Florida Tangerine Peel Oil – The Changing Cultivar Landscape

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Citrus fruits have been a valuable and prized flavor and fragrance ingredient for thousands of years. The ability of citrus to easily crossbreed has provided us with a large family of different fruits, many with very unique and interesting organoleptic properties. From the world's most popular fruit, oranges, to specialty fruit like bergamot, the many citrus species are important raw material sources for the flavor and fragrance industry.

One important family of citrus varieties is the mandarins. These easy-to-peel fruits with a deep, reddish-orange color and interesting flavor are prized worldwide as fresh fruit. Although the dominant growing areas for mandarins have been China and the Mediterranean, mandarin cultivation in Florida has been carried out since the mid 1800s. In Florida, the mandarin varieties (and related hybrids) are usually referred to as tangerines, tangelos and tangors. Although the essential oils of Florida tangerines are noticeably different from mandarin fruits grown in Europe or China, these essential oils have found an important place in the repertoire of ingredients in our industry. Unfortunately, changing market conditions are radically altering the balance of tangerine cultivars grown in Florida and consequently the availability of these important raw materials.

Tangerines have been grown in Florida since at least 1825.[1] The fruits were primarily grown for the fresh fruit market and provided a nice compliment to the more-common oranges because of their distinctive color, flavor, as well as the "easy-to-peel" characteristic. With the subsequent development of the large-scale orange juice concentrate industry after the 1940s, the addition of tangerine juice to orange juice provided a cost-efficient means to add desirable color to orange juice produced from early-ripening, but color-poor orange varieties. This practice was codified in the USDA standard of identity for orange juice which allowed up to 10 percent tangerine juice content in orange juice without any label declaration (21 CFR 146.140).

One of the oldest varieties of tangerine grown in Florida was the Dancy. This variety originated in Florida in 1867 and became the dominant tangerine grown in Florida by the 1940s.[2] In 1959, the USDA released a new tangerine hybrid – the Robinson tangerine – which resulted from a cross between a Clementine tangerine and an Orlando tangelo. Although officially only 3/4-parts tangerine, the Robinson shared many physical characteristics of a tangerine and was officially classified as such.[3,4]

In addition to these two tangerines, several related tangerine hybrids have also been traditionally grown in Florida. Tangelos arise from a cross between a tangerine and a grapefruit. The dominant tangelo variety, the Orlando, was released by the USDA in the 1930s. The physical appearance of these fruit is somewhere between a tangerine and a sweet orange. Other tangelo varieties include the Minneola and the Nova. Tangelos are a popular fresh fruit and have been widely grown for this market. Tangors arise from a cross of a tangerine and a sweet orange. The Temple orange, probably a tangor hybrid, has been grown in Florida since the early 1900s.[5] The Temple orange, as the name suggests, has the appearance of a sweet orange and is usually referred to as such. The Murcott, or Honey tangerine, also became commercially important in Florida in the early 1940s. Although the early history of this variety is sketchy, it is most likely a tangor hybrid developed in the period between 1910 and 1920.[6] Murcotts look somewhat like tangerines, and are the latest maturing of the tangerine-type fruits. This fruit has traditionally been popular in the fresh fruit market. By 1980, the Florida Department of Agriculture citrus survey of bearing commercial trees reported 757,000 Dancy trees, 623,000 Robinson trees, 1.6 million Tangelo trees (75 percent of the Orlando cultivar), 1.6 million Temple trees and 864,000 Murcott trees. While these numbers seem large, the tangerines have always been grown as a specialty fruit. During the same tree census, while nearly 60,000 acres were devoted to tangerines and all related hybrids, more than 576,000 acres were growing oranges.

Within this environment of available fruit, the peel oil from the Dancy tangerine developed into the most preferred for flavor and fragrance applications. This was due to the very attractive organoleptic properties, as well as the availability of the oil since the fruit was processed for juice applications. The Dancy peel oil had a strong, sweet, and very characteristic flavor and odor that was somewhat like the traditional mandarin oil and very complementary to the other available citrus essential oils in the United States.

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Figure 1. Number of commercial bearing Dancy, Robinson, Sunburst and Fallglo trees in Florida from 1980 - 2000[9]

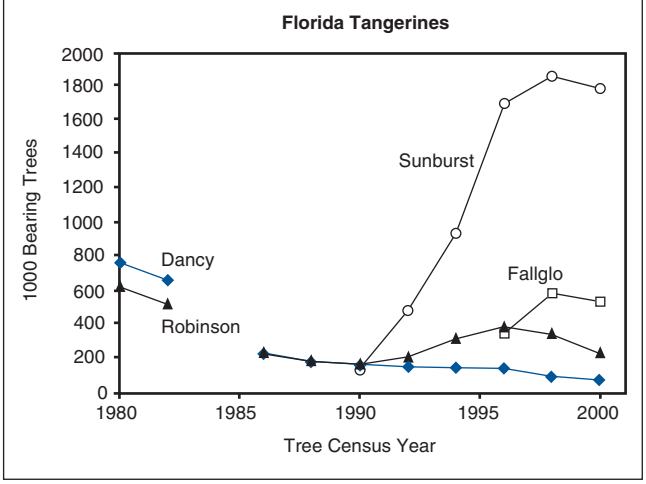
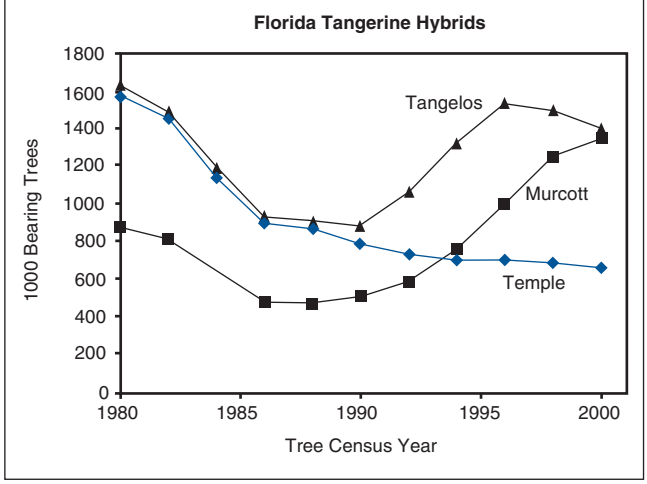


Figure 2. Number of commercial bearing Tangelo, Murcott and Temple trees in Florida from 1980 - 2000[9]

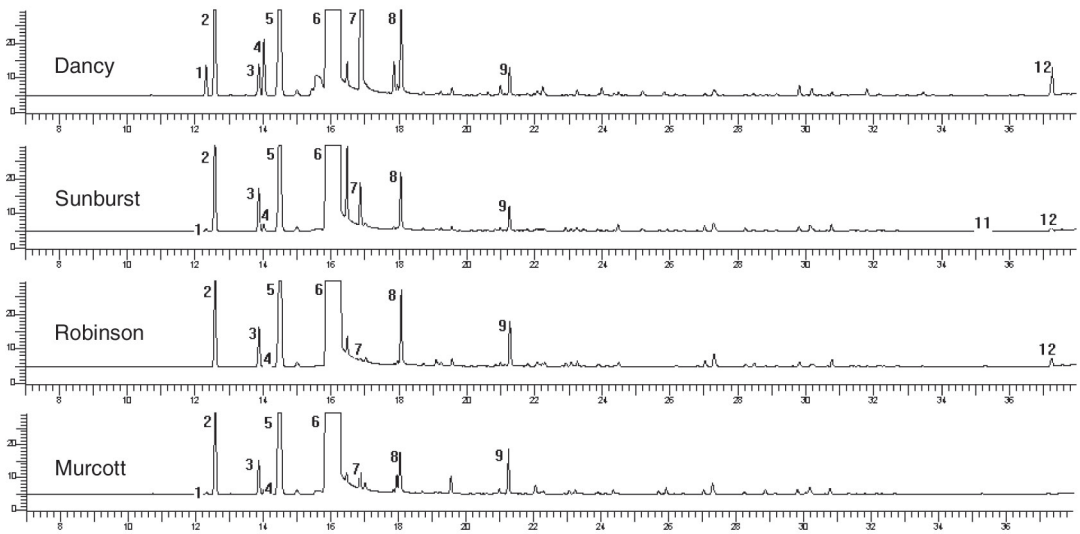


However, the market conditions that led to the routine availability of the Dancy peel oil have rapidly changed. The first major effect resulted from the release of two new tangerine hybrids by the USDA. The Sunburst variety was released in 1979 (Jackson and Futch, 1993).[7] This variety resulted from a cross between two citrus hybrids both with 3/4 tangerine parentage – the Robinson and the Osceola. The Sunburst fruit has the physical appearance of a tangerine with an excellent, dark reddish-orange color both on the rind and inside the fruit. The Fallglo variety was released in 1987.[8] This variety is a result of a complex hybridization process, resulting in a fruit with 5/8 tangerine parentage. The fruit has the physical appearance of a tangerine and is classified as such for marketing purposes. Both of these cultivars have become relatively popular with growers.

Second, the Dancy tangerine variety has fallen out of favor with growers. The fruit is difficult to pick and handle without damage, trees tend towards alternately bearing small fruit, and the trees are susceptible to disease. And finally, tangerine hybrids in general have been strongly influenced by fresh fruit market competition and lower demand for tangerine juice to "color" orange juice. The effect of these forces has been dramatic on tangerine availability. Figure 1 shows the number of trees in commercial production for the tangerine cultivars for the time period 1980-2000. Figure 2 shows the similar data for the tangelo/tangor hybrids. These data are taken from the Florida Department of Agriculture which conducts a commercial citrus inventory every two years.[9] Some data in the Figures are missing for the year 1984 because the citrus inventory did not break out all of the tangerine cultivars.

Several features are evident from the two figures. First,

Figure 3. GC chromatograms for typical Dancy, Sunburst, Robinson and Murcott peel oil; peaks are 1 – thujene, 2 - α-pinene, 3 – sabinene, 4 - β-pinene, 5 - myrcene+octanal, 6 - limonene, 7 - γ-terpinene, 8 – linalool, 9 - decanal, 10 – valencene, 11 - β-sinensal, 12 - α-sinensal



the number of bearing Dancy trees has plummeted from 757,000 in 1980 to 65,000 in the year 2000 survey. Robinson shows a similar drop during the 1980's, although the number of trees increased due to extensive new plantings in the early 1990's. Meanwhile, the Sunburst variety has taken off very quickly, becoming the dominant tangerine variety by 1994, with 25 times more bearing trees than Dancy by the year 2000. The Fallglo cultivar has also grown quickly with more than 500,000 trees in commercial production by year 2000. Figure 2 shows that during the same time period, tangelo production dipped in the 1980s, probably a result of the devastating freezes in 1983, 1985 and 1989, but recovered by 2000. Murcott production has been steadily rising and Temple production steadily falling during this time period. Compared with the number of Dancy trees in year 2000, there were 1.4 million tangelo trees, 1.3 million Murcott trees and 649,000 Temple trees. While fruit production does not directly translate into oil availability, since only fruit that is processed and the peel oil properly collected generates usable oil, this precipitous drop in Dancy production is clearly a problem.

Meanwhile, rising consumer interest in "exotic" fruit flavors including tangerine, and the declining production of Dancy tangerine oil is forcing the flavor and fragrance industry to look for alternatives to satisfy our flavor and fragrance demands. Market conditions leading to the trends described above are unlikely to change quickly, therefore, we need to investigate alternate raw material sources. The other tangerine cultivars grown in Florida are of obvious interest.

The rest of this article is devoted to a description of the peel oils from the other Florida tangerine-like cultivars as compared to the Dancy "gold-standard". These observations are based upon commercial samples I have examined in the last few years. The reader must keep in mind that commercial samples can differ from laboratory-prepared samples due to a number of various factors. These include the fact that fruit processors do an imperfect job of sorting fruit by variety, and of separating fruit byproducts during processing. Furthermore, fruit is picked when it is commercially feasible, not necessarily when optimally ripe. However, from the standpoint of the flavor and fragrance industry, we need to work with the raw materials that are available to us.

Dancy tangerine: As mentioned above, the oil from the Dancy tangerine remains the "gold standard" of the Florida tangerine oils. The peel oil is a dark reddish-orange color with a specific gravity typically around 0.848 (at 25°C). Figure 3 shows a GC chromatogram using a non-polar stationary phase of typical Dancy peel oil with the main peaks identified.[a] The peel oil is easily distinguished from orange peel oil by GC analysis; most noticeably the Dancy oil lacks β-sinensal which is present in orange at levels higher than α-sinensal. Additionally, the presence of β-pinene and γ-terpinene are clear mandarin-like markers. The mid-volatility peaks after decanal are also noticeably different from orange. Fresh Dancy peel oil has a very sweet smell that is easily identified as "tangerine-like". However, the oils lack the strong methyl-N-methyl anthranilate character of the Italian mandarins. The total wet-aldehyde of Dancy peel oil is typically around 1.0 to 1.2% measured as decanal.

Sunburst tangerine: Sunburst tangerine is currently the tangerine variety grown in the largest quantities in Florida. Commercial samples of Sunburst peel oil are now routinely available. The peel oil is as dark or more darkly colored than Dancy oil, and the specific gravity is typically higher, closer to 0.850. Figure 3 shows a typical GC chromatogram. The Sunburst peel oil typically has much lower β-pinene, γ-terpinene and α-sinensal than Dancy oil. The total aldehyde of Sunburst peel oil is usually lower than Dancy, closer to 0.8 percent. Organoleptically, Sunburst peel oil is very tangerine-like, although less intense than Dancy oil and somewhat "heavier." Upon dry-out, the odor is less "peely" than Dancy oil.

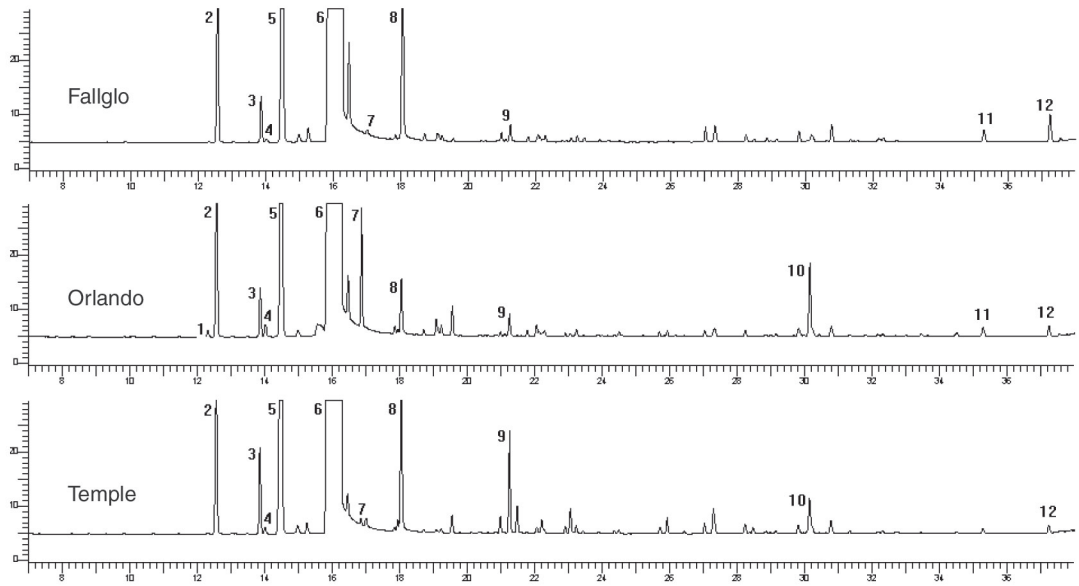
Robinson tangerine: Robinson tangerine oil is occasionally available commercially. Although there are a lot of Robinson tangerines grown, historically, this oil was not usually collected. Robinson peel oil has a specific gravity that is usually somewhat lower than Dancy oil, around 0.846, and a color somewhat lighter than Dancy. Figure 3 shows a typical GC chromatogram. The chromatogram is similar in many ways to Sunburst, but the γ-terpinene level is usually even lower. The total aldehyde of Robinson peel oil is also similar to that for Sunburst. Organoleptically, the peel oil smells like a mixture of orange and tangerine oils, with a weaker tangerine character than Sunburst. Upon dry-out, only a very weak tangerine odor remains.

Honey tangerine (Murcott): Murcott peel oil is occasionally available in the marketplace, although in somewhat limited quantities. Of the samples I've seen, the typical specific gravity is 0.846 and the color much lighter than typical Dancy oil. Figure 3 shows a typical chromatogram. The GC shows almost no sinensal content as well as very low β-pinene and γ-terpinene. Although not apparent from the figure, the level of octanal in Murcott oil is more typical of orange oil than tangerine oil. The total aldehyde is typically around 1.2 percent. Organleptically, I have found Murcott oil to be more like orange oil with a trace of "tangerine" character. Interestingly, Hearn and Krezdorn (1992) indicate that Murcott oil can be blended with Dancy oil to give an "excellent product".[3]

Other tangerine hybrids: For completeness, Figure 4 shows GC chromatograms for samples of Fallglo, Orlando and Temple peel oils. Commercial availability of these samples in quantity is rare and the results herein are based on only a handful of samples of each variety. However, several features are apparent. Fallglo peel oil shows evidence of both α- and β-sinensal, similar to orange peel oil. The other tanger–

[a]GC data was collected using a 0.32 mm diameter x 30 m column, 1.00 mm EC-1 film thickness. The temperature program started at 40°C, held 3 min, ramped at 5°C/min to 185°C, held for 5 min, ramped at 45°C/min to 250°C, held for 3 min. Peaks detected using a FID detector. Peaks identified by MS, retention time comparison with authentic standards, and/or comparison with the published literature.

Figure 4. GC chromatograms for typical Fallglo, Orlando and Temple peel oil; numbered peaks are same as in Figure 3



ine markers — β-pinene and γ-terpinene — are also very low. Orlando peel oil also shows both sinensals, as well as an enhanced level of valencene, which is also characteristic of orange oil. The Temple peel oil chromatogram looks even more like an orange oil. Like the Murcott oil, the Temple peel oil shows higher levels of octanal than are found in the other tangerine hybrids. The odor of Fallglo peel oil is similar to Sunburst oil initially, but lacks tangerine character upon

dry-out. Orlando peel oil is very much like a mixture of orange and tangerine peel oil, with only a weak tangerine character. Upon dry-out, the odor is similar to Robinson oil. Hearn and Krezdorn (1992) suggest Orlando tangelos as a potentially excellent mandarin-type peel oil source. Kesterson and Hendrickson (1969) reported that Orlando peel oil had a flavor that was similar to tangerine oil, but with only about half of the flavor strength.[3,10] The Temple peel oil is very much like a midseason Florida orange oil.

Conclusion

In summary, the changing dynamics of the Florida tangerine market is strongly limiting the availability of Florida Dancy peel oil. Although Dancy oil from Mexico is one alternative, the other Florida tangerine hybrids are a natural place to look for a substitute. Good quality Sunburst peel oil is probably the most similar oil to Dancy and is a good alternative for many situations. Robinson, Murcott and maybe even tangelo oil may be suitable for some specific applications. Unfortunately, none of these options is an ideal replacement for the original.

References

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