Prompt handling reduces processing-tomato losses

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Fruits held for a 24-hour period, simulating processing delays, suffered shriveling, decay, and loss of flavor quality and nutritive value.
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Although most canning tomatoes are processed soon after harvest, it is not uncommon for delays to interfere with prompt handling. These delays can result in both direct losses (due to physical damage, shriveling or water loss, and decay) and indirect losses (partial lowering of flavor quality and nutritive value) as a result of compositional changes. The extent of such losses, of course, is related to fruit condition when picked, and is strongly influenced by fruit temperature both at harvest and during transit. Fruit temperatures can be several degrees higher than ambient air temperatures, especially when the tomatoes are exposed to direct sunlight. This study was conducted to evaluate the effect of temperature on respiration rates and compositional changes of processing tomatoes during a 24-hour period simulating possible delays between harvesting and processing.

Materials and methods

Fruits of two cultivars ('UC 134' and 'VF 145B-7879') were obtained from plants grown in the field at Davis using standard cultural practices during the 1975 and 1976 seasons. Two field boxes of hand-harvested fruits of each cultivar were used per test. Three 10-fruit samples were placed in jars under a controlled air flow at 30°C (86°F) and 40°C (104°F). Their respiration rate (mg CO_2/kg-hr) was colorimetrically determined every 6 hours for 24 hours. Data shown in figure 1 are means of three replicates from a representative test. The remaining fruits were divided into three lots of 30 to 50 fruits each. One lot was subdivided into three samples which were frozen immediately to represent initial fruit composition. The other two lots were held at 30° and 40°C (relative humidity between 30 and 50 percent) for 24 hours, then three samples of each were frozen and kept at −40°C until analyzed. Chemical analyses included total solids, soluble solids, reducing sugars, pH, titratable acidity, and reduced ascorbic acid (vitamin C) content. Data shown in figure 2 are means of six replicates from two tests on 'VF 145B-7879.' Corrections were made on all chemical analyses data for stored fruits to account for weight loss during holding as follows: reported value = measured value × (final wt/initial wt). Statistical analyses were performed using analysis of variance and LSD test.

Results and discussion

Tomatoes held for 24 hours at 30° and 40°C averaged 1.3 and 1.8 percent weight loss, which was mostly water loss due to transpiration. Using mean respiration rate values during 24 hours, loss in dry matter was estimated to be 0.08 and 0.13 percent at 30° and 40°C, respectively. The respiration rate of 'UC 134' fruits was slightly higher than that of 'VF 145B-7879' fruits at both temperatures (fig. 1). At 40°C, CO_2 production rates were about 1.5 times those at 30°C. Respiration rate declined with time. The initially high rates may be related to mechanical damage during harvesting and handling of the fruits. Physical damage to the fruits stimulates respiration rate in proportion to its severity.

Several compositional changes (fig. 2) took place during the 24-hour holding period, including losses in total solids, soluble solids, and reducing sugars. Losses were greater at 40° than at 30°C, but only those at 40°C were statistically significant. A loss of 0.2 percent in total solids was found, and is particularly significant because of the thousands of tons of fruit that may be exposed to such conditions during a season. In 1977, California produced 6.75 million tons of processing tomatoes.

There was also a significant loss of acidity (decrease in titratable acidity and increase in pH values) as a result of holding the fruits for 24 hours at both temperatures. Increased pH can make fruits unsuitable for processing into products that cannot be acidified. The loss of ascorbic acid in fruits held at 40°C has implications in nutritive value.

It is safe to assume that the losses suffered under normal commercial conditions of mechanical harvesting and bulk handling are much greater than those measured in this study because of the rough handling.

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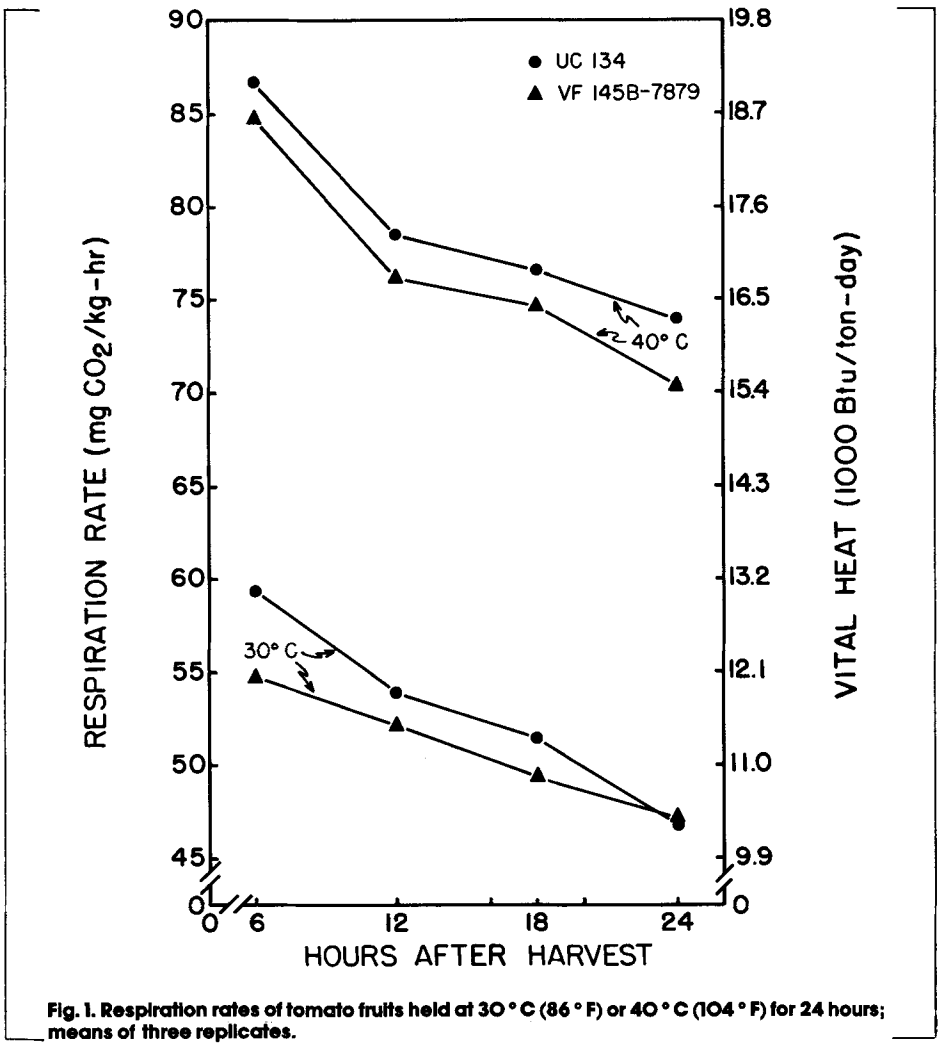

Fig. 1. Respiration rates of tomato fruits held at 30 ° C (86 ° F) or 40 ° C (104 ° F) for 24 hours; means of three replicates.

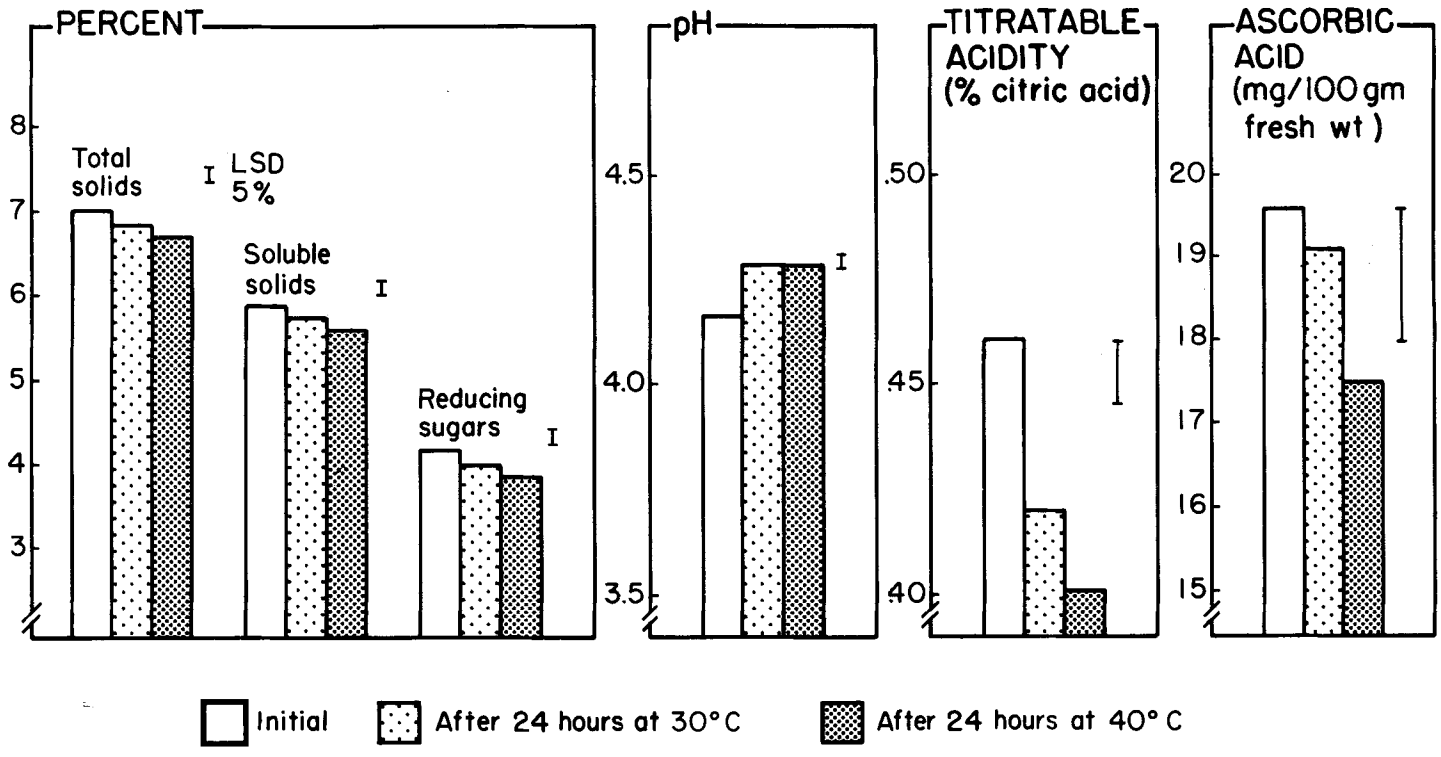

Fig. 2. Compositional changes in 'VF 145B-7879' tomato fruits after holding for 24 hours at 30 ° C (86 ° F) or 40 ° C (104 ° F); means of six replicates.