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3 Change Agents Shaping Fragrance Formulation

Updating the Regulatory Landscape

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WHERE THE WORLD COMES TO ITS SENSES

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Reframing Regulatory Restraints in F&F

Since attending IFEAT Vancouver 2022 last October, my mind keeps going back to the Medal Lecture, "Catalysts of Change," given by Berjé's Kim Bleimann. With nearly 50 years of experience in F&F, Bleimann joined Berjé in 1973 before ultimately assuming ownership and becoming president in 1981 and is now the current chairman of the board of directors.

Bleimann said, "Thunderstorms are building all around us," referencing the European Green Deal and the threats that the possible forthcoming regulations will have on the F&F industry, "if we are not diligent and mindful, the flavor and fragrance industry could be, no, *will* be in peril."



P&F+ has tapped professionals from all aspects of the F&F industry to discuss the impacts of F&F regulatory updates.

The Berjé chairman went on to highlight how REACH has negatively affected the F&F industry in "what was structured as a definitive restraint of trade dressed in safety while vehemently denying that fact."

He stressed that these restrictions could not only affect the creativity and innovation of the F&F industry but also cost companies millions to get ingredients approved, saying, "Death by regulation is real."

Currently, F&F professionals are being tasked to re-envision formulations to adhere to ever-changing regulations while also battling supply chain issues. What knowledge could they benefit from in the near future, or even in the now?

In the March issue, *Perfumer & Flavorist+* has tapped professionals from all aspects of the F&F industry—from those wearing lab coats to those who are championing bills handled by the United States Congress and beyond to discuss the impacts of regulatory updates in both flavor and fragrance.



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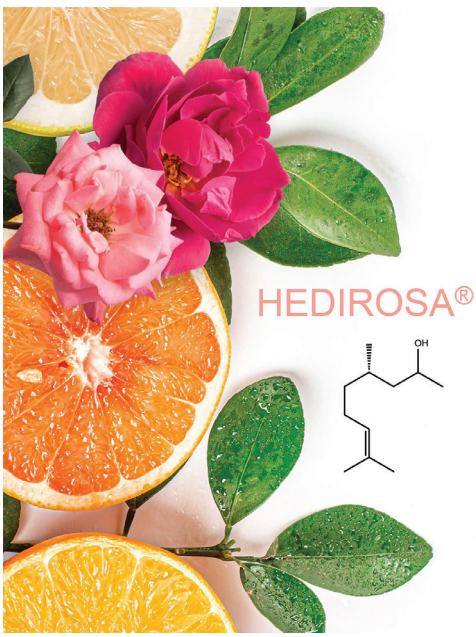


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https://www.symrise.com/scent-and-care/aroma-molecules/flavor-ingredients/#Passifloran

Outstanding flavor ingredient passifloran works well in tropical fruit flavors and essentially contributes to passion fruit creations. It enriches the natural juiciness and the typical fruity character. On the savory side, passifloran increases sulphur notes and the body. The use level in food ranks from 1 ppb to 50 ppm.



Hexyl cinnamic aldehyde

Natural Advantage

www.natadv.com

Natural Advantage introduces natural hexyl cinnamic aldehyde (FEMA# 2569, CAS# 101-86-0). With a fresh jasmine and gardenia odor, natural hexyl cinnamic aldehyde is a unique product that can be described as sweet, fruity, floral, citrus, green and smooth. The warm and slightly herbaceous undertones that arise with this product make it an essential part of teas. Although it is known for enhancing sweetness and uplifting and amplifying flavors, hexyl cinnamic aldehyde also has a refreshing calming effect that is much desired in tea beverages. This material would work well for honey, fruit, floral, and tea. Recommended use levels are 0.5 ppm to 10 ppm. It is EU and U.S. natural, kosher, vegetarian, non-GMO.



Natural trans-α-Bergamotene 80

Isobionics

https://www.isobionics.com/global/en/product-finder/natural-trans-alpha-bergamotene-80.html

Natural trans-alpha-bergamotene 80 (FEMA# 4960, CAS 13474-59-4) has never been isolated before but Isobionics succeeded in producing natural trans-α-bergamotene by fermentation. The product is a clear colorless to pale yellow liquid and has a very mild, waxy oily citrus note. It dries waxy candle-like, olive oil. The taste can be described as citrus, especially lime and lemon, light fruity, orchard fruit and oily.



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www.tournaire.fr/en/emballages/ap25ap28-2

Tournaire expands the sampling range of bottles, adding a tamper-evident closing system from 20 cc to 315 ml. The tamper-evident closure is great for sampling products that need to be protected. Aluminum bottles are lightweight, seamless and U.N.-approved with tamper-evident closures. Feel free to email us at contact@tournaire.fr for more information.



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St. John's Bread Solid Extract

Citrus and Allied Essences Ltd.

www.citrusandallied.com/botanical-extracts/

St. John's Bread Solid Extract (FEMA #2243, CAS #84961-45-5) is a building block in chocolate and cocoa flavors. It has a similar profile to chocolate but is not as rich or sweet. It also has a fruity, fermented top note similar to molasses.



Buchu oil

Berjé

www.berjeinc.com/products/essential-oils/buchu-leaf-oil/

Berjé's buchu oil is intensely pungent and sulfuric, with green and leafy notes that can be overbearing when smelled neat. However, when used in small doses, buchu makes an excellent modifier for cassis, raspberry, grapefruit, and mango profiles. In fragrance, buchu oil works well in colognes and chypre bases.

THE FUTURE OF BIOTECHNOLOGY IN FLAVOR & FRAGRANCE AROMA INGREDIENTS

Isobionics discusses the future of biotechnology, sustainability and its role at BASF.

This year marks Isobionics' 15-year anniversary since its debut in 2008. Since its inception, Isobionics has been committed to crafting innovative biotech-based aroma ingredients for applications across flavor and fragrance. In 2019, Isobionics was acquired by BASF, strengthening the company's natural F&F ingredient portfolio.

As the F&F industry continues to experience a growing need for natural ingredients, biotech-based aroma ingredients can offer affordable and available solutions. Wanting an insider's look at the biotechnology market, *Perfumer & Flavorist+* (*P&F+*) connected with key players on the BASF team as well as Isobionics CEO Toine Janssen to discuss the company's growth, its role within BASF and upcoming initiatives.



***P&F+*: Congratulations on Isobionics 15th anniversary! Can you share a little about the company's founding and how it has grown over the years?**

Toine Janssen [TJ]: Isobionics was founded in 2008. Since then, a lot has happened. More than 10 years ago we introduced, as the first company in the world, fermentation-based natural valencene in the market and developed the first fermentation-based natural nootkatone. In 2020 we partnered with BASF for our first fragrance ingredient, santalol, which was, and continues to be, very well perceived in the Indian market. We also opened a new distillation plant in 2021. Due to the continuing growth, we are able to open an extension of the plant in 2023. These are huge steps from a start-up to what we are today. I am very proud of our innovations since the beginning because they are high quality, always available and have a constant organoleptic profile.



Toine Janssen, CEO, Isobionics

I have experience in innovation as a serial entrepreneur—I founded several innovative companies and brought the first digital television to the market. A colleague introduced me to the Brightlands campus in Geleen, the Netherlands, where they asked me to start an innovative company to produce isoprenoids. Seeing the potential for the technology, Isobionics was founded with a focus on the production of flavors. During this time, we expanded our business and launched several new citrus flavor ingredients. In total, we are proud to have developed the portfolio to more than 15 products. In the same way, our team has grown from a small one-person team to 30 colleagues, now strongly integrated into the BASF biotech team and Aroma Business unit.

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***P&F+*: From your perspective, what are some of the key market drivers in the industry at the moment?**

TJ: Renewability is one of the key drivers in the flavor and fragrance industry. The customers demand products that have at the same time high quality, are biobased and reliably available.

Biotechnology is the key—by using a fermentation-based process for our products, we can provide the market with natural aroma ingredients while avoiding the challenges connected to extraction of aroma ingredients from plants e.g., purity and weather dependency.

We also produce products that are scarce in nature, such as a sandalwood oil replacer, with high reliability and constant availability at a very competitive pricing. The sandalwood tree needs to grow for 30 years before it can be used in the traditional production of sandalwood oil. Producing sandalwood oil via fermentation preserves the woods since not a single gram of sandalwood tree is needed.

***P&F+*: Can you share some of the current projects Isobionics is working on?**

TJ: We are always looking for opportunities to complete our portfolio with a few crucial citrus sesquiterpene products. These will be products that the customers have been requesting for years and that will fit perfectly into our platform.

Another attractive topic to explore, together with flavorists and customers, is the possibility of using our fermentation technology outside the citrus application. For example, we have developed some fruit demo formulations, which show the potential of our products in i.e., apple, pear and blueberry applications.

***P&F+*: What does the future hold for Isobionics? Any short-term or long-term initiatives you can share?**

TJ: Isobionics fits perfectly to the BASF white biotechnology R&D expertise and the BASF business activities in the F&F market. In this regard, together with BASF, we aim to further develop our fermentation technology platform to achieve lower production costs and enable the introduction of many more fragrance products. Long-term, the platform can play a role in several additional markets, e.g., in cosmetics.

***P&F+*: What position does white biotechnology have within the BASF?**

Reinhard Zschoche [RZ]: White biotechnology has been an important technology pillar for BASF for a long time. We built our first fermentation plant in the 1980s. For decades, we have been producing vitamins and enzymes with the help of microorganisms. Of course, the core of our company is still chemistry and most of our products are still produced chemically today. But since we started our first biotech process, the field of biotechnology advanced tremendously, and it keeps getting more powerful. This development presents new possibilities beyond naturally occurring molecules for which microorganisms are a natural choice as the production system. Today we regularly look at all our products and evaluate whether we could make them more efficiently through biotechnology. And for more and more products the answer becomes "yes," and the number of products that we produce through biotechnology constantly increases.



Reinhard Zschoche, Ph.D., NBD & Tech. Marketing, Aroma Ingredients, BASF

***P&F+*: What role does sustainability play here?**

RZ: Sustainability is the defining megatrend of the 2020s. At BASF we constantly look for products and solutions with a favorable sustainability profile for our customers. To that end, our engineers squeeze out every little inefficiency in our processes to optimally use the input raw materials and energy. Therefore, changing a process from chemistry to biotech can be a fundamental game changer because it allows us to switch from fossil feedstocks to

renewable ones. While chemical processes typically are optimized towards using fossil oil, in contrast, microbes are naturally adapted to use renewable natural feedstocks such as sugar or plant-based oils. Hence, biotech reduces fossil fuel mining and contributes to removing CO_2 from the atmosphere by storing it in our products. So, with biotechnology, we have a lever to reduce the product's carbon footprint.

***P&F+*: What does white biotechnology mean for the aroma ingredients?**

RZ: Our noses evolved over millions of years to detect volatile molecules in the environment, and until the beginning of the 20th century all fragrance ingredients were of natural origin. The synthetic molecules that were created in the past 120 years typically imitate a naturally occurring scent, often however without capturing its entirety. These synthetics drove fragrance innovation in the 20th century, they expanded the palette that perfumers can work with and grace to their low cost and high impact appealing scents are broadly accessible. The reinvention of naturals through synthetic biology is the 21st-century avant-garde of aroma ingredients. Biotechnology allows us to produce natural molecules that are difficult to synthesize chemically, and whose concentrations in plants are so low that comparatively large areas are needed to produce them agriculturally. But with modern biotechnology, we are now able to produce these natural ingredients efficiently in a bioreactor from natural raw materials and in a quality never seen before.

***P&F+*: What do you mean by that? Aren't these molecules available from plants already?**

RZ: They are but in a different purity. If one for example isolates valencene from citrus oils, one will never obtain 100% pure valencene, but carry over components that are impossible to separate by distillation. With biotechnology, we can deconstruct naturals by selecting specific biological pathways from a plant, and in that way provide creators with slices of an olfactory bouquet that were never smelled before. The new purity that comes from biotech unlocks new possibilities for perfumers and flavorists, allowing them to reinvent natural scents and tastes.

***P&F+*: What was the impact of the acquisition by BASF on the innovation at Isobionics? What did Isobionics and BASF each contribute?**

RZ: At the point of acquisition by BASF, Isobionics had developed a very efficient bacterial strain for the production of terpenes with an excellent organoleptic profile. In addition, the company had built up an impressive pipeline of ingredients for development. The first one, santalol, was jointly launched in 2020, one year after the acquisition. BASF contributes the regulatory expertise required to introduce these new products to the market, and the biotech process development excellence needed to upscale and continuously improve the production process. With BASF's expertise in these fields, we are able to materialize Isobionics' product pipeline much quicker and bring new ingredients to our customers sooner.



Biotechnological processes are often more efficient than classical chemical production and require less raw materials and energy. Usually they are based on renewable raw material and exhibit a beneficial carbon footprint. The first steps in process development for new substances take place in the fermentation laboratory in Ludwigshafen.



White biotechnology uses microorganisms and enzymes to produce chemical and biochemical products. The microorganisms are bred for each new substance and further developed for the production process.

BASF also provided a strong customer base and worldwide sales force to expand our business together. We have now several focused natural flavor sales colleagues in the top markets and integrated the fragrance portfolio into our existing organization.

***P&F+*: Isobionics was not a widely known company back then. How did the business find out about Isobionics?**

Steffen Götz [SG]: At BASF we constantly scout for innovative companies and start-ups that fit our markets and technologies. BASF is deeply anchored in the aroma ingredients market. Isobionics was standing out with a very promising new technology addressing key market trends for more renewables-based and natural aroma ingredients with consistently high quality. We saw complementary capabilities between Isobionics and BASF as well as a strong fit between our teams. The acquisition was a logical consequence.



Steffen Götz, VP Aroma Ingredients, BASF

***P&F+*: How are customers reacting to the additional offerings from Isobionics to the BASF Aroma Product portfolio to sustainable, renewable and natural products?**

SG: Customers are responding very positively to our product portfolio development. With our increased offerings, we address our customers' needs for more renewables-based and natural aroma ingredients. By ensuring good biodegradability and contributing to biodiversity through preserving natural resources we further enable our customers to meet their sustainability targets. Our customers appreciate the joint innovation power of Isobionics and BASF in biotechnology, providing the basis for new innovation partnerships. Last but not least, the synergies between Isobionics and BASF, e.g., in fermentation and downstream processing, enable a very competitive offering with great potential for future development.

***P&F+*: How does the acquisition of Isobionics fit in with BASF Aroma Ingredients' overall strategy for the future?**

SG: There is a strong strategic fit for Isobionics within the BASF Aroma Ingredients portfolio. We aim to be the global leading supplier of aroma ingredients and lead the sustainability transformation within this industry. Isobionics perfectly fits our ambition to increase our offering of renewable-based ingredients. Further, Isobionics is a core building block to develop our aroma ingredients portfolio to address the demands of our customers more broadly. There are strong synergies on the innovation, production, and customer side which will enable continued strong growth of the Isobionics portfolio within BASF.

***P&F+*: What role will biotechnology play for BASF Aroma Ingredients portfolio in the future?**

SG: Biotechnology will continue to play a key role in BASF's Aroma Ingredients portfolio to address the needs of our customers. We will further invest in our biotechnology capabilities and capacities to meet our customers' demands for more renewables-based and natural aroma ingredients with consistently high quality and the lowest possible CO_2 footprint while preserving natural resources. We will leverage our biotechnology platform to develop new aroma ingredients which enable our customers to be even more successful in their markets.

IFF Unveils Plant Protein Meat Alternative Innovation, Supro Tex

IFF announced the global launch of its plant-based protein, Supro Tex, designed to accelerate growth in the meat alternative category beyond ground meat burgers. Said to provide a very similar texture to chunky pieces of whole-muscle animal protein, Supro Tex does not require major capital investment for manufacturers to begin production. The 80% protein is based on soy protein, comparable in quality to animal protein, per IFF that is marketed as a dry product.



By 2035, market researchers predict that one in 10 portions of protein is likely to be plant-based.

Michel Mellema, global innovation director of IFF's Re-Imagine Protein program, stated, "What makes Supro stand out in the plant-based space is–for the first time, meat alternative manufacturers can make tender, plant-based protein, whole muscle pieces or chunks without the need for major capital investments or a refrigerated supply chain. This is the latest from IFF's Re-Imagine Protein program, where we accelerate the development of breakthrough ingredients and technologies to meet the needs of our customers and consumers. By combining science and creativity, we're developing an end-to-end portfolio of plant-based solutions that pushes past traditional boundaries to change the way people eat."

By 2035, market researchers predict[a] that one in 10 portions of protein is likely to be plant-based. The IFF tech is also hoping to address the more than 40% of global consumers[b] who are highly interested in meat alternatives with the same taste and texture as animal-origin meat.

Mellema added, "This is a paradigm shift. We are expanding our offerings to more meat alternative players. Today, we have solutions and technical knowledge to support customers who use High Moisture Extrusion technology (HME), which is an excellent technology, but not necessarily suitable for all meat alternative players. That's why we developed Supro Tex– a single, easy-to-use product that can deliver similar texture to what HME products provide, but without major capital investments."

Supro Tex is designed to offer high-process tolerance, neutral flavor and color allowing manufacturers can easily reproduce pieces of differently textured meats by adjusting hydration levels and custom flavor systems. According to IFF, Supro Tex pieces are gluten-free and require no animal products.

Ulrik Madsen, senior designer, Culinary, IFF, shared, "In a patent-pending process, soy protein is combined with other texturants to improve the firmness of the protein pieces after hydration. Due to their unique composition, Supro Tex chunks retain their texture throughout manufacturing—without breaking apart when in a tumbler or simmering—as compared to typical low-moisture extruded products."

p&f+

[a]*https://www.bcg.com/publications/2021/the-benefits-of-plant-based-meats*
[b]*https://www.healthfocus.com/global-protein-report/*

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Starco Brands Acquiring Skylar

Starco Brands is acquiring Skylar, in a move that affirms the company's path to acquire "behavior changing" technologies and brands.

Under terms of the deal, Skylar will operate as a separate business unit within Starco Brands, continuing to be led by Cat Chen.

Starco Brands acquired Art of Sport, the athlete-inspired personal care brand co-founded by Kobe Bryant, in September 2022.

Starco Brands' founder and CEO Ross Sklar said, "We are so happy to welcome Skylar to the Starco Brands family. Cat Chen and her team have done an incredible job pioneering and building a ground-breaking, clean, beautiful, premium, incredibly well-scented, and recyclable fragrance brand that most thought impossible just a few short years ago. With a strong retail, DTC and subscription business, we look forward to working with Cat and her team to take Skylar to the next level and build the next industry power brand."



Skylar is a maker of fragrances that are hypoallergenic and safe for sensitive skin.

Chen said, "I've always been attracted to the beauty of fragrance. When I found that my newborn daughter was allergic to traditional fragrance, I set out to create a line that was as safe as much as it was aspirational. I'm incredibly proud of the clean fragrance brand we've built, as we set out to completely disrupt the $50B perfume market. I look forward to leveraging the Starco Brands infrastructure to continue that disruption and take the brand to new heights."

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Flavor Partnership Ventures: IFF, Mane and Symrise



To better understand how to improve the sensory quality of meat alternatives, Symrise has announced a partnership with scientists from Wageningen University & Research in the Netherlands, Nissin Food Holdings, Starfield Food & Science Technology, AAK, Vivera and GoodMills Innovation.

With the food flavors market is projected to reach $21.3 billion by 2027[a] (growing at a CAGR of 3.5% from 2022 to 2027), flavor houses are looking for ways to maximize trends and problem-solve current challenges in markets. Sometimes these problems can't be taken on solo. Here are the latest partnerships in flavor from leading companies in artificial intelligence, certifications, ingredient research and more.

IFF AI-Driven Personalized Nutrition Platform Partnership

IFF's partnership with Salus Optima, a British-based, digitally-enabled personalized nutrition, health and wellness company, has created an artificial intelligence (AI)-driven personalized nutrition platform. The platform is designed to help consumers understand their unique metabolic response to food, supplements, activity and sleep, accessible via mobile phones and wearables.

IFF Partnership Targets Iron Tolerability

IFF announced the company's partnership with the Universidad Católica San Antonio de Murcia (UCAM), to showcase the tolerability of its AB-Fortis iron ingredient. AB-Fortis is an iron salt encapsulated in alginate—a natural seaweed-derived polysaccharide. Per IFF, the AB-Fortis maintains its encapsulation in the stomach to avoid triggering gastrointestinal (GI) discomfort and then releases iron in the intestine for optimal absorption.

Mane Kancor and Natures Spices Announce Partnership

This new enterprise works in the space of ground, cracked and milled spices and seasoning blends. The announcement of the venture was done by Geemon Korah, CEO, executive director of Mane Kancor at Kochi.

Symrise Partnership Examines Sensory Quality of Meat Alternatives

To better understand how to improve the sensory quality of meat alternatives, Symrise has announced a partnership with scientists from Wageningen University & Research in the Netherlands, Nissin Food Holdings, Starfield Food & Science Technology, AAK, Vivera and GoodMills Innovation.

Symrise Partnership with Norwest Ingredients Solidifies Verified Mint Achievement

Symrise's partnership with Norwest Ingredients, and the mint farmers who supply them, has enabled the ability to offer its customers products with mint verified at the gold level of SAI Platform's Farm Sustainability Assessment (FSA).

p&f+

[a]*https://www.yahoo.com/now/food-flavors-market-worth-21-120000622.html*

OVR Debuts First Spatial Scent Technology for the Metaverse

You may remember OVR's (Olfactory Virtual Reality) name from the cover of the June 2022 issue. Within the article, "OVR Technology's Scentware for Virtual Reality," CEO and co-founder Aaron Wisniewski, alongside Sarah Socia, vice president of Scentware, shared their insight on the various facets of the newly developed technology. On a mission to unpack the various aspects of well-being, OVR Technology has merged the worlds of virtual reality and olfactory to create the Architecture of Scent (AOS). Assembling a team of researchers, practitioners and technologists, AOS is designed to use scent to stimulate and access memory to transform cognition, emotion and behavioral responses.

Since then, the company has been diversifying its technology and expanding its reach. The updated tech, called "ION3" is the first spatial scent technology for the metaverse.

Scents are both released and cleared with near zero latency allowing for rapid cycling of experience without odor buildup.

How It Works

The ION3 patented microtechnology is said to create extremely precise, nano bursts of scent without the use of heating elements or fans. The reusable scent cartridge has eight base scents that can be used to create multiple combinations and variations. Scents are both released and "cleared" with near zero latency allowing for rapid cycling of experience without odor buildup.

A patented software plugin is said to understand user behavior in the virtual world and send real-time wireless signals to hardware components for activation. It works with all digital content developed in Unity or Unreal. The interface mimics audio components so virtually zero up-skill is needed.



The ION3's reusable scent cartridge has nine base scents that can be used to create multiple combinations and variations.

The OVR release reads, "Scents are complex mixtures of aroma molecules that we formulate based on our sensory expertise as well as chemical data we get from frequent 'field sampling' in nature[..] Some scents are extremely accurate and realistic while others are more suggestive. It all depends on the application and desired outcome. "

All scents are water-based and approved by IFRA for safety. Scentware creation is also informed by psychology, neuroscience, and research.



Kohler Launches Sprig Shower Aromatherapy System



Also featured at CES 2023 is Kohler's Anthem Digital and Statement Showering Collection.

With well-being and functional products growing in popularity, Kohler has launched two products incorporating aromatherapy at CES 2023.

The global aromatherapy market size[a] is expected to surpass around $5.62 billion by 2030 with a registered CAGR of 11.2% during the forecast period 2022 to 2030. At the same time, Pinterest[b] highlighted showers as a key self-care trend for 2023. In fact:

- Shower routine aesthetic searches are up 460%
- Amazing showers walk in searches are up 395%
- Shower bomb searches are up 90%
- Home spa bathroom searches are up 190%

Sprig is Kohler's new lifestyle brand, consisting of shower infusion systems with natural shower infusion pods, versatile body and linen mists and bath bombs said to provide a peaceful escape through aromatherapy.

Sprig infusion systems retrofit to an existing shower to diffuse aromatherapy into the water, to "elevate a daily routine into a moment of escape to enhance well-being."

For instance, the Relax Shower Infusion Pod consists of a chamomile and green tea scent that inspires calm. Each pod is enhanced with hyaluronic acid and sodium PCA to deliver self-care experiences for the user's skin and hair.

Ingredients for the Relax Shower Infusion Pod include: Water (Aqua), Glycerin, Heptyl Glucoside, Fragrance (Parfum), Phenoxyethanol, Caprylyl Glycol, Acacia Senegal Gum, Hyaluronic Acid, Sodium PCA, Xanthan Gum, Tocopheryl Acetate, Geraniol, Heptanol, Sodium Phytate, Eugenol, Citronellol, Limonene, Coumarin, Benzyl Benzoate, Citral, Farnesol and Citric Acid.

As a 2023 CES Innovation Award honoree, Kohler's Stillness Infinity Experience bath is a multi-sensory smart bathing experience said to transform the bathroom into a sanctuary for relaxation and comfort. The freestanding bath brings together water, light, fog and aromas to create an immersive experience to be customized through the Kohler Konnect app.

p&f+

[a] *https://www.precedenceresearch.com/aromatherapy-market#:~:text=The%20global%20aromatherapy%20market%20size,forecast%20period%202022%20to%202030.*

[b] *https://www.gcimagazine.com/consumers-markets/news/22591830/4-beauty-trends-for-2023-pinterest-predictions*

Mane Debuts Two Facilities in India



The location in Byadgi also hosts a newly commissioned supercritical fluid extraction plant, extracting spices, herbs and flowers using food-grade CO_2.

On December 22, 2022, Mane announced the debut of two facilities in India—Angamaly, Kerala and Byadgi, Karnataka. The Angamaly isolation plant is designed to craft natural colors and is said to be equipped with a distributed control system (DCS) for operational precision, energy-efficient equipment and an enhanced solvent recovery system.

During the inauguration ceremony, Mane president Jean Mane laid a foundation stone for the Angamaly administration building and officially launched True Spice Express, a public vending machine selling whole spices, spice powders and blends.

Jean Mane also inaugurated the administration office and isolation and enrichment plant for Oxikan natural antioxidant solutions in Byadgi, Karnataka. The location in Byadgi also hosts a newly commissioned supercritical fluid extraction plant. This new plant extracts spices, herbs and flowers using food-grade CO_2.



PROFILE: ZERLINA DUBOIS

The master perfumer shares her fragrance journey, advice for newcomers and how the industry has evolved.

In late 2022, former Procter & Gamble master perfumer Zerlina Dubois announced her retirement from the company. Known for her decorated wins throughout the fragrance sector, *Perfumer & Flavorist+* (*P&F+*) reached out to learn more about Dubois' next adventure in the industry. Just weeks later, she updated her LinkedIn position to CEO and founder of Zerlina Inc.

With nearly four decades of experience in fragrance, Dubois shares her journey to becoming a master perfumer, advice for newcomers and what pushes her to create winning formulations.

***P&F+*: What led you to the fragrance industry?**

Zerlina Dubois [ZD]: Thirty-six years ago, I had just completed a degree in studio art and biochemistry with a master's degree in organic chemistry. I was exploring ways to combine my passion for art with my strong technical curiosity in chemistry. I was fortunate to find perfumery (or maybe perfumery found me) when I encountered an opportunity to explore this amazing field. I joined Procter and Gamble (P&G) as a perfumer-in-training. This was the perfect fit for me.

I genuinely love making fragrances, discovering new molecules and technologies, and ultimately making olfactive art. I am a person who thrives on thinking with both my right brain and my left brain. I love to look for the unapparent connections. Sometimes this can get messy, and it is never linear. As an artist I always look for new things to inspire me, and this allowed me to start the Fragrance Trends program. A perfumer searches broadly for inspiration—a new molecule, a new food, fashion, art, and design are some of the places to lose ourselves in search of ideas. I have always partnered to drive holistic designs into brands. The fragrance tells a story and needs to fit with the consumer expectation for the journey of a product. The fragrance has a functional job, an emotional job and a social job. I always look closely at what is going on in the world to decide what is going to be important for the next big fragrance creations. This is how you create iconic fragrances—they must be in tune with the pulse of the consumer.



Zerlina Dubois merged her passion for art and curiosity in chemistry to ignite her path to becoming a perfumer.

Applying this approach over the years has led me to create hundreds of formulas across all of P&G's beauty brands and forms. Even as a skilled perfumer, it ultimately is a game of hard work and being willing to go the distance to create multiple modifications to get to the winner. I am thankful to have had so many great opportunities to not only create fragrances, but to cultivate the scent signatures shaping consumer tastes and scent expectations across product categories. As I have designed fragrances for Pantene from the time P&G acquired the brand, I have helped curate the overall "smell of shampoo" for consumers around the world. While Olay traditionally focused on the smell of skin products from Olay pink lotion to its face creams, I helped broaden the scent horizon and now the Olay body washes are some of my favorite creations that make the consumer smile in the shower and last on the skin. My favorite launch was Camay, Zerlina Dubois. The fragrance was elegant yet had power and technology that really made it stand out in a memorable way for the brand.

I have never been happy with staying at status quo. I always think outside of the box. One of my

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favorite phrases you will hear if you work with me is "You might think I am crazy but let's try this." This has allowed me to push the boundaries of creativity by trying all sorts of crazy combinations. Unexpected combinations are where I have seen the biggest wins.

In addition to my strong creative passion, I never forgot about the science. This led me to generate over 75 patents that allowed P&G to push the boundaries of performance on fragrance. Understanding technology and the product chassis is key to getting the best performance from your fragrance. I am always thinking about how to leverage scent and the sense of smell with various partners inside and outside of the industry. This has allowed me to go beyond and really push performance.

My passion for fragrance has always been connected to the beauty industry. I truly believe men and women want smells that make them feel beautiful and happy. Fragrances are a part of our happiness. My job as a perfumer is to help the world be a better place.

***P&F+*:** What is some advice for people coming into the perfumery field?

ZD: A perfumer must have passion, perseverance, and the ability to think creatively. A perfumer has to be able to take critique. People will tell you they like your fragrance one day, they don't like your fragrance the next day, and will always tell you how to make it better. Feedback is a gift if used wisely. How you handle this is what will define your outcome.

I have trained many perfumers. Some succeed and some don't. I see that those who are willing to push the boundaries are the ones who become shining stars. Never be afraid to try new perfume raw materials. Never be afraid to try new combinations. Try to overdose a material to create a new experience. And it is important to know your basics. Know how to create the best jasmine, rose and muguet. These basics are the fundaments that can take you anywhere. Know your materials and have your favorites, but never avoid using something just because you don't personally like it. You are creating for the consumer, not yourself. The best evaluators and perfumers remove their personal preferences from their work.

As in music, we take inspiration from the past. We study formulas that have helped shaped the market, and we learn. Perfumery is a lifetime of learning and innovating. We take the notes of Chanel, Tresor and other classics and combine them in new ways. We add specific materials for bloom, residuality and signature. It is about pushing the pitch in a new way with a balance of



Dubois passion for science led her to generate over 75 patents that allowed P&G to push the boundaries of performance on fragrance.

powerful materials. It is always the unexpected that creates the new iconic signature. The bold trendy niche brands can inspire the work for mass market brands. But timing is everything. It is important to find the right inflection point in the market to successfully launch a new signature scent, particularly one that redefines or challenges the "norm" in a particular brand or category. We influence market trends and the scent expectation for products. We also drive emotions and memories through smell. What is the next smell of comfort, safety and energy? What should the next shampoo smell like?

As the world is changing, we need to think about responsible fragrance creation. I see the power of nature and naturals coming back. We must make sure we embrace learning and understanding our natural materials. The quality of our palette of ingredients is important to really drive what the consumer wants. We need to give our consumers a "window in" to our creative process—the reason we picked certain materials. This is about being responsible, sustainable, and cruelty free. I was part of the Each and Every brand, an all-natural deodorant that appeals



Dubois urges up-and-coming perfumers to never be afraid to try new combinations.

to this new consumer. We handpicked the natural materials, and we celebrated these ingredients as we told the story of the fragrance.

The world is ever- changing, and this impacts our approach to fragrance creation. For instance, we will always have female scents and male scents, but the future of gender and what this means for fragrance will evolve. I saw this with my work on Old Spice and Head and Shoulders. How we define and create unisex, gender-neutral scents will continue to evolve. Every new generation of consumers is open to trying things we may not have expected to work in the past. One must never assume. It is important to continually challenge ourselves to push the boundaries. A rose scent today can be liked by all genders and all ethnic cultures. But then you also have special scents that mean something for a unique group of people. For perfumery this will open the way we think and create.

***P&F+*:** Can you share your first scent memory?

ZD: I grew up in an Asian family, and I always had the smell of spices, chai, and big bold scents in the kitchen. This has led me to always add a touch of an "edible" nuance in my fragrances. A touch of a spice or fruit is often a good hook and can lead to the next new signature.

Some of my early career influences were in the midst of the big bold scents of the 80s. These scents were trendsetters. For example, Poison with damascones, Cool Water with allyl amyl glycolate, Giorgio with anthranilates. I learned to appreciate the power of the perfume material overdose in making a signature style statement.

I feel thankful to have experienced a world where perfumers regularly shared and taught each other. I learned from some of the best in the industry. Sophia Grojsman was my mentor, and I aspired to be like her. She taught me her famous gadgets and tricks. She said everyone loves roses. Roses make people feel beautiful. She is a legend in perfumery and one of the first great female perfumers.

***P&F+*:** What does the future of fragrance look like from your perspective?

ZD: I believe the best fragrances for the future will be creations born from great collaborations among perfumers. Having two or more creative minds drives to big wins. I began collaborating with perfumers early in my career and never worked in a silo. Creativity is about finding those unique combinations. Having two creative minds helps push the boundaries in ways not possible otherwise.

As I sum up my journey, I believe the essence of creating a great fragrance is having a vision and a goal to do something more powerful than just make a "smell." Perfumery is about evoking a memory and bringing an emotion. It is about making people's lives better each day through scent experiences with signature to entice, and power and depth to perform and last. Tell your story through the art and science of perfumery to bring joy into this world.



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Thirty ppm of isoamyl alcohol fits in with the brighter components of blueberry, 20 ppm is ideal in blackberry, while 500 ppm is best in honey applications.



BY JOHN WRIGHT
johnwrightflavorist@gmail.com

Flavor Bites: Isoamyl Alcohol

This touchy material can seem harsh and unpleasant at high levels, but at modest levels it can add brightness without becoming at all unpleasant.

Isoamyl alcohol, 3-methyl butanol (FEMA# 2057, CAS# 123-51-3), has a sharp fusel character. As a wine enthusiast, the character of isoamyl alcohol is not necessarily welcome. It might be mildly interesting in a fresh Gamay wine from Beaujolais, but aging wine is generally seen as beneficial, in part because the level of isoamyl alcohol is significantly reduced.

As with many other flavor chemicals, this is a little misleading. Isoamyl alcohol can seem harsh and unpleasant at high levels, but at modest levels it can add brightness without becoming at all unpleasant.

Note that the dose rates given throughout this article are the levels suggested for use in flavors intended to be dosed at 0.05% in ready-to-drink beverages or in a simple bouillon.

Fermented Flavors

Beer: In all alcoholic beverages the effect of isoamyl alcohol is modified by the ethanol level. Higher levels of ethanol reduce the impact of isoamyl

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alcohol. A good starting level of isoamyl alcohol in light beer flavors is 6,000 ppm, slightly higher in dark beer flavors.

Brandy: Most brandy flavors take mature Cognac as their ideal target and the ideal level of isoamyl alcohol is relatively moderate, again around 6,000 ppm.

Bread: Bread flavors vary, but some level of fermented note is usually helpful. One thousand ppm of this raw material is a reasonable starting point.

Rum: Light and dark rum flavors are dramatically different in many respects, but the ideal level of isoamyl alcohol is actually quite similar, around 5,000 ppm.

Tequila: Aging has a dramatic effect on tequila, increasing the vanilla character exponentially. It is best to formulate tequila flavors cautiously, using levels of isoamyl alcohol in the vicinity of 2,000 ppm.

Whisky: The character of whisky is more complex and powerful than other spirits and the ideal level of isoamyl alcohol in whisky flavors reflects this fact. Ten thousand ppm is an effective level.

Wine: Levels of this ingredient in wine flavors vary with the style of wine, but 5,000 ppm is a good initial level in both red and white wine flavors.

Yeast: The nature of yeast flavors is driven by the balance between the ethyl esters and isoamyl alcohol. Four thousand ppm of isoamyl alcohol works well in most combinations.

Orchard Fruit Flavors

Apple: Most orchard fruit flavors are best served by low levels of isoamyl alcohol. Apple flavors are an exception. Depending on the profile, levels as high as 2,000 ppm are not out of place.



Most brandy flavors take mature Cognac as their ideal target and the ideal level of isoamyl alcohol is relatively moderate, again around 6,000 ppm.

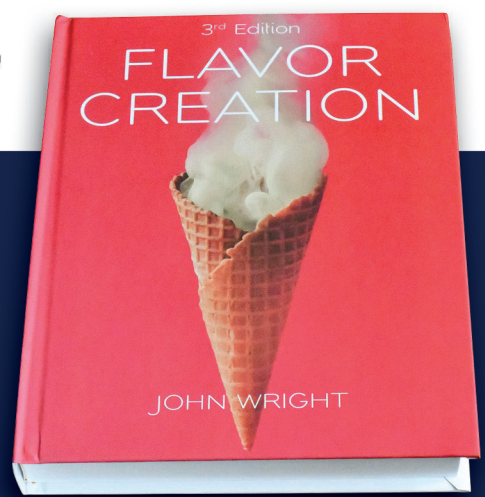
Apricot: Apricot flavors fit better into the norm for the category. A modest addition of around 20 ppm of isoamyl alcohol lifts and brightens the profile.

Cherry: Twenty ppm is also a decent level for most types of cherry flavor, perhaps a little higher if benzaldehyde is especially dominant.

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Peach: The brightening effect of isoamyl alcohol works as well in peach flavors as it does in apricot flavors. Twenty ppm is, again, an ideal level of addition.

Pear: A somewhat higher level is acceptable in pear flavors, offsetting their higher ester levels. Upwards of 100 ppm is effective.

Berry Fruit Flavors

Blackberry: As was the case with orchard fruit flavors, berry flavors generally work better with modest additions of isoamyl acetate. Twenty ppm is ideal.

Blackcurrant: Even lower levels, around 10 ppm, work best in most styles of blackcurrant flavor.

Blueberry: Thirty ppm of this ingredient fits in with the brighter components of blueberry flavors and helps lift the impact even higher.

Cranberry: The same 30 ppm level is also ideal in cranberry flavors, offsetting the profile damping effect of the aliphatic acids.

Raspberry: Isoamyl alcohol works well in conjunction with hexanol in raspberry flavors at 20 ppm. The effect is to brighten the profile and add freshness.

Other Fruit Flavors

Banana: Given the typically high levels of isoamyl acetate, it is no surprise that isoamyl alcohol is very effective in banana flavors. Eight hundred ppm is a good starting point.

Grape: This raw material makes a good addition to all types of grape flavors. In practice it is most useful in floral-oriented white grape types, at levels ranging up to 600 ppm.

Kiwi: Kiwi flavors are quite delicate, but they can make good use of relatively high levels of isoamyl alcohol, up to 500 ppm.

Orange: Isoamyl alcohol might not seem to be a good idea when trying to steer an orange flavor in a juicier direction but is surprisingly effective at 500 ppm.

Passionfruit: Passionfruit flavors are normally so bright that adding isoamyl alcohol might seem to be "gilding the lily." Despite that, adding as little as 30 ppm is distinctly helpful.

Pineapple: Pineapple flavors are somewhat similar to passionfruit flavors and the same 30 ppm level of addition of isoamyl alcohol has the same beneficial effect.

Other Flavors

Coconut: Isoamyl alcohol lifts all types of coconut flavors, ranging from 150 ppm in most types up to 300 ppm in coconut water types.



It is best to formulate tequila flavors cautiously, using levels of isoamyl alcohol in the vicinity of 2,000 ppm.

Hazelnut: This ingredient adds realism to all nut flavors, but it is most effective in hazelnut flavors. Levels range up to 1,000 ppm.

Honey: Honey flavors come in many different shapes and sizes. Isoamyl alcohol is useful in all of them, but especially in clover honey types. Five hundred ppm is the best level of addition.

Olive: Creating authentic olive flavors are an interesting challenge and high levels, up to 3,000 ppm, of isoamyl alcohol contribute to the solution.

Peanut: Peanut flavors become better balanced with lower levels of isoamyl alcohol than hazelnut flavors, around 200 ppm.

Soy Sauce: A moderate level of isoamyl alcohol, around 100 ppm, makes perfect sense for soy sauce flavors, given the fermentation aspect of soy sauce.

Tea: The same comments apply equally to black tea flavors, and the same 100 ppm level works equally well

Tomato: A modest hint of isoamyl alcohol lifts fresh tomato flavors. Thirty ppm is ideal. This ingredient is much less helpful in processed or heated tomato profiles.

Walnut: Isoamyl alcohol is helpful in walnut flavors but the effect is less obvious than other nut flavors. One hundred ppm is a good starting point.



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FOOD SAFETY'S IMPACT ON F&F REGULATIONS

Why recategorization of food allergens, recalls and remodeled requirements could influence the industry.

BY LUKE GROCHOLL, PH.D., head of food regulatory experts, MilliporeSigma



The FDA's approach to food safety will likely result in many new regulations impacting the industry.

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In late January 2020 Talia Day, the mother of two young children with severe food allergies testified before the United States Congress on the dangers of undeclared allergens. Her children, like an estimated 1.6 million other Americans, are allergic to sesame. With support from her testimony and the work of groups like FARE[a] (Food Allergy Research & Education), the FASTER Act[b] was signed into law requiring that sesame be declared on food labels as a major food allergen.

Sesame was already considered major food allergen in Europe, Canada, Australia, New Zealand, much of the Middle East and parts of Asia. Now in the United States all GMP and manufacturing controls for allergens must include sesame. Furthermore, if present in any quantity, sesame must be called out on product labels. The addition of sesame as a major food allergen requires flavors and fragrance companies to review their processes and supply chains to ensure that any potential source of sesame is identified and controlled. Recent changes to food allergen requirements were not exclusive to the United States. Japan is also expanding its list of major food allergens with walnuts being shifted from a voluntary disclosure status to mandatory labeling.



The addition of sesame as a major food allergen requires flavors and fragrance companies to review their processes and supply chains to ensure that any potential source of sesame is identified and controlled.

Smells Great, but How Does it Feel?

Although the recategorization of sesame and walnuts as major food allergens may heavily impact much of the food industry, it will be a minor challenge compared to proposed EU cosmetic regulation changes for the flavors and fragrances industry. Regulation (EC) No 1223/2009 currently identifies two dozen chemical substances and two botanical extracts as fragrance allergens. A proposed update to the regulations expands the list of fragrance allergens to 82 substance and extracts. The scope of this change is significant as it will likely triple the number of fragrance allergens that require reporting in the EU. Once implemented, a thorough review of all raw materials for fragrance applications will likely be required to maintain compliance with any changes to the EU cosmetic regulations. The European Commission is currently reviewing comments made on the proposed draft and an adoption transition period will be included for new mandates.

A Tiny Molecule and a Major Food Recall

Europe also had a major requirement change stemming from the largest food recall in EU history. While this issue again originated with sesame, it was not due to allergenic concerns.

In September 2020 sesame seeds imported from India were found to be contaminated with ethylene

[a] *foodallergy.org*
[b] *congress.gov/bill/117th-congress/senate-bill/578*

oxide, also called ETO. Ethylene oxide is powerful fumigant and is commonly used to sanitize medical equipment. It is also used as a sanitizing agent for foods (most commonly spices) and food equipment in some parts of the world. It is a small, volatile molecule which disperses into very small or porous spaces and quickly dissipates, thus its utility for treating medical equipment. It is a known carcinogen; however, it exhibits reproductive toxicity when ingested. So, how did it contaminate Indian sesame resulting in some 3,000 product recalls?

Ethylene oxide fumigation of sesame seeds in India is not uncommon. Treatment with ETO will kill salmonella, a significant risk in warm, humid Indian granaries. Since it is volatile, ethylene oxide should quickly dissipate bringing any residual ETO to below 0.1 ppm (<0.1 mg/kg) as recommended by safety limits. In the presence of moisture and chloride sources, such as salt, ETO can readily convert to 2-chloroethanl (2-CE), a much less volatile compound that may not evaporate from treated seeds, thereby making it an excellent proxy in testing for ethylene oxide. 2-Chloroethanyl has its own toxicological concerns, however, so the presence of 2-CE is still a major issue.

But it was not just sesame seeds. The initial report from the autumn of 2020 raised the concern about ETO which was subsequently found in bean gum, guar gum, and xantham gum from Turkey and other regions. Many of these ingredients are commonly used as thickening agents, emulsifiers, and stabilizers in food products ranging from ice cream to chewing gum. But where was the ETO coming from?



The scope of the recategorization of sesame and walnuts as major food allergens is significant in the cosmetics realm as it will likely triple the number of fragrance allergens that require reporting in the EU.

Ethylene oxide is a raw material used in the production of some common food additives such as polysorbate and polyethylene glycol. For this reason, the EU set a limit of not more than 0.2 mg/kg (ppm) ethylene oxide for these food additives. But now ETO and 2-CE were being found in many other food ingredients. Treatment with ethylene oxide as a sanitizing agent, the suspected source in sesame seeds, was thought to be the cause, but investigations found ETO fumigation unlikely for many of the contaminated products. Finally, a likely source was identified. Food ingredients must be stored in sanitary conditions but packing and shipping them introduce potential hazards. Sea freight in particular may find ingredients contained in a warm, wet environment ideal for microbiological growth. Some shipping firms thought they had found a solution; they were treating shipping containers with ethylene oxide.

Sea freight containers create a major challenge for sanitary shipping. They are often large and difficult to clean. Decontaminating the containers with sanitizing detergent or bleach can leave residual odors that would impact the quality of the food shipped. Ethylene oxide presented a seemingly ideal solution. Shipping containers could be treated with the ETO and then aired out to let the volatile material evaporate before loading with food. However,



since 2-chloroethanol readily forms in the presence of chloride and water, as found in seaside conditions, residual 2-CE remained to contaminate food and ingredients.

As a result, the EU implemented screening of imported foods, particularly from Asia where ETO treatment is more common. Additionally, the requirements for food additives were updated. Previously only those food additives manufactured using ethylene oxide as a raw material had specified limits on the amount of ETO. Now the regulation[c] stipulates that ethylene oxide cannot be used for sterilization of food additives and further sets a specification of no more than 0.1 mg/kg (ppm) ETO in any food additive used in the EU.

Although EU regulations distinguish flavors from food additives and the regulation does not directly impact flavor ingredients themselves, many flavor formulations require food additives as stabilizers, surfactants, antioxidants and other technical functions. Flavors and fragrances companies must ensure that any ingredient classified as a food additive meet this strict ethylene oxide limit.

A New Vision for Food Safety

To help prevent significant food safety issues like the national baby formula shortage, the FDA commissioned an independent expert panel in July 2022 to review their food programs. This report[d], published in December by the Reagan-Udall Foundation, outlines several recommendations and highlights areas for improvement. Acting on this report, the FDA plans a "new vision" to quickly resolve potential and known food safety hazards. This report demonstrates the FDA's continued commitment to food safety and will result in many new regulations that impact the flavors and fragrances industry. Although an overhaul of the FDA's approach to food safety may take many years, it will likely result in many new regulations impacting the flavors and fragrances industry.

[c] *eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012R0231*

[d] *reaganudall.org/sites/default/files/2022-12/Human Foods Program Independent Expert Panel Final Report 120622.pdf*



Perfumers need to be more comfortable being uncomfortable, explore new ingredient ideas and learn to win with the palette of the future.

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3 CHANGE AGENTS SHAPING FRAGRANCE FORMULATION

How perfumers can best navigate three areas currently having the biggest impact on the fragrance industry.

BY PHIL PORTER, research fellow perfumer, Procter & Gamble

The fragrance industry, like many, is currently undergoing the fastest rate of change in its millennia of history. These winds of change are going to have a major impact on the way perfumers and perfume houses work and the winners will be those best adapted to change. For consumer goods companies' investment in perfume over other ingredients and package options is a choice and to continue to attract this investment perfume houses will need to pivot to address these changes while maintaining focus on delighting the consumer.

I see three areas in particular having the biggest impact on the fragrance industry—regulation, sustainability and machine learning.

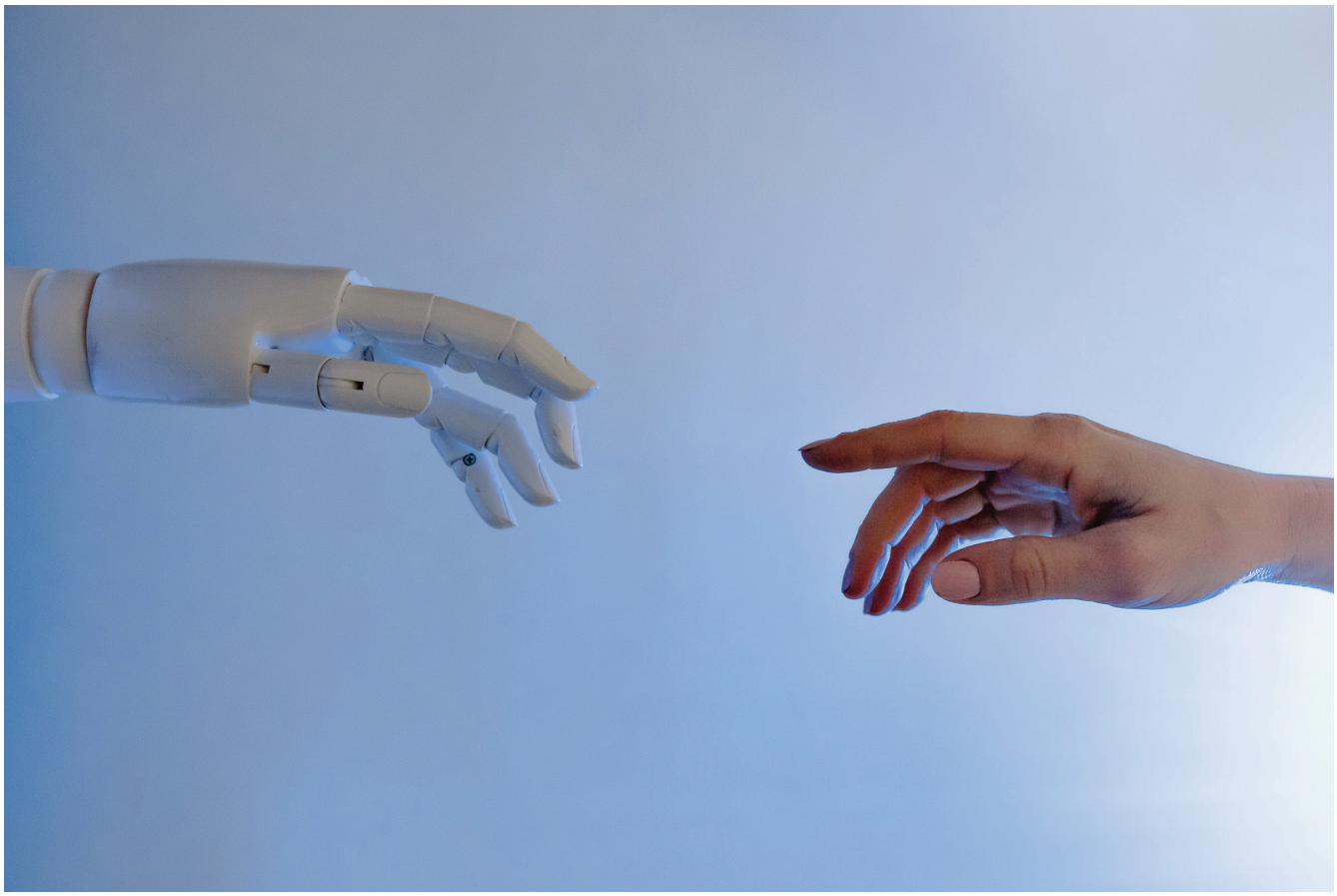
Regulation

Henry Ford is claimed to have said his customers were asking for a faster horse and he gave them the motor car. This may be apocryphal but the transition in only a few years from mostly horse to mostly car was actually driven more by sanitation and regulation than speed or convenience.

Our industry is also being shaped by regulation—changing classification of existing materials and challenges in registering new ones. Faced with the potential disappearance of valued materials perfumers naturally ask for new materials that will fill the gap and allow them to continue to design in the way they know. The unintended result however is that whenever a material is threatened with removal from the perfumer's palette there is a proliferation of new potential replacement materials aiming, as much as possible, to be a 'drop-in' alternative.



Consumer education is also critical, science-based information builds industry credibility alongside deeper consumer understanding and appreciation for fragrance.



Perfumers failing to share formula tips and tricks leads to information disparity with the AI tools that are populated with all known formulas in a given environment.

However, this desire to maintain palette continuity means that a significant portion of industry R&D resource is tied up in effectively keeping us in the past trying to develop 'faster horse' versions of current materials. Perfumers need to be more comfortable being uncomfortable, explore new ingredient ideas and learn to win with the palette of the future. To paraphrase Wayne Gretzky—we need to skate to where the puck is going to be not where it has been.

Sustainability

Sustainability can sometimes seem like a bewildering whack-a-mole of multiple, often contradictory, elements; renewability, biodegradability, biogenicity, carbon footprint. Sometimes a win in one area is a loss in another vector. At Procter & Gamble, we believe the Life Cycle Analysis tool is the best guide to delivering products with an optimized sustainability profile.

For perfumer and perfume design two things become apparent with the desire to minimize carbon footprint. The first is that if we are to assess the full carbon impact of a perfume in functional products, each individual ingredient will need to pull its weight. Materials with little or no olfactive impact will struggle to justify the carbon contribution. This will trigger a move to more impactful materials with higher odor value. Perfume dosages in finished products will become lower over time. This does not mean a drop in performance or investment, simply a move to greater mass efficiency.

This can be an advantage for the perfume industry. As perfume competes with other investment choices in the design of a finished product its flexibility in mass efficiency is a benefit. We will also see perfume delivery technologies play an increasingly important role in smart, targeted delivery of perfume to key consumer touchpoints.

A second area that will be challenged is the continued use of steam distilled naturals in perfumes. There's an accepted consumer belief that essential oils are good for people and the planet. Of course, this isn't necessarily true and just because something is natural doesn't mean it is sustainable or healthy (see my earlier point about a horse-based transport system).

In our industry we often read that 10,000 kg of rose petals or 250 kg of lavender are needed to make 1 kg of essential oil. This rarity is often exploited. The flipside of this scarcity is that it looks like very poor yield. Through the lens of carbon footprint the land, water and energy use in extracting many essential oils will become increasingly unsustainable.

More upcycling along with new and more sustainable agricultural and extraction processes will play a role. To a degree the future of biogenic carbon also lies with biotechnology and the ability to efficiently convert natural feedstocks into the aroma chemicals we need. This, coupled with green chemistry, will be the main driver of new ingredient technologies. The legendary Chanel perfumer Ernest Beaux is quoted as saying, "We'll have to count on chemists to find new substances if we are to make new and original notes. The future of perfumery is in the hands of chemistry." I would say the future of perfumery is now in the hands of biochemistry.

Consumer education is also critical. The industry has come together to proactively lead the way here with the Fragrance Creators Association's Fragrance Conservatory initiative. This is an online tool that empowers consumers with the science-based information they need to become confident in the scented products they use. This builds industry credibility alongside deeper consumer understanding and appreciation for fragrance.

Machine Learning

The promise of artificial intelligence (AI) is that it can perform intellectual tasks far more efficiently than a person or even a group of people. The current star of AI is ChatGPT—an open AI application that can answer questions, write complex essays or tell jokes upon request. And while professors may not want to see AI written essays from students, consumers don't care so much about the design provenance of a fragrance —AI designed scents are already being actively exploited in personal care.

Will AI replace perfumers? AI can certainly replace many predictable tasks of the perfumer but once again perfumers need to adapt. Just as the invention of the film camera removed the job of image capture from the artist—so the artist was freed to become more creative in their output and AI should spur a boost in creativity. The robots base their decisions on available data and they're not as well suited to creating Ernest Beaux's "new and original notes" which should provide a virtuous cycle of perfumers adopting new materials and technologies more quickly.

The common perfumer practice of working in isolation also needs to change with the expansion of AI tools. Perfumers failing to share formula tips and tricks leads to information disparity with the AI tools that are populated with all known formulas in a given environment. Game theory has a few things to say in such an information asymmetry and cooperative game theory says the best outcome for the group is to follow a collaborative strategy, the best outcome being when everyone in the group is doing what's best for themselves and the group. In other words, to survive in an AI world—perfumers need to collaborate more and perfume houses need to reward accordingly.

"Adaptability, technical acumen and frequent personal re-invention will become increasingly important to succeed."

The world does not have a whole lot of perfumers and I expect it will continue to be a fun and challenging career for those lucky enough to pursue it. Adaptability, technical acumen and frequent personal re-invention will become increasingly important to succeed. However, to weather these winds of change perfumers need to explore and embrace the materials and technologies of the future, they need the space and permission to do this and they need to do it more collaboratively.

p&f+

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FRAGRANCE POLICY AND REGULATION ADVANCES & EFFORTS

Understanding recent updates in ingredient policies in cosmetics, testing and fragrance.

BY FRAGRANCE CREATORS ASSOCIATION



Fragrances are among the most highly tested ingredients in the consumer marketplace and, through constructs such as the RIFM, our industry has long promoted the safe use of fragrances.

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Since 1927, Fragrance Creators Association (Fragrance Creators) has been proud to represent the fragrance industry. Our members have invested in a best-in-class fragrance ingredient safety program, are committed to consumer education, and have pledged[a] to collectively better advance perfumery, for people and for the planet.

2023 is already proving to be an important year for fragrance policy and regulation, and we see major opportunity to strengthen consumer trust and understanding. While Fragrance Creators is advancing a number of important policies—more below on that to come below—a key area of focus for us is the modernization of cosmetics regulations. With the passage of the fiscal year 2023 omnibus package, we were pleased to see our longstanding efforts materialize in the Modernization of Cosmetics Regulations Act (MoCRA).[1] We are grateful for our industry partners in this effort, in particular the Personal Care Products Association and the Independent Beauty Association as well as engagement from the broader stakeholder community.

Background

The fragrance industry has been advancing best-in-class science for decades to substantiate the safety of our ingredients and we are proud of our safety record. In addition, fragrances are subject to many state and federal laws that govern fragrance manufacturing. However, we recognized that key statutory provisions authorizing the Food and Drug Administration's (FDA) regulation of personal care products had not been updated in over 80 years. There was a broadly recognized need to revise the statute to meet the needs of today's consumer. By including MoCRA, the fiscal year 2023 omnibus created a modern cosmetics regulation framework—including for fragrance in cosmetic products—that advances science, safety, innovation and consumer confidence.

MoCRA makes broad changes to the cosmetics industry as a whole. Fragrance Creators being the representative of the fragrance industry, just one part of the larger personal care products landscape, we are focused on the fragrance relevant regulatory requirements stemming from this law. With Fragrance Creators' president and CEO, Farah K. Ahmed, being an FDA alumni and our decade's long relationships with FDA, especially in the Office of Cosmetics and Colors, we are well positioned to partner with the agency towards sound implementation of MoCRA and aid our members as they work to comply with the new regulatory requirements.

Fragrance Allergen Labelling

We were pleased to see the fragrance allergen labelling provision included in MoCRA. The fragrance industry has long supported informing consumers about potential sensitizers in products so people with allergies can find products that work for them. Our award winning fragrance education resource, The Fragrance Conservatory[b], empowers the public with sound, science-based information about fragrance ingredients, safety, benefits and more. We have worked on allergen disclosure laws across the country and stand ready to bring that

[a] *www.fragrancecreators.org/fragrance-creators-association-launches-responsible-industry-stewardship-program*

[b] *www.fragrancecreators.org/world-class-fragrance-education-resource-the-fragrance-conservatory-continues-to-grow*



By including MoCRA, the fiscal year 2023 omnibus created a modern cosmetics regulation framework—including for fragrance in cosmetic products—that advances science, safety, innovation and consumer confidence.

experience with us to work with the FDA as they promulgate a rulemaking to implement this new labelling requirement.

Assuring Safety

Our industry is also at the forefront of science, using new innovative methods to substantiate the safety of our ingredients. Fragrances are among the most highly tested ingredients in the consumer marketplace and, through constructs such as the Research Institute for Fragrance Materials (RIFM), our industry has long promoted the safe use of fragrances. The fragrance industry has over 50 years of experience analyzing ingredients for safety and looks forward to educating the broader industry as they comply with the safety substantiation piece of the new law. The new law also brings with it serious adverse event reporting mandates, registration requirements, good manufacturing practices regulation and more. While applicable mainly to the cosmetic manufacturers, the fragrance industry is prepared to aid our downstream customers with our expertise and experience.

Alternative Methods

The fragrance industry also has played a powerful role in developing alternatives to animal testing. We were pleased to see the sense of United States Congress included in the bill that animal testing should be phased out in substantiating the safety of cosmetics, with appropriate, limited exemptions. We urge the federal government to act on that sense of Congress and are prepared to discuss our industry's experience in alternatives to animal testing.

Our Work Beyond MoCRA

Fragrance spans across product multiple product categories—from cosmetics to cleaning products to industrial uses and beyond. This gives our association a unique perspective and vast experience across multiple regulatory constructs. So while we are focused on MoCRA implementation and compliance, we continue to accelerate our leadership on other policy and regulatory issues, and to strengthen consumer trust and appreciation. We are:

- Actively working in Canada as they update their Canadian Environmental Protection Act;
- Engaging with the Environmental Protection Agency on their new and existing chemicals programs under the Toxic Substances Control Act;
- Advocating at the state level with legislators and regulators alike, including New York and California, as they attempt to implement their own regulatory programs;
- Growing our public education initiatives by expanding The Fragrance Conservatory, and investing in research, like our recent benefits of fragrance in household products study[c];
- Coordinating with international stakeholders to determine the North American impacts of global actions; and more.



Fragrance Creators is actively growing its public education initiatives by expanding The Fragrance Conservatory, and investing in research, like the association's recent benefits of fragrance in household products study.

Fragrance has the power, beyond all frontiers and cultures, to uplift lives. We will remain focused on working strategically and partnering effectively to deliver meaningful results that ensure our industry will continue to uplift people and the planet.

References

1. Modernization of Cosmetics Regulation Act of 2022, HR2617 – 117th Congress (2021 – 2022): Consolidated Appropriations Act, 2023, HR2617, 117th Cong., §3502 (2022).

[c] *www.fragrancecreators.org/new-fragrance-benefits-study*



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Indian Sandalwood's Role in the Growing Sandalwood Oil Market

Understanding the shift in sandalwood market in terms of versatility, usage and sourcing.



The so-called "king of woods," offers a soft-creamy wooden signature profile as well as a liquid gold appearance.

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The sandalwood oil market size is projected to reach $175 million by 2028, growing at a CAGR of 8.9% from 2021 to 2028. The evolution of the sandalwood market, more specifically the Indian Sandalwood market, has seen a shift as far as versatility, usage and sourcing. *Perfumer & Flavorist+* (*P&F+*) connects with Dominique Sergi, global account sales manager at Santanol to shed light on the ingredient and how it is transforming within the fragrance and cosmetics industry.

***P&F+*: Generally, how is Indian Sandalwood sourced?**

Dominique Sergi [DS]: Indian sandalwood trees are indigenous primarily to India. High demand and unscrupulous forestry management gradually depleted local resources leading to deforestation in their native environments and fostering a large dubious market. With illegal deforestation and inadequate replanting, the Indian tree was listed as vulnerable to extinction in the wild in the early 2000s.

At the same period, a sustainable approach has been proposed by pioneer companies in Australia to encourage the establishment of sustainable plantations. *Santanol* promptly seized this opportunity.

For centuries the wood from *Santalum spicatum,* the Australian endemic botanical tree, was extracted to yield Australian sandalwood essential oil.

Since the 1990s, *Santalum album*, the East Indian tree botanical species has been largely planted in plantations in the northern part of Australia, covering large areas where land and water were largely available. Initially, the lands were semi-desert, and the plantations have enhanced biodiversity thanks to the presence of many insects, birds, and animals that are now living in the cultivated areas.

The Australian sustainable production of East Indian sandalwood essential oil is now recognized as a top and preferred quality by the industry.

It is a long-term investment and engagement as it takes at least 15 years for the *Santalum album* tree to mature and develop heartwood which yields the precious oil.

There are also many other routines to follow before the oil in its final form is obtained such as:



High demand and unscrupulous forestry management gradually depleted local resources leading to deforestation in their native environments and fostering a large dubious market.

- Grading of the wood and carefully monitored documentation to ensure robust traceability is maintained throughout the processing;
- Three-to-six-month month drying process before the harvested wood is chipped;
- Several days to run the distillation;
- Many distillation samples to be analyzed and selected to create customized blends.

***P&F+*: Can you share any sustainability innovations that have been developed in recent years?**

DS: Everything needs balance, so we are committed to protecting and supporting the wildlife and biodiversity of the region as well as the surrounding indigenous community.

Water management is also a key factor we consider daily. Irrigation systems in our plantations are by natural gravity and flood irrigation, so there is no need for power or diesel-driven pumps.

Sustainable innovation can have an impact on three steps of the value chain:

Agro-Forestry

Preserving biodiversity: The mix of trees around *Santalum album* is of importance and the selection represents a real in-house savoir-faire. The *Santalum album* tree is surrounded by several different host plants during its growth phases creating a diverse ecosystem. By avoiding a monoculture in the plantation areas we have created an ecosystem that attracts and conserves an abundance of wildlife, including wallabies, reptiles and many species of birds and insects.

End-to-end control: We started collecting the seeds of our most "elite" trees and have created a seed orchard. With this, we are now able to solely plant the healthiest and most diverse seeds from the orchard, giving us control over the supply and improving the oil quality and yield of our sandalwood trees for years. The R&D center is continuously developing new methods to ensure the most efficient usage of our resources to create the highest quality trees. In our own plantations in Western Australia, harvesting and planting are rotated annually to ensure a reliable, uninterrupted and consistent supply for the foreseeable future.

Preserving soil and water: We have developed different techniques using moisture probes in the soil and tree sap flow meters to ensure the water is used in the most efficient way.

Nitrogen is a key nutrient for plant growth that is conventionally added in the form of fertilizer. As said above, a unique requirement of a sandalwood tree is the need for host trees to sustain it. Therefore, host selection has focused on utilizing leguminous species, which have the ability to extract nitrogen from the air and make it available through their root system. This way the sandalwood trees can receive nitrogen naturally.

We choose to use natural approaches to support the healthy growth of our trees such as pruning, natural soil biology, and resilience to diseases through symbiotic relationships with microorganisms. One of our latest approaches is bringing in a herd of goats that are working daily to perform natural weed control. The naturally added organic fertilizer they provide to the soil is a plus and further improves the land.



The sandalwood oil market size is projected to reach $175 million by 2028, growing at a CAGR of 8.9% from 2021 to 2028.

Wood Preparation & Upcycling

The way we use specific rich parts of the wood (heartwood), stands as a technological and sustainable way to innovate. The spent charge from the distillation is the by-product that is sold into various



It is a long-term investment and engagement as it takes at least 15 years for the Santalum album *tree to mature and develop heartwood which yields the precious oil.*

markets with close to zero waste from the production process.

Distillation: Improving the distillation process in terms of green energy optimization is another sustainable axis to continuously improve our Indian Sandalwood essential oil production.

All power supplied to the factory where the distillations are performed is derived from green renewable energy: the plantation operations use hydroelectric power from the Ord River.

Water from parts of the distillation process is recycled to ensure efficient water usage.

***P&F+*: What are some of the nuances of Indian Sandalwood's olfactive profile? How does it differ from others?**

DS: Compared to all other sandalwoods, what makes East Indian sandalwood also called Mysore sandalwood (in recognition of its birthplace in India) the most unique is its highest concentration of α and β santalols (70-90%).

α santalol is said to be responsible for the therapeutic nature of the oil, and β santalol, gives Indian sandalwood its incomparable olfactive profile. The so-called "King of Woods," offers a soft-creamy wooden signature profile as well as a liquid gold appearance.

Native Australian sandalwood differs slightly with a more herbaceous profile with green facets.

***P&F+*: How has it evolved over time and how is it used today in the fragrance and cosmetic industry?**

DS: Known for thousands of years, sandalwood was first used by the Egyptians to embalm their mummies. It is also used in India during funeral ceremonies to allow the soul to rise.

Indian sandalwood oil is a rare and expensive ingredient which, above its use in the most iconic successes through the history of perfumery, especially in fine fragrance, has a religious dimension as well as medicinal and cosmetic properties.

Santalum album oil has been utilized for many centuries in both Ayurvedic and traditional Chinese medicine. Skin beneficial effects have been now studied with scientific in-vivo techniques.

Santalum album oil is today emerging as an interesting active source of many phytochemicals with other personal care promising applications.



The panel likes maltyl isobutyrate for sweet brown flavors such as French vanilla, brown or cooked sugar, maple, butterscotch, caramel, coffee, molasses, chocolate and malt.



BY CYNDIE LIPKA
Principal flavorist,
Bell Flavors and Fragrances

Organoleptic Characteristics of Flavor Materials

The panel offers usage insights for materials including neryl propionate, 3-mercaptohexyl acetate and more.

Organoleptic Evaluation Panelists

- **Bill Aslanides**, Senior Flavorist, Synergy Flavors, Inc.
- **Deborah Barber**, Senior Flavorist, FONA
- **Nicole Hernandez**, R&D Manager and Senior Flavorist, FlavorChem
- **Christina Hook**, Flavorist, Bell Flavors and Fragrances
- **Judith Michalski**, Senior Flavorist, abelei flavors
- **Andrew Petrou**, Flavorist, Savory, Bell Flavors and Fragrances

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Maltyl isobutyrate

Source: Vigon
FEMA# 3462, CAS# 65416-14-0
Not naturally occurring.
Odor neat: Sweet, brown slightly fruity (raisin or dark berry), caramelic, malt, fermented,
Taste: @ 5 ppm: Somewhat weak, generically brown.
Taste: @ 10 ppm: Brown, sweet, cooked sugar, caramelic, cotton candy, with some body and depth.
*Possible application*s: Maltyl isobutyrate is one of those compounds that has slipped under the wire a bit. The panel likes this material for sweet brown flavors such as French vanilla, brown or cooked sugar, maple, butterscotch, caramel, coffee, molasses, chocolate and malt. We also felt that this would work nicely in dark berry profiles, fig, raisin and date profiles.
➤Vigon: *www.vigon.com*

8-Hydroxy para cymene

Source: Bedoukian
FEMA# 3242, CAS# 1197-019-9
Natural occurrence: Apricot, bilberry, black currant, carrot, cranberry, currant, dill, ginger, lime, oregano, parsley, black pepper.
Odor: @ 0.1%. Sweet, cloying, floral, powdery, herbaceous, slightly medicinal.
Taste: @ 0.1 ppm. Sweet, powdery, floral, slight berry or cherry.
Taste: @ 0.2 ppm. Sweet, powdery, floral, berry, herbaceous, cranberry, grape, cherry, other berries.
*Possible application*s: The panel felt that this material would work nicely in berry profiles, especially cranberry and dark berries and cherry. For herbal profiles, we thought of thyme and oregano.
➤**Bedoukian:** *www.bedoukian.com*

Cinnamicaldehyde

Source: Excellentia
FEMA# 2286, CAS# 104-55-2, organic
Natural occurrence: Apple, bergamot, bilberry, cassia, cinnamon, cranberry, fig, fingered lime, grape, grapefruit, honey, lemon, lime, mandarin, plum, rum, tomato, yuzu.
Odor: @ 1%. Sharp, cinnamic, sweet, slight brown cinnamon notes on dry out.
Taste: @ 1 ppm. Warm cinnamon notes, brown, slightly spicy.
Taste: @ 2 ppm. Astringent, woody, sharp, brown, sweet and more distinct.
*Possible application*s: With the natural occurrence list in mind, I thought for sure we could find some notes that were not as expected. And the big surprise of this cinnamicaldehyde is that it did contain some warm cinnamon notes that are found in the spice. So, all the spice blends like Garam masala, chai and pumpkin spice blends came to mind. But we did have mention of cherry and honey as well. I think that I could easily see this in bilberry, cranberry, fig, plum and tomato at even lower levels!
➤**Excellentia:** *www.excellentiainternational.com*



Lemon, lime, lemoncello, lemon meringue and lemon teas is a nice solid start for balm leaves extract.

Balm leaves extract (Melissa oil)

Source: MilliporeSigma
FEMA# 2112, CAS# 8014-71-9
Odor: @ 1%. Tea-like, fresh, citrus, sweet, floral, powdery, fatty, herbal, dry and becomes more lemony on the dry out.
Taste: @ 1 ppm. Slightly herbal, lemony, tea-like, fresh, terpenic, rosy, fatty and floral.
Taste: @ 3 ppm. Citrus, lemon candy, grassy, slightly waxy, floral, olive.
*Possible application*s: If we focus on the lemon pool: lemon, lime, lemoncello, lemon meringue and lemon teas we have a nice solid start here. I think this would brighten mandarin and clementine to give it a bright lift. Melissa oil would fit nicely in other flavored tea profiles such as Earl Gray. Because it contains about 50% citral, there is an interesting brightness which is not fake, candy

and sharp like straight citral. Savory uses include generic herbs and spices for lift and freshness. I'll evaluate this in my next olive flavor creation, too!

➤**MilliporeSigma:** *www.sigmaaldrich.com*

trans-2-Octenal

Source: Bedoukian

FEMA# 3215, CAS# 2548-87-0

Natural occurrence: Apple, apricot, avocado, bread, chicken, clam, cocoa, coffee, fig, fish, ginger, guava, lemon, mandarin, mushroom, mustard, olive, pork, potato, rice, tea and wheat.

Odor: @ 1% ppm. Peaky, sharp, waxy, citrus, fatty, green, oily.

Taste: @ 0.5 ppm. Greasy, potato, fatty, astringent, peely, cucumber.

Taste: @ 1 ppm. Fatty, waxy, rubbery, clam, mouth coating.

*Possible application*s: Despite the slight green character, the panel found some good savory notes in this aldehyde. We saw fats from all different meat sources such as chicken, pork, lamb and beef. It would be interesting for whitefish and clam. It would lend authenticity to fried flavors including potato chips or fries, as well as some of the high fat nut profiles. We think this could find a home in fruit flavors, but at a very low level such as 0.05 ppm for pear, or citrus zest or watermelon flavors.

➤**Bedoukian:** *www.bedoukian.com*

5-Methyl-2-phenyl-2-hexenal (Cocal hexenal)

Source: Natural Advantage

FEMA# 3199, CAS# 21834-92-4, natural

Natural occurrence: Cocoa, hazelnut, malt, peanut, potato chip, sesame seed, and tea.

Odor: @ 1%. Brown, sweet, slightly musty, floral, nutty, chocolate, malty, roasted, bready, ammonia-like on the dry out.

Taste: @ 5 ppm. Nutty, malty, chocolate, floral, slightly honey, cooked, raisin, brown, sharp.

Taste: @ 10 ppm. Cocoa, cooked, sweet, nutty, honey, chocolate, floral, grainy, malty, musty, earthy.

*Possible application*s: The panel felt this cocal was very heavily directed towards nutty profiles such as peanut, hazelnut, Brazil nut and black walnut as well as toasted sesame profiles. Other sweet brown profiles mentioned include honey, bread, funnel cake, toffee, vanilla, caramel and malt. Certainly we need to mention chocolate and cocoa as well. Some savory flavors come to mind as well such as ancho, chipotle and Urfa chili peppers. There was some mention of lobster and crab as well.

➤**Natural Advantage:** *www.natadv.com*



The panel thought that 3-mercapto-3-methylbutyl would work well in tropical fruits like mango, passion fruit, guava and, of course, durian.

3-Mercapto-3-methylbutyl formate

Source: Symrise

FEMA# 3855, CAS# 50746-10-6

Natural occurrence: Vanilla, beet, benzoin, citronella, coffee, clove, nutmeg, Peru balsam, rum and whiskey.

Odor: @ 0.01%. Green, sharp, dark, roasted, savory, brown beefy, alliaceous, cannabis.

Taste: @ 0.01 ppm. Alliaceous, beefy, fatty, savory, roasted, coffee.

Taste: @ 0.05 ppm. Alliaceous, savory, more roasted, dark, tropical, coffee.

*Possible application*s: I was a little terrified of this compound initially but at the right dosage, it's actually quite nice. It has some alliaceous notes which work in green onion, scallion, onion and garlic profiles. It also seems like it would work for roasted notes for meat especially beef, coffee and sesame. The panel thought that this would work well in tropical fruits like mango, passion fruit, guava and, of course, durian. I would be remiss if I forgot to mention, hops, beer and cannabis flavor profiles.

➤**Symrise:** *www.symrise.com*

3-Mercaptohexyl acetate

Source: Treatt
FEMA# 3851, CAS# 136954-20-6, natural
Natural occurrence: Grapefruit, guava, hops, passion fruit, wine.
Odor: @ 0.01%. Green, sharp, tropical, sweaty, grapefruit, late sweet fruity, banana, roast beef.
Taste: @ 0.005 ppm. Hops, tropical fruit, skunky, black currant, tropical fruit, roast beef, green, banana.
Taste: @ 0.01 ppm. Grapefruit, guava, passion fruit, strong sulfur, green, cooked, onion.
*Possible application*s: There appears to be a very fine line between the ability to use this in fruits such as pear or banana or some grape varieties and then the more sulfurous tropical fruits such as mango, passion fruit, guava, grapefruit, black currant and certainly an ideal candidate for durian and hops. With the alliaceous overtones at the higher level, we can easily see this for roasted profiles and roast beef. Oddly, this compound does contribute some mouthfeel at very low levels.
➤**Treatt:** *www.treatt.com*

Neryl propionate

Source: MilliporeSigma
FEMA# 2777, CAS# 105-91-9, natural
Natural occurrence: Vanilla, beet, benzoin, citronella, coffee, clove, nutmeg, Peru balsam, rum and whiskey.
Odor: @ 1%. Slightly floral, powdery, citrus, slightly plastic, sweet, lemon, tropical.
Taste: @ 3 ppm. Melon, waxy, honeydew, green, fresh, citrus, berry, floral, fruity.
Taste: @ 6 ppm. Melon, waxy, honeydew, citrus, waxy, soapy, green, floral, waxy, earthy, vegetative.
*Possible application*s: This ester happens to be a happy compound for me. It brings sunshiney thoughts! The panel can see this in all the melon profiles and the lemon profiles including lemon curd. But it would be delightful in celery, squash, pumpkin and mushroom.
➤**MilliporeSigma:** *www.sigmaaldrich.com*

6-Methylheptanal

Source: Bedoukian
FEMA# 4498, CAS# 63885-09-6
Natural occurrence: Curry, lemon, mandarin, and orange.
Odor: @ 0.1%. Green, waxy, aldehydic, citrus, but more honeydew on the dry out and savory fatty.
Taste: @ 0.1 ppm. Green, citrus, hops, cheesy, oily, waxy.
Taste: @ 0.3 ppm. Strong, waxy, citrus, oily, green, aldehydic.
*Possible application*s: This aldehyde presents an oily character which is somewhat green. Therefore it would work well in most citrus profiles, green tea, cilantro, tropical profiles. It could also be tried in hops or beer flavors and some tropical.
➤**Bedoukian:** *www.bedoukian.com*

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