8 Processing of citrus juices
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8.1 Introduction

The citrus growing areas in the United States are located in the States of Florida, California, Texas and Arizona. The largest crop is harvested in Florida where over 90% of the oranges and approximately 55% of grapefruit are processed into juice products. Brazil’s crop is larger than Florida’s, where even larger percentages of oranges are processed for juice. Other citrus growing areas in the Western Hemisphere include Mexico, Central America, Puerto Rico, Jamaica, Dominican Republic and countries on the northern part of South America. The machinery used for the processing of citrus juices in these countries and in other regions, such as Spain, Italy, Israel and around the Mediterranean is quite similar.

Most of this chapter deals with the processing of oranges in the State of Florida, USA, with which the author is most familiar. The handling of grapefruit, tangerines, lemons, limes, etc. is quite identical in most ways to that of oranges, though some of these citrus varieties require additional process equipment for certain by-products.

The basic unit in Florida for describing the size of the orange crop is the fruit box. A box of oranges, by definition, weighs 90 lb and a box of grapefruit weighs 85 lb. The harvesting season crosses over the New Year and has a duration of 7–10 months, depending on varieties; 123,100,000 boxes of oranges (61,550 US tons) were harvested during the 1986–1987 season of which 92% went to processing, the balance going to the fresh fruit market. In the same season, 49,800,000 boxes (2,116,500 tons) of grapefruit were harvested with 56% of the crop processed for juice. Of the approximately 113 million boxes of oranges processed in the 1986–1987 season, the juice from 96 million boxes was concentrated to make frozen concentrated orange juice (FCOJ).

By-products resulting from the processing of citrus fruit include dried peel for livestock feed, molasses concentrated from liquid pressed from the peel, commercial d-limonene, which is distilled peel oil, and ‘cold pressed’ oil, the processes of which are discussed later in this chapter. The production of livestock feed from the processing of all varieties of citrus in Florida for the 1986–1987 season was 600,626 tons of dried peel and 27,811 tons of molasses. d-Limonene production was 13,483,000 lb.
8.2 Fruit harvesting and transport

The harvesting of citrus fruits in Florida begins when the fruit reaches maturity standards set by the United States Department of Agriculture (USDA) and the Florida Department of Citrus. For juices, these regulations have to do with Brix-acid ratio (see Glossary), color, oil content, etc. and in general are set to ensure quality products.

The picking of fruit for the orange juice market begins in September with most of the juice going to the single strength market. There are four main varieties of oranges growing in Florida for the juice (and fresh fruit) market. The earliest oranges consist of Hamlin and Parson Brown varieties. These early fruits are harvested mostly from October to December. Mid-season fruit (called Pineapple oranges) mature during the first 3 months of the year. Late season fruit (Valencia oranges) are harvested from March to June.

The production of FCOJ usually begins early in December when the soluble solid (sugars) content is around 12% (12° Brix). With evaporators operating at full capacity, concentrate production drops by 5% if infeed Brix is 11.5° instead of 12°.

Hand picked and mechanically harvested fruit are brought from the groves to the roadside and loaded into trucks (tractor-trailer type), which hold 500–550 boxes of fruit. The trailers are then trucked to the processing plant.

8.3 Unloading and storage of fruit

These operations are shown diagrammatically in Figure 8.1. The trailers are approximately 8 ft wide × 40 ft long. Trailer sides extend approximately 5 ft above the bed of the trailer. After weighing, the trucks are hauled to the

![Figure 8.1 Schematic diagram of fruit unloading and storage.](image-url)