The Uncommon Citrus Universe

How the rapid proliferation of citrus flavor profiles, notions of authenticity, technical breakthroughs, supply issues and global taste preferences are reshaping the ingredient landscape

"If you look back 20 years ago, flavorists would have been content to work with one or two orange oils, and a couple of lemon oils," says Erlon Pereira, the recently appointed global competence director, citrus, for Symrise AG. "Today, we must have a number of special products to really represent the authentic taste of the Peruvian lime, the Mexican lime, etc., because then they can customize whatever flavor direction they might need."

Pereira has a unique perspective on the continuous evolution of citrus, particularly in flavors and beverage applications. His role connects him to the global citrus community in Symrise, networking with technical and commercial colleagues around the world. Pereira is responsible for addressing local and global market needs, in addition to identifying long-term investment and technology development goals in the citrus arena.

Complexities of Flavor Profiles

"Citrus is by definition a very complex area," says Pereira. "We're talking about more than 150 genera. Of course the most important genus is *Citrus*, which comprises what we can call 'common citrus.'" He quickly adds, "It's difficult to say what's 'common' because we have about 1,600 varietals of citrus species." In terms of global importance, the leading citrus fruits include orange, lemon, lime, tangerine, grapefruit and mandarin which, by Pereira's estimate, comprise about 90% of citrus production.

When he speaks about citrus, Pereira speaks of "flavor directions." These directions have evolved over the last few decades as a result of globalization and increasing travel among consumers, which has exposed them to novel flavor experiences. And so today, says Pereira, "Even what we call common is not really so common anymore."

He continues, "Let's take orange, for example. We might be talking about 15 different mainstream commercial varieties. Some of those might be more relevant for the United States or Mexico or Spain—the Valencia type of oranges. Other types of oranges (e.g.: pera) are more common and preferred in other areas, such as Brazil.

"Of course there are some specific citrus directions that might be more relevant for one region than for others," he concludes. "For instance, kumquats are very important in Asia, whereas in Latin America or North America, they're almost unknown."

"The review yielded several fascinating taste insights—Venezuela, China and the Philippines are somehow in the same cluster in terms of orange carbonates preferences, whereas Japan and Italy are in a totally different side of the PCA (principal component analysis) chart," says Erlon Pereira, Symrise's global competence director, citrus. "Driving optimum preference demands very specific creative development processes, carefully considering the market and the final application."

At the same time, Pereira notes that the company has invested in several projects to pursue "special citrus directions."

Analytical Science + Consumer and Sensory Insights = Authenticity

"In Brazil 20 years ago, if you went to the supermarket, you could only find one type of lemon," says Pereira. "If you go to the same supermarket today, you have Italian lemon, Argentinean lemon and so forth. Twenty years ago we could not find Valencia orange in the fresh fruit market in Brazil. Today we can."

This exposure of consumers to new citrus types has forever changed consumer expectations, says Pereira: "Today's well-informed consumers expect and demand authenticity, a demand we can readily meet through smart sourcing, clever science and advanced processing methods."

To meet more specific consumer tastes requires complementary expertise. "Analytical science allows us to understand on a molecular basis what makes a specific

Erlon Pereira

citrus fruit characteristic—what makes the Valencia orange recognizable as a Valencia orange and not as a bitter orange," says Pereira. "We combine that with consumer preference and consumer insights such as the desirability of various 'freshly squeezed' tonalities. By putting those two things together, we can determine exactly the drivers of liking for one specific reagion and/or product application. No matter the region of the world, [consumers are] really looking for the authentic profile and a fresh character, like when you're squeezing a ripe, juicy, freshly picked orange. Now we can do that."

Pereira continues, "We've made some very interesting studies of consumer preference in terms of orange carbonated drinks all over the world. What are the most preferred profiles? The review yielded several fascinating taste insights—Venezuela, China and the Philippines are somehow in the same cluster in terms of orange carbonates preferences, whereas Japan and Italy are in a totally different side of the PCA (principal component analysis) chart. Driving optimum preference demands very specific creative development processes, carefully considering the market and the final application. The most important thing is to know how to do that and to have the tools to do it—both the analytical tools and the sensory tools that allow us to rank and understand preferences and pinpoint with considerable accuracy the drivers of liking."

Affordable Innovations

"Authenticity is one of the main drivers our clients are looking for," says Pereira. "That extends from low-cost private label to well-established global brands to premium-priced specialist niche offerings. A good example can be seen in the powdered instant beverages segment, and how some brands have evolved in the last decade, delivering consumers a very authentic fruit juice flavor."

He adds, "Clients are always asking for increased stability and superior performance as this leads to more pleasurable experiences for consumers. In a cola beverage, for instance, consumers are seeking a refreshing taste experience. Our collective challenge is to deliver that desired taste profile whether our products are nine days, nine weeks or nine months old. Over the last five years,

Further Reading: Citrus Oils and FTNF Flavors
Learn more about these key ingredients from around the world on **Page 26** of the March 2012 issue of *Perfumer & Flavorist*, "Photos and Select Highlights from IFEAT 2011: Lemon, orange, lime, bergamot and mandarin oils, citrus FTNF and more" (*www.perfumerflavorist.com/magazine*).

enhanced stability is an area in which Symrise has put a lot of effort, especially on the R&D side, to understand what is behind quality deterioration over time in citrus and of course come up with innovative solutions."

"In order to achieve shelf life stability, a number of technologies are applied," says Pereira.

Symrise researchers have worked to fully understand the degradation kinetics and oxidization pathways of citrus materials, while also pursuing information technologies to enable the flavorist teams to tie this scientific knowledge back into their daily creative work when developing a new flavor for a client. Increased stability in powder beverages, Pereira notes, largely relies on delivery/encapsulation systems, which also preserve the freshness of ingredients throughout shelf life.

But Pereira cautions, "It's not just about smart science. We also have to work hard to ensure competitive cost-in-use performance because consumers demand affordable solutions."

Extraction: Getting More Out of Citrus

In part, affordable solutions come from optimized technologies that allow companies to extract more from the citrus co-product than was possible in years past.

"In our own development program we've been reinventing technologies, using renewable solvents and increasing the efficiency of the purification processes," says Pereira. "Today, we're constantly refining and evolving our extraction technologies, isolating unique molecules, and achieving much higher yields than we were able to a few years ago. Another key element to address sustainable affordability has to do with long-term strategic partnerships in the areas of processing."

Pereira notes that Symrise maintains complementary expertise with orange processors to increase efficiencies. "They have direct access to the groves and harvest and extract the juice in less than 24 hours after picking the fruits," he explains. "We work in close cooperation with our partners on the ground, enabling access to the freshest possible ingredients direct from the source. As with our other taste competence platforms, our efforts are helping to shape the entire value chain as efficiently and sustainably as possible."

Symtrap, a separation technology that allows the company to recover aroma molecules from citrus processing streams, presents one such example of complementary expertise[a]. Sourcing agility is achieved via the mobile and flexible equipment, which allows the company to go to source rather than shipping large amounts of material to a Symrise facility. Using this technology, Symrise is able to recover volatiles on site that would otherwise be lost.

The company's separation technology can concentrate water streams anywhere from 250 to 1,000 times. Instead of shipping dozens of tons of material, the company is able to concentrate and then transport hundreds of kilos of stable product: natural flavoring complexes from the named fruit.

This process simultaneously reduces costs and the need for climate-controlled storage facilities and dramatically improves the company's citrus carbon footprint. Affordable sustainable solutions like this one, Pereira says, are developed incrementally. He adds that there are more valuable molecules sill being pursued in other byproduct streams. Future development will seek to capture those unique materials and further boost overall extraction efficiency.

At the same time, the company has upgraded its natural extract and flavor processing facilities, producing multi-concentrated (MC) oils. Meanwhile, Pereira notes that Symrise has ceased using non-renewable petroleum-based solvents in favor of renewables such as sugar cane ethanol.

Roller Coaster Prices and Other Citrus Supply Issues

"Citrus is a natural crop subject to many climatic variations, and equally as dramatically impacted by the unstable global economic situation over the last four years," says Pereira. "Consequently, high volatility has been a major issue for everyone connected with citrus."

For these reasons, Symrise has maintained a Brazilian operation since 2007, ensuring close proximity to a region that represents 60% of global orange processing.

"If you look back 15 years, the historical price of orange oil was about $1/kilo," says Pereira. "If you look more closely at just the last five years, it has been somewhat of a roller coaster ride."

The volatility in recent years has not only affected flavor houses, but also consumer goods and beverage companies.

"Recently, the price for orange juice is the highest it's ever been," says Pereira. "Of course consumers start looking for something more affordable. The main challenge we have today is not only the cost being high or low, it's also the extreme volatility, which makes everything more difficult in terms of planning, contracting and availability of materials."

Beyond Superficial Sustainability

"Sustainability isn't something that's nice to have, it's vital," says Pereira. "For the growers, the processors, the flavor producers and the juice-based beverage producers, it means survival. Citrus is a natural crop; in the long run, if the whole value chain is not sustainable, we are not sustainable."

The challenge for citrus producers is to increase the productivity of groves and farms without using more land, water, and harmful chemicals. The top orange proces-

[a] Symtrap is a trademark of Symrise.

sors, Pereira explains, own enough farms to cover 20–40% of their citrus needs. The rest of the required volume is purchased from independent growers. Therefore, cascading responsibility throughout the value chain is a critical path to success.

"Sustainable sourcing of citrus fruits, and thereby citrus oils and raw materials, demands careful management," says Pereira.

The citrus business is an important one for Brazil, he says. Over the last 50 years the country has taken the lead in orange production and processing in comparison with traditional producing areas. The orange growers currently face many challenges that are very much connected with sustainability, like soil and water utilization, modern techniques for disease control, competition from other crops (e.g. sugar cane), etc. And, Pereira says, in many ways Brazilian growers and processors are setting the path to overcome these challenges.

For example, local growers are using "precision agriculture" to micromanage plantations one tree at a time. The use of high-tech equipment like GPS and modern agricultural practices in plantations is leading to optimized irrigation, reduced fuel consumption, and highly selective use of fertilizers at greatly reduced usage levels. By combining GPS data with information about soil conditions, it is possible to pinpoint irrigation where the soil is on the dry side and to use fertilizers only where the soil has fewer nutrients.

"It's not something in the future," says Pereira. "It's happening right now.

The Future: Consistent and Sustainable Value Delivery

"Much of Symrise's current innovation processes are focused on squeezing the last drop of value from the citrus crop," says Pereira. "This includes creating novel extracts of great flavor value from things that are currently wasted; finding new materials in waste streams is both economically feasible and highly sustainable. Many projects at the advanced stages of feasibility testing are derived from this concept."

The company is also focusing on naturally occurring citrus compounds that can be used outside of citrus categories.

"We can extract some materials from the fruit and apply a number of precise purification technologies to yield molecules that help us develop flavors that help our customers reduce the amount of sugar in a beverage."

These flavoring substances with flavor modifying properties can be claimed as natural and "derived from the named fruit." Creative flavorists can formulate these substances into flavor systems to reduce sugar in formulations by 25–30% without sacrificing taste.

"Delivery systems are also constantly evolving," Pereira concludes. "How do we make sure everything that we've created will be 'freshly squeezed' and zesty until the end of the shelf life?"

To that end, Symrise in 2011 completed an expansion phase of its Singapore operations, opening a new facility and launching a new encapsulation technology, Evodry[b]. The technology allows for improved particle distribution in powdered products and thus better flowability, less dusting and improved stability. Used primarily for citrus and vanilla, the technology allows for improved spray-dried products with more stability, shelf life, faster dilution and better flavor preservation.

Pereira, hinting that more innovations are to come, adds, "When it comes to citrus there are always many more oranges, lemons, limes and tangerines than you originally imagined. Consumer taste preferences keep evolving and so too must the winning citrus taste solutions."

[b] Evodry is a trademark of Symrise.