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Bleaching and Dyeing Royal Ann Cherries for Maraschino or Fruit Salad Use

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SUMMARY

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2. Processing of Royal Ann cherries for maraschino and fruit salad purposes is rapidly assuming industrial proportions in the cherry producing sections of the Northwest.

3. Approximately 10,000 barrels or 2,500,000 pounds of cherries were treated in Oregon in 1930.

4. In the past, the industry has suffered serious loss through cracking of the fruit in the bleaching treatment.

5. The action of several bleaching and hardening agents has been studied.

6. For general use sulfur dioxide solutions are recommended for bleaching cherries, but under certain conditions sodium sulfite solutions may be employed.

7. Calcium carbonate (precipitated chalk or whiting) was found superior to hydrated lime as a hardening agent.

8. Hardening and reduction of cracking are aided by small amounts of tannic acid, magnesium sulfate, and calcium sulfate.

9. Maturity is an important factor from the standpoint both of cracking losses and of quality of finished product.

10. Immature fruit cracks in the bleach liquor to a less extent and is more resistant to bruising and similar injury than mature cherries.

11. The effect of various hardening materials and dyeing procedures on the finished cherry is discussed.

Bleaching and Dyeing Royal Ann Cherries for Maraschino or Fruit Salad Use

By

D. E. Bullis and E. H. Wiegand

RECOMMENDATIONS

Harvesting and handling. Fruit picked several days before full ripeness is best suited for bleaching.* There is less color developed in the greener cherries and hence they are more easily bleached. The green fruit remains firmer and is, therefore, less subject to breakage in the processing and, lastly but very important, the less mature cherries are not so susceptible to bruises and similar injuries which cause permanent brown discolorations on the finished product.

Cracked, bruised, scarred, and deformed fruits should be sorted out before barreling.

Fruit picked during damp, cool weather should be allowed to stand for at least twelve hours in a dry place before barreling. This practice will lower the turgidity of the fruit enough to reduce cracking in the bleach.

Bleach solutions. For general use the 1-percent or 1½-percent sulfur dioxide solutions are most satisfactory. The 1½-percent solution is advised for general use. Sodium sulfite solution of 1½-percent sulfur dioxide content may be used if the cherries are to be dyed or preserved in salt brine immediately after bleaching is completed.

Sodium sulfite solutions require a longer time than sulfur dioxide to bleach the color from the cherries.

The sulfur dioxide (SO_2) solutions are prepared by bubbling the compressed gas into water through a lead pipe perforated with small holes and placed in the bottom of the tank. By noting the loss of weight of the gas cylinder the approximate strength can be estimated before the final test is made. This can be done best by measuring the volume of liquid in the tank and computing the weight. Keep the cylinder of SO_2 (sulfur dioxide) on a scale and the loss in weight can be checked very readily.

A 1½-percent sodium sulfite solution may be prepared by adding 25 pounds of anhydrous sodium sulfite to 100 gallons of water. The strength is tested by the same method used for sulfur dioxide solutions.

Testing the bleach solution. After checking the loss in weight in the cylinder so that it approximates the desired strength, the following test should be made to determine accurately the sulfurous acid strength. Take

*For those who determine picking date by the juice density (Ore. Agric. Exp. Sta. Bul. 247) it is suggested that for bleaching, fruit be harvested at a juice density of about 2° Balling below that recommended for fresh-fruit shipment for the same variety.

a 500 c.c. Erlenmeyer flask and add ¼- to ½-inch of water. Then fill a 25 c.c. pipette by suction with standard iodine solution. This should be slightly above the mark. Quickly place the finger tip over the pipette stem before the liquid level drops to the line, then by raising the finger tip very slightly, allow the level of the iodine solution to drop slowly to the point where the *bottom* of curved liquid surface is just even with the mark. Now transfer the pipette to the Erlenmeyer flask and allow the iodine to drain into it. As soon as the iodine has run down, touch the tip of the pipette to the side of the flask to remove the drop on the tip.

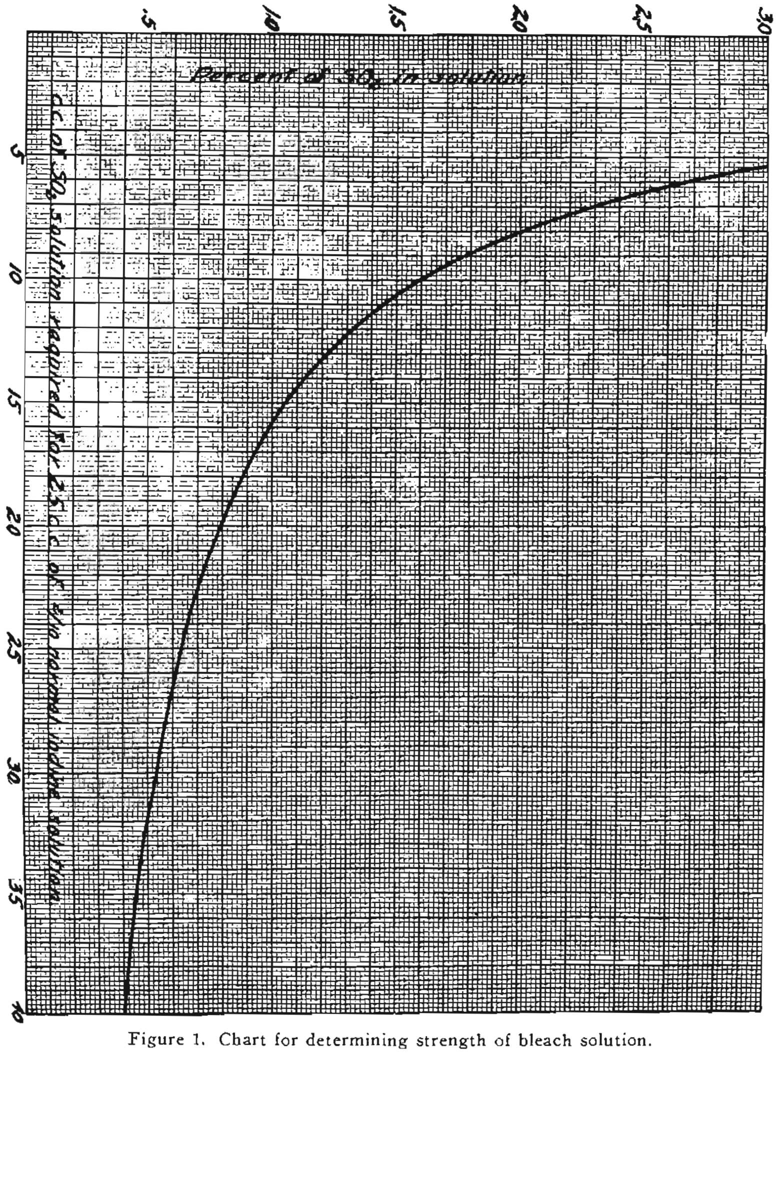

Figure 1. Chart for determining strength of bleach solution.

Next prepare a starch solution as follows: To ½ pint of *cold water* add as much corn-starch as can be heaped on a dime. Place on a hot plate or stove and heat to boiling with *constant stirring* to prevent lumping of the starch. This solution may be kept in a bottle but should be made up fresh every few days as it may mold or become unfit for use if kept too long.

Add to the iodine solution in the flask about ½ teaspoonful of the starch solution. Now fill the 10 c.c. measuring pipette with the bleaching solution and bring the level of the liquid to the zero mark. Then allow the bleaching solution to run slowly from the pipette into the flask containing the iodine solution with occasional rotation of the flask to keep the solution well mixed. As the reaction nears completion the color of the iodine solution becomes purple. At this point add the bleaching solution very slowly and at the point where one drop dispels all color from the iodine solution place the finger tip tightly on the pipette stem to stop the flow and read the volume used, remembering *always to read* to *bottom* of the curved surface of the solution in the pipette.

Now refer to the chart to obtain the strength of the bleach solution. Move your pencil point to the right from zero on the base line of the chart until the number of cubic centimeters (c.c.) of bleach solution used in the test is reached. Then move upward from the bottom of the chart until the curve is met. From this point of intersection move the pencil point horizontally to the left until the edge of the chart is reached. Then read the strength of the bleach solution from the vertical reference line at the left edge of the chart.

For example, suppose that 9.4 c.c. of solution are required to react with 25 c.c. of iodine. It is found that the line from the point on the base representing 9.4 c.c. intersects the curve at the point which corresponds to 1.7 percent strength of bleach. Likewise, where 15.2 c.c. are used, it is found that the strength is 1.05 percent.

When the bleach solution has been made and tested for the proper strength it should be mixed with the other ingredients necessary properly to harden the tissue of the cherry. This can best be done in a separate tank where the hardening materials can be kept agitated while filling the barrels. Unless well stirred, an excess of hardening agents may be added to certain barrels which will prevent the proper action of the sulfur dioxide resulting in bacterial spoilage. If a tank with a capacity slightly greater than the tank for making the sulfur dioxide solution is used, better mixing can be obtained.

Hardening agents. The following tabulation gives a number of formulas which have proved satisfactory in experimental work.

A good grade of commercial hydrated lime is satisfactory.

For the calcium carbonate either precipitated chalk or ordinary whiting are suitable forms to employ because their fineness of subdivision facilitates solution. Whiting is far the cheaper of the two.

With the 1½-percent sodium sulfite bleach solution, one may use 5 pounds of lime or, better, 7½ pounds of calcium carbonate with or without 2½ pounds of magnesium sulfate and 1 pound of tannic acid per 100 gallons. Again it is emphasized that the sodium sulfite combinations are not recommended for general use.

SO₂	Pounds per 100 gallons					Experiment number
	Lime	Calcium carbonate	Tannic acid	Magnesium sulfate	Calcium sulfate	
%						
1	5	....	1	2½	....	17 A
1	....	5	....	....	....	26 A
1	....	7½	....	....	....	27 A
1	....	5	1	2½	....	38 A
1½	7½	....	1	2½	....	18 B
1½	....	7½	2	....	....	36 B
1½	....	7½	1	2½	....	39 B
1½	....	7½	1	....	2½	42 B

Barreling and storage. Containers for bleaching are fir barrels which have been coated with paraffin. The head is removed and the exact amount of cherries is weighed into the barrel. The weight found to be most satisfactory is 240 pounds for the standard 52-gallon barrel. The use of more fruit causes too large an expansion, which brings on cracking of the fruit.

After the solution has been placed on the fruit and the barrel stored away, it should be carefully observed. The barrel should be rolled at intervals of at least once or twice a day to prevent hardening agents settling out on the bottom of the barrel. The spoilage previously mentioned will occur in many instances if this is allowed to take place. Oftentimes only a portion of the barrel may be involved. After a period of ten days the rolling can be discontinued but the barrel should be observed and kept filled with liquid. For the first few days solution should be added to the barrel daily to replace that absorbed by the cherries.

Where cool storage rooms such as basements protected from the heat are available, these can be advantageously used for the storage of the cherries until ready for further handling in the preparation process.

Leaching and dyeing. Fruit should be leached at least twelve hours in running water after pitting and before dyeing. This treatment is necessary to reduce the sulfur dioxide content to a permissible amount and to remove salts which tend to soften the fruit when boiled in the dye solution.

From ½ to 1 pound of baking soda and 1½ ounces of erythrosine dissolved in 12 gallons of water is sufficient for 100 pounds of pitted fruit. The amount of dye may be varied slightly depending on the depth of color desired in the finished product. The color may also be controlled to some extent by the time the fruit remains in the dye solution. To set the dye properly, add about ¼ pound more of citric acid than was used of soda or from ¾ pound to 1¼ pounds per 12 gallons of dye solution. The first sirup should be between 20° and 30° Balling density and should contain about 1½ ounces of citric acid per 100 pounds of sirup. Building up the sirup should take place at the rate of 4°-5° Balling daily. Before adding the flavoring extract the fruit should be drained, rinsed in a light sirup, packed in the desired containers and covered with a sirup of approximately the same density as that of the final "building up" sirup. The amount of flavor added will depend on the type of extract used and must be determined for each extract. Sterilization time is dependent on the size of containers and temperature.

Use of benzoate of soda. Where benzoate of soda is used as a preservative in the manufacture of maraschino cherries, not more than .1 percent by weight should be used. It must be specified on the label as indicated by the pure food law.

Caution. When making up maraschino cherries do not use any container made of iron. Contact of this metal with the fruit causes discoloration. Copper is the metal which is preferable for handling after the fruit is removed from its wooden containers. Glass lined, monel or Alleghany metal vessels also are suitable to use for handling this product.

EXPERIMENTAL

In recent years the cherry-producing districts of Oregon have indicated an increasing interest in the preparation of cherries for maraschino use. During the 1930 season approximately 10,000 barrels or 2½ million pounds of cherries were bleached in Oregon. Some of these were shipped in the bleach solution or in salt brine to eastern concerns for dyeing, but the majority were manufactured into maraschino or fruit salad cherries in this state. This industry deserves encouragement, since it furnishes an outlet for a portion of the Northwest's increasing Royal Ann cherry crop.

Present methods. The accepted method of bleaching cherries in this country is by use of a solution of sulfur dioxide gas in water with or without the addition of a small amount of hydrated lime as a hardening agent. The fruit is allowed to remain in the bleach solution until it is desired to prepare the product for market which may be from three to six months after barreling. The fruit is then leached, pitted, dyed, built up to the proper sugar content, flavored, and sterilized.

The bleaching treatment commonly employed often causes severe cracking of the skins which is detrimental to the appearance of the finished product. The bleach may also soften the fruit to such an extent that it breaks up or becomes "mushy" in the dyeing and sugaring treatment.

Purpose of the present investigation. The present work was undertaken to find out what concentrations of bleach solutions were most suitable and what substances could be added to the bleach which would, to some extent, overcome the cracking and softening of the fruit. To make this information of any value it was also necessary to study the effect of the various hardening agents on the absorption of the dye by the fruit and on the firmness, color, and general appearance of the finished maraschino cherry.

Plan of experiments. Because there was little available information in the literature or elsewhere it was desirable to carry out some preliminary tests on hardening agents before attempting any experimentation on a large scale. For this work 300 pounds of Royal Ann cherries from Yuba City, California, were procured through the generosity of Skinner and Schnabel of that place. These were received May 29—June 3, 1929. Samples were placed in half-gallon glass-top fruit jars to which were added various combinations of hydrated lime, tannic acid, alum, salt, and formaldehyde with 1-percent, 1½-percent or 2-percent solutions of sulfur dioxide (SO_2) as the bleaching reagent. A few combinations containing salt, lime, and alum were bleached with 4-percent SO_2 solutions.

With a month's observations on these lots as a guide, the plan for the work on the 1929 crop of Oregon cherries was outlined as indicated in Table II. Variations of the most promising combinations, together with some new ones, were studied during the 1930 season and are tabulated in Table III. Reference to experiments will be made by numbers as given in these tables.

Materials used. In 1929 solutions of sulfur dioxide (SO_2) and of sodium sulfite were used for bleaching agents. Only sulfur dioxide solutions were used in 1930.

For hardening agents hydrated lime (referred to as "lime" in this Bulletin), calcium sulfate, alum, tannic acid, magnesium sulfate, and calcium carbonate were used both years, proportions being changed somewhat and more extensive tests being made with calcium carbonate combinations during the second season's work.

Erythrosine is extensively used for coloring maraschino-type cherries. It is acid-fast and is therefore more suitable for fruit coloring than acid-soluble dyes. This dye was used exclusively in these experiments.

GENERAL METHODS

Bleaching. Duplicate 2-pound samples of unstemmed fruit were placed in half-gallon glass-top fruit jars. The proper weights of the various salts were added, after which 800 c.c. of the bleach solution was placed in each jar. The rubber and lid were put in place and the wire bail pressed down to seal the jar. For four or five days the jars were thoroughly shaken once daily to mix the contents, after which they were placed on shelves in the laboratory where they remained for about five months.

Examination of the bleached fruit. When opened the liquid was poured into a beaker, the fruit rinsed with water and dried slightly to facilitate detection of skin checks. The cherries were then separated into three lots; (1) perfect fruits, (2) fruits having only fine checks on the skin, and (3) fruits having deep cracks through the skin and into the flesh. The loss in strength of the bleach solution was determined by titrating a sample with standard iodine solution. Since this loss was found to be quite uniform, the test was omitted in the 1930 experiments.

Pitting and leaching. Pitting was done by hand, using the regular pitting spoon made for that purpose. The pitted fruit was then leached for 16 to 24 hours in cold running water to remove bleach solution and salts. Of the 1929 samples only one of each duplicate set was leached, the other being dyed without leaching. All of the 1930 samples were leached. In case samples were not to be dyed immediately after pitting, they were returned to their respective bleach solutions and then leached when wanted for dyeing.

Dyeing. For the 1929 leached samples, 300 gms. of pitted fruit, 500 c.c. of water, 2 gms. of sodium bicarbonate and 0.4 gm. of erythrosine were placed in a beaker, brought to a boil, and simmered for about one-half hour, after which the sample and dye solution were returned to the jar. At 24-hour intervals for the following two days, the fruit and liquid were brought to a boil and returned to the jar. Following the last heating, each jar was treated with 4 gms. of citric acid, stirred or shaken to dissolve the acid and allowed to stand for 48 hours to precipitate or "set" the dye in the fruit.

For the unleached samples, the treatment was the same except that the samples were rinsed well and 5 gms., 8 gms., and 10 gms. respectively of sodium bicarbonate were used for the ¾-percent, 1-percent and 1½-percent sulfur dioxide bleach strengths.

The procedure was altered slightly for the 1930 experiments. Five hundred gms. of pitted fruit, 700 c.c. of water, 5 gms. of sodium bicarbonate and 0.5 gm. of erythrosine were used for all samples and the dye was "set" by adding 10 c.c. of a 50-percent citric acid solution. As noted before, all 1930 samples were leached. One sample of each duplicate set was dyed by the intermittent heating process described for the 1929 leached samples. The other sample of each duplicate was colored by a continuous process in which the sample was simmered in the dye solution for four hours with occasional addition of water to replace that lost by vaporization. The sample was then set aside for 24 hours after which the dye was set in the usual way, allowing 24 to 48 hours for completion of the reaction.

Siruping and flavoring. The building-up process was essentially the same for both years' experiments with the exceptions noted below. All samples were rinsed thoroughly in three changes of warm water to remove as much as possible of the precipitated dye from the pit cavity and surface of the fruit. After draining, the 1929 lots received 500 c.c. of 30° Balling density sugar solution, containing 2 gms. of citric acid. The 1930 samples received 700 c.c. and a similar sugar solution, containing 5 c.c. of a 50-percent citric acid solution.

After bringing to a boil and boiling slowly for 5 to 10 minutes, the fruit and sirup were returned to the jars. At 24-hour intervals the sirup was drained from the fruit, enough sugar added to increase the Balling reading about 5°, brought to a boil and poured back on to the cherries. This treatment was continued until the sirup had attained a density of between 45° and 50° Balling.

The sugar solutions on the 1930 lots which were dyed by the continuous process were built up 3° or 4° Balling twice daily, until the desired sirup density was reached.

After several days the fruit was examined as to color, texture, color of sirup, etc., and then drained, packed in pint jars, covered with a 45° to 50° Balling sirup containing about 0.1 percent citric acid, flavoring added, jars sealed, sterilized, and set aside for future observation. The flavoring used was imitation maraschino flavor, the principal component of which is benzaldehyde.

Explanation of color and texture grades used in Tables IV and V. To simplify tabulation, grades of color and texture have been designated by numbers. For bleached fruit color, 1 indicates a bright yellow, 2 indicates a darker or duller yellow, and 3 indicates undesirable color as brown or gray, caused by excess of some hardening agents. For bleached fruit texture, 1 indicates firm condition, 2 indicates fair firmness and 3 indicates soft or mushy condition.

For dyed fruit color, 1 indicates bright, brilliant color, 2 indicates slightly dull color and 3 indicates "off" colors such as brown or purple. For dyed fruit texture, 1 indicates firm, crisp cherries, 2 indicates fair firmness and tougher condition and 3 indicates a soft undesirable condition.

DISCUSSION OF RESULTS

Condition of fruit. The cherries purchased for the 1929 and 1930 experiments were picked in a slightly less mature condition than is usual for canning or fresh shipment. As will be noted later in the discussion, maturity is quite an important consideration in the loss by cracking during the bleaching process. Owing to rains which occurred a few days previous to picking, the 1930 fruit was rather seriously cracked when received. These rain-cracked fruits were not removed before bleaching and consequently the percentage of cracked cherries in Table V is not due entirely to the bleaching combination used.

Effect of bleaching agents on cracking, texture, and finished product. Experiments 1a, 1b, and 1c of Table IV and 1A and 1B of Table V show quite unmistakably what may be expected from the use of sulfur dioxide solutions in the absence of hardening agents. More than 90 percent of the fruits were badly cracked and only a negligible number remained uninjured.

Although the color was excellent, the cherries had been so softened by the action of the solution that in many cases the flesh fell from the pits. Obviously fruit of such texture is entirely unsuitable to withstand the dyeing and siruping processes.

In experiments 1d, 1e, and 1f where sodium sulfite solutions were used, the injury from cracking was greatly reduced, but here again the fruit was too soft for consideration and the color was only fair. Another serious objection to the use of sodium sulfite solutions, either alone or with hardening agents, is the high incidence of a bacterial spoilage which will be discussed more fully elsewhere in this Bulletin. For this reason sodium sulfite solutions were not used in the 1930 experiments. The penetration of erythrosine dye into the flesh of the fruit was not adversely influenced by either of the bleaching agents.

Effect of hardening agents on cracking, texture, and finished product.

Lime. The addition of hydrated lime to the sulfur dioxide bleach solutions brought about some reduction in the percentage of cracked fruits, but strangely enough, when used with sodium sulfite bleach solutions the cracking was increased over that occurring when no lime was added. The firmness of the fruit was greatly improved by lime, but with the greater applications the desired color of the bleached fruit was greatly impaired by darkening which carried through to detract from the quality of the dyed fruit. The higher amounts of lime also favored bacterial spoilage of fruit in the bleach solution.

Calcium carbonate. In 1930 a series of experiments was prepared in which calcium carbonate was substituted for lime in the sulfur dioxide bleach solutions. It proved to be superior to lime in several respects; there was less cracking, the color of the bleached fruit was better, an excess of calcium carbonate did not darken the fruit as did an excess of lime, and there was less bacterial spoilage. A study of Table V will also show that in many of the combinations replacement of lime by calcium carbonate has resulted in better color and texture and at least as good control of the cracking.

Magnesium sulfate and calcium sulfate. Magnesium sulfate with sulfur dioxide solutions gave good color to the bleached fruit, but was of doubtful value in reduction of cracks or in hardening the cherries. When used with sodium sulfite bleaches, cracking was reduced, and the firmness was very good, but the color of the bleached fruit was only fair.

The action of calcium sulfate in the sulfur dioxide bleaches was very similar to that of magnesium sulfate except that the texture was somewhat better. In the sodium sulfite bleaches, calcium sulfate, like magnesium sulfate, greatly improved the firmness and reduced cracking in approximate proportion to the amount used.

Both sulfates had the property of imparting to the dyed fruit a brilliancy that was lacking in most other combinations. This was especially noticeable in the lots which were not leached before dyeing.

When either of the sulfates was combined with lime in the sulfur dioxide bleach solutions, the percentage of cracked fruits was reduced somewhat and the color and firmness were especially good in the 1930 experiments, 5 to 10, but not quite as satisfactory in the 1929 lots, 32 and 33.

In experiments 29 to 34 (1930), the substitution of calcium carbonate for lime, although not affecting the proportion of cracked fruits, did improve the color and texture of both the bleached and dyed fruit.

Alum. Addition of alum to bleach solutions proved to be of no value. Cracks in the cherries were deep and the fruit was very soft and mushy. In the experiments where lime, calcium carbonate, or other materials were used with alum such beneficial effects as were observed were no greater than had been noted from the use of the other materials alone. Considerable bacterial spoilage was noted in the sodium sulfite and alum combinations.

An example of actual detriment through use of alum may be noted in lot 49B of 1930. The Waterhouse is a variety very resistant to cracking or checking, but here is an instance where checking has been doubled and cracking trebled by adding alum to lime or to calcium carbonate.

Tannic acid. Tannic acid used as a hardening agent with sulfur dioxide bleach solutions prevented cracking to some extent and imparted only fair color and texture to the bleached product. A combination of tannic acid and lime with sulfur dioxide bleaches proved to be one of the best preventives of cracking that was employed. In general, the tannic acid–lime combinations were characterized by extreme firmness of flesh; in fact some breakage and loss were experienced in pitting these lots because of the crispness of the flesh combined with the tendency of the pits to cling to the flesh. However, the poor color which results from use of tannic acid with low strengths of bleach solution or high percentages of lime makes its value questionable. Dull white to gray-blue colored fruits were prominent in these combinations, which absorbed the dye very slowly and when finished were of a purple tint instead of the desired brilliant red. Experiments 21, 22, and 23 of the 1929 work contained many examples of this "off" color. In experiments 14, 15, and 16 in 1930, where less tannic acid was used, the color was better than in the 1929 lots, but was still unsatis-

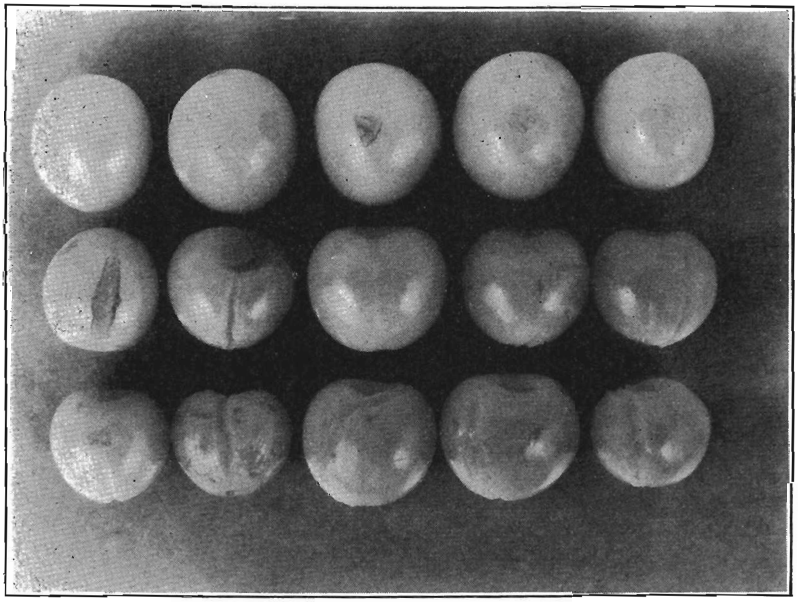

Figure 2. Bleached cherries showing cracking injury. Proper hardening agents prevent much of this loss.

factory. In a number of other combinations (17 to 25 and 38 to 46, 1930) tannic acid was further decreased with very good results. In lots 35, 36, and 37 of the 1930 experiments which contained calcium carbonate in place of lime, the color was very good and "off" color individuals were absent. Cracking was decreased below that observed when tannic acid was absent, texture was excellent without brittleness in most cases, color was very good except in a few samples of high lime content and no "off" colored fruits were found in the dyed product. Here again calcium carbonate was found preferable to lime in the various combinations.

It is probable that the poor color observed in the tannic acid samples containing high lime percentages is due to the ease with which tannins form colored oxidation products, especially in alkaline solutions. The fact that the most of the discoloration generally took place at or near the surface of the bleach liquid favors this explanation.

Citric acid. To provide an acid condition citric acid was used in a number of combinations with sodium sulfite bleach solutions but the poor color, characteristic of most of the sodium sulfite bleach samples, and the soft condition of the fruit in nearly all citric acid lots, indicated it to be of no value.

Relationship of maturity to cracking and color. Very early in these experiments it was noted that small, immature cherries withstood the bleaching treatment better than the large ripe ones. A quantitative measurement of this relationship provided the data for Table I.

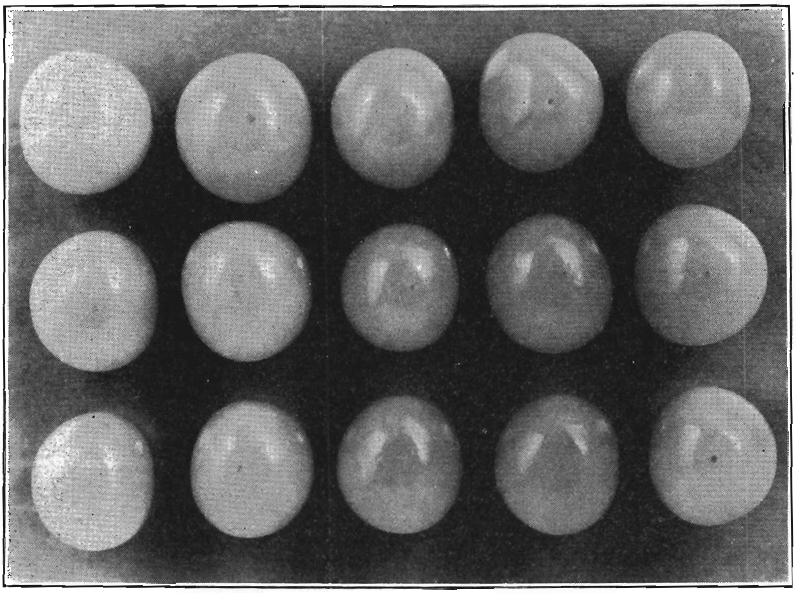

Figure 3. Bleached cherries showing the desired color and freedom from cracks and blemishes.

TABLE I. EFFECT OF MATURITY ON CRACKING AND COLOR OF BLEACHED FRUIT

(a) 1929 Crop

Lot	Number of jars	Whole	Checks	Cracks	Remarks
		%	%	%	
20° Float	3	92	6	2	Greener fruit had better color and texture of flesh. Riper fruit shows brown spots due to bruises and blemishes.
30° Float	6	94	5	1	
40° Float	6	83	11	6	
40° Sink	6	55	32	13	

1 pound fruit, 400 c.c. 1½ % SO_2 solution, 5 gms. lime per jar.

(b) 1930 Crop

Lot	Large fruit				Small fruit				Remarks
	Number of jars	Whole	Checks	Cracks	Number of jars	Whole	Checks	Cracks	
		%	%	%		%	%	%	
20° Float	0	....	....	....	1	92	5	3	Riper fruit darker and more blemished, due to mature condition
30° Float	2	65	23	12	2	74	18	8	
40° Float	2	48	33	19	2	30	29	41	
40° Sink	2	31	42	27	2	25	38	37	

1 pound fruit, 400 c.c. 1½% SO_2 solution, 3 gms. lime per jar.

Cherries were separated according to stage of maturity by placing them successively in 20°, 30°, and 40° salometer salt solutions. The fruit which floated in each solution represented individual cherries of approximately the same ripeness.* In 1930 the fruit was sized into large and small cherries after being graded for maturity. It is quite apparent from a study of Table I that the two greener divisions contained a much lower percentage of cracked fruits and a higher proportion of whole fruits than the two riper fractions. Examination of the bleached fruit also showed that brown spots due to bruises, limb rubs, or wind burn were much more prevalent

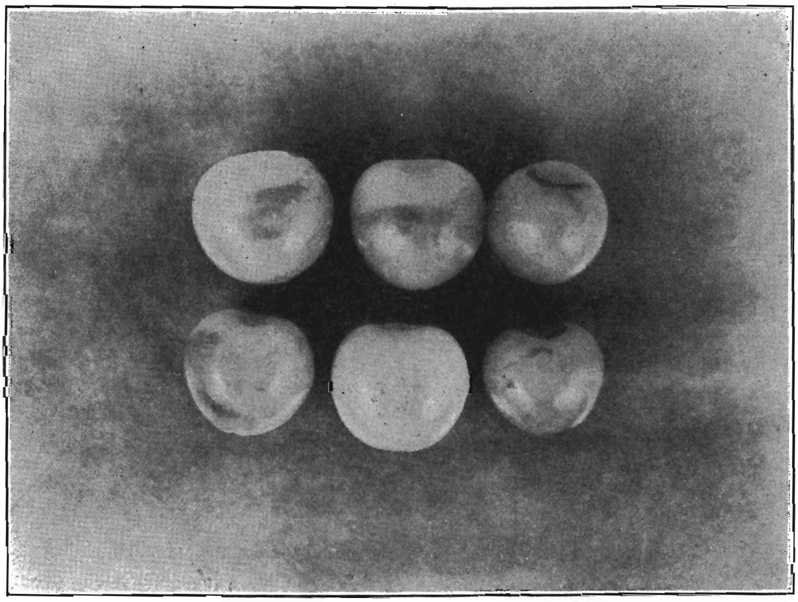

Figure 4. Blemishes common to mature fruit. Bleaching will not remove these.

in the riper fruits. These imperfections detract much from the appearance of the dyed product. From the rather limited observations it may be assumed that cracking is more closely related to stage of ripeness than to size of the fruit.

Other factors affecting cracking. The turgidity of the fruit when placed in the bleach solution determines, to some extent, the cracking loss. Very turgid fruit, such as might be picked during cool, showery weather or in the early morning, can absorb very little water without cracking. For instance, during the 1930 season a commercial plant in Salem experienced excessive cracking on a lot of cherries picked during cool, rainy weather and placed in the bleach immediately upon receipt at the packing plant. Some of the same lot of fruit after standing for several hours on the receiving floor bleached with only a normal cracking loss.

*A more complete discussion of this gravity method of separation may be found in Oregon Agricultural Experiment Station Bulletin 252.

It has been observed that cherries grown under conditions of more sunshine and lower humidity than are normal to the Willamette Valley during cherry season, undergo very little cracking in the bleach, using only lime as a hardening agent. Fruit from The Dalles section has been very resistant to cracking.

It may be presumed that dry winds and sunshine have toughened the skin to the point where cracking is a negligible factor.

Spoilage occurring during the bleaching process. The cracking loss from use of unsuitable bleach or hardening agents has been discussed. A more serious loss may be brought about by bacterial action. Experiments in which sodium sulfite bleach, or low strength sulfur dioxide bleach were employed, or lots to which excessive amounts of lime had been added, were especially susceptible to this type of spoilage. Infection takes place shortly after the fruit is placed in the bleach solution and the focus of infection is at or near the pit. The manner in which the organism gains entrance to the inside of the fruit is not understood, but,probably it is through abrasions of the skin or through the stem end.

At first, gas pockets are formed in the fruit and in the more advanced stages nothing remains of the cherry but a shell containing the pit and filled with gas under some pressure. In case the gas pressure ruptures the skin, the cavity is filled with the bleach liquor. Hydrogen sulfide gas is produced from the sulfites present and in many cases much of the sulfite or sulfur dioxide has been decomposed. Figure 5 illustrates very clearly the characteristic appearance of fruit spoiled by this infection in contrast to bleached cherries in normal condition.

Fortunately, control of this infection is simple and consists primarily in maintaining an excess of sulfur dioxide over that necessary to dissolve the lime added as hardening agent. Once the bleach solution has thoroughly diffused through the fruit, it appears there is no danger of infection. Professor J. E. Simmons of the Bacteriology department, who is studying the morphology and cultural characteristics of this organism, and to whom the authors are indebted for the information concerning it, states that he has been able to culture the organism in fresh or canned cherries, but so far has found it impossible to obtain growth in cherries which have been preserved by bleach solutions.

Decrease in bleach strength. The strength of the bleach liquor covering the fruit becomes lower after standing several months. With one exception this loss is due primarily to diffusion processes and to leakage of the sulfur dioxide gas from the barrels. In the experimental lots stored in half-gallon fruit jars for about six months this decrease in strength was approximately $\frac{1}{4}$ percent in the solutions used (e.g. $1\frac{1}{2}$-percent solutions decreased to $1\frac{1}{4}$ percent, 1-percent solutions to $\frac{3}{4}$ percent, and $\frac{3}{4}$-percent solutions to $\frac{1}{2}$ percent). The exception to this more or less general behavior was observed in jars to which considerable lime was added. Here, no doubt, the sulfur dioxide is precipitated as calcium sulfite by the excess of lime added. It is under such conditions that the greatest damage from bacterial infection takes place.

Shrinkage and pitting losses. Diffusion and shrinkage losses on experimental two-pound samples of Royal Anns kept in bleach solutions for five to six months averaged 8.25 percent for 30 samples. The average loss incurred in stemming and pitting these samples was 12.03 percent or a total loss of 20.28 percent. Two lots of Waterhouse variety underwent an average shrinkage of 3.25 percent and a stemming and pitting loss of 18.10 percent, or a total of 21.35 percent which is quite similar to the total loss for Royal Anns.

Shrinkage and pitting loss for one commercial packer was 24.7 percent in 1929 and 23.5 percent in 1930. These cherries were shipped to New York City after pitting and rebarreling in dilute salt brine. Further shrinkage of approximately 5 percent and 3½ percent respectively for 1929 and 1930 was experienced between the time of rebarreling and the time of receipt in New York City (six to eight weeks).

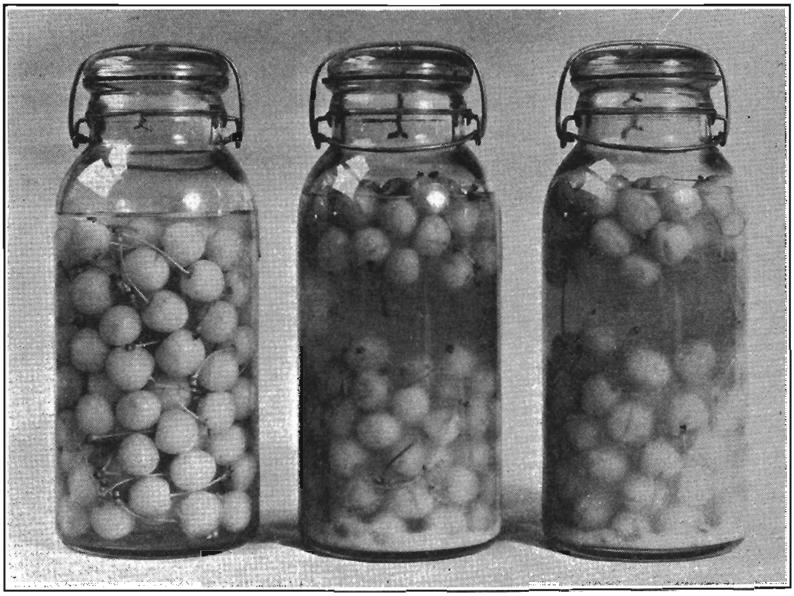

Figure 5. Spoilage resulting from bacterial infection during the bleaching period. The jar at the left is not infected.

EFFECT OF DYEING PROCEDURES ON COLOR AND TEXTURE OF FINISHED PRODUCT

The effect of the various hardening agents on dye absorption has been considered in discussing those materials. The relation of some of the modifications used in the dyeing process to the color and texture of the finished cherry should be mentioned briefly.

Leaching. Observations on the 1929 series indicated that leaching was a very necessary practice. Cherries that have been leached thoroughly withstand the boiling incident to dyeing and siruping much better than fruit which contains the bleach solution and salts. In fact many of the latter samples were badly disintegrated in dyeing. Also there appears to be less tendency for the dye to "bleed" into the sirup if the cherries have been thoroughly leached. After coloring, the unleached samples have a brilliance slightly superior to the leached ones, but this desirable quality is more than discounted by the poorer texture.

Rapid versus slow dyeing and finishing. The 1930 duplicate samples were dyed and siruped by two different methods as outlined earlier in this Bulletin. It was observed that the four-hour continuous boiling used in the rapid process was a severe treatment and in a large percentage of the samples caused softening and wrinkling of the fruit. The final color appeared to be duller than that of corresponding samples dyed by the usual procedure. Building up the sirup twice a day, particularly near the end of the process, did not give enough time between treatments for proper diffusion and consequently excessive wrinkling was experienced. In view of the inferior product obtained by the rapid process it seems inadvisable to recommend it in spite of the time saving effected.

ACKNOWLEDGMENT

The authors wish to thank the following for assistance and information given during the course of this investigation: Professor J. E. Simmons, department of Bacteriology; Skinner and Schnabel, Yuba City, California; H. G. Miller; J. A. Wells; Max Gehlhar; Glen Hogg; The Dalles Cooperative Growers; and Reid, Murdoch and Company.

Appendix

TABLES II-V

TABLE II. OUTLINE OF EXPERIMENTS FOR 1929 CROP

	Sulfurous acid solution equivalent to			Sodium sulfite solution equivalent to		
Treatment	¾% SO_2	1% SO_2	1½% SO_2	¾% SO_2	1% SO_2	1½% SO_2
Check	1 a	1 b	1 c	1 d	1 e	1 f
Magnesium sulfate, 2½ gms.	2 a	2 b	2 c	2 d	2 e	2 f
Magnesium sulfate, 5 gms.	3 a	3 b	3 c	3 d	3 e	3 f
Magnesium sulfate, 10 gms.	4 a	4 b	4 c	4 d	4 e	4 f
Calcium sulfate, 2½ gms.	5 a	5 b	5 c	5 d	5 e	5 f
Calcium sulfate, 5 gms.	6 a	6 b	6 c	6 d	6 e	6 f
Calcium sulfate, 10 gms.	7 a	7 b	7 c	7 d	7 e	7 f
Lime, 2½ gms.	8 a	8 b	8 c	8 d	8 e	8 f
Lime, 5 gms.	9 a	9 b	9 c	9 d	9 e	9 f
Lime, 10 gms.	10 a	10 b	10 c	10 d	10 e	10 f
Alum, 2 gms.	11 a	11 b	11 c	11 d	11 e	11 f
Alum, 2 gms.+lime, 2½ gms.	12 a	12 b	12 c	12 d	12 e	12 f
Alum, 2 gms.+lime, 5 gms.	13 a	13 b	13 c	13 d	13 e	13 f
Alum, 2 gms.+lime, 10 gms.	14 a	14 b	14 c	14 d	14 e	14 f
Alum, 1 gm.	15 a	15 b	15 c			
Alum, 1 gm.+lime, 2½ gms.	16 a	16 b	16 c	16 d	16 e	16 f
Alum, 1 gm.+lime, 5 gms.	17 a	17 b	17 c	17 d	17 e	17 f
Alum, 1 gm.+lime, 10 gms.	18 a	18 b	18 c	18 d	18 e	18 f
Tannic acid, 2 gms.	19 a	19 b	19 c			
Tannic acid, 4 gms.	20 a	20 b	20 c			
Tannic acid, 4 gms.+lime, 2½ gms.	21 a	21 b	21 c			
Tannic acid, 4 gms.+lime, 5 gms.	22 a	22 b	22 c			
Tannic acid, 4 gms.+lime, 10 gms.	23 a	23 b	23 c			
Citric acid, 2 gms.				24 d	24 e	24 f
Citric acid, 1 gm.				25 d	25 e	25 f
Citric acid, 1 gm.+tannic acid, 4 gms.				26 d	26 e	26 f
Citric acid, 1 gm.+alum, 2 gms.				27 d	27 e	27 f
Citric acid, 1 gm.+magnesium sulfate, 2½ gms.				28 d	28 e	28 f
Citric acid, 1 gm.+magnesium sulfate, 5 gms.				29 d	29 e	29 f
Citric acid, 1 gm.+ calcium sulfate, 2½ gms.				30 d	30 e	30 f
Citric acid, 1 gm.+calcium sulfate, 5 gms.				31 d	31 e	31 f
Magnesium sulfate, 2½ gms. +lime, 5 gms.	32 a	32 b	32 c			
Magnesium sulfate, 2½ gms. +lime, 10 gms.	33 a	33 b	33 c			
Calcium carbonate, 2½ gms.				34 d	34 e	34 f
Calcium carbonate, 5 gms.				35 d	35 e	35 f

TABLE III. OUTLINE OF EXPERIMENTS FOR 1930 CROP

Treatment	Sulfurous acid equivalent to 1% SO_2	Sulfurous acid equivalent to 1½% SO_2
Check	1 A	1 B
Lime, 5 gms.	2 A	2 B
Lime, 7½ gms.	3 A	3 B
Lime, 10 gms.	4 A	4 B
Magnesium sulfate, 2½ gms.+lime, 5 gms.	5 A	5 B
Magnesium sulfate, 2½ gms.+lime 7½ gms.	6 A	6 B
Magnesium sulfate, 2½ gms.+lime, 10 gms.	7 A	7 B
Calcium sulfate, 2½ gms.+lime, 5 gms.	8 A	8 A
Calcium sulfate, 2½ gms.+lime, 7½ gms.	9 A	9 B
Calcium sulfate, 2½ gms.+lime, 10 gms.	10 A	10 B
Alum, 2 gms.+lime, 5 gms.	11 A	11 B
Alum, 2 gms.+lime, 7½ gms.	12 A	12 B
Alum, 2 gms.+lime, 10 gms.	13 A	13 B
Tannic acid, 2 gms.+lime, 5 gms.	14 A	14 B
Tannic acid, 2 gms.+lime, 7½ gms.	15 A	15 B
Tannic acid, 2 gms.+lime, 10 gms.	16 A	16 B
Tannic acid, 1 gm.+magnesium sulfate 2½ gms.+lime, 5 gms.	17 A	17 B
Tannic acid, 1 gm.+magnesium sulfate 2½ gms.+lime, 7½ gms.	18 A	18 B
Tannic acid, 1 gm.+magnesium sulfate 2½ gms.+lime, 10 gms.	19 A	19 A
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+lime, 5 gms.	20 A	20 B
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+lime, 7½ gms.	21 A	21 B
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+lime, 10 gms.	22 A	22 B
Tannic acid, 1 gm.+alum, 2 gms.+lime, 5 gms.	23 A	23 B
Tannic acid, 1 gm.+alum, 2 gms.+lime, 7½ gms.	24 A	24 B
Tannic acid, 1 gm.+alum, 2 gms.+lime, 10 gms.	25 A	25 B
Calcium carbonate, 5 gms.	26 A	26 B
Calcium carbonate, 7½ gms.	27 A	27 B
Calcium carbonate, 10 gms.	28 A	28 B
Magnesium sulfate, 2½ gms.+calcium carbonate, 5 gms.	29 A	29 B
Magnesium sulfate, 2½ gms.+calcium carbonate, 7½ gms.	30 A	30 B
Magnesium sulfate, 2½ gms.+calcium carbonate, 10 gms.	31 A	31 B
Calcium sulfate, 2½ gms.+calcium carbonate, 5 gms.	32 A	32 B
Calcium sulfate, 2½ gms.+calcium carbonate, 7½ gms.	33 A	33 B
Calcium sulfate, 2½ gms.+calcium carbonate, 10 gms.	34 A	34 B
Tannic acid, 2 gms.+calcium carbonate, 5 gms.	35 A	35 B
Tannic acid, 2 gms.+calcium carbonate, 7½ gms.	36 A	36 B
Tannic acid, 2 gms.+calcium carbonate, 10 gms.	37 A	37 B
Tannic acid, 1 gm.+magnesium sulfate, 2½ gms.+calcium carbonate 5 gms.	38 A	38 B
Tannic acid, 1 gm.+magnesium sulfate, 2½ gms.+calcium carbonate 7½ gms.	39 A	39 B
Tannic acid, 1 gm.+magnesium sulfate, 2½ gms.+calcium carbonate 10 gms.	40 A	40 B
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+calcium carbonate, 5 gms.	41 A	41 B
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+calcium carbonate, 7½ gms.	42 A	42 B
Tannic acid, 1 gm.+calcium sulfate, 2½ gms.+calcium carbonate, 10 gms.	43 A	43 B
Tannic acid, 1 gm.+alum, 2 gms.+calcium carbonate, 5 gms.	44 A	44 B
Tannic acid, 1 gm.+alum, 2 gms.+calcium carbonate, 7½ gms.	45 A	45 B
Tannic acid, 1 gm.+alum, 2 gms.+calcium carbonate, 10 gms.	46 A	46 B
Lime, 5 gms.		47 B
Calcium carbonate, 5 gms. (Waterhouse cherries)		48 B
Calcium carbonate, 5 gms.+alum, 2gms. (Not in duplicate)		49 B

TABLE IV. 1929 CROP

	Bleached fruit						Dyed fruit					
							Leached			Unleached		
Lot	Whole	Checks	Cracks	Color	Texture	Remarks	Color	Texture	Remarks	Color	Texture	Remarks
	%	%	%									
1a	2	4	94	1	3	Very mushy	*	*		*	*	
b	0	5	95	1	3	Very mushy						
c	2	6	92	1	3	Very mushy				1	1	
d	54	7	39	2	3	1 jar discarded; gas organism spoilage (d, e)						
e	62	9	29	2	3							
f	64	16	20	2	2							
2a	1	34	65	1	2							
b	2	31	67	1	2							
c	2	19	79	1	3							
d	69	10	21	2	1							
e	72	16	12	2	1							
f	67	22	11	2	1							
3a	2	27	71	1	2							
b	0	23	77	1	2							
c	1	13	86	1	3							
d	61	14	25	2	1	1 jar discarded; gas organism decomposition						
e	52	23	25	2	1							
f	74	20	6	2	1							
4a	1	23	76	1	2							
b	1	19	80	1	2							
c	0	12	88	1	3							
d	72	9	19	2	1							
e	53	28	19	2	1							
f	56	30	14	2	1							
5a	2	29	69	1	1		2	1	Clearer sirup than unleached (5a–f)	1	2	More brilliant than leached (5a–e)
b	8	25	67	1	1		2	1		1	2	
c	8	27	65	1	2		2	1		1	2	
d	40	24	36	2	1		1	1		1	1	
e	61	21	18	2	1		2	1		1	1	
f	67	24	9	2	1		1	1				
6a	5	32	63	1	1		2	1	Clearer sirup than unleached (6a–c)	1	2	More brilliant than leached (6a–c)
b	14	33	53	1	1		2	1		1	2	
c	4	20	76	1	2		2	1		1	2	
d	42	20	38	2	1		1	1	Same as unleached (6d–f)	1	1	Same as leached (6d–e)
e	48	25	27	2	1		1	1		1	1	
f	84	14	2	2	1		1	1				

7a	5	31	64	1	1		2	1	Clearer sirup than unleached	1	2	More brilliant than leached
b	5	31	64	1	1		2	1		1	2	
c	5	25	70	1	2		2	1		1	2	
d						Discarded; gas organism decomposition						
e	41	27	32	2	1		2	1				
f	67	19	14	2	1		1	1		1	1	
8a	23	64	13	1	2		1	1	Sirup clearer than unleached	1	1	Color more brilliant than leached
b	15	73	12	1	2		1	1		1	1	
c	13	44	43	1	2		2	1		1	2	
d	27	7	66	2	2							
e	5	7	88	2	2							
f	11	17	72	2	2							
9a	32	55	13	1	1		2	1	Clearer sirup than unleached	1	1	More brilliant than leached
b	36	54	10	1	2		2	1		1	1	
c	26	51	23	1	3		2	1		1	1	
d	15	6	79	2	2							
e	23	9	68	2	2							
f	24	15	61	3	2	1 jar discarded; gas organism spoilage						
10a						Discarded; gas organism spoilage						
b	38	45	17	2	1		2	1		3	1	Brilliant color
c	45	43	12	1	1		1	1		1	1	Brilliant color
d	23	12	65	3	2	Gas organism infection severe						
e	6	7	87	3	2	1 jar discarded; gas organism spoilage						
f	20	19	61	3	2							
11a	0	2	98	1	3		1	3				
b	2	5	93	1	3		1	3				
c	2	6	92	1	3		1	1				
d	39	27	34	2	2							
e	57	19	24	2	2							
f	50	29	21	2	2							
12a	16	39	45	1	2					1	1	Slightly more brilliant than leached
b	25	37	38	1	2		2	1	Less color to sirup than in unleached	1	1	
c	12	28	60	1	2		1	1		1	1	
d	23	2	75	2	2	1 jar discarded; gas organism spoilage						
e	6	4	90	2	2							
f	12	8	80	2	2							

TABLE IV. 1929 CROP (Continued)

	Bleached fruit						Dyed fruit					
							Leached			Unleached		
Lot	Whole	Checks	Cracks	Color	Texture	Remarks	Color	Texture	Remarks	Color	Texture	Remarks
	%	%	%									
13a	42	35	23	1	2		2	1		1	1	
b	43	28	29	1	2		2	1	Sirup clearer than unleached	1	1	More brilliant than leached
c	35	29	36	1	2		1	1		1	1	
d	6	3	91	2	2							
e	8	10	82	2	2							
f	3	5	92	2	2							
14a	62	30	8	1	2		1	1		1	1	
b	57	33	10	1	2		1	1	Sirup clearer than unleached	1	1	
c	52	23	25	1	2		1	1		1	1	
d	13	5	82	2	2	1 jar discarded; gas organism spoilage						
e	17	14	69	2	2							
f	15	15	70	2	2	Gas organism present						
15a	0	5	95	1	3							
b	4	8	88	1	3							
c	2	6	92	1	3							
16a	19	46	35	1	1		1	1		1	1	
b	19	41	40	1	1		1	1	Slightly duller than unleached	1	1	More color in sirup
c	1	16	83	1	1		1	1		1	2	
d	8	2	90	2	2							
e	11	2	87	2	2							
f	6	7	87	2	2							
17a	43	36	21	1	1		1	1		1	1	
b	33	43	24	1	1		1	1	Clearer sirup than unleached	1	1	More brilliant than leached
c	19	43	38	1	1		1	1		1	1	
d	3	2	95	2	2							
e	7	5	88	2	2	1 jar discarded; gas organism spoilage						
f	3	4	93	2	2							
18a	48	25	27	1	1	Slight gas organism infection						
b	27	39	34	1	1		1	1	Clearer sirup than unleached			
c	31	36	33	1	1		1	1		1	1	
d	1	4	95	2	2	Gas organism infection						
e	4	2	94	2	2	1 jar discarded; gas organism spoilage						
f						Discarded; gas organism spoilage						

19a	25	54	21	2	2		2	1				
b	14	58	28	2	2		2	1	Sirup clear			
c	28	33	39	2	2		2	1				
20a	21	56	23	2	2		2	1		2	3	Mushy
b	38	46	16	2	2		2	1				
c	31	50	19	2	2		2	1				
21a	80	19	1	3	1		2	1		2	1	
b	89	11	0	2	1		2	1	Purple color to	2	1	Purple color
c	46	46	8	1	1		2	1	some fruits	2	1	to some fruits
22a	71	21	8	3	1	A little gas organism						
b	81	16	3	3	1	A little gas organism						
c	96	3	1	1	1		2	1		2	1	
23a	69	10	21	3	1	Gas organism infection						
b	89	8	3	3	1	A little gas organism						
c	85	12	3	2	1		2	1		3	1	Brown color
24d	27	33	40	2	3	Cracks extremely soft						
e	24	33	43	2	3	Cracks extremely soft		2				
f	63	25	12	3	3	Cracks extremely soft	1	2				
25d	31	26	43	2	3	Cracks extremely soft						
e	46	26	28	2	3	Cracks extremely soft	1	2				
f	45	36	19	3	2	Cracks extremely soft	1	1				
26d	78	17	5	3	1							
e	76	19	5	3	1							
f	71	28	1	3	1							
27d	38	31	31	2	2		2	2				
e	52	28	20	2	2							
f	69	21	10	2	2		1	1				
28d	51	25	24	2	3		2	1				
e	51	33	16	2	3		2	1				
f	73	24	3	2	3	Cracked fruits extremely	1	1				
29d	49	33	18	2	3	soft	2	1				
e	53	30	17	2	3		1	1				
f	74	20	6	2	3		1	1				
30d	70	19	11	2	2							
e	78	12	10	2	2		2	1		1	1	
f	69	26	5	2	2		2	1		1	1	
31d	71	12	17	2	2		1	1		1	1	
e	78	7	15	2	2					1	1	
f	96	3	1	2	2	Very small cherries	1	1		1	1	
32a	44	41	15	3	2		1	1		1	1	
b	56	33	11	3	2		1	1	Clearer sirup	1	1	More brilliant
c	38	37	25	2	2		1	1	than unleached	1	1	than leached

TABLE IV. 1929 CROP (Continued)

	Bleached fruit						Dyed fruit					
							Leached			Unleached		
Lot	Whole	Checks	Cracks	Color	Texture	Remarks	Color	Texture	Remarks	Color	Texture	Remarks
	%	%	%									
33a	66	20	14	3	2	Gas organism present						
b	68	24	8	3	2		2	1	Sirup clearer	1	1	More brilliant than leached
c	41	47	12	2	2		2	1		1	1	
34d	65	34	1	2	2					1	1	
e	27	64	9	2	2		1	1		2	1	
f	14	65	21	2	2		1	1		1	1	Slightly more brilliant
35d	56	39	5	2	2		2	1	Sirup clearer	2	1	
e	69	25	6	2	2		1	1		1	1	
f	49	47	4	2	2		1	1		1	1	

*Absence of data indicate discard of samples before dyeing because of poor condition or color.

TABLE V. 1930 CROP

	Bleached fruit						Dyed fruit					
							Slow process			Rapid process		
Lot	Whole	Checks	Cracks	Color	Texture	Remarks	Color	Texture	Remarks	Color	Texture	Remarks
	%	%	%									
1A	1	7	92	1	2	No sludge. Discarded; too mushy to dye	*	*		*	*	
B	0	6	94	1	3							
2A	32	35	33	1	1	No sludge	1	2		2	2	More wrinkled
B	22	29	49	1	1	No sludge	1	2		2	2	More wrinkled
3A	42	25	33	1	1	Considerable sludge	1	1		2	2	
B	38	32	30	1	1	Considerable sludge	1	1		1	2	
4A	44	30	26	2	1	Much sludge; trace gas organism	1	1		2	2	
B	39	29	32	1	1		1	1		2	2	
5A	38	31	31	1	1	Trace sludge	2	1		2	2	
B	23	38	39	1	1	No sludge	1	1		2	2	
6A	37	36	27	1	1	Much sludge	1	2		2	2	
B	32	33	35	1	1	Some sludge	1	1		2	1	
7A	49	30	21	2	1	Sludge	2	2		2	2	
B	44	29	27	1	1	Sludge	1	1		2	1	
8A	40	26	34	1	1	No sludge	1	1		2	2	Wrinkled
B	22	43	35	1	1	No sludge	1	1		2	1	Wrinkled
9A	50	22	28	1	1	Much sediment	2	1		2	2	
B	39	34	27	1	1	Some sediment	1	1		2	2	
10A	35	26	39	2	2	Much sediment; gas organism spoilage in 1 jar						
B	41	35	24	1	1	Much sediment	1	1		2	2	Wrinkled
11A	29	21	50	1	2	No sediment	2	1		3	2	
B	37	24	39	1	2	No sediment	2	1		3	2	
12A	29	33	38	1	1	Some sediment	1	2		2	3	
B	34	40	26	1	1	No sediment	1	2		2	3	
13A	60	12	28	1	1	Sediment. 1 jar discarded; gas organism						
B	45	26	29	1	1	Sediment	1	1	Very firm	2	3	Very soft
14A	45	29	26	1	1	No sediment	1	1		2	2	
B	39	26	35	1	1	Little sediment	1	1		2	2	
15A	63	20	17	1, 2	1	Sediment; 1 jar dark colored						
B	56	21	23	1	1	Sediment	2	1		2	1	
16A	49	25	26	3	1	Sediment. Discarded because of dark color						
B	55	24	21	2	1							

TABLE V. 1930 CROP (Continued)

	Bleached fruit						Dyed fruit					
							Slow process			Rapid process		
Lot	Whole	Checks	Cracks	Color	Texture	Remarks	Color	Texture	Remarks	Color	Texture	Remarks
17A	54	29	17	1	1	No sediment	1	1		2	2	
B	40	28	32	1	1	Trace sediment	1	1		2	2	
18A	46	22	32	1	1	Sediment						
B	51	21	28	1	1	No sediment	1	1		2	2	
19A	58	17	25	3	1	Sediment						
B	46	44	10	2	1	Sediment						
20A	39	33	28	1	1	Slight sediment	1	1		2	2	
B	38	40	22	1	1	Slight sediment	1	1		2	2	
21A	46	23	31	2	1	Some sediment						
B	34	37	29	1	1	Trace sediment	2	2		3	2	
22A	39	31	30	3	1	Sediment						
B	41	36	23	2	1	Sediment						
23A	33	38	29	1	1	No sediment	2	2		2	2	
B	25	33	42	1	1	No sediment	2	2		3	2	
24A	65	18	17	1	1	Sediment						
B	40	33	27	1	1	Slight sediment	2	1		2	2	
25A	75	9	16	1	1	Sediment						
B	46	39	15	1	1	Sediment						
26A	50	35	15	1	1	Color exceptionally good. No sediment, checks very small	1	1	Very good color	1	1	Very good color
B	24	50	26	1	1		1	1		1	1	Very good color
27A	63	26	11	1	1		1	1		2	1	
B	40	47	13	1	1		1	1		2	1	
28A	51	33	16	1	1	Trace gas organism infection. Sediment	2	1		2	2	
B	46	34	20	1	1	Exceptional color and firmness. Sediment	2	1		3	1	
29A	50	29	21	1	1	No sediment, exceptionally good color	1	1	Very good	2	1	
B	6	37	57	1	2		1	1	Very good	2	1	
30A	39	41	20	1	1	Little sediment. Color very good	1	1		1	1	
B	40	43	17	1	1	No sediment. Color very good	1	1		1	1	
31A	20	46	34	1	1	Sediment. Color very good	2	1		3	1	Wrinkled
B	42	32	26	1	1	Little sediment	1	1	Very firm	2	2	

32A	49	38	13	1	1	No sediment	1	2		2	3	
B	3	57	40	1	1	Checked over large area. No sediment	1	2		1	2	
33A	19	51	30	1	1	Little sediment	1	1		2	2	
B	25	62	13	1	1	No sediment	1	1		1	1	
34A	25	33	42	1	1	Sediment	2	1		3	1	
B	46	28	26	1	1	Trace sediment	1	1		2	1	
35A	50	32	18	1	1	No sediment	1	2		1	2	
B	29	56	15	1	2	No sediment	1	2		1	2	
36A	53	27	20	1	1	Sediment. Very good color						
B	57	34	9	1	1	No sediment. Very good color	2	1		2	1	
37A	38	30	32	1	1	Sediment						
B	50	31	19	1	1	Little sediment	1	1		2	1	
38A	60	27	13	1	1 }	No sediment. Color very good	1	1 }	Color slightly lighter than rapid process	1	1	
B	38	41	21	1	1 }		1	1 }		1	1	
39A	36	26	38	1	1	Little sediment	1	1		2	1	
B	55	24	21	1	1	No sediment	1	1		1	1	
40A	35	30	35	1	1	Sediment	1	2		2	2	Slight wrinkling
B	40	35	25	1	1	Trace sediment	1	2		2	2	Slight wrinkling
41A	44	29	27	1	1	No sediment	1	1		2	1	
B	34	48	18	1	1	No sediment	1	1		1	1	
42A	32	34	34	2	1	Slight sediment	2	1		2	1	
B	68	23	9	1	1	Trace sediment	1	1		1	1	
43A	54	35	11	3	1	Sediment, some gas organism infection	2	1		2	1	
B	60	31	9	2	1	Sediment	1	1		2	1	
44A	58	32	10	1	1	No sediment	2	2	Tough	2	2	Tough
B	51	37	12	1	1	No sediment	1	1		2	1	
45A	48	28	24	1	1	Trace sediment	1	1		3	2	
B	54	36	10	1	1	No sediment. Very good product	1	1		2	2	
46A	38	32	30	2	1	Some gas organism. Sediment	1	1		2	2	
B	43	41	16	1	1	Trace sediment	1	1		2	2	
47B	94	4	2	1	1 }	Waterhouse variety. No sediment, extremely firm and of excellent color				2	2	
48B	93	5	2	1	1 }		1	1				
49B	84	10	6	1	1 }		1	1				

*Absence of data indicate discard of samples before dyeing because of poor condition or color.