

The Citrus Trail

Key limes do not come from the Florida Keys.

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Even within the flavor and fragrance industry itself, there is often a certain amount of confusion surrounding lime and its derivative, lime essential oil. The confusion stems largely from the fact that there are actually two different types of lime, which are most often used in essential oil production—the Persian lime (*Citrus latifolia*) and the Key lime (*Citrus aurantifolia*). The cause of clarity isn't helped by the fact that in Spanish and Portuguese, the languages of several major lime producing countries, the word for lime, "limon", is actually the same as the word for lemon. The authorities themselves aren't above the confusion either, with several official reports having been released in regards to the quantities of lemon grown in Peru, only for people to realize that the reports were actually referring to Key limes. The exception to this confusion is France, where there are two very different words for the two main varieties—"limette" (Key lime) and "citron vert" (Persian lime).

Persian Limes

Persian limes are the larger of the two varieties. They grow on almost thornless trees and are seedless and similar in size and shape to lemons. Grown in significant quantities in Mexico and Brazil, where they are called Tahiti limes, and to a lesser extent in Florida, the Persian lime is popular as a fresh fruit and for use in catering due to its seedless nature. In Brazil, the national drink, the "caipirinha", is a lively mixture of lime, distilled sugar cane, sugar and ice and accounts for the popularity of the Persian lime in that country. It's also grown in smaller quantities in Spain and Argentina for the local fresh fruit markets.

Expressed lime oil is generally, but not always, derived from the Persian lime. In Brazil, Tahiti lime oil (from the cold pressed Persian lime) is a by-product of the production of lime juice. It is also significantly influenced by orange production, which is the dominant citrus fruit in the



Persian limes.

country. Lime processing generally takes place during the quieter periods of orange production and the quantities of Tahiti lime oil produced can vary from 15-50 tonnes per year.

Expressed lime oil from Persian limes is usually expressed using FMC type extractors or, particularly in Mexico, rasping equipment.

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Key Limes

The Key lime is much smaller and rounder than its Persian cousin. Yellow when fully mature, they are often harvested while still green. The primary prod-

uct derived from Key limes is distilled lime oil, typically produced in countries such as Mexico and Peru. It is obtained by initially pressing the lime to obtain an emulsion of juice and oil. The emulsion is then pumped to the stills where the oil is distilled away from the juice by direct steam injection—a process that can take up to 14 h. Much of the flavor of distilled lime oil is actually formed during



Key limes.

this process, when the oil is in contact with the naturally hot acidic juice. In the West Indian process however, the juice is largely separated from the settled oil layer after storage and prior to distillation.

Two types of expressed lime oil can also be produced from Key limes as a by-product of lime juice processing. These are called type A or type B lime oils. Type B is the initial product, made by rasping the peel of the fruit using

pelatrice, or brown-type, equipment. The resulting oil/water emulsion is then centrifuged to liberate the cold pressed (CP) lime oil. Subsequently, the whole rasped fruit is crushed, producing a juice/oil emulsion. This in turn is centrifuged to separate the elements, producing a type A CP oil which is both lighter and has considerably different organoleptic characteristics to type B oil due to the fact it has been in direct contact with the acidic juice.

The citral content of CP Key lime oil is usually around 5 percent, whereas in distilled oil it is typically less than 0.3 percent. In CP oil, α -terpineol may be present at 0.3 percent, but in distilled oil it is common to find as much as 7.5 percent. The two varieties of oil also differ considerably in color, distilled oil being a pale yellow/green, even sometimes approaching colorless, whereas CP oil is much darker green.

Growing Key Lime Trees

The rough planting distance for lime trees should typically be 8 m x 6 m, and they will require significant irrigation throughout the arid times of the season. Key lime trees are often grafted on to rootstock, usually rough lemon rootstock, to inhibit disease. However, this tends to result in a lower useful life for the tree of about 15 years, compared with 30 years for a pip grown tree. It takes three months for the fruit to develop from flower to mature lime and while

trees will produce some crop after two years, it is not until it reaches four years that good quality limes are produced in any significant quantity.

Market Forces

The majority of Key limes are processed in Mexico, with a small amount of processing being done in Peru. Peru became a major producer in the 1980s when a priest who had previously worked as a missionary in Mexico transferred to Peru and realised that there was a good local industry growing Key limes. He encouraged a co-operative, Coochul, to invest in basic stills and process distilled lime oil. The arrival of Peru into the lime oil market and subsequent increase in supply (at its peak it produced >180 tonnes of oil), forced prices down from around \$15 per pound to \$4.50 per pound between 1982 and 1987. At one stage, there were 11 distillers in Peru, but the Mexicans fought back, increasing the efficiency of their distilleries and fruit processing plants. There are now only four or five major distillers in Peru and the price of distilled Key lime oil has risen to \$7 per pound. It is still a major price reduction however, and compares well with the \$3.50 per pound that RC Treatt was selling distilled lime oil for in 1932 and \$6 per pound for cold pressed lime oil in the same year.

Cultural Factors

There is a very strong demand for fresh fruit in South America, particularly limes. In Mexico, every table and every restaurant will often have numerous condiments derived from Key limes to add color and flavor to many staple dishes. In Peru, a popular dish is Ceviche — raw fish marinated in lime juice. In effect, the local demand for fresh fruit helps subsidise the industrial fruit processing industry in these countries.

In contrast, where there is not a high indigenous demand for fresh fruit the cost of fruit in general is higher and consequently lime cultivation and production is more difficult. This has been the case in several African countries, such as the Ivory Coast, which in the 1970s was the third largest lime processor in the world, but where rising fruit prices meant that it became less and less economically viable. Zanzibar, too, was a successful lime producer, but a combination of disease and political change destroyed the industry on the island.

Other Varieties of Lime

There are many other varieties and hybrids of lime. Thailand, for example, cultivates the Kaffir lime, the leaf of which is used extensively in cooking. The fruit is also processed on a small scale to make distilled lime oil, although Kaffir lime oil has a unique flavor and composition. Kaffir limes are mid-green color with a rough, bumpy skin compared to the smooth skinned Persian and Key limes. The Kaffir lime's high α -terpineol content of 6 or 7 percent is one of the few similarities with distilled Key lime oil.

India, too, has its own variety, the thin-skinned Kagzi Kalan lime which is used extensively in Indian cuisine — lime pickle for example. There is some occasional processing of distilled lime oil in India but it is used mainly in the local beverage market.

Conclusion

Lime juice has been a popular flavor with consumers since the sixteenth century. Its health benefits were recognised early on, too. In the eighteenth century its high vitamin C content was recognised as a cheap and effective treatment for scurvy, a fatal disease common among sailors that develops due to a severe shortage of vitamin C. The British government passed an Act in 1867 whereby all British ships had to carry sufficient lime juice for the crew's daily quota, hence the common American reference to British people, including the authors, as "limeys".

With all the different types of lime available and the corresponding variety in the types of lime oil that are produced, food and beverage producers have a considerable range of flavoring oils to choose from, depending in their specific requirements. ■

References

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