Establishing a Quality Control System

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In recent years, the production and marketing of fresh stone fruits has increased rapidly, but consumption remains low at approximately 5.9 pounds per capita per year for nectarines and peaches, and 1.3 for fresh plums and prunes. Surveys (Bruin, 1991) to explain this low consumption indicate that consumers object to hard fruit and lack of flavor (Table 1). As the volume of shipments is still increasing, greater attention must be given to the production and delivery of high quality stone fruits.

Table 1. Consumer satisfaction with peach purchases.

Consumer complaint	%
Little flavor	30
Too hard	21
Too soft	5
Mealy	13

Preliminary and limited studies associated high soluble solids concentration (SSC) with higher consumer acceptance. Unfortunately, there are more factors involved such as acidity, phenolics, volatiles, etc. in consumer acceptance than just the simple SSC value. Thus, since we do not know enough about consumer acceptance and stone fruit chemical composition during maturation/ripening, we are not able to propose any quality standards. Furthermore, the variability of the SSC among fruit from different orchards and within the tree is so large that it is impossible to set any minimum maturity standard.

The best way to assure high quality produce is by using the right cultivars, training systems, pruning, thinning, good irrigation and fertilization practices, etc., in combination with late harvesting.

It also is essential to evaluate production processes by establishing a quality control system. It will help to identify, segregate and keep records of fruit quality. Also, it will help to evaluate the effect of changes in cultural practices on fruit quality and to identify cultivars with high SSC levels. A correct handling of the information will benefit growers and the California fruit industry's reputation.

Measurement of pH and Titratable Acidity

D. Garner, C.H. Crisosto, P. Wiley, and G.M. Crisosto

I. Materials

A. Required: pH meter or phenolphthalen, burette, burette clamp and stand, gram scale, graduated cylinder, beakers, 0.1N NaOH solution

B. Optional: magnetic stirrer & stir bar, automatic titrator

II. Procedure

A. Obtain at least 50 mls of clear juice by one of the following methods:

1. Cut fruit, press with a hand press, and filter through cheesecloth, or
2. Cut fruit into a blender, homogenize, centrifuge slurry, and pour off clear liquid for analysis.

** Sugar levels often vary within the fruit, being higher at the stem-end and lower at the calyx-end. For this reason, it is important to use longitudinal slices of fruit (from end to end) when sampling.

B. Make sure samples are at room temperature before taking measurements.

C. Measure the pH of the samples with a pH meter and record the value.

D. For each sample, weigh out 6 grams of juice into a 100 ml beaker.

E. To each sample, add 50 mls of water.

F. Titrate each sample with 0.1 N NaOH to an end point of 8.2 (measured with the pH meter or phenolphthalen indicator) and record the milliliters (mls) of NaOH used.

G. Calculate the titratable acidity using the following formula:

$$\% \text{ acid} = \frac{[\text{mls NaOH used}] \times [0.1 \text{ N NaOH}] \times [\text{milliequivalent factor}] \times [100]}{\text{grams of sample}}$$

Commodity	Predominant Acid	Milliequivalent Factor
Stone fruit, apples, kiwifruit	Malic Acid	0.067
Citrus	Citric Acid	0.064
Grapes	Tartaric Acid	0.075

Measurement of Fruit Firmness

D. Garner, C.H. Crisosto, P. Wiley, and G.M. Crisosto

I. Materials

A. Effegi penetrometer or Magness-Taylor pressure tester, either hand-held or mounted on a stand for consistency.

II. Procedure

A. Make sure all fruits tested are comparable in temperature since warm fruits are usually softer than cold fruits.

B. Make 2 puncture tests per fruit, once on each of the opposite cheeks, midway between the stem-end and calyx-end.

C. Remove a disc (about 2 cm in diameter) of the skin with a stainless steel vegetable peeler or sharp knife.

D. Use an appropriate tip (plunger) size for each commodity (5/16" for stone fruit and kiwifruit, D'Anjou pears, Bosc pears, Comice pears, Bartlett pears, and Winter Nellis pears; 7/16" for most apples).

E. All determinations for a given lot should be made by one person to minimize variability.

F. Hold the fruit against a stationary hard surface and force the tip into the fruit at a uniform speed (take 2 seconds).

G. Depth of penetration should be consistent to the inscribed line on the tip.

H. Record reading to the nearest 0.5 lb or 0.25 kg.

1. The unit should be written as poundforce (lbf) or kilogram (kgf) in order to avoid confusion with the units of mass.

III. Maintenance

A. Before use on a given day, work the plunger in and out about 10 times to loosen up the springs inside the instrument.

B. Clean the tips after use to prevent clogging with fruit juice.

IV. Calibration:

A. Hold the firmness tester in a vertical position and place the tip onto the pan of an accurate scale.

1. Press down slowly on the firmness tester until the scale registers a given weight, then read the firmness tester. Repeat this comparison 3 to 5 times. If you find that the instrument is properly calibrated, it is ready to use.

B. If the instrument reading is not in agreement with the scale reading, find out the magnitude and direction of the difference and proceed as follows:

1. Effegi fruit penetrometer:

   a) Unscrew the chrome guide nut to remove the plunger assembly.

   b) To make the instrument read lower, insert washers between the spring and the stationary brass guide.

   c) To make the instrument read higher, insert washers between the chrome guide nut and the stationary brass guide on the plunger shaft.

   d) Reassemble and recheck for calibration.

2. Magness-Taylor Pressure Tester:

   a) Remove the plunger assembly from the barrel of the instrument and remove the bolt and washers from the end of the plunger assembly.

   b) Pull the plunger and spring out of the metal cylinder, then shake the washers out of the cylinder.

   c) To make the instrument read lower, move washers from inside to outside the metal cylinder.

   d) To make the instrument read higher, move washers from outside to inside the metal cylinder.

   e) Reassemble and recheck for calibration.

C. If the indicator needle does not stop or does not release properly, clean the case in the area of the release button, remove the plunger assembly, and then lubricate the inside of the instrument with an aerosol lubricant.

Measurement of Soluble Solids Content

D. Garner, C.H. Crisosto, P. Wiley, and G.M. Crisosto

I. Theory

A. Sugars are the major soluble solids in fruit juice. Other soluble materials include organic and amino acids, soluble pectins, etc. Soluble solids concentration (SSC%, ^{o}Brix) can be determined in a small sample of fruit juice using a hand held refractometer. This instrument measures the refractive index, which indicates how much a light beam is "bent" when it passes through the fruit juice.

B. Temperature of the juice is a very important factor in the accuracy of reading. All materials expand when heated and become less dense. For a sugar solution, the change is about 0.5% sugar for every 10^{o}F. Good quality refractometers have a temperature compensation capability.

II. Materials

A. 0-32% Brix temperature compensating refractometer, distilled water, Kimwipes, 5 or 10% sugar solution.

III. Procedure

A. Extract clear juice from fruit to be sampled.

1. Sugar levels often vary within the fruit, being higher at the stem-end and lower at the calyx-end. For this reason, it is important to use longitudinal slices of fruit (from end to end) when sampling.

B. Place a drop of juice on refractometer prism.

C. Lower cover plate and read.

2. In juice samples with a high starch content, like unripe kiwi, it may be difficult to read the refractometer because the starch settles out on the prism. To remedy this, put your thumb on the cover plate, turn the refractometer upside down, and re-read. This way the starch settles out on the cover plate and does not blur the reading.

D. Rinse prism between samples with distilled water and dry with a soft, lint-free tissue (Kimwipe).

IV. Refractometer maintenance and calibration

A. Clean the instrument after each use with distilled water. Dry with a soft tissue (Kimwipe).

B. Calibrate with a drop of distilled water. Adjust reading to 0 ^{o}Brix if necessary with the small set-screw on the back. Verify accuracy with a drop of 5 or 10% sucrose solution (5 grams sugar in 100 mls of distilled water).

C. Do not submerge the refractometer when cleaning. If water gets into the instrument it will need to be sent out for repair and resealing.

Starch-Iodine Test

D. Garner, C.H. Crisosto, P. Wiley, and G.M. Crisosto

I. Materials required

A. Iodine-potassium iodide solution

1. Dissolve 10 grams (about 1 teaspoon) of potassium iodide crystals in 1 1/8 cups clean water in a 1-quart container.
2. Swirl until crystals dissolve.
3. Add 2.5 grams (about 1/4 teaspoon) iodine and swirl until all iodine dissolves.
4. Dilute the solution with water to make one quart.
5. Protect the solution from light to prevent the chemicals from degrading i.e., put in an opaque container or wrap the container with aluminum foil, or store in a dark cabinet. A fresh solution should be made each season.

II. Procedure

A. Cut the fruit in half at the equator-- midway between and perpendicular to the axis passing through the calyx-end and the stem-end of the apple.

B. Dip one of the cut surfaces in the iodine-potassium iodide solutions and soak for 30 seconds.

C. Rinse for 5 seconds in tap water

D. Evaluate according to the following scale developed for Granny Smith:

0 = 25% of the area within the core line is white, all of the cortex is blue.

1 = 50% of the area within the core line is white, all of the cortex is blue.

2 = 100% of the area within the core line is white, all of the cortex is blue.

3 = 100%of the area within the core line is white, 25% of the cortex area is white (usually patchy).

4 = 100%of the area within the core line is white, 50% of the cortex area is white (usually patchy).

5 = 100%of the area within the core line is white, 75% of the cortex area is white (usually patchy).

6 = 100% of the surface is white.

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