'Avonblue', 'Sharpblue', 'Delite', and 'Tifblue' (Table 1). On the basis of these data, 'Beckyblue' and 'Woodard', were the better rooting cultivars in the CO_2 and IBA treatments, but 'Tifblue' and 'Sharpblue' rooted as well as 'Woodard' without IBA and CO_2. Thus, the physiological state and genetic make-up influence rooting of rabbiteye blueberry cultivars and data sets from several years and different locales are needed to distinguish further among cultivars.

There were no differences among treatments, nor among cultivars in survival of rooted cuttings in the nursery. Survival of cuttings in the nursery was 86%, across all treatments.

Literature Cited

1. Hartmann, H. T. and D. E. Kester. 1975. Plant propagation: principles and practices. Prentice Hall, Englewood Cliffs, N.J. 662 pp.
2. Kossuth, S. V., R. H. Biggs, P. G. Webb, and K. M. Portier. 1981. Rapid propagation techniques for fruit crops. Proc. Fla. State Hort. Soc. 94:323-328.
3. Lyrene, P. M. 1981. Juvenility and production of fast-rooting cuttings from blueberry shoot cultures. J. Amer. Soc. Hort. Sci. 106:396-398.

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PRESERVATION OF TROPICAL FRUITS BY DRYING

B. A. Campbell and C. W. Campbell
15301 S.W. 269 Terrace,
Homestead, Florida 33032

Additional index words. ambarella, apple banana, carambola, guava, horse banana, longan, loquat, lychee, mamey sapote, mango, papaya, purple mombin, tamarind.

Abstract. **Tropical fruits can be processed successfully by drying. A small electric dehydrator is practical and convenient for processing fruit grown in the home garden in South Florida. Pre-treatment of fruit has certain advantages but all the species tried can be dried successfully without it. The dried fruit should be stored in a refrigerator or freezer if kept for more than a few days when the temperature and relative humidity are high. Information is given on ambarella, apple banana, carambola, guava, horse banana, longan, loquat, lychee, mamey sapote, mango, papaya, purple mombin and tamarind. Dried tropical fruits make a delicious snack and drying is a good way to use and preserve small amounts of excess dooryard fruit.**

Home gardeners in South Florida have become increasingly interested in drying the tropical fruits they grow in their gardens. A solar drier can be used (5), but this type of dryer is somewhat large and difficult to store when not in use. Also, constant watch much be kept on the dryer during the drying time because of the possibility of heavy rains or other severe weather conditions (many of our fruits ripen during the rainy season) and there is usually no area in the home where the drying trays can be stored overnight where the humidity is low and insects cannot invade the trays. These problems make a solar dryer undesirable for many home gardeners.

A small electric food dehydrator is practical for home use. This paper describes our experience in drying of a variety of tropical fruits.

Procedure

All fruit was dried in a Waring Electric Food Dehydrator except for the fruit leathers which were processed in the oven of an electric stove. The dehydrator consisted of a round base unit, 5 round perforated trays with a center hole and a domed, plastic cover. When the dehydrator is plugged in, air is drawn into the intake of the base unit, heated and blown into the drying chamber by means of a fan. The air is circulated through the drying chamber and the moisture laden air rises to the top and is exhausted through the vents in the cover. The machine is designed to maintain a temperature of 140°F. The tropical fruit species used are listed in Table 1.

Fruit was harvested when fully mature and ripened at room temperature, if necessary. All bruised and decayed portions were removed at the time of preparation for drying. Each kind of fruit was prepared in one or more of the following ways. 1) Fruit was left whole (lychee, longan, tamarind, purple mombin). 2) Fruit was cleaned, pitted, and cut in half (loquat) or sliced (guava, carambola, purple mombin). 3) Fruit was peeled and sliced (apple banana, horse banana). 4) Fruit was peeled, pitted and sliced (mamey sapote, mango, ambarella). 5) Fruit was pitted and cubed and placed in a blender and chopped to form a puree (carambola). 6) Fruit was peeled, pitted and cubed, placed in a blender and chopped to form a puree (mango, mamey sapote, loquat, and ambarella). 7) Fruit was peeled, soaked in water and put through a colander to extract the pulp (tamarind).

After the fruit was prepared by methods 1, 2, 3, or 4, it was placed on the shelves of the pre-heated dehydrator and dried until leathery. In methods 5, 6, and 7 the pulp was poured onto a cookie sheet lined with plastic wrap and placed in the oven with the temperature set on "warm" (3) and left until the pulp could be peeled from the plastic wrap. The oven was used because it would process a large cookie sheet of pulp while the dehydrator would only make small sheets with a hold in the middle. The dehydrator shelves had to be covered with plastic wrap and a hole left in the middle for ventilation, if used for leather making.

Results

Evaluations were obtained from individuals and groups of various sizes who were invited to taste the dried fruits. In general, the dried tropical fruit that was processed was all of fair to excellent quality. Ratings differed somewhat according to the personal tastes of the evaluators.

Table 1 lists the methods used to prepare each fruit, the approximate drying times, evaluation of the product and method of drying. The drying times are only approximations because they vary according to ambient temperature and atmospheric humidity and the relative amount of moisture in the fruit. Drying time must be determined by the appearance and texture of the fruit.

Discussion

Many tropical fruits that are grown in home gardens in South Florida can be dried and preserved successfully at home. Solar drying is a satisfactory and economical method in a hot dry climate. In a hot rainy climate, such as ours in

Table 1. Evaluation of drying methods for tropical fruits.

Fruit Name: Common	Fruit Name: Scientific	How prep[z]	Approx. drying time (hr)	Evaluation of product	Equipment
Ambarella	*Spondias cytherea* Sonn.	4 6	8-10 24	Excellent flavor, texture, color Excellent flavor, texture, color	Dehydrator oven
Apple banana	*Musa* x Apple	3	6-12	Excellent color, texture, flavor	Dehydrator
Carambola	*Averrhoa carambola* L.	2 5	10-12 24	Excellent color, texture, flavor Excellent color, texture, flavor	Dehydrator oven
Guava	*Psidium guajava* L.	2 6	5-6 24	Good flavor but poor texture Poor	Dehydrator oven
Horse banana	*Musa* x Orinoco	3	6-8	Excellent color, texture, flavor	Dehydrator
Longan	*Euphoria longana* Lam.	1	24	Good flavor and texture	Dehydrator
Loquat	*Eriobotrya japonica* Lindl.	2	12-14	Tart but good. Poor color	Dehydrator
Lychee	*Litchi chinensis* Sonn.	1	24	Good flavor & texture	Dehydrator
Mamey sapote	*Calocarpum sapota* (Jacq.) Merr.	4 6	8-10 24	Excellent color, flavor, texture Poor	Dehydrator oven
Mango	*Mangifera indica* L.	4 6	8-10 24	Excellent flavor, texture, color Excellent flavor, texture, color	Dehydrator oven
Papaya	*Carica papaya* L.	4	8-10	Excellent color & texture; flavor strong	Dehydrator
Purple mombin	*Spondias purpurea* L.	1 4	24 5-6	Poor flavor, texture, color Good flavor, texture, color	Dehydrator oven
Tamarind	*Tamarindus indica* L.	1 7	8-10 24	Excellent color, texture, flavor Excellent color, texture, flavor	Dehydrator oven

[z]Numbers correspond to methods in the text.

South Florida, a solar drier is not as convenient. Heavy rains, overnight storage of partially dried fruit (drying may take several days) (4) and insect damage to the fruit are problems. These problems can be solved (1) but when they are added to the necessity of watching the drying fruit so that it can be taken inside in case of heavy rains or severe winds and finding proper storage for the dryer they make solar drying of fruit too inconvenient for many home gardeners.

In the South Florida climate a small electrical food dehydrator makes drying simple and convenient. The oven of the household electric or gas stove can be used also but this is not as satisfactory as a home-built or commercial electric dehydrator.

Many methods of pre-treatment are recommended for fruit (1, 3). These methods prevent darkening, help preserve the vitamins A and C that are present in the fruit, shorten drying time and lengthen storage time (3). They include treatment with burning sulfur, dipping in a lye solution, dipping in salt solution, dipping in ascorbic acid solution, dipping in sodium bisulfite solution (6) and blanching by steam or in sugar syrup.

A few pre-treatments were tried before it was decided not to use any. The treatments were too much trouble for small amounts of fruit and in most cases did not improve the flavor or appearance significantly. Loquats became quite dark when dried without pre-treatment but this did not seem undesirable to most people and the fruit tasted good. Bananas darkened slightly but not enough to be objectionable and flavor was not significantly affected. Dipping the banana slices in lime juice preserved their color but gave the fruit a lime flavor. Dipping the loquat in lime juice had little effect on browning but did change the flavor slightly. Steam blanching prevented darkening in the loquat but increased drying time and was a lot of trouble. Sugar syrup blanching of papaya and loquat improved the flavor, texture and color of the fruit but increased drying time, added sugar and was time-consuming.

Most tropical fruit can be dried without any pre-treatment although some darkening may occur. For those who do not want to add chemicals to their food, drying without pre-treatment can be important. This shortens preparation time and is an advantage to a housewife with limited time to spend.

The Waring Food Dehydrator that was used to dry the fruit had a fixed temperature of 140°F which worked very well. Some food dehydrators have a temperature control which allows a range of temperatures to be used. This could be an advantage with some fruits. When the leather was made in the oven the temperature was set at the lowest setting (2). This is probably a little warmer than 140°F and is not as desirable because of color and flavor changes at higher temperatures.

Under hot and humid conditions dried fruit can be stored in the refrigerator for 6-8 months or for longer periods in the freezer. Storage at room temperature is not practical because even fruit stored in tightly closed containers will absorb moisture from the air and become moldy.

The banana, mango, mamey sapote, loquat and carambola were especially good when dried. The other fruits tested were acceptable to most people. More work needs to be done with the purple mombin, which received poor ratings in our tests, because acceptable dried products are made from this fruit in some other countries, such as Mexico.

Dried fruit makes an excellent nutritive snack without the addition of salt or sugar. Drying offers a simple way to preserve tropical fruit from the home garden.

Literature Cited

1. Coleman, R. L., C. J. Wagner, Jr., and R. E. Berry. 1980. Solar drying mango slices and mechanically deseeded muscadine grapes. Proc. Fla. State Hort. Soc. 93:334-336.

2. Croux, Irene. 1976. Oven drying, the best way to preserve foods. Sheed, Andrews and McNeel, Inc., Kansas City, MO.
3. Miller, M. W., F. H. Winter, and G. K. York. 1977. Drying food at home. U.S. Dept. Agr. Home and Garden Bul. No. 217.
4. Wagner, C. J., Jr., W. L. Bryan, and R. E. Berry. 1977. Preliminary solar drying studies of some Florida fruits and vegetables. Proc. Fla. State Hort. Soc. 90:158-161.
5. Wagner, C. J., Jr., R. L. Coleman, and R. E. Berry. 1979. A low-cost, small-scale solar dryer for Florida fruits and vegtables. Proc. Fla. State Hort. Soc. 92:180-183.
6. Wagner, C. J., Jr., R. L. Coleman, W. L. Bryan, and R. E. Berry. 1978. Preliminary studies on SO_2 absorption in mangos, nectarines, and peaches prepared for drying. Proc. Fla. State Hort. Soc. 91:117-119.

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CONDITIONING 'TAHITI' LIMES TO REDUCE CHILLING INJURY

DONALD H. SPALDING AND WILLIAM F. REEDER
U. S. Department of Agriculture,
Agricultural Research Service,
Subtropical Horticulture Research Station,
13601 Old Cutler Road,
Miami, FL 33158

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Abstract. **'Tahiti' ('Persian') limes (**Citrus latifolia **Tan.), conditioned by holding for 1 wk at 45, 50, 55, 60, or 70°F prior to storage for 2 wk at 35°F, developed less chilling injury than nonconditioned limes. Color was still acceptable in conditioned and nonconditioned limes at the end of the 3-wk-test period, but decay development at 60 and 70°F was severe in nonconditioned limes chilled at 35°F. The percentage of acceptable fruit was 91% in conditioned, but only 32% in nonconditioned limes. Limes conditioned by exposure to 30 or 40% CO_2 for 1 day at 70°F developed more rind injury during chilling than nonconditioned limes.**

Chilling injury (CI) is a time and temperature dependent problem which can seriously affect the marketability of 'Tahiti' limes held too long at 45°F and below (3). Chilling injury appears in the rind as small pitted areas or, in more serious cases, as brown, sunken areas of various sizes and shapes arising from the coalescense of small areas of injury. Development of a method to condition limes to withstand storage at chilling temperatures would be most useful for extension of normal shelf life, retention of green color, and protection against the harboring of unwanted pests. Various methods, such as prestorage treatment with CO_2 or holding at a given temperature, have been extensively investigated for curing or conditioning grapefruit by Hatton and Cubbedge (1, 2). Early workers had noted that holding early season grapefruit for 3 days at 70°F reduced subsequent rind breakdown at refrigerated temperatures (3). Based on these clues, Hatton and Cubbedge (2) developed a method of conditioning grapefruit at 50 or 60°F for 1 wk prior to low temperature storage. Our objectives were to study how similar conditioning methods affect the development of CI in limes.

Materials and Methods

Washed and waxed limes were obtained on the day of picking from a commercial packinghouse in Dade County, Florida. Size 54 limes (54 limes/10-lb. flat) were used for all treatments. The limes were returned to the laboratory and those free of decay and blemishes were sorted by color into similar samples of 50 limes for each treatment. Rind color of limes was measured by comparison with color plates specially prepared to simulate the range of lime colors and having numerical ratings in which, for example, 6.53 is dark green and 1.00 is yellow (4). All limes selected met or exceeded the minimum color index of 3.18 (corresponding to USDA, PL-2, lower limit "mixed" used by federal inspectors), and met or exceeded all standards for U.S. No. 1 grade (6). Limes for each treatment were repacked in 10-lb. flats, with or without 1.5 mil polyethylene liners, the tops of which were folded over before the top of the flat was replaced.

In the first test, limes conditioned for 1 wk at 50°F before chilling were compared with nonconditioned limes packed in flats, with and without 1.5-mil polyethylene liners, and chilled at 35 or 40°F for 2 wk. The nonconditioned limes were held for 1 wk at 50°F after chilling to provide comparable postharvest temperature exposure for all treatments. Limes were then examined for color, decay and CI.

In the second test, polyethylene liners were used in all flats. Limes were conditioned by holding them at 45, 50, 55, 60 or 70°F for 1 wk prior to chilling for 2 wk at 35°F. Nonconditioned control limes were first chilled at 35°F for 2 wk, and then held at 45, 50, 55, 60 or 70°F. After storage, all limes were rated for color, decay and CI. Acceptable fruit met the minimum color standard, were free of decay and had no more than a trace of CI.

In the third test, limes were conditioned for 1 day at 70°F in an atmosphere of 30 or 40% carbon dioxide, maintained by "flow-through" mixtures of CO_2, O_2 and air as described by Hatton and Cubbedge (1, 2), prior to chilling in normal air for 2 wk at 35°F. Nonconditioned control limes were held in .03% CO_2 (normal air) for 1 day at 70°F prior to chilling with the conditioned limes. Fruit were then examined for CI.

Chilling injury was rated on the basis of rind symptoms using the following scale: O = none; 1 = trace (occasional spot, barely noticeable); 2 = slight (several small brown sunken areas or a single confluent area up to 1/2 inch in diameter; lime considered saleable); 3 = moderate (2 to 3 brown, sunken, confluent areas 1/4 to 1/2-inch in diameter or 1 area 1/2 to 3/4-inch in diameter or sufficient small areas (less than 1/4-inch in diameter) to produce an unsaleable appearance); and 4 = severe (2 areas over 1/2-inch in diameter or more than 3 areas 1/4 to 1/2-inch in diameter or 1 area over 3/4-inch in diameter).

Results and Discussion

Limes conditioned for 1 wk at 50°F developed less CI than nonconditioned limes held under comparable conditions (Table 1). Differences in CI were most apparent in limes stored at 35°F, since only slight CI developed in limes held at 40°F for 2 wk. No decay or color differences were noted during the period of this test (data not shown).