic trends in fruit and vegetable processing in Florida and the South.

What have been the trends in fruit and vegetable processing in Florida and the South and how do these trends compare with the trend for the Nation? We had available for the preparation of this paper, statistics by states on the value of the output of food manufacturing. This was all foods; however, from personal experience, we know much of the growth in food manufacturing in Georgia has been in the broiler industry. We believe the greater proportion of the growth in Florida has been from horticultural crops, and more specifically citrus products.

The accompanying chart compares the growth of food manufacturing for Florida, the South, and the United States from 1947 through 1958. Since the actual dollars are deflated, with the 1947-49 price level equal to 100, the bars show the relative increase in terms of physical volume. The percentage figures on the bars represent the increase from the 1939 volume as a percent of the 1939 volume. The rate of growth has been much greater in Florida than in the South and the United States. Developments in the citrus industry in this State were important factors in the faster rate of growth for Florida.

It is interesting to note that the greatest rate of growth occurred between 1947 and 1954. The increase in food manufacturing in Florida in 1947 amounted to 75 percent of the output in 1939 while the volume had grown in 1954 to the point that the increase amounted to 311 percent of total volume for 1939. During this period, 1947-54, rapid changes occurred in the citrus processing industry in Florida. Growth in food processing in Florida has continued to increase; however, the rate of growth in terms of physical volume was not as great between 1954 and 1958.

In actual dollars, food manufacturing in Florida has increased from 69 million dollars in 1939 to 868 million in 1958—an increase of almost 12 times the 1939 volume. For the South, the increase was almost six times; and for the United States, it was only four times the 1939 actual dollar volume.

What about the future? There is little to be gained from a post-mortem unless such study will lead to plans for the future. It is my opinion that the trend in fruit and vegetable processing in Florida will continue upward; however, the rate will probably not be as great as that from 1947 to 1954. This refers to those horticultural crops especially well adapted to Florida, such as citrus and other sub-tropical fruits and vegetables.

CLEVENGER AND A QUICK PEEL OIL DETERMINATION METHOD FOR FROZEN CITRUS CONCENTRATE, A COMPARISON

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The determination of peel oil in frozen citrus concentrate serves a dual purpose. It indicates that the standard for grade is being met, and in practice it is a necessary aid to quality control of flavor. The quicker the peel oil content is known the greater the degree of control. The standard Clevenger (1) method for determination of peel oil in citrus juices requires about one and one half hours to run. Constant attention may also be necessary over this period to assure a high degree of accuracy. This leaves much to be desired by the quality control operator.

When a quick method for peel oil determination is applied it must be compared with the Clevenger since here lies the accepted standard. Kilburn and Petros (2) reported a method for the rapid determination of peel oil in single strength orange juice for babies. It required about twelve minutes to run and showed a good correlation with the Clevenger.
This rapid method was modified for use in the frozen concentrate operation.

The results of Clevenger and "quick oil" determinations, run on aliquots of the same concentrate samples collected by the USDA personnel, were compared. The Clevenger figures were taken from the USDA record, while the quick oil figures are those from the record of an individual plant technician. It is interesting to note that duplicate runs by the quick oil method read within plus and minus .0005%/wt. peel oil of a calculated mean.

**Materials and Methods**

*Apparatus:* The distillation apparatus consists of a 500 ml. Florence flask, an asbestos insulated Kjeldahl trap and a Graham type condenser in vertical position to facilitate drainage. A Lumetron 401 Colorimeter with a 420 mu filter is used to measure light transmission of the turbid distillate. A 750 watt electric heater is sufficient for heating. Isopropyl alcohol U.S.P. is used.

*Procedure:* 100 ml. of diluted concentrate and 5 ml. of isopropyl alcohol are measured into the Florence flask. The Kjeldahl trap and condenser are connected and 20 ml. distilled into a 50 ml. graduate cylinder. The distillate is mixed by swirling. Water is added to the 50 ml. mark and mixed by inversion. A proportion of the turbid solution is transferred to a colorimeter tube and the light transmission is measured against a water blank. The transmission readings are converted to oil concentration by using a standardization curve. Fresh steam distilled peel oil, centrifuged and dried with anhydrous sodium sulfate is used to make a standard alcoholic peel oil solution. Increments of this oil solution, built up to a total 5 ml. alcohol volume, are added to 100 ml. of water, distilled and treated as stated above. Light transmissions from this operation are used to prepare the standardization curve.
Discussion

Sample Preparation: The composite sample routinely drawn by the USDA operator was mixed and a 400 gram sample taken for the standard Clevenger (1) determination. From the remainder of the composite sample a 50 ml. volume was pipetted into a 500 ml. graduated cylinder and diluted to 400 ml. with water. A 100 ml. sample of the diluted juice was used to make the quick oil determination. A suitable juice dilution must be picked such that the light transmission of the turbid distillate falls between 50 and 90%.

Comparison of the Two Methods: Figures 1, 2, 3 are plotted as grouped Clevenger means against quick oil percent by weight. Plus and minus one standard deviation is shown for each group mean. The frequency of occurrence is shown for each Clevenger group. The dashed line is the calculated regression line. On an average the quick oil figures read about 60% higher than the Clevenger.

Figure 1, shows the comparison of the season's (all USDA operators inclusive) Clevenger and quick oil values. The regression line slope is 0.35.

Figures 2 and 3 show the comparison of Clevenger and quick oil values where the Clevenger figures are by individual USDA operators “A” and “B”. The regression line slopes are 0.31 and 0.61 in this order. This variation in regression probably indicates a difference in the individual Clevenger operators technique.

Summary

A statistical comparison is made of the standard Clevenger and a turbidimetric quick peel oil determination method used in frozen citrus concentrate. A good correlation between the two methods is shown. The figures of individual Clevenger operators show a variation in correlation.

LITERATURE CITED


THE TASTE OF CITRUS JUICE III. MODIFYING THE pH
BY ION EXCHANGE

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The pH of citrus juice is determined by the relative concentrations of citric acid and citrate salts. The relationship between pH and the free acid to salt ratio is shown in the Figure No. 1. The relationship in citrus juice was determined for approximately two hundred samples of grapefruit juice, five hundred samples of orange juice, fifty samples of tangerine juice and a few samples of calamondin juice. Acid and salt concentrations were determined by the ion exchange method previously reported (1). The relationship in citrate buffers was determined by mixing various volumes of citric acid and trisodium citrate solutions and measuring the pH with a Beckman Model G. The values for two strengths of buffers, bracketing the normal concentration of citrus juice, are shown in the graph. The determinations were repeated with potassium citrate, and ammonium citrate. These salts yielded values identical with those for sodium citrate. Similar relationship was determined by Sinclair (2), using a different method.

The pH of juice can be modified by changing the relative acid to salt concentration by addition or removal of either component. In this way the pH can be either raised or lowered, depending upon nature of the change. Some of the methods that may be used to modify the pH of juice are listed in the following table.

<table>
<thead>
<tr>
<th>To Raise pH</th>
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<tbody>
<tr>
<td>1. Increase salt concentration by addition.</td>
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<tr>
<td>2. Increase salt and decrease acid concentration by neutralization with an alkaline material or by substituting alkali metal cation for hydrogen ion through ion exchange.</td>
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<tr>
<td>3. Reduce the acid concentration, leaving the salt unchanged, by substituting the anion of very weak acid for a portion of the citrate.</td>
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<tr>
<th>To Lower pH</th>
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<tr>
<td>4. Increase the acid concentration by addition.</td>
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