Market Quality and Precooling Rates of Strawberries Packed in Various Containers

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Contents

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Summary

Strawberries shipped by air from California to eastern markets averaged 3.5- and 9.6-percent cutting damage, respectively, when packed in paper-pulp and plastic-mesh baskets. Overall damage (cutting plus bruising) on arrival averaged 13.6 percent in the pulp and 18.2 percent in the plastic baskets.

Half-cooling times for palletized loads of berries packed in fiberboard trays with plastic baskets averaged about 2 hours in an ordinary room precooler and 30 minutes in a forced-air precooler. Berries packed in plastic-mesh trays cooled almost twice as fast as those in fiberboard trays in an ordinary room precooler. Berries in plastic baskets cooled about 20 percent faster than those in pulp baskets in an ordinary room precooler. Cooling rates for the fruit in both types of basket were almost identical in a forced-air precooler.

Background

California strawberries are normally packed in fiberboard trays, with twelve 1-pint plastic-mesh baskets fitted into each tray. The trays of berries are then palletized and shipped to market.

Berry cutting and bruising is a major problem in air shipments to eastern markets. Although these defects usually do not make the fruit unsalable, they do detract from the general appearance and lower the quality of the berries at wholesale and retail markets. In tests conducted in 1967, cutting and bruising averaged as high as 19 percent in berries sent by air from California to the east coast.[1]

Proper precooling before air shipments of strawberries is necessary to maintain quality. Previous tests have shown that berries precooled to about 35° F. before shipment arrived in better condition and with less decay than berries only partially precooled or not precooled before shipment.[2]

This study was designed to (1) measure the amount of cutting and bruising in strawberries shipped in two types of pint baskets and (2) measure the precooling rates of strawberries in various containers and in two types of room precoolers.

Methods

Six test shipments were made from Salinas or Watsonville, Calif., to New York, N.Y., to compare the quality of strawberries packed in paper-pulp and plastic-mesh baskets. Berries were packed in both types of basket in the field and were shipped in the same pallet loads to assure similar handling. Test trays of fruit were placed

[1] Harris, C M., Porter, F. M., and Harvey, J. M. freight shipment of california strawberries in mechanically refrigerated rail cars. U.S. Dept. Agr. ARS 51–21, 10 pp., illus. 1967.

[2] Harvey, J. M., Couey, H. M., Harris, C. M., and Porter, F. M. air transport of california strawberries: factors affecting market quality in summer shipments—1965. U.S. Dept. Agr. Mktg. Res. Rpt. 751, 12 pp., illus. 1966.

in the top, middle, and bottom layers of the pallets. These trays were recovered at the wholesale market in New York City. The fruit was rated for amount of cuts, bruises, and decay on arrival and after holding for 1 day at 60° F.

Three tests were made to compare cooling rates of berries in various containers and in two types of room precoolers. In all tests entire pallet loads of berries were packed in each type of container tested. The pallets were then placed in adjacent positions in the room precooler.

The first comparison was made with berries packed in fiberboard trays and plastic-mesh trays. Plastic-mesh baskets were used in both types of tray. Cooling rates for these pallets were measured in an ordinary room precooler.

Two other tests were made comparing berries packed in plastic-mesh and paper-pulp baskets. Both types of basket were held in fiberboard trays. One test was made in an ordinary room precooler and the other in a forced-air precooler. The latter forces cold air through the pallet loads of fruit and thus increases cooling efficiency.[3] [4]

In all tests the fruit temperatures were measured with thermocouple cables attached to a temperature-indicating potentiometer. Measurements were made in the bottom, middle, and top layers of 72-tray pallet loads (12 trays high). Measurements in each layer were made at the side where air entered the pallet, in the center of the pallet, and where air left the pallet. The temperature of fruit near the center of the tray was measured in each of the nine trays located in the above positions.

Berry temperatures and ambient air temperatures were recorded at 15-minute intervals in the forced-air precooler and at 30-minute intervals in the room precooler.

Half-cooling times were calculated from these measurements for all the cooling tests. The half-cooling time is the time required to reduce the temperature difference (strawberry temperature minus room air temperature) by one-half.

[3] GUILLOU, RENE. COOLERS FOR FRUITS AND VEGETABLES. Calif. Agr. Expt. Sta. Bul. 773, 65 pp., illus. 1960.

[4] MITCHELL, F. G., MAXIE, E. C., and GREATHEAD, A. S. HANDLING STRAWBERRIES FOR FRESH MARKET. Calif. Agr. Expt. Sta. Cir. 527, 15 pp., illus. 1964.

Results

Shipping Tests

Berries shipped in paper-pulp baskets had about one-third as many cuts as berries shipped in plastic-mesh baskets (table 1). Bruises, however, were slightly greater in berries shipped in pulp baskets. These berries had significantly less overall mechanical damage (cuts plus bruises) than berries in plastic baskets. There was no significant difference in decay of strawberries shipped in the two types of baskets.

TABLE 1.—*Cuts, bruises, and decay of strawberries shipped by air from California to eastern markets in paper-pulp and plastic-mesh baskets*

Time of examination and type of container	Cuts [1]	Bruises [2]	Cuts plus bruises	Decay
On arrival:	*Percent*	*Percent*	*Percent*	*Percent*
Pulp	[3] 3.5	[3] 10.1	[3] 13.6	1.7
Plastic	9.6	8.6	18.2	1.9
After holding 1 day at 60° F.:				
Pulp	[3] 3.3	[3] 12.5	[3] 15.8	4.7
Plastic	9.8	11.5	21.3	4.5

[1] Berries with less than ¼-inch-long cuts were not included.

[2] Berries with less than ¼-inch-diameter total area of bruises were not included.

[3] Differences in amount of cuts and bruises in pulp and plastic baskets were significant at 1-percent level at both examinations.

Precooling Tests

In an ordinary room precooler, the cooling rate of berries in plastic-mesh trays was almost twice as fast as that of berries in fiberboard trays (fig. 1). The half-cooling times for berries in plastic and fiberboard trays were 80 and 140 minutes, respectively (fig. 2).

After 4 hours of precooling, temperatures within the pallet load of berries packed in fiberboard trays ranged from 41° to 48° F. (fig. 3), whereas temperatures of berries packed in plastic trays ranged from 39 to 40.5 (fig. 4). Fruit in

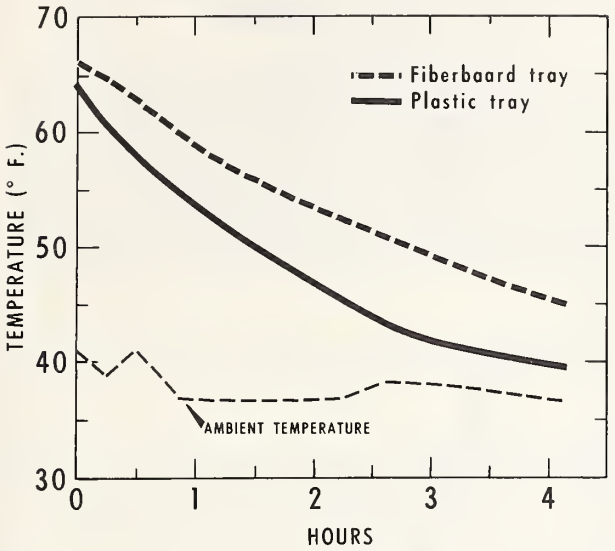

FIGURE 1.—Cooling rates in ordinary room precooler of strawberries in fiberboard and plastic trays with plastic baskets.

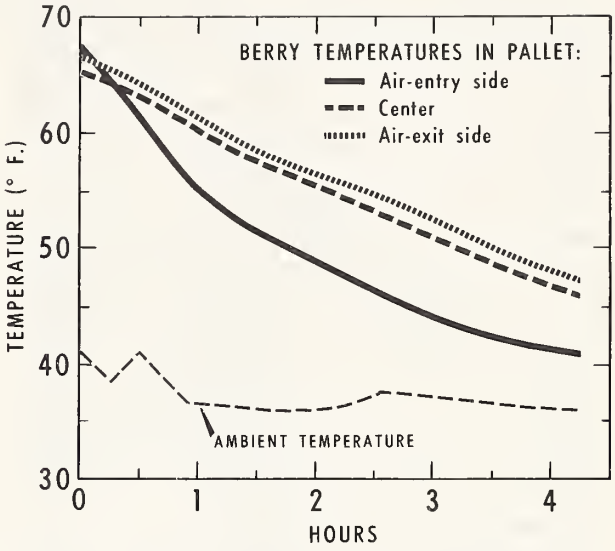

FIGURE 3.—Cooling rates in ordinary room precooler at different locations in pallets of strawberries packed in fiberboard trays with plastic baskets.

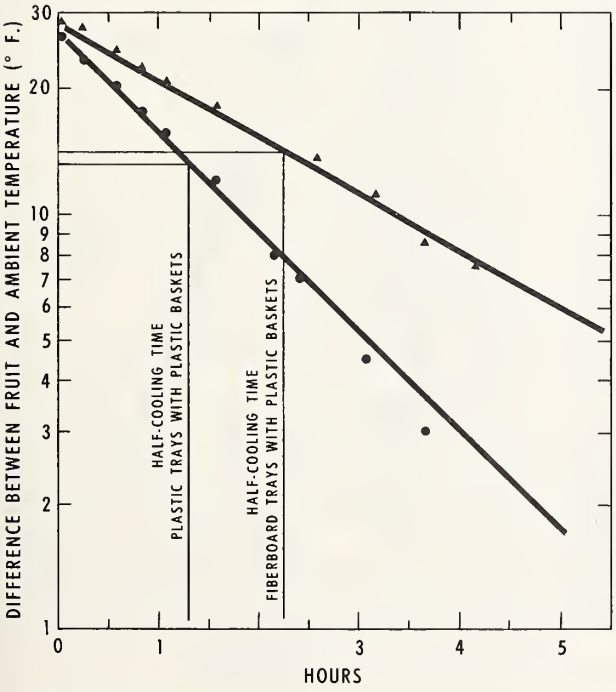

FIGURE 2.—Half-cooling times in ordinary room precooler of strawberries in plastic and fiberboard trays with plastic baskets.

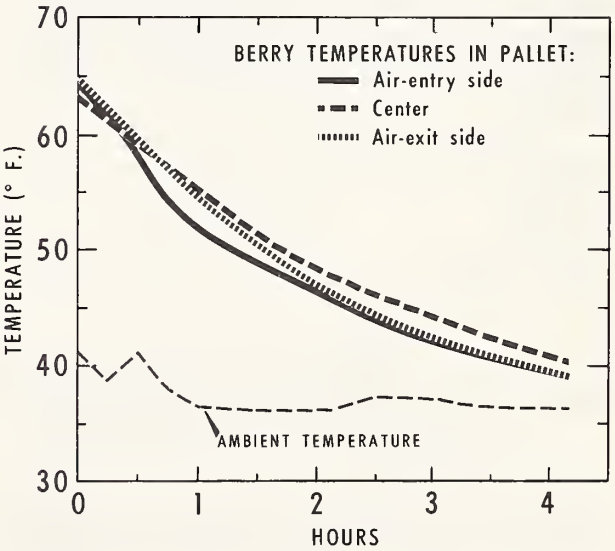

FIGURE 4.—Cooling rates in ordinary room precooler at different locations in pallets of strawberries packed in plastic trays with plastic baskets.

fiberboard trays cooled fastest on the air-entry side of the pallet and cooled much slower in the center and on the air-exit side. Fruit in plastic trays cooled more uniformly, with the center of the pallet cooling at a slightly slower rate than the air-entry and air-exit sides.

In a forced-air precooler, cooling rates were identical for berries packed in plastic-mesh and paper-pulp baskets (fig. 5). The half-cooling time for berries in both types of basket was 30 minutes (fig. 6). All berries were down to an ambient temperature of 40° F. in 2 hours. Berries on the air-entry side of the pallet cooled slightly faster than those on the air-exit side (fig. 7). After 1 hour the temperature spread between the entry and exit sides of the pallet was 3°, but these temperatures equalized after 2 hours.

In an ordinary room precooler, cooling rates of berries were slightly slower in the pulp than in the plastic baskets (fig. 8). The half-cooling times for berries in plastic and pulp baskets were 95 and 120 minutes, respectively (fig. 9). Berries in the pulp baskets averaged about 2° F. warmer than those in plastic baskets during precooling.

Temperature variation within the pallet was much greater in the room-cooled fruit (fig. 10) than in the forced-air-cooled fruit (fig. 7). After 2 hours the difference between fruit temperatures on the air-entry and air-exit sides of the pallet was 7° F. (fig. 10). After 4 and 6 hours the difference was 5°. About 4½ hours were required to reduce all berry temperatures to 40°, even though ambient temperatures dropped below 32° during precooling.

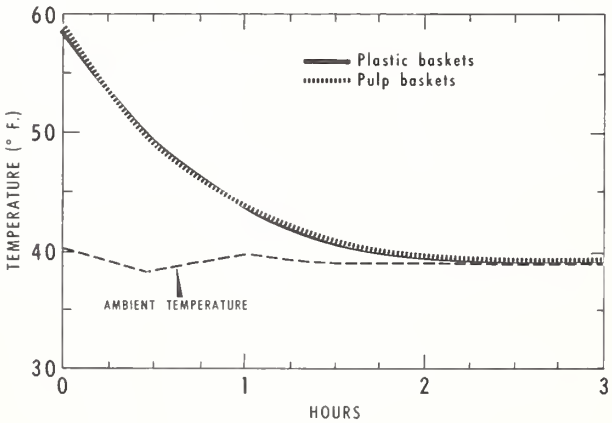

FIGURE 5.—Cooling rates in forced-air precooler of strawberries in fiberboard trays with plastic and pulp baskets.

Discussion

Some cutting and bruising damage is inevitable in strawberries during shipment because of the inherent tenderness of the fruit. Much of the cutting damage in plastic-mesh baskets, however, occurs in berries lying above the top edge of the baskets because the fruit is pressed down against

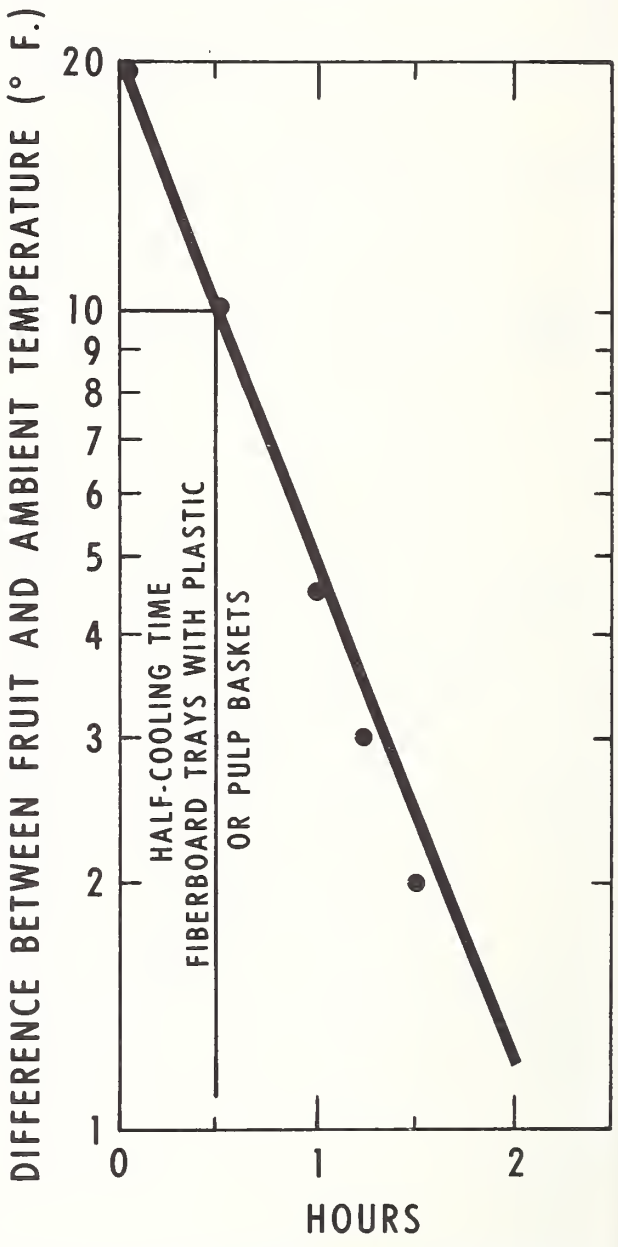

FIGURE 6.—Half-cooling times in forced-air precooler of strawberries in fiberboard trays with plastic or pulp baskets.

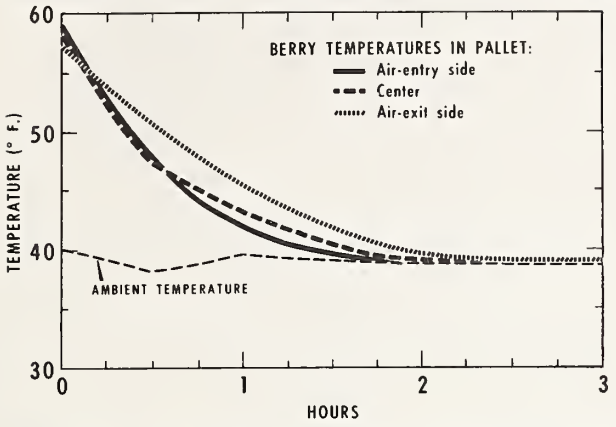

FIGURE 7.—Cooling rates in forced-air precooler at different locations in pallets of strawberries packed in fiberboard trays with plastic and plup baskets.

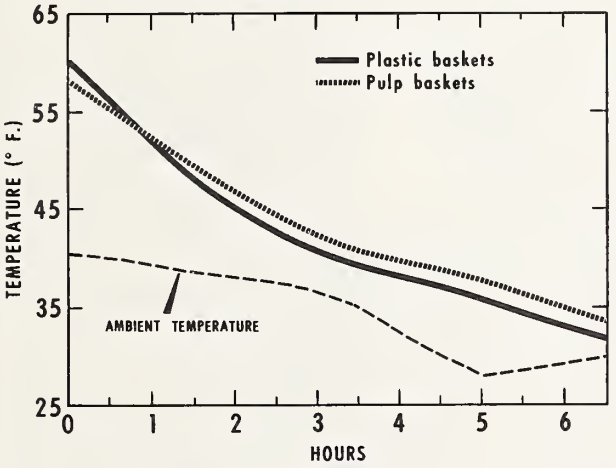

FIGURE 8.—Cooling rates in ordinary room precooler of strawberries in fiberboard trays with plastic and pulp baskets.

the basket rims. This damage could be reduced by using a pulp or plastic basket with edges that are not so sharp.

Pallet loads of berries cooled much faster in a forced-air precooler, regardless of the container used, than in an ordinary room precooler. In the former, cooling also was more uniform throughout the palletized loads.

The plastic-mesh tray was not tested in a forced-air precooler, but this tray greatly facilitated cooling in an ordinary room precooler.

Previous work [5] has shown that in a 24-hour

[5] HARVEY, J. M. TIME AND TEMPERATURE EFFECTS ON PERISHABLES SHIPPED BY AIR. Fifth Conf. Transportation of Perishables, Davis, Calif., Proc., Mar. 28–29, pp. 56–64, illus. 1961.

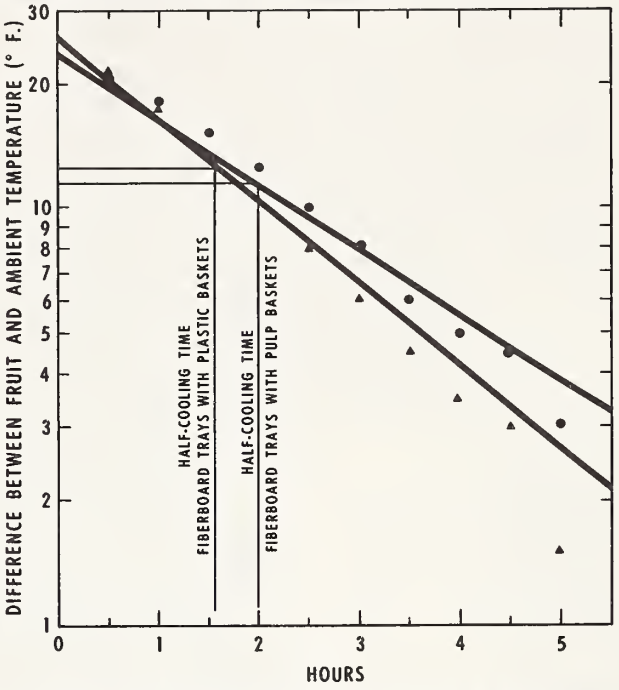

FIGURE 9.—Half-cooling times in ordinary room precooler of strawberries in fiberboard trays with plastic and pulp baskets.

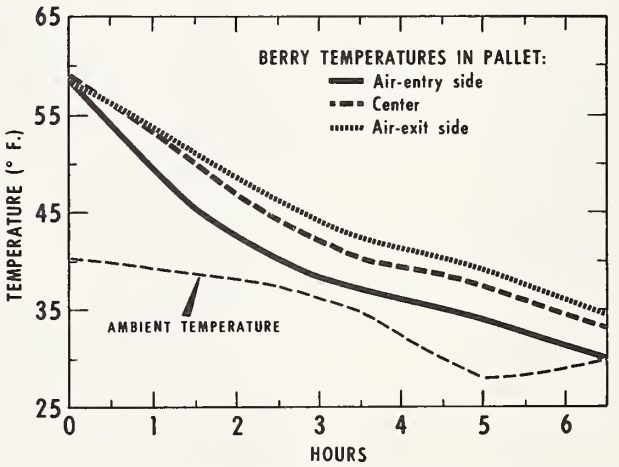

FIGURE 10.—Cooling rates in ordinary room precooler at different locations in pallets of strawberries packed in fiberboard trays with plastic and pulp baskets.

period twice as much decay occurs in strawberries held at 55° F. as at 34° and about four times as much decay at 70° as at 34°. These results emphasize the importance of fast, uniform precooling of strawberries and maintenance of low fruit temperature during subsequent marketing.

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