Posthavest Handling

The CCA Cherimoya Handbook

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Introduction

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The challenge facing the grower, packer, distributor, and retailer is how to deliver a high quality fruit which will produce consumer satisfaction.

The development of maturity indexes which can be used to harvest cherimoya fruit needs to be developed. This may require establishing individual standards for specific cultivars.

Once the fruit is harvested, its transportation and storage will be subject to being held at a wide range of temperatures, humidities, and concentrations of ethylene.

Volume movement of fruit will require careful attention to the details of ensuring the arrival of high quality fruit that provides the flavor and taste to insure repeat sales. Consumer dissatisfaction will adversely impact sales and cause market prices to decline.

Maintaining Postharvest Quality of Cherimoya

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A grower can do everything right, but if the postharvest quality of the fruit is not maintained, there will be difficulty in marketing the fruit. Some of the very characteristics that make this fruit so attractive, also make it difficult to handle. So much so that for long distance travel it must be air shipped. The soft, delicate, sweet, fragrant fruit are highly perishable and learning some of their basic physiology will aid in improving storage and shelf life.

Maturity and Ripeness

Maturity is a stage in the cherimoya fruit when it has reached a state of maximum acceptability to the consumer. It will not be ready to eat until it is ripe, however. Ripening occurs after the fruit has been picked or has been knocked to the ground by wind or some other force. As a result, it is not always easy to determine when the best picking time is to obtain the best tasting fruit.

Nonclimacteric fruits like orange or strawberry taste as good as they will ever get at picking.

Cherimoyas, along with such fruits as avocado and banana, are called climacteric (Fig.1). The fruit continues to respire after picking, continuing to convert starch to sugar and increasing in fragrance. The fruit softens and ripens.

The higher the respiration, the faster the fruit softens. In respiring, the fruit gives off heat and carbon dioxide. The heat produced by cherimoyas is large compared to many other fruits. In addition, ethylene is produced which is a gas that accelerates the softening of fruit.

Outside (exogenous) sources of ethylene from other ripening fruit, such as banana can also speed the softening process. Exposure to ethylene (100 ppm for 1-2 days) can ripen mature-green fruit in about 5 days if kept at 15°C (59°F) (Kader & Arpaia).

In the cherimoya, best eating quality is found at maximum sugar content and acidity and this state is typically found at the ethylene peak.

Cherimoyas at room temperature ripen in 6-7 days. The more mature the fruit, the sooner it will ripen off the tree. If left long enough fruit will ripen on the tree.

Figure 1. Respiration and ethylene production in cherimoya after harvest (Kosiyachinda and Young, 1975).

Determining when a cherimoya fruit is ready to harvest is generally done by changes in skin color. Other indicators, such as the appearance of a cream color between segments of the skin and increased surface smoothness of the carpels can also be used. However, these indicators do not always reveal fruit of the utmost eating qualities.

Work done in Japan has shown that later pollinated fruit, and therefore later forming fruit often has a higher sugar content (Nomura et. al., 1997), regardless of fruit appearance. This agrees with work done by Palma et. al.(1993).

Other factors such as pulp firmness and soluble solids have also given erratic results in relation to fruit ripeness (Palma et.al., 1993). As yet, it appears

Respiration and Ethylene Levels After Harvest

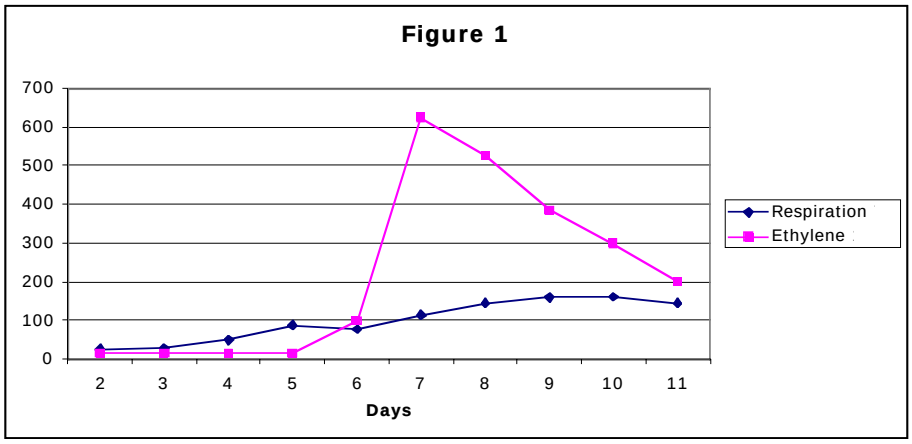

Table 1. 1991/92 Cherimoya sugar content (% Brix).

	Pierce	McPherson	White	Nata	Bays	Fino de Jete	Booth	All Cultivars
Ave. Brix	21.1	20.28	17.92	19.33	18.5	22.94	20.18	20.03
Samples	47	20	39	46	2	9	14	177
Max Value	30	24	22.5	24	19	24.5	24	30
Min Value	15	16.5	15	16	18	22	16	15
Variance	11.97	5.84	3.31	3.81	0.25	0.75	6.02	4.58
Std. Dev.	3.46	2.44	1.82	1.95	0.5	0.86	2.45	1.93

the best indicator of fruit ripeness is still visual inspection.

A key factor that changes with fruit quality is the sugar content. As the fruit matures it increases in sugar content. The sugar concentration can be measured by a refractometer. The unit measures are in Brix which is the concentration of soluble solids in a solution. In the case of cherimoya and most other fruits, sugar is the principal soluble solid.

Different cherimoya varieties vary in sugar content. A three-year study by Emerich (1994) demonstrates this variation.

Table 1 shows this variation in 7 varieties in a sampling from the 1991/92 harvest season. The average sugar content of the 'Fino de Jete' is higher than all the other varieties, but the 'Pierce' had the highest maximum sugar content for a fruit in that year, and this relationship was true for all three years of the study.

Acidity increases as well as sugars as fruit ripens (Palma et. al., 1993). Acidity increases until the second climacteric rise, also coinciding with the highest sugar content and the best eating quality.

As a dessert, fruit quality is most commonly associated with sugar and acidity, but other nutritional aspects are also found in the cherimoya, as can be seen in Table 2.

Table 2. Nutritional components of cherimoya*

Component	Content per 100 gm fruit
calories	94 calories
water	73 grams
sugar	0.02 grams
carbohydrates	18 grams
fats	0.1 grams
proteins	1.30 grams
fiber	2.00 grams
calcium	32 milligrams
phosphorus	37 milligrams
iron	5 milligrams
thiamin	0.1 milligrams
riboflavin	0.1 milligrams
niacin	0.9 milligrams
ascorbic acid	9 milligrams
beta-carotene	18 milligrams

***adapted from Bowes, 1998**

Temperature Effect on Ripening

The higher the fruit temperature, the faster the rate of ripening. In fact through respiration the fruit generates considerable amounts of heat. Heat generation and respiration more than double for fruit held at 10∞C (50°F) versus 20°C (68°F) (Kader & Arpaia, 1999).

This heat generation accelerates ripening , if the heat is not removed. Heat will escape easily if ripening occurs in the open air, but in a confined space without air circulation, fruit temperatures can climb, resulting in blackening of the skin.

Temperature management is necessary if fruit is to be held for a certain amount of time, yet provide the consumer with a desirable piece of fruit. Depending on the cultivar, ripeness stage and duration, fruit can be held at 8-12°C (46-54°F) at 90-95% relative humidity for 5 - 10 days.

Chilling injury - pink, bluish, brown discoloration of the flesh, mealy flesh, failure to develop full flavor or blackening of the skin - can result if temperatures below 8°C are used. The lower the temperature, the shorter the duration the fruit can be held without damage.

In order to optimize storage time, pre-cooling of fruit with forced-air helps. This practice rapidly lowers the fruit temperature to that of the storage temperature and should be done as soon as the fruit is picked. the goal is to slow the rapid respiration phase which begins soon after picking.

Simply placing fruit in a coolroom or refrigerated truck is not a preferred method of cooling. Without the rapid cooling of forced-air, the warm fruit from the field will continue respiring at a rapid rate until the flesh temperature cools to the storage temperature.

Cherimoya fruit responds well to controlled atmosphere storage (CA). The optimum CA storage atmospheres range from 3-5% oxygen and 5-10% CO_2. Fruit can be kept up to 6 weeks at 10°C (50°F) in 5% oxygen and

the ripened at 20*C (68*F) with good flavor. CA storage results in firmer fruit and delayed ripening due to lower respiration and ethylene production. Exposure to <1% oxygen and/or >15% CO_2 can result in development of off-flavors and uneven ripening (Kader & Arpaia, 1999).

Postharvest Management

Cherimoya is a highly perishable fruit. The peel will turn brown a few days after harvest due to natural enzymatic processes. This browning is accelerated by any physical injury or if the fruit is cut or peeled.

In order to present the finest looking fruit to the consumer, care must be shown in avoiding mechanical damage. Smooth skinned varieties, such as 'Booth' and 'Chaffey' tend to damage less than 'Spain' which has more pointed carpels.

Temperature management is another factor to be considered. As with most fruit chilling injury can result when fruit is held too long at suboptimal temperatures.

Chilling injury can be superficial and fruit can ripen normally with short storage periods of near 0°C (32°F). However, from a marketing stand point, this is not recommended. There is still much to be learned about optimum fruit storage, but the guidelines suggested by Kader and Arpaia are the best we have today.

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Field Attention to Reduce Post Harvest Losses

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Important to good fruit is its treatment in the field, i.e., growing a tree and fruit that have good health. The point to look for in good tree health is vigor and one of the first indications of this is that throughout the growing period of the tree there are signs of growth — growing tips. This is often attained by proper soil management. New growing tips mean that new growth is always being put on so that potential sun burn of both tree and fruit can be avoided.

A healthy tree and proper soil moisture at harvest is often indicated when the fruit stem at harvest gives a snap.

More objective means of determining fruit maturity are needed. Typically color and carpel size are now the determinant, and the standards vary with fruit size and variety. Carpels are the fruit segments that are readily apparent when the fruit is split open.

Typically, fruit changes from a shiny to a slightly dull appearance at maturity, from dark green to yellowish green. Carpel size is determined by fruit load on the tree, the more numerous the fruit, the smaller the carpels as well as smaller fruit. One reason for adjusting fruit load is so that carpel size can be an easy measure of fruit maturity.

Cultural practices which affect good fruit quality are irrigation, pruning, thinning and fertilization. Proper irrigation and fertilization will allow for even fruit growth.

Fall irrigation is critical, since this is when the skin is elastic and can harden if the tree is allowed to dry.

The first rain can swell the fruit and cause skin cracking. It is important to keep fruit sizing at an even rate to avoid this problem. Cracking can also be induced by heavy fogs or dews.

Pruning and thinning are important to crop load and fruit size. Overly large fruit or too many fruit per tree can predispose the fruit to disorders, such as cracking and uneven growth that leads to russeting. Fruit ripens from the outside to the inside of the canopy. The fruit needs light to develop color and skin thickness and it is for this reason pruning is important.

Thinning is a practice which removes scarred and misshapen fruit and controls crop load. The aim is to leave about 100 fruit on 5-year old trees and about 200 on 10-year old trees.

Common fruit disorders which can be affected by orchard practices are bruising, russeting and splitting. These blemishes have been rated as the most serious impediment to increasing the popularity of cherimoyas.

Bruising can occur when the fruit is on the tree, at harvest, and during handling or transit. One of the goals of hand pollination and pruning is to assure that fruit is set clear of limbs and other fruit to avoid rubbing.

In windy areas, windbreaks should be considered to reduce wind damage.

At harvest, the rule is "two hands," meaning, the picker should pay full attention to each individual fruit. The fruit should be set into a box as if it were an egg. If you hear a noise in placing the fruit in the box, you have damaged the fruit.

A good picker can pick one-handed and cradle the fruit, two or three in the other arm, but this procedure takes practice. Don't overload the box and stick to one tray depth.

Once in the box, don't let the fruit roll around in the box: "lump, lump, bump, bump."

Once the box is loaded and placed on the flatbed of the truck, watch those speed bumps; slow down.

Unlike avocado and citrus where the stem is cut flush with the fruit, the stem in cherimoya is snapped off just above the union with the fruit. Leaving the fruit stem on the fruit can potentially lead to more bruising since a stem may puncture neighboring fruit. Moreover, it has been found that fruit ripening is delayed by removing the stem.

Russeted Skin

Russeting in cherimoyas is a darkened area that usually appears where the skin is thinnest; on older, more mature fruit; and on parts of the fruit experiencing wind chaffing.

This blemish is actually small cracks in the skin that can eventually lead to fruit splitting under severe conditions. To avoid this problem, reduce exposure to winds that will stress the fruit and ensure even irrigation so that fruit growth is continuous.

Splitting Fruit

Thin-skinned varieties are more susceptible to splitting, but this damage can occur in all varieties. Uneven fruit growth, due to improper irrigation where extremes of wet and dry are often experienced is the cause of fruit splitting in most fruit.

Excessive nitrogen fertilization, especially in the late fall has also been implicated in a number of other fruit species.

We are still looking for the ideal harvesting and transportation methods to reduce damaged fruit at sale. Popenoe related his experiences of searching for fruit in Mexico.

He would pick fruit, pack it in straw, put it on a flat car and send it to the West Indies Garden in Altadena. The train would stop at every whistle stop on the way to Altadena; but despite this treatment, the fruit still arrived in an acceptable condition.

We have lost something today with our modern refrigeration methods. We need to recreate the natural environment of low ethylene and open coolers that gives the best shelf life to our short-lived fruit.