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Here is a partial listing of our Nature Identical and Synthetic flavor and fragrance ingredients. Many items are Food Grade, Kosher and Halal Compliant with paperwork available on line.

- Fema 4553 CIS-3-Nonenyl Acetate
- Fema 4554 Cis-6-Nonenyl Acetate
- Fema 4556 2,3,3-Trimethylindanone
- Fema 4559 Magnolia Bark Extract
- Fema 4561 3-Methylthiopropyl Mercaptoacetate
- Fema 4573 Methyl Octyl Sulfide
- Fema 4575 Diisoamyl Disulfide
- Fema 4581 Dodecanethiol
- Fema 4582 2-Hydroxyethanethiol
- Fema 4586 Methyl Isobutanethioate
- Fema 4587 3-Mercaptopropionic Acid
- Fema 4595 Melon Acetal
- Fema 4596 Cinnamic Aldehyde Propylene Glycol Acetal
- Fema 4599 Ocean Propanal
- Fema 4600 D-Trehalose Dihydrate
- Fema 4612 2-Ethyl-2-Hexenal
- Fema 4616 2-Hexylidene Hexanal
- Fema 4617 Trans-2-Tridecenol
- Fema 4618 Phenoxyethyl Propionate
- Fema 4620 2-Phenoxyethanol
- Fema 4622 Piperonal Propylene Glycol Acetal
- Fema 4623 Benzyl Levulinate
- Fema 4624 P-Methylbenzyl Alcohol
- Fema 4626 Benzyl Nonanoate
- Fema 4627 Anisaldehyde Propylene Glycol Acetal
- Fema 4630 2-Ethylhexyl Benzoate
- Fema 4631 2-Ethyl-3-Methylthiopyrazine
- Fema 4632 2-Ethoxy-3-Isopropyl pyrazine
- Fema 4635 Phenylethyl Isoamylether
- Fema 4639 2-Methoxypyridine
- Fema 4640 6-Methoxyquinoline
- Fema 4642 2-Thienylmethanol
- Fema 4643 2-Acetyl-5-Methylthiophene
- Fema 4648 Cyclotene Butyrate
- Fema 4649 3-Methylthio propylamine
- Fema 4651 1-Nonene
- Fema 4654 Methyl Beta-Phenyl Glycidate
- Fema 4659 2,3-Epoxydecanal
- Fema 4660 Vanilmandelic Acid
- Fema 4663 Tobacco Cyclohexenone
- Fema 4666 Alpha-Bisabolol
- Fema 4673 Delta-Hexadecalactone
- Fema 4675 L-Isoleucine
- Fema 4676 1-(2-Furfurylthio)-Propanone
- Fema 4679 Arachidonic Acid
- Fema 4685 Delta-Tridecalactone
- Fema 4686 2-Methyl-3-Thioacetoxytetrahydrofuran
- Fema 4699 Ferrous-L-Lactate
- Fema 4702 Dimethyl Dihydrocyclopentapyrazine
- Fema 4703 Cinnamyl Benzoate
- Fema 4710 L-Threonine
- Fema 4712 L-Alanyl-L-Glutamine
- Fema 4724 Trans-4-Tert-Butylcyclohexanol
- Fema 4745 6-Methoxy-2,6-Dimethyl Heptanal
- Fema 4750 Cis-3-Hexenyl Salicylate
- Fema 4752 N-Acetyl-L-Glutamic Acid
- Fema 4753 1,3-Propanediol
- Fema 4757 Mangosteen Distillate
- Fema 4775 Sandal Pentenol
- Fema 4759 Sassafras Acetate

For a complete list of all our natural, natural identical & synthetic ingredients visit us at our web: www.pentamfg.com

Penta

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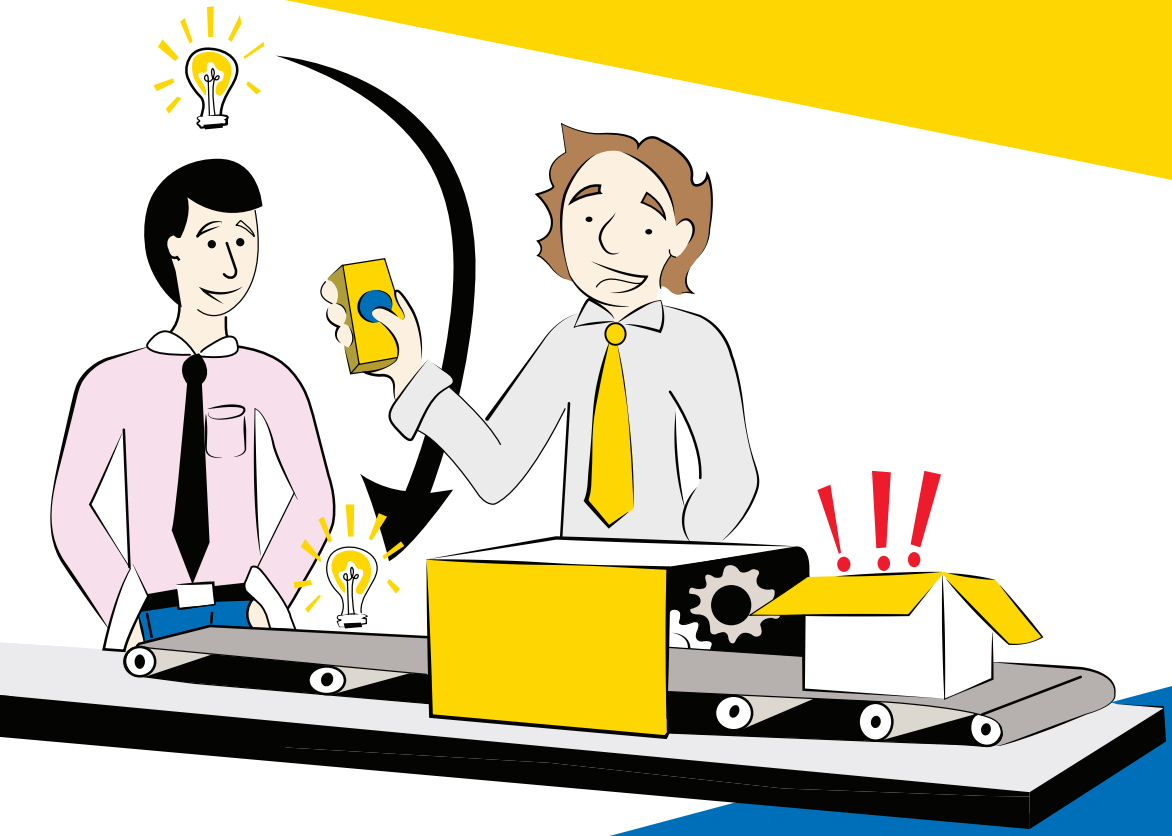

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DENIZ ATAMAN
Managing Editor
dataman@allured.com

A Whirlwind of Change

From mid-August until the end of September, the Gulf of Mexico and Atlantic coasts were hit with detrimental hurricanes, Harvey, Irma and Maria. Devastating southern Texas, Florida and Puerto Rico, hundreds of billions of dollars are expected to be spent on the rehabilitation of these areas.

What happened in these four weeks has not only sparked countless rescue missions and first-aid efforts on the national level, but it raises a question about the intensity of hurricane season and its link to climate change. In an article from the Washington Post[a], Michael Ventrice, a research meteorologist at the Weather Company said, "We are seeing some of the hottest ocean temperatures in the planet in the western Caribbean Sea. This is like rocket fuel for developing tropical cyclones. A major concern for late-season development."

What does this mean for F&F? In an extreme case, Florida's $10 billion citrus industry has been on the decline due to citrus greening disease and has been dealt another blow from Hurricane Irma. Many citrus farmers have lost 70 to 100% of next year's crops, which raises the question of whether or not farmers have the resources to replant and continue.

It's no secret that naturals are a part of a volatile market. There is only so much the industry can control when it comes to producing a consistent harvest each year. Along with research in curing citrus greening and rehabilitation efforts post-hurricane, perhaps this is an opportunity for the industry to focus on other areas of development. This could very well be discovering emerging markets for new materials and trends (page 16), sourcing and distribution strategies, adjacent industries (page 38) and improving a circular economy.

Ultimately, when your environment is healthy, your business is healthy. At *P&F* our thoughts and prayers are with those affected by these global natural disasters.

I hope you enjoy this issue.
With warmth from New York City,

Deniz Ataman
Managing Editor

[a] *https://www.washingtonpost.com/news/capital-weather-gang/wp/2017/09/23/harvey-irma-maria-why-is-this-hurricane-season-so-bad/?utm_term=.a7266cf96884*

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More events are posted at www.PerfumerFlavorist.com/events. *Filter events by topic and region; submit event announcements; access exclusive event coverage and photo albums.*

November 1—**Circle of Champions;** New York, NY; *www.fragrance.org*

November 7–8—**Vanilla Meeting 2017;** San Juan, Puerto Rico; *www.vanillameeting2017.com*

November 14—**IFRANA 2017 Annual Meeting;** Hasbrouck Heights, NJ; *www.ifrana.org/annual-meeting-2017*

November 14—**Pôle Parfums, Arômes, Senteurs et Saveurs (PASS)**; Grasse, France; *www.pole-pass.fr/accueil.html*

November 15—**WFFC Fall Seminar;** Saddlebrook, NJ; *www.wffc.org*

November 28–30—**Fi Europe;** Messe Frankfurt, Germany; *www.figlobal.com/fieurope*

2018

February 4–7—**International Spice Conference;** Crowne Plaza, Jaipur, Rajasthan, India; *www.internationalspiceconference.com*

February 16–17—**Flavours & Fragrances Expo 2018;** Mumbai, India; *www.flavoursandfragrancesexpo.com*

March 8—**18th Annual West Coast Flavor Industry Forum;** Garden Grove, California; *www.chemicalsources.org*

June 5–7—**World Perfumery Congress;** Palais des Congrès Nice Acropolis, Nice, France; *wpc.perfumerflavorist.com*

July 15–18—**IFT 2018;** Chicago, Illinois; *www.ift.org*

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Raw Material Bulletin

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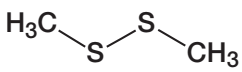
Haldin Pacific Semesta now offers ***Black Tea Essenstrate*** (CAS# 68916-73-4), which tastes and smells like freshly brewed black tea leaves with malty, smoky, brisk, earthy, spiced and nutty notes. It appears as a colorless liquid, soluble in water, low-dose usage and is easy to formulate with. It is applicable for various beverage and personal care applications, especially RTD tea beverages like fruit teas, milk teas, original teas and chai teas. This is also suitable for halal certification.

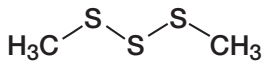
Firmenich has launched ***Coffee Extr Ws 918977***, where smoky and roasted notes are deeply concentrated in a differentiating yet water soluble and colorless ingredient.

The company now also offers ***Orriscience Cte 8% 950289***, which displays powdery, floral, elegant creamy notes with a long lasting effect. It performs well when creating with red or exotic fruit flavors.

Natural Advantage has introduced EU and U.S. natural, kosher and non-GMO, ***dimethyl disulfide*** (FEMA# 3536, CAS# 624-92-0). Dimethyl disulfide occurs naturally in cabbage, cauliflower, cooked beef, fish, garlic, pineapple, rutabaga and strawberry. It is used in cheese, onion, garlic, poultry, soup and savory flavors. It has the flavor and odor of cabbage and is an active component in cheese. Its use levels in finished goods are 0.3 ppm to 9 ppm.



This company also offers EU and U.S. natural, kosher and non-GMO, ***dimethyl trisulfide*** (FEMA# 3275, CAS# 3658-80-8). Dimethyl trisulfide occurs naturally in cabbage, cocoa, coffee, corn (maize), cooked beef, cooked chicken, garlic, onion, peas and sauerkraut. Taste and odor are strong onion, garlic and meaty. It is used in garlic, onion, spice, meat, soup and savory flavors. Dimethyl trisulfide is an active component in cheese flavors. It is used at 0.01 ppm to 1 ppm as consumed in finished goods.



Agan Aroma & Fine Chemicals Ltd. has launched ***aganile*** (CAS# 10461-98-0), which consists of fresh, floral, geranium and grapefruit notes. This material is best used for functional fragrances.

The company also launched ***pomelone*** (CAS#75490-39-0), which consists of citrus, grapefruit and vetiver notes to enhance fine and functional fragrances.

Sigma-Aldrich Flavors & Fragrances has introduced ***sabinene, natural, 75%*** (CAS# 3387-41-5), which has taste characteristics of woody, spicy and camphoreous. Its odor characteristics consist of woody, spicy, citrus and terpy with green, oily and camphoreous nuances. This material can best be used in tropical, mango, berry, marjoram, spice and vanilla.

Tobacco extract, FG (CAS# 8037-19-2) was also launched by this company. Its taste characteristics consist of being bitter, astringent, tobacco and hay-like, with a brown dried fruit aftertaste. The odor characteristics are brown, tobacco, sweet hay-Iike, leafy and herbal with a dried fruit nuance. The uses for this material include tobacco, fenugreek, mate, cedarwood, birch tar, fig, coffee and leather.

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EXTRACTING
WITH BOLDNESS

■ BY JOHN WRIGHT
johnwrightflavorist@gmail.com

Flavor Bites: 2-Acetyl pyrrole

Exhibiting an interesting caramel characteristic, this material offers a pleasant authenticity to many brown and savory flavors, even berries.

The first truly original dish that I remember was created by a self-taught chef called John Tovey who, many years ago, owned a truly spectacular hotel and restaurant on the shores of Lake Windermere called Sharrow Bay. John Tovey may have deviated a long way away from the expected career path of his contemporaries but he more than made up for it in terms of creative originality and showmanship. His restaurant was always booked solid for many months ahead. The chef was totally in charge, and he was the master of ceremonies each evening. Diners had absolutely no choice of dishes, they were all served the dishes that John Tovey chose on the night. My most spectacular experience at this palace of gastronomy was deceptively simple. A leg of local Lakeland lamb cooked at a very high temperature in a sealed Dutch oven, surrounded by hay. The hay smoldered gently and infused the lamb with a magnificent coumarinic caramel note.

As you might imagine I have made several attempts to recreate this culinary treat, some more successful than others. The key to success is definitely not allowing the hay to actually catch fire!

Sadly, coumarin itself has languished under a toxicity cloud for my entire career. Many suggested substitutes recreate some aspects of the lactonic hay note, but they all miss key parts of the complex character of coumarin. Also occasionally called methyl 2-pyrrolyl ketone, 2-acetyl pyrrole (FEMA# 3202, CAS# 1072-83-9) is an interesting caramel character with no obvious lactonic notes. Nevertheless, it does capture a vital dusty element of the coumarin profile – the bit that reminds me of the caramelic note of burnt hay (minus the lamb).

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.

Brown Flavors

Chocolate and Cocoa: Here, 2-acetyl pyrrole adds pleasant authenticity to chocolate flavors at around 500 ppm and to cocoa and dark chocolate flavors at 1,000 ppm.

Coffee: Similar levels, in the region of 500 ppm are equally effective in coffee flavors, adding complexity and realism.

Licorice: A level of 800 ppm provides welcome depth to licorice flavors and prevents them from falling into the trap of being too simplistic and one dimensional.

Malt: Levels of 2-acetyl pyrrole in malt flavors vary depending on the profile of the flavor involved. Typical malted milk flavors are best served by around 1,000 ppm but much higher levels work well in aggressively malty flavors.

Molasses and Brown Sugar: This ingredient really comes into its own in molasses and brown sugar flavors, enhancing the impact of the flavors significantly. A level of 3,000 ppm is a good start in molasses flavors and a slightly lower level, nearer 2,000 ppm works better in typical brown sugar flavors.

Tea: An addition of 2-acetyl pyrrole is most effective in red tea flavors, such as oolong, and here 3,000 ppm is a reasonable starting point. It is also quite effective in black tea flavors but a better level is 1,000 ppm in this category. The use of this ingredient in green tea flavors is a matter of opinion, personally I think it does not work so well.

Vanilla: This chemical only plays a small part in the character of vanilla bean style flavors, but it

does round out the profile nicely at 200 ppm. French vanilla and Tahiti style vanilla bean flavors are another matter. A level of 500 ppm is a good starting point in these types, but really the sky's the limit.

Nut Flavors

Almond: An addition of 2-acetyl pyrrole is effective in all nut flavors because the caramel note smells quite authentic in this category and the dusty note also works well. A level of 300 ppm is a good starting point in toasted almond flavors.

Hazelnut: An addition of 300 ppm also proves to be highly effective in hazelnut flavors, adding realism and depth.

Peanut: The same level, 300 ppm, is also ideal in peanut flavors, with the dusty note of 2-acetyl pyrrole making a very effective contribution.

Walnut: Of all nut flavors walnut is the area where 2-acetyl pyrrole is most at home. A level of 500 ppm is ideal.

Savory Flavors

Beef, Roast: Given my introduction to this article, it is not surprising that savory flavors represent a significant potential for 2-acetyl pyrrole. Roast beef flavors benefit from high levels of addition: 3,000 ppm or more.

Chicken: A similarly high level, around 2,000 ppm, is also very effective in chicken flavors.

Lamb: No surprises here, even without the smoldering hay aspect, lamb flavors benefit from high levels of addition. A level of 4,000 ppm is probably ideal.

Pork: Pork flavors are somewhat similar to chicken in respect of the caramel notes and 2,000 ppm also works well in this context.

Potato, Fried: Moving on to savory vegetables, the ideal levels of use drops somewhat, but 500 ppm is still a good initial level in potato flavors.

Sesame: A level of 800 ppm adds depth to toasted sesame flavors and can be especially helpful in rounding out flavors that are based on sesame oil.

Soy Sauce: This material is an important part of the character of naturally fermented soy sauce. Levels of use can vary dramatically, but 3,000 ppm is generally a good starting point.

Tomato: This chemical might seem more at home in processed or dried tomato flavors but in practice it also works well in fresh tomato flavors, all at around 500 ppm.

Other Flavors

Blackberry: This ingredient is not one that naturally springs to mind in respect of fruit flavors but it is always interesting to experiment. The effect of low levels, around 200 ppm, in blackberry flavors adds an interesting dusty note but does not detract from the freshness of the impact.

Brandy: More substantial levels are entirely acceptable in spirit flavors, and 1,000 ppm of this ingredient adds ralism to brandy flavors.

Coconut: This ingredient is more at home in toasted coconut flavors, where 1,000 ppm is an ideal level, than in fresh coconut flavors.

Whisky: Some whisky flavors try to recreate burnt peat and, although smouldering peat is nowhere near as attractive as smouldering hay, there is some family similarity. An addition of 1,000 ppm is a good level in normal whisky flavors, higher if the character is very peaty.

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Forward Thinking: Generation M – A Halal Lifestyle

With the growing population of Muslim millennials, halal food, beverage and beauty are emerging and have considerable potential for F&F suppliers and consumer goods manufacturers.

Growing Muslim Population

Halal is an Arabic word meaning "lawful or permitted," with halal food being that which adheres to Islamic law. The slaughtering of animals or poultry needs to be done in a specific way, and certain animal byproducts, along with alcoholic beverages—such as pigs, beer and wine, respectively—are restricted. Halal beauty refers to products manufactured, produced and composed of ingredients that are "permissible" under Islamic law. Similar to the certification and labeling of kosher and vegan products, halal products are governed. Islamic Food and Nutrition Council of America (IFANCA), American Halal Foundation, ISWA Halal and U.S. Halal Certification are a handful of U.S. certifying agencies.

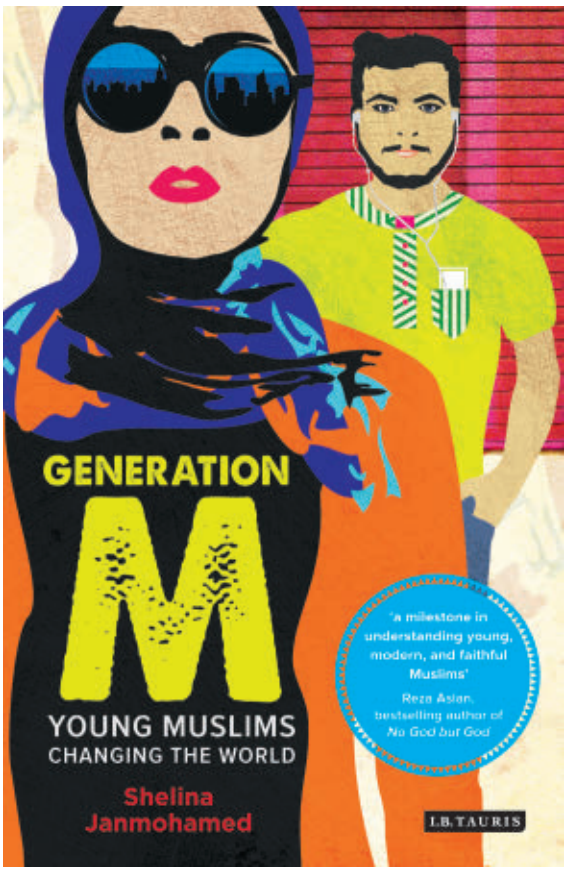
Want More on Fragrance Trends?
Check out page DE1 of the November digital edition for a closer look at ancient Vedic fragrance traditions and trends in India.

According to Pew Research[1], in 2015 Muslims made up 24.1% of the global population. Today, the number of Muslims is expected to increase by 70% from 1.8 billion in 2015 to nearly 3 billion in 2060, making up 31.1% of world's population. It is estimated that only 0.2% of the world's Muslims live in North America. In the United States, Muslims are projected to double from 0.9% of the population in 2010 to 2.1% by 2050.[2] Although often associated with the Middle East-North Africa region, a large Muslim population lives in the Asia-Pacific region. With this large and growing Muslim population, Islam is the world's second-largest religion after Christianity.

Generation M: Young Muslims Changing the World, by author Shelina Janmohamed[a], launched in November 2016, and explores the influential cultural phenomenon of young Muslims who believe their identity encompasses both faith and modernity. Also referred to as "Muslim Millennials" and "Mipsters (Muslim Hipsters)" this young demographic is changing stereotypes, and their purchasing power will be influential as they shape and drive the future of the Muslim population. Last year, the Muslim Lifestyle Expo [b], "U.K.'s first multi-sector events platform that captured the best of global Muslim lifestyle," was launched. After a successful event, this year the Muslim Lifestyle Expo was held on Oct. 28–29, 2017, and showcased businesses aimed at this burgeoning consumer market including modest fashion shows, live food demos by top chefs and educational seminars.

With the growing population of Muslims, halal food, beverage and beauty are emerging and have considerable potential for fragrance and flavor suppliers and consumer goods manufacturers. According to a Jan. 24, 2017, *Quartz* article,[3] the global Islamic market was worth over $3.6 trillion in 2013 with the market projected to be worth over $5 trillion by 2020.

[a]*www.amazon.com/Generation-Young-Muslims-Changing-World/dp/1780769091*



"Generation M: Young Muslims Changing the World" book by author Shelina Janmohamed explores the influential cultural phenomenon of young Muslims also known as "Muslim Millennials" and "Mipsters (Muslim Hipsters)." Photo courtesy of Shelina Janmohamed.

Halal Food & Beverage

The global halal food market is projected to be worth $1.6 trillion by 2018.[4] This sector is also estimated to be growing faster than the general food sector, and is predicted to make up 17.4% of the world food market by 2018. According to Technavio,[5] the halal food market in the United States is expected to grow at a CAGR of 3.48% during the 2017–2021 period. The global halal meat, poultry and seafood market in the United States accounted for about $15.37 billion in 2016, while the halal food market retail segment in the United States accounted for about $14.50 billion in 2016. Nielsen research estimates that U.S. grocery and convenience stores sales reached $1.9 billion in the 12 months through August 2016, a 15% increase from 2012. From U.S. restaurants to supermarkets, halal sales are projected at $20 billion this year, up by one-third since 2010, according to the Islamic Food and Nutrition Council of America.[6]

After noticing the demand for Halal food within the Muslim cab driver population, **The Halal Guys**[c] opened its first food cart on 53rd and 6th Avenue in New York City in 1990. Today, The Halal Guys are a global brand and have more than 350 restaurants currently in development world-wide. In August, the brand developed a mobile app to simplify online ordering and shorten lines in the restaurants.

In Birmingham, U.K., Ali Imdad, a 2013 *Great British Bake Off* contestant and business partner, Mohammed Vakas, own and operate the **Artisan** dessert bar. Catering to Generation M, in addition to dessert, Artisan serves mocktails such as ***Raspberry Spice*** (with a hint of almond and cinnamon), ***Banana Coladas*** and ***Mint Mojitos***[d].

[b]*muslimlifestyleexpo.co.uk/*
[c]*www.qsrmagazine.com/news/halal-guys-announce-first-lto-and-mobile-app*
[d]*www.theguardian.com/lifeandstyle/2016/oct/15/muslim-consumers-entrepreneurs-economy*

***Haloodies** introduced **Halal Food To Go**, a new range of high quality chargrilled chicken protein snacks currently offered in **Plain'N'Simple** and **Hot'N'Spicy** flavors.* Photo courtesy of Haloodies.

Haloodies[e] ("halal" and "foodies") is a U.K. brand of packaged halal meats that "produce products to meet the convenience needs of millennial Muslims because we understand their needs." ***Peri Peri Chicken Mini Split Sticks*** and ***Battered Chicken Fillets*** are recent new products. In July 2017, Haloodies introduced **Halal Food To Go**, a new range of high quality chargrilled chicken protein snacks currently offered in ***Plain'N'Simple*** and ***Hot'N'Spicy*** flavors. To expand the brand, Haloodies is targeting the Middle East as its first-ever export market. The brand has been negotiating with major United Arab Emirates (UAE) retailers and hopes to export its chicken snacks by September 2017.

Khalils Luxury Halal Marshmallows,[f] a U.K.-based brand launched a Kickstarter campaign in January 2016 to offer luxury handmade halal-certified marshmallows. The marshmallows are formulated with 100% natural colors and flavors, and contain no animal or dairy byproducts. The marshmallows are offered in 10 flavors: ***Arabic Coffee***, ***Banana & Walnut***, ***Egyptian Dates***, ***Lemon Drizzle***, ***Mango***, ***Moroccan Mint & Chocolate***, ***Pistachio & Honey***, ***Simply Vanilla***, ***Strawberry Dream*** and ***Toasted Coconut***.

The demand for the global market for halal-certified products has led to the exploration of camels as a substitute for pork gelatin. The UAE University team, led by Sajid Maqsood of the university's department of food science research, suggests that there is potential for camel skin to be used as an alternative raw material with further research needed.[7]

Halal Beauty

According to Grand View Research,[8] the global halal cosmetics market size was valued at U.S. $16.32 billion in 2015, and is expected to drive continuous and steady growth of the market by 2025. Technavio reports that the halal cosmetics market is expected to rise to $52.39 billion by 2021, up from $26.47 billion in 2016.[9] The APAC region is expected to create the largest revenue and maximum incremental growth throughout the period between 2017–2021 with a CAGR of nearly 15%. The personal care segment is predicted to lead the halal market globally with 97.18% market share in 2021, while the retail segment is anticipated to draw a CAGR of 14.41% by the end of the forecast period.

With the increased demand for halal products, companies are seeking halal certification. Majelis Ulama Indonesia (MUI) is considered one of the top three worldwide halal bodies, which is reportedly recognized by about 40 countries across the globe. There are a variety of brands that have achieved halal certification such as Korean beauty player Cosmax, Malaysian skin care Clara International Beauty and U.K. fragrance supplier Seven Scent while BASF announced that 145 of its personal care products comply with halal standards.

Hair Care To Meet Muslim Consumers' Needs

In addition to products that use halal ingredients, there is a growing demand for products that address Muslim consumers' hair care needs due to the use of a hijab (headscarf). In January 2017, Le'Jemalik Salon and Boutique opened in New York's Bay Ridge Brooklyn neighborhood. Founded by Huda Quhshi, the women-only salon was designed as a space for Muslim women to receive beauty services in a comfortable environment. In Malaysia, Unilever introduced the **Sunsilk Hijab Recharge**[g] hair care line co-created with natural hair expert Jamal Hammed in April 2017. The range is formulated with natural ingredients and uses a "fragrance release pearls technology that delivers up to 48 hours of freshness and fragrance." It is offered in three variants: ***Hijab Refresh***, ***Lively Strong Hairfall*** and ***Anti Dandruff.*** The Hijab Refresh is enhanced with fig, "known as the heavenly fruit amongst the Muslims" and is formulated to cleanse sweaty scalps, grease, residue and oily hair while the Lively Strong Hairfall Solution contains ginseng

[e] *www.haloodies.com*
[f] *www.kickstarter.com/projects/1569170613/khalils-the-finest-halal-marshmallows*
[g] *www.pamper.my/news/beauty/hair/sunsilk-hijab-recharge-keeps-hair-stay-fresh-48-hours/*

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In Malaysia, **Safi Shayla Hair Spa** is a local halal brand "which consists of a unique and comprehensive range of skincare, personal care and toiletry products developed exclusively to meet the needs of modern Muslim women and men." ***Itch-Control Shampoo*** and ***Shayla Oil Control Shampoo*** are new products both formulated with Habbatus Sauda (black cumin), menthol and a scent that lasts for up to 24 hours. The Itch-Control contains argan oil while the Oil Control contains citrus to clean pores, remove excess oil and dirt.

Halal Skin Care

In August 2017 in Indonesia, **Unilever** launched the ***Pureline Hijab Fresh Hand & Body Lotion*** line with an "Instant Cooling Burst" technology to provide a solution to the specific needs of the Muslim population, targeted at the millennial Muslims. The products are focused on whitening and available in four SKUs: ***Cool & Fresh***, ***Extra Moisture***, ***Healthy & Bright Hand***, and ***Nourish & Protect***. **Nurish Organiq** is "Malaysia's no. 1 halal brand infused with 100% natural and organic ingredients." ***Nurish Organiq Brightening Face Essence*** and ***Nurish Organiq Brightening Night Cream*** are new products that claim to have four times the whitening action and are formulated with frangipani, hibiscus, bilberry and cucumber.

Inika's new **Vegan Mascara Long Lash in Black** *"uses 100% plant derived and natural ingredients" and has vegan, halal, cruelty free, and truth in beauty certifications. Inika's* **Certified Organic Vegan Lipstick After Dark** *color is a best seller among the brand's Muslim consumers. The lipstick is formulated with certified organic argan, avocado and jojoba seed oils and features vegan, halal, cruelty-free, and truth in beauty certifications.* Photos courtesy of Inika Organics.

Halal Cosmetics

Halal beauty is a hot topic and this year—the Cosmetics Business Regulatory Summit 2017, held from October 17–18, 2017, in Barcelona, featured a "Trend spotting: Halal beauty" presentation by Salma Chaudhry, the founder of The Halal Cosmetics Company.

Dubai-based beauty line **Luscious Cosmetics**, a vegan cruelty-free color cosmetics brand, sells its products in Sephora stores in Hong Kong, Malaysia, the Philippines, Singapore, and Pakistan. In August 2017, it entered the U.S. market and is available online and in select stores nationwide, targeting women of color. The newest product is a line of ***Heartbreaker Matte Lipsticks*** offered in 18 different shades.

Australian brand **Inika Organics** is self-described as the "healthiest makeup brand in the world," and has multiple certifications including organic, vegan, cruelty-free and halal. The brand launched in the United States in April 2017. The ***Certified Organic Lip Glaze*** range of seven colors has been reformulated, with ***Long Lash Vegan Mascara*** is the newest product.

Orly's nail care brand debuted a porous **Breathable Treatment + Color** collection, which is formulated similarly to contact lens technology and allows oxygen and hydration to pass through the polish. Excited about this technology, *MuslimGirl.com* and Orly collaborated on the limited edition ***#HalalPaint collection***[h], which are made out of 100% halal ingredients and featured six water-permeable nail polishes with tailored names such as ***Wallah Bro Wipe Out*** and ***Haram-Bae***.

U.S. Halal Opportunities

The rising young Muslim population coupled with their spending power is creating a demand for the development of halal food, beverage and beauty products. Additionally, the increase in organic and vegan products driven by the health and wellness trend creates further interest in halal products for non-Muslim consumers because of their similar ethics and high-quality standards.

According Technavio research,[9] in the APAC region last year non-Muslim consumers accounted for approximately 31% of halal cosmetics purchases and the figure is expected to rise. Shiseido's Za-cosmetics brand in Malaysia obtained a halal certification in Vietnam in 2012 and sells 28 halal certified products. According to Mintel,[10] 0.93% of beauty and personal care products launched in 2016 in APAC carried a halal claim, compared to 0.35%

[h] *www.halalpaint.com/*

of global product launches in 2016. Mintel reported that global halal claims for facial skincare products from January 2013 to November 2015 have steadily increased. In 2013, 0.2% of facial skin care products contained a halal claim, compared to 0.3% in 2014 and 0.5% in 2015.

There are a few large consumer packaged food manufacturers who are halal certified and offer halal products in Muslim countries, but they do not necessarily carry these products in the United States. For example, according to a *Bloomberg* September 14, 2016, article,[6] Nestlé has 151 halal factories, from Malaysia to Pakistan, and distributes hundreds of certified products across the world—except for America. Mondelez International Inc. also services predominantly Muslim countries like Indonesia and Saudi Arabia, but only sells a handful of its halal products in the United States. In addition, U.S. retailers like Walmart and Kroger offer halal products where there is local demand. Crescent Foods, the nations' leading provider of Premium Halal Chicken, is offered in 77 U.S. Walmart locations in Delaware, Illinois, Indiana, Iowa, Maryland, Michigan, New Jersey, Ohio, Pennsylvania, Texas and Wisconsin. Crescent Foods recently launched a range of All Natural Premium Grass-Fed, Grass-Finished Angus Beef.[i]

Currently the U.S. halal food, beverage and beauty market is a small but an expanding niche market, ripe for growth opportunities for fragrance and flavor suppliers and consumer goods manufacturers. The opportunity for U.S. suppliers to produce Muslim-friendly products is more about the clean ingredients used and less about the religious beliefs, particularly for beauty products. The Muslim population is expected to grow more than twice as fast as the overall world population between 2015–2060 and opportunities for companies to enter this market abound. Expect to see the demand for halal and Muslim-friendly food, beverage and beauty products to escalate and create opportunities for new product innovations.

[i] *crescentfoods.com/crescent-halal-chicken-now-at-a-walmart-near-you/*

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All photos courtesy of John Stephen.

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The Juice: John Stephen, the Cotswold Perfumer

Exactly how John ended up flying around France with renowned fragrance folk, and having his own laboratory atop an idyllic cottage at the Cotswolds, is not a typical story of a perfumer.

When you ask John Stephen what he is most proud of in life, the answer he gives is getting a PPL-IR (a private pilot instrument rating license). It is a license that only a few private pilots earn, allowing the use of commercial flight paths and blind flight through clouds. He first spent 10 years jumping out of planes, after a pub dare in 1980 turned into a real obsession. Eventually, he decided to fly too.

"I flew Luca Turin and Chandler Burr to France, and we traveled around together like the terrible three," said John. "The owner of Fragonard, François, has a beautiful cottage on the hills of Grasse, and we spent most of our days trying to work out what to have for dinner that night," John laughed. "The life they lead is quite something else; quite luxurious. I'd ask if we could talk about the fragrances yet and François would say 'later, later.'"

John successfully pitched one of his perfumes, with the aid of Luca Turin, to be considered for the selection at Fragonard, but the board of directors had not initially warmed to the idea: "They chose my fragrance but the board was quite split. I was going against a French supplier, and the French buying perfume from an English perfumer wasn't an easy pitch. I had Luca on my side and that made all the difference in the end."

John is most known in the U.K. for creating fragrances for the English heritage barbershop and grooming brand Czech & Speake, and for owning and running the Cotswold Perfumery at the chocolate box village of Bourton on the Water.

"The location has definitely made a difference. This is such a place for tourists, and in the early years, the shop was the business. The growth of that has enabled everything else, and now the other side of the business is much bigger," explained John—the other side being independent perfumery for niche brands, wealthy individuals and own brand products, as well as running his short perfume-making courses.

Exactly how John ended up flying around France with renowned fragrance folk, and having his own laboratory atop an idyllic cottage at the Cotswolds, is not a typical story of a perfumer.

A Bottle of Perfume with Four Gallons of Petrol

John's parents were based in the Cotswolds. His father was a textbook example of a larger-than-life character: He set up new business deals after another and sweet-talked his way into and out of situations. John and his sister did not entirely understand their mother's reluctance to support yet another hare-brained idea. "We used to wonder why mother was so negative about dad's new ideas," said John. "We didn't understand at the time what he was really doing and just loved the fact he was always coming up with something."

After switching college degrees from electrical engineering to sociology, John changed his path again in 1975 after his mother passed away to run the family business that is Cotswold Perfumery.

And come up with ideas he did: African violets, off-peak strawberries, paint that could kill flies when landed upon… and perfume.

"I think perfume was one of his last-ditch efforts to avoid his other business ideas and unfinished deals catching up on him," said John. "Because he had a chat with his solicitor [lawyer] who said 'you know, if you're not careful, you could go to prison for some of this.' He'd seen Avon and looked at various ways of selling large volumes of perfume and came up with an idea."

What was the brilliant idea that would get all his debts paid and save him? Regent Petrol had a major presence in the U.K. at the time, with plenty of petrol stations. They ran a promotion: a gift with purchase for every four gallons of petrol. "Dad said 'you know, we could offer them a bottle of perfume as the gift," explained John. "And so he did some calculations, and worked out he'd need 800,000 bottles of perfume just for the first order. So he went and bought 800,000 sample sized bottles, and we got busy labeling and filling them up. He explained to us it would be important to be ready. He went to see them only after we had done all of that."

The 800,000 perfume samplers were left unsold.

The DIY Approach

"Mum was left running things, and we helped, but by the time dad went to prison, I was off to University. I was 17," explained John. "Life was quite chaotic back then—and we had one shop and no money, so mum was working really hard to make something out of it. We only had one chance. Mum got the money and the original perfumery was bought for £6,000 in 1966."

The current Cotswold Perfumery is not at the business' original location—the original shop was smaller and on the river, and there was a separate lab a quarter of a mile away.

"I would make perfume and help out as much as I could. Of course, back then I had no idea what I was doing, so I made some really terrible perfumes, but then you didn't have any regulations to worry about either," John laughed. "You could do pretty much what you wanted."

John initially set off studying electrical engineering on a sandwich course—a period working in the industry. "I looked at the other electrical engineers and thought, 'do I really want to end up living my life just like these people?'" said John. "I changed direction completely and did sociology. After I finished my

degree, mum died. It was 1975 [when] I took over running of the business. I quickly realized how much chemistry you need. I started reading about it, and gradually learning more."

John has since qualified as a chartered chemist, mainly to fulfill the requirements of cosmetics regulations and local trading standards—he did not want to have to use other people to check product safety. In fact, a kind of do-everything-yourself approach is central to how John has lived his life, even down to his shop fittings and hobbies. While originally driven by necessity (he did not have the funds to fit his shop out, or have enough staff to help sweep the floors in the beginning)—the ethos stuck.

When the current premises became available, John approached a local bank. He dreamed of having everything in one place and designing a bespoke perfume lab space for himself on the top floor. No more running back and forth between buildings to check stock levels—something he had gotten used to in the days before computers and the internet.

When the bank stalled on his loan until the last minute, John approached every other local bank with a business plan and forecasts and got his loan—only to find out that the family selling the property was impatient and set a challenge for buyers: the first one to bring in a contract wins.

"I ran down to the local solicitor and told him the situation. 'How quickly can you get it done?' He said, 'well, in about three weeks," said John. "I wandered back to the perfumery slowly with my head down and thought, now what? Then it occurred to me—I'm going to see what there is out there about conveyancing, and I remember it being 4 o'clock at the time. So I raced to Cheltenham and bought a book on it. I stayed up all night and by the morning, I'd written my own contract."

First thing in the morning, John marched to a local solicitor to be verified, then headed to the owner of the prospective new perfumery premises: "I went to see Gordon at 10 a.m. the next day, handed him the contract and said, 'here you are.' His jaw dropped."

John developed and launched his Cotswold Perfumery course as a result of growing public interest and a lack of consumer knowledge in perfumery. The first course focuses on a basic understanding of lingo, raw materials and blending, while the second course emphasizes business and regulatory matters.

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From a Local Shop to Global Perfumery

Initially, the shop in Bourton on the Water and the range of fragrances sold within was the scope of the business. John's experimentation in the early years resulted in the development of a core range of classic fragrances—fougere, oriental, aldehydic, floral—covering most basic fragrance families. The range has evolved over the years, though is currently in need of an update. "It's one of those things that keeps niggling at the back of your mind—the perfumes and the packaging both need an update, but we've been so busy with other work that it always slips down on the list of things-to-do," explained John. "And were I to update the fragrances, we'd disappoint all the current customers—I might have to do a second range."

> "I think you need passion. I think you need to be in love with the sense of smell and have a certain joy about smelling things; an excitement. You need to be excited by and interested in everything—you know, the type who goes for a walk and stops to smell the flowers."

When an approach was made by Czech & Speake, leading to a fruitful relationship and several successful fragrances, the rest was history: "You know what this industry is like, once people know you and what you can do, the word of mouth spreads," said John.

The regulatory side of running a small perfume business has been the biggest change over the years. "A perfumer working for a large supplier doesn't have to know the details or deal with it to the degree I have to," explained John. "They might have six full timers running a regulatory department and with us, it's just me."

The demands are just the same; there are no exceptions for small businesses. This is something John really focuses on during his Level Two perfumery course (the more advanced day, aimed at people seriously considering perfumery as a career). The life of an artisanal or independent perfumer is quite different to that of a corporate one, though few wear quite as many hats as John does.

Perfumery in One Day

"I was approached by W.H. Smith. They asked if I would do a one-day course for them to teach people how to make perfume. I said 'Don't be so stupid—you can't possibly do it in a day. Goodbye.'"

Four months later, W.H. Smith were back: "They begged me to do something, as they hadn't found anyone else and they had so many people asking."

John went away to think about what he could do in a day and developed an entry level introductory day to perfumery, suitable for all skill levels. The course became available via W.H. Smith, but after the first year, difficulties with administration frustrated John to a point where he did not want to renew the contract: "I'd get people calling me and asking where the course details were; whether their booking had really been confirmed; all sorts of things. I'd have five people turning up for a 10-person course one day—and then another 15. People arrived, already angry," explained John.

John adapted the course and developed an additional day for people who want to go beyond a hobby or a nice day out—and thus launched his Cotswold Perfumery courses.

The first day could, indeed, be attended by almost anyone—though some degree of numeracy and ability to understand proportions are needed. Even with the basic course, John still takes care to introduce the fragrance families, the lingo of perfumery, and the methods of raw material production before you get to blend. The blending happens with a set of pre-selected and pre-diluted materials, by drop. Participants leave with a bottle of finished perfume at the end of the day, which makes the day a self-contained package.

The second day is mostly spent on the business side of perfumery—and on regulatory. It includes further blending and discussion on formulation, but the day is almost intended to act as a toolkit for those genuinely determined to find out more, and as a warning—essentially asking, "are you sure you want to take all of this on?"

"I've had about 25% of those who complete the level one course go on to do level two," explained John. "I do sometimes get students who are terrified of numbers, and it can be hard to help them in the time available."

The Ones Who Stop to Smell the Flowers

In the time John has been involved with perfumery, a great deal has changed. Access to information and to supplies of raw materials looks nothing like

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The life of an artisanal or independent perfumer is quite different to that of a corporate one, though few wear quite as many hats as John does.

they did a few decades ago. "In the beginning, I had to beg people to supply me. I'd found a supplier who sent me a catalog, but they'd quoted the wrong prices for my small half a kilo orders and were almost not going to sell to me. I had to really plead with them," explained John.

Consumers, perfume enthusiasts and wannabe-perfumers alike now have access to much more information than before—some of the information is not accurate, or is not interpreted correctly. There is still a fair amount of deliberate obfuscation out there too.

As someone who encounters so many industry hopefuls, John has formed opinions on who really has the potential to become a perfumer.

"I think you need passion. I think you need to be in love with the sense of smell and have a certain joy about smelling things; an excitement. You need to be excited by and interested in everything—you know, the type who goes for a walk and stops to smell the flowers," said John.

"If you have that love of it first, it gets you through all the hard work.

"Second, you have to have an eye. The same way someone might be really interested in fashion but not have an instinct for what goes well together—it's the same with smell. I think the technical knowledge—you just knuckle down and learn it. That's the easiest bit, really, even though it is, of course, very hard.

"You need to overcome whatever it is that is holding you back," said John. "You need to have obsession and determination."

Rarely is it as easy to say that someone practices what they preach.

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For the Love of Food:

The Path Forward for Proactive Food and Flavor Safety

As the industry evolves to embrace food safety standards and mitigate hazards, food and ingredient manufacturers can take steps to outpace regulations and protect their brands

BY CHERISE HYLTON, Quality Manager and Ellie Gillaspie, Quality Assurance Lead, Emerald Kalama Chemical, LLC

Understanding and implementing new rules for food safety has been complex. For many manufacturers, it can be unclear what the current best practices are to prevent contamination and ensure compliance. This is particularly challenging in flavors, a complex market segment with many players. Manufacturers may use a variety of different flavor ingredients sourced from multiple suppliers to create the mouthwatering appeal that differentiates a product. Understanding the drivers for recent changes in food safety regulations, certification options and actions food manufacturers should take will bring some clarity to this cloudy picture.

It's clear that a major shift was needed throughout the entire supply chain to improve protection in the food supply. Prior to new regulations such as the FDA Food Safety Modernization Act (FSMA), food safety throughout the industry followed a reactive model. By adopting practices that identify and prevent issues such as contamination, manufacturers protect public health, consumer trust and the integrity of their reputations and brands.

The World Health Organization estimates that one in ten people worldwide fall ill, 33 million healthy life years are lost and 420,000 people die due to foodborne illness every year (one-third of those deaths are estimated to be children under five).[1] With FSMA, the U.S. is leading the way within the global food industry. Manufacturers and regulatory agencies in many countries, aware of the significant threat of foodborne illness and other hazards within the food supply chain, are treating U.S. standards for food safety and quality as globally recognized benchmarks. Some countries are also adopting similar legislation to FSMA—such as China's 2015 revised Food Safety Law and Canada's Safe Foods for Canadians Act.

It is critical for manufacturers of food products and ingredients worldwide to understand the requirements to minimize risk, identify gaps and noncompliance issues and implement needed changes quickly.

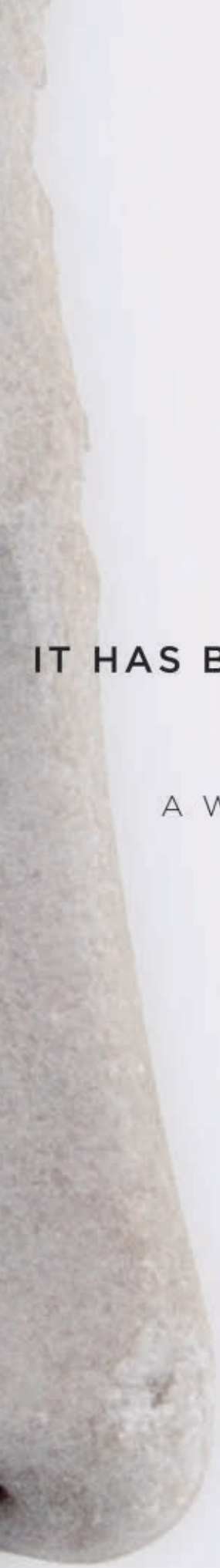
Why Did the Approach to Food Safety Need to Change?

FSMA is the most sweeping reform of U.S. food safety laws since the 1930s. Initially signed into law in 2011, the Act came with many ambitious deadlines for rulemaking and rolling out new standards. It was not surprising when the complexity of such a huge undertaking led to progress shortfalls and general industry confusion about exactly what standards and requirements changed and when. Rules continued to be implemented over the next five years, culminating in a complete implementation last year. However, the confusion has not completely abated. Many requirements, such as foreign supplier verification, are less clear than requirements for preventive control and hazard management, the latter being a step that many manufacturers were already doing to meet the changing needs of the market.

The goal of introducing risk-based preventive controls within the food industry is to reduce the potential for contamination and minimize recalls, which is a departure from the days of simply

(Continued on Page 34)

F-1. The types of products shown below have been linked to notable food contamination outbreaks or recalls in the U.S.



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(Continued from Page 31)

developing a responsive plan for when contamination had already happened. FSMA was developed in response to a well-known industry need for such a paradigm shift. In 2009, 90% of American voters said they supported the adoption of greater federally mandated food safety measures, up from 53% in 2008, which was no doubt bolstered by a rash of food contamination outbreaks and subsequent recalls in the 2000s.[2] Recalls of products such as ice creams, pet food, seasonings, baked goods (including flour, frozen waffles and snack cakes), hummus, soups, teas, frozen vegetables, pre-bagged salad mixes and meat products in the late 1990s and early 2000s significantly influenced consumers and even led some manufacturers to file for bankruptcy when they could not recover.

In 2009, 90% of American voters said they supported the adoption of greater federally mandated food safety measures, up from 53% in 2008.

Recalls—whether issued voluntarily by manufacturers or mandated by the FDA—can be related to a number of potential or confirmed hazards: pathogenic contamination, spoilage potential, improper packaging or labeling, undeclared allergens and foreign ingredients. In some notable cases that garnered media attention, multiple manufacturers were forced to issue recalls after a hazard had been linked to a particular supplier. For example, cases of rice proteins and wheat glutens sourced from Chinese suppliers tested positive for melamine, which resulted in recalls of various dairy products in the U.S. Cases such as this underscore the importance for manufacturers to vet supplier food safety practices, registrations and certifications, in addition to adopting their own food safety programs.

Foodborne illnesses cost the U.S. food industry $55.5 billion every year.[3] Beyond the extensive costs of a recall and lost revenue, food contamination can also devastate a brand, wiping out all of the consumer trust that a manufacturer has worked to earn. For manufacturers of end products, it can be very difficult to control hazards upstream in the supply chain, such as ingredient manufacture, transport or harvesting. However, the end product brand will still suffer in the event of a recall regardless of the source of contamination.

This is why FSMA and current c-GMPs call for greater control and traceability throughout the supply chain. Most manufacturers know that they need to maintain a Hazard Analysis and Risk-based Preventive Control (HARPC) plan, but it is also necessary to take the extra step of assessing suppliers to ensure they have done the same. If an ingredient is sourced from a supplier without rigorous preventive controls, there is a significant risk for contamination to enter the supply chain, tainting the manufacturer's operation and escalating the possibility of a recall.

Meeting FSMA and Current c-GMPs

Although FSMA does not require third party certification, this is the easiest way for manufacturers to verify that ingredient suppliers meet food safety standards. Third party certification facilitates the identification of gaps and drives continuous improvement and conformity to the standards.

No two food safety plans are the same. Commonly adopted food safety certification schemes include FSSC 22000, SQF, IFS and BRC, which are ISO accredited, Global Food Safety Initiative (GFSI) recognized schemes (ISO standards are independent, non-profit, transparent, and maintained by global, cross functional experts). There are a number of factors for manufacturers to consider when selecting one of these schemes, including:

- **How Comprehensive Is It?** – Some processes rely on a process/product scheme, which essentially involves "checking the boxes" on certain requirements. Others are more rigorous and require a strict management certification scheme as well as surveillance audits. The more rigorous the scheme, the harder it is to become certified and also maintain certification, but this ensures a higher level of conformity and tighter hazard control. Some schemes, lay out a very complex and proscribed set of controls, whereas others serve more as a framework, allowing manufacturers some flexibility while ensuring all standard requirements are met.

  Ideally, the scheme or combination of schemes should call for:

  - Food safety and quality management system (internal audits, traceability, policies, organizational structure, supplier approval, procedures)
  - Site standards (equipment, maintenance, waste disposal, hygiene, storage/transport)
  - Product control (design, testing, packaging)

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- Lavandin Oil Super
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- **Is it Recognized Globally?** – To ensure a particular certification scheme meets all applicable standards and regulations, manufacturers should ensure it is accepted by the GFSI, the European Cooperation for Accreditation (EA) or other accreditation bodies located in regions where the product may be imported/sold. In general, if a certification is accepted by EA, most accreditation bodies will likely accept it.

T-1. Glossary of Key Food Safety Terms

Term	Description
c-GMP's (Current Good Manufacturing Practices)	Prior to FSMA, provided the framework for U.S. food safety regulation, enforced by the FDA under 21 CFR and other agencies around the world. If a product is manufactured to meet c-GMP's, it may also indicate that it meets all minimum regulatory requirements for that region (but not necessarily in all regions).
Certified/Accredited to Meet…	Indicates a manufacturer has met the standards of a 3rd party certification program. The scheme, not the facility or products, are certified. A manufacturer's full portfolio is not necessarily covered by the certified scheme, and the scheme generally needs to be re-certified periodically.
Codex (Alimentarius)	A set of globally recognized food product and process standards developed by the UN and WHO. Defines a HACCP system and guidelines for its application, utilized by some certification schemes such as BRC.
FCC (Food Chemicals Codex)	A set of globally recognized standards for food ingredient quality and purity, including flavors. Contains specifications for "food grade" ingredients. A product label indicating a product is FCC indicates that the product meets the FCC specifications, but does not guarantee that the product has been tested or certified to meet the standard.
FD&C Act (U.S. Food, Drug, and Cosmetic)	Passed in 1938, gave the FDA authority to oversee the safety of food additives such as flavors. Products (especially colorants) labeled FD&C must be batch tested to ensure they meet FCC specifications.
Food-Grade	Indicates that a product that is fit for human consumption, though not with respect to any particular regulation. Evaluate whether a food-grade ingredient and supplier meets all requirements for the intended application, such as FCC specifications, FDA registration, and 21 CFR restrictions.
FSMA (U.S. Food Safety Modernization Act)	Indicates a manufacturer meets all FDA rules, but does not necessarily mean that a manufacturer has a certified food safety scheme or that it has been audited. Does not replace c-GMP's, but rather works with them for comprehensive coverage of products and practices. International food/ingredient manufacturers whose products may be distributed in the U.S. must also comply.
GFSI (Global Food Safety Initiative)	Provides globally recognized food safety benchmarks. Recognizes schemes that meet current benchmarks for HACCP, a food safety management system, and good practices for manufacturing and distribution. Examples of GFSI-recognized schemes include BRC, FSSC 22000, IFS, and SQF.
GRAS (Generally Recognized As Safe)	Indicates that experts consider a particular chemistry safe for human consumption. Does not indicate if a particular product is safe or meets specifications.
HACCP (Hazard Analysis and Critical Control Point)	A plan to identify and manage risks to food safety, mandated by the U.S. FDA and USDA/FSIS for juice and seafood processors. Primary focus is raw materials, products, and processes.
HARPC (Hazard Analysis and Risk-Based Preventive Control)	FSMA-provisioned plan to identify and manage risks to food safety. Does not apply to HACCP- or USDA-regulated facilities. Designed to be more comprehensive than HACCP, requiring a detailed recall strategy and re-analysis every three years or when new products or equipment are added.
PRP's (Pre-Requisite Programs)	Integrate hazard control and c-GMP's for a holistic food safety program. Incorporated into regulations.

- **How It Works with Other Process-Related Schemes** – Some certification schemes incorporate or are designed to integrate with other necessary processes. For example, FSSC 22000 incorporates ISO 22000, PAS 220 PRPs, HACCP, and Codex and also integrates with supply chain systems, ISO 9001 for quality and ISO 14001 for environmental management.

- **Number and Complexity of Audits** – For schemes such as SQF and FSSC 22000, audits occur in multiple stages for a more rigorous approach. There may also be surveillance audits in addition to registration audits and internal audits.

Actions for Manufacturers to Take

As a food product or ingredient manufacturer, there are a number of critical steps to ensure that all food safety requirements, including c-GMP's, are being met, minimizing the potential for a recall and the related costs and reputation damage that come with it.

1. **Adopt a food safety certification scheme that meets the needs of your operation and applicable regulations.** It is important to understand all regions where products may be imported and ensure the scheme meets the standards for that region.
2. **Ensure that all ingredient suppliers also meet the same standards.** No matter how rigorous a manufacturer's food safety program may be, they open the door for contamination when selecting upstream ingredients, such as flavors that have been produced to less stringent standards. The easiest way to ensure that ingredients have been produced in a manner that minimizes risk is to seek manufacturers offering third party certification.
3. **Ask suppliers if they are FDA registered – even if they are not located in the U.S.** If a flavor ingredient manufacturer is located in Europe and imports to the United States, both the original flavor manufacturer and the end product manufacturer must be registered with the U.S. FDA. In addition, FSMA's section on foreign suppliers mandates that these manufacturers meet the same standards as U.S. manufacturers.

FSMA gives the FDA the power to conduct random audits at any time. If a manufacturer can't establish traceability for all ingredients, it could result in a disruption to operations, or at worst, a failed audit and a potential mandatory recall. Even manufacturers outside the U.S. could be subject to an FDA audit if they supply food ingredients such as flavors that are sold into the U.S.

Six years after FSMA was passed, prescriptive food safety management continues to become increasingly standard across the international supply chain. However, there is still a long road ahead until the shift away from classical reactive methodology is complete. The number of FDA recalls has barely lowered even with implementation of increasingly rigorous standards, with 8,305 FDA products recalled in 2016, versus 9,288 in 2011.[4] USDA recalls actually increased over the same time frame, from 103 recalls involving approximately 40 million pounds of food in 2011 to 122 recalls involving approximately 58 million pounds in 2016.[5]

Few would disagree that preventive controls are the best tools we have to protect both brand reputation and the end consumer, while also guarding against the fallout from a recall. While changes to global food regulations can be complex and even confusing, by taking the appropriate steps, food manufacturers can get ahead of requirements and greatly minimize hazards in their operations.

p&f

EU REGULATIONS INFLUENCING THE FRAGRANCE INDUSTRY

With consumer safety at the forefront of product development, EU and global regulations facing fragrances in cosmetics can offer robust and dynamic research methods for an evolving label.

BY HELENA EIXARCH and DAVID ANDREW, TSGE Consulting Ltd., Concordia House, St. James Business Park, Grimbald Crag Court, Knaresborough, North Yorkshire, HG5 8QB, U.K.

With the aim of promoting consumer safety, the fragrance industry is self-regulated by the IFRA Code of Practice, which is adopted by fragrance houses worldwide.

IFRA and RIFM – Voluntary Measures

The International Fragrance Association (IFRA) represents the interests of the fragrance industry with the main purpose of promoting the safe use of fragrances worldwide.[1] The Research Institute for Fragrance Materials (RIFM) is the scientific arm of IFRA.

The IFRA Code of Practice includes scientifically-based recommendations (usage standards) which are intended to ensure the safe use of fragrance materials in products. The RIFM international Expert Panel, which consists of dermatologists, pathologists, toxicologists and environmental scientists, is completely independent of the fragrance industry, and assesses the available scientific data on fragrance ingredients. The Expert Panel evaluations are used by IFRA to develop their Code of Practice Standards on fragrance material usage.

The Code of Practice is adopted by IFRA member companies worldwide, and affects the manufacture and handling of all fragrance materials, for all types of applications, including cosmetics and toiletry products. Although IFRA membership is voluntary and the Code of Practice is not legally binding, adherence is mandatory for IFRA members. According to IFRA figures, its member companies currently supply 90% of the global fragrance market. Most cosmetic product manufacturers expect their fragrances to comply with IFRA standards.

The IFRA Code of Practice is regularly amended to include new or revised usage restrictions. The most recent (48th) amendment was published in 2015 and it is expected that the 49th amendment will be published in the second quarter of 2018. Following the publication of an amendment, there is usually a period of adaption before full compliance is required, to allow industry to implement the changes.

The EU Cosmetics Regulation – Legally Binding Measures

As membership to IFRA is not compulsory, not all fragrance houses follow its recommendations. Nevertheless, this does not imply that non-IFRA compliant fragrances are unsafe for use in cosmetics.

Any cosmetic product placed in the EU market must comply with the provisions of EU Regulation 1223/2009 (the Cosmetics Regulation),[2] and this also includes ingredients used in fragrances. Any fragrance house wishing to commercialize their products in the EU must therefore comply with the cosmetics regulation, regardless of their IFRA affiliation status. In contrast to the IFRA Code of Practice, the Cosmetics Regulation is legally binding. Therefore, in the case of discrepancy between the IFRA Code of Practice and the provisions of the Cosmetics Regulation, the latter must be applied in the EU.

According to the Cosmetics Regulation, some fragrance ingredients are banned. Entries 423 to 450 and 1133 to 1136 in Annex II of the Cosmetics Regulation list these substances, which include alanroot oil (*Inula helenium* L.), fig leaf absolute (*Ficus carica* L.), and costus root oil (*Saussurea lappa* Clarke) among others. All of these ingredients are also prohibited under the IFRA Code of Practice. Annex II of the Cosmetics Regulation also bans three essential oils, of which two are also prohibited by the IFRA Code of Practice (see **T-1**).

In addition to the banned substances listed in Annex II, Annex III of the Cosmetics Regulation includes restrictions on the use of some fragrance ingredients. According to the Regulation, 26 fragrance allergens (entries 45, 67 and 69 to 92[a]) must be declared on a cosmetic product's label ingredient list if these are present at concentrations above 0.001% (for leave-on products) or 0.01% (for products that are rinsed off). The aim of this requirement is to ensure that sensitive (i.e. allergic) consumers are informed of the presence of allergens in the cosmetic product. Nevertheless, the final concentration of these fragrance allergens in the finished product is not restricted by the Cosmetics Regulation. In contrast, the IFRA Code of Practice establishes concentration limits in the finished product for these allergens, except for linalool and limonene, for which only specification standards are stated (i.e. peroxide levels should be kept to the lowest practical

[a]Entry 79 (HICC) is to be deleted, see section "Recent amendments to the Cosmetics Regulation".

T-1. Essential oils banned by the EU Cosmetics Regulation and comparison to IFRA Standards.

Species	CAS #	Annex II entry	IFRA Standards
Chenopodium ambrosioides L.	8006-99-3	76	Prohibited
Juniperus sabina L.	90046-04-1	294	N/A
Lippia citriodora Kunth. (Verbena)	8024-12-2	450	Prohibited

level); interestingly, the Cosmetics Regulation does restrict the peroxide values for limonene to below 20 mmoles/L for the pure substance.

Other ingredients restricted by Annex III of the Cosmetics Regulation are listed in **T-2**. As stated in the table, restrictions required by the Cosmetics Regulation are not always in line with the IFRA Code of Practice.

Recent Amendments to the Cosmetics Regulation

In common with the IFRA Code of Practice, the provisions of the Cosmetics Regulation regarding fragrance ingredients are scientifically supported.

Proposals for the inclusion of ingredients in the Regulation's annexes may come either from industry or from National Competent Authorities. A dossier with data on the ingredient is submitted to the Scientific Committee on Consumer Safety (SCCS), who reviews the information provided and issues an opinion on the safety of the ingredient.[3] Based on this scientific opinion, the European Commission drafts an official proposal for adaptation to the Annexes of the Regulation. The Standing Committee on Cosmetic Products (COSCOM) discusses and votes on the proposal. If the proposal is accepted, a formal amendment to the regulation is issued and published in the Official Journal of the European Union (OJ), meaning that the regulation has been officially amended, including bans or restrictions on an ingredient.

Following this procedure, three fragrance allergens were banned from use in cosmetic products in August 2017.[4] The SCCS had previously concluded in its 2011 opinion[5] that hydroxyisohexyl

T- 2. Fragrance ingredients restricted by the EU Cosmetics Regulation Annex III, excluding fragrance allergens, and comparison to IFRA Standards.

Ingredient name	CAS #	Annex entry	EU Cosmetics Regulation restriction	IFRA Standards
Musk xylene*	81-15-2	96	Maximum 1.0% in fine fragrance Maximum 0.4% in eau de toilette Maximum 0.03% in other products	Prohibited
Musk ketone	81-14-1	97	Maximum 1.4% in fine fragrance Maximum 0.56% in eau de toilette Maximum 0.042% in other products	Musk ketone should only be used if it contains less than 0.1% musk
Methyl eugenol	93-15-2	102	Maximum 0.01% in fine fragrance Maximum 0.004% in eau de toilette Maximum 0.002% in fragrance cream Maximum 0.0002% in other leave-on products and oral products Maximum 0.001% in rinse-off products	Maximum 0.02% in fine fragrance Maximum 0.008% in eau de toilette Maximum 0.004% in fragrance cream Maximum 0.0004% in other leave on products Maximum 0.001% in rinse-off products Maximum 0.01% in non-skin, incidental skin contact
Balsam Peru oil, extracts and distillates	8007-00-9	154	Maximum 0.4%	Concentration limits depending on product type
Liquidambar orientalis oil and extract (Styrax)	94891-27-7	180	Maximum 0.6%	Styrax distillates – concentration limits depending on product type
Liquidambar styraciflua oil and extract (Styrax)	9046-19-3 / 94891-28-8	181	Maximum 0.6%	Maximum 0.6%
Acetyl hexamethyl tetralin	21145-77-7 / 1506-02-1	182	Maximum 0.1% in leave on products except: • Hydroalcoholic products 1% • Fine fragrance 2.5% • Fragrance cream 0.5% Maximum 0.2% in rinse-off products	N/A
Ethoxdiglycol	111-90-0	297	Maximum 2.6% in sprayable fine fragrances	N/A

*This ingredient is expected to be banned from cosmetic products, see section "The CLP Regulation and expected amendments to the Cosmetics Regulation"

3-cyclohexene carboxaldehyde (HICC or lyral), 2,6-dihydroxy-4-methyl-benzaldehyde (atranol) and 3-chloro-2,6-dihydroxy-4-methyl-benzaldehyde (chloroatranol) should not be used in cosmetic products as these are the fragrance allergens which appear to be responsible for the highest number of cases of contact allergy. As a consequence, these allergens were included in Annex II of the Cosmetics Regulation (banned ingredients), and entry 79 of Annex III (which permitted the restricted use of HICC) was deleted. In order to provide a reasonable period of time for industry to adapt to these changes, the ban on the placing on the market will effectively apply from 23 August 2019, and 23 August 2021 will be the deadline for the withdrawal of any cosmetic product containing these ingredients.

It should be noted that atranol and chloroatranol are natural components of oak moss (*Evernia prunastri*) and treemoss (*Evernia furfuracea*) extracts, which are separately regulated by entries 91 and 92 of Annex III of the Cosmetics Regulation, respectively. The IFRA Code of Practice currently restricts the concentration of HICC (different concentrations depending on the product type) and limits the levels of atranol and chloroatranol below 100 ppm in oak moss and treemoss extracts; however, these restrictions are not in line anymore with the provisions of the EU Cosmetics Regulation.

Expected Amendments to the Cosmetics Regulation

The Scientific Committee on Consumer Products (SCCP), the predecessor of the SCCS, concluded in its 2005 opinion[6] that *Tagetes erecta, Tagetes minuta* and *Tagetes patula* extracts and oils, which are widely used fragrance ingredients, should not be used in cosmetic products as no safe limits had been demonstrated. The SCCS revised the opinion in 2015 after a dossier update[7], and concluded that for *Tagetes minuta* and *Tagetes patula* extracts and oils in leave-on products (except sunscreen products), a maximum concentration of 0.01% is safe, provided the alpha terthienyl (terthiopene) content in the extracts and oils does not exceed 0.35%.

The SCCS also concluded that these ingredients should not be used in sunscreen products. In a later comment to the opinion, the SCCS also stated that a 0.1% should be established as the maximum concentration for these ingredients in rinse-off products. A draft commission regulation implementing the SCCS recommendations was published in July 2017. This draft bans *Tagetes erecta*, restricts the use of *Tagetes patula* and *Tagetes minuta* (including purity specifications regarding terthiopene), and bans the use of *Tagetes patula* and *Tagetes minuta* in sunscreen products. The deadline for comments was 10 September 2017. The proposed date for adoption is the fourth quarter of 2017 and 9-month and 12-month adaptation periods are expected for placing on and withdrawal from the market, respectively.

Fragrance Ingredients under SCCS Assessment

As stated above, amendments to the Cosmetics Regulation are based, to a great extent, on the opinions of the SCCS. The SCCS has recently reviewed or is currently considering several issues which concern the fragrance industry.

> According to IFRA figures, its member companies currently supply 90% of the global fragrance market.

In the same opinion of 2011 that led to the banning of three allergens in cosmetic products[5] (see above), the SCCS also identified 129 fragrance ingredients which have been shown to be sensitizers in humans (including the already regulated 26 allergens). Of these, 82 were classified as established contact allergens in humans, 24 were categorized as established contact allergens in animals, and 23 were considered likely contact allergens by a combination of evidence.

The SCCS was of the opinion that the consumer should be made aware of the presence of these substances in cosmetic products, meaning the list of allergens to include on the product label would increase from the current 26 allergens to a minimum of 82 substances (established contact allergens), and potentially up to 129 ingredients if all of them were to be considered. A public consultation on this proposal was launched by the European Commission in February 2014 (closed in May 2014), but up to date, no legal changes have been implemented.

The technical difficulties and economic implications of this proposal have slowed down a regulatory

process that was initially expected to be completed by the beginning of 2015. As an example of the concerns raised by the industry, IFRA responded to the consultation by addressing two issues.[8] Firstly, a concern was raised over the need to develop new analytical methods to determine the concentration of the newly identified fragrance allergens. In November 2016, this was successfully addressed, when IFRA released the protocol for the analytical method to quantify 57 suspected allergens (and isomers) in fragrance materials.[9]

> The Scientific Committee on Consumer Products was of the opinion that safe levels of exposure to allergenic substances should be based on clinical data and/or elicitation low-effect levels.

Secondly, IFRA was of the opinion that substance labelling "has not helped protect people already sensitized from elicitation while often confusing the vast majority of the other un-sensitized population," and that this situation would be "even more relevant when extending the list of allergens." IFRA's proposals to address correct delivery of information to the consumer included the use of pictograms, pack warnings, web-based sources and free access to consumer help desks. Up to the present, no consensus has been reached on the most appropriate approach to inform the allergic consumer.

As a final comment on the same SCCS opinion of 2011[5], it also suggested that 12 single chemicals and eight natural extracts should be subject to concentration limits in cosmetic products. As further scientific work is needed to determine these concentration limits, no regulatory action has been undertaken so far.

Other Fragrance-Related Topics

In October 2016, the European Commission submitted a third request for an opinion on acetylated vetiver oil. The first request was submitted in 2005 by the European Flavor & Fragrance Association (EFFA) to the SCCP, who released an opinion in 2006[10] stating that the information submitted was "inadequate to assess the safe use of the substance." A second request was submitted by IFRA in 2013. After the corresponding SCCS opinion was released in 2014,[11] and during the commenting period, IFRA raised the necessity to modify the initial request. IFRA recommended several safe concentration limits for acetylated vetiver depending on the cosmetic product category in which the ingredient is intended to be used. The current (third) submission requests the SCCS opinion on the safety of acetylated vetiver oil as a fragrance ingredient in cosmetic leave-on and rinse-off products at the concentration limits established by IFRA. The initial deadline for this opinion was March 2017, but a request for clarification was sent to the applicant and the publication of the final opinion has been delayed.

Butylphenyl methylpropional (BMHCA, lilial or lysmeral) is one of the fragrance allergens listed in Annex III of the Cosmetics Regulation (entry 83, see above). This ingredient is regulated for labelling purposes but has no concentration restrictions. Nevertheless, the IFRA Code of Practice establishes concentration limitations depending on the product type. In 2013, a public consultation was launched to address the possible classification of the ingredient as a reprotoxic compound according to the CLP Regulation. In response, IFRA requested the SCCS opinion on the ingredient. The SCCS opinion,[12] published in 2015 and revised in 2016, concluded that BMHCA is not safe for use as a fragrance ingredient in leave-on and rinse-off type cosmetic products at the concentration limits established by IFRA. The SCCS could not draw a firm conclusion on the mutagenicity of BMHCA, and expressed its concern that the ingredient poses a risk of inducing skin sensitization in humans.

In June 2017, a second opinion on BMHCA was requested to the SCCS, after IFRA submitted a new dossier containing additional data. The new dossier clearly distinguishes between the para and meta isomers of the ingredients, defending the use of para-BMHCA. It also includes a revised proposal for maximum use levels of p-BMHCA in different cosmetic product types. The deadline for the publication of the draft opinion is December 2017. It is important to note that an official classification proposal for BMHCA as a Category 2 reprotoxic substance under

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One of the strongest links between fragrance and cosmetics is in skincare, which continues to be a growing segment in both markets. Though there are differences between EU cosmetic regulations and IFRA standards, both entities push towards robust and dynamic research methods for consumer safety and labeling.

the CLP Regulation was submitted in May 2017. If the ingredient is finally included in Annex VI of the CLP Regulation (a process with a timeline of about 2 years) and no positive opinion is delivered by the SCCS, BMHCA would be effectively banned from use in cosmetic products in the EU.

In 2006 IFRA published and implemented a dossier describing the Quantitative Risk Assessment (QRA) methodology.[13] The QRA methodology aims to assess the sensitization risk of fragrance ingredients, that is, to establish concentration limits below which these ingredients do not pose a danger for consumers. The use of QRA for fragrance ingredients should facilitate the establishment of IFRA Standards. Despite the QRA representing an important step forward in skin sensitization risk assessment, it was recognized that further refinement to the method was needed. In fact, the SCCP reviewed the method in 2008 and concluded that "the model has not been validated and no strategy of validation has been suggested."[14] They were of the opinion that there was no confidence the identified thresholds for skin sensitizers were safe for the consumer.

Some additional criticisms were, firstly, that the QRA model was based on data from sensitization tests in humans (e.g. Human Repeated Insult Patch Tests (HRIPT)), which does not have an in-depth method description and is considered to be unethical to perform. Secondly, epidemiological and experimental data providing information on sensitization/elicitation reactions in consumers by marketed products were not integrated in the QRA model.

The SCCP was of the opinion that safe levels of exposure to allergenic substances should be based on clinical data and/or elicitation low-effect levels. Nevertheless, the SCCP recognized that, after refinement and validation, models like the QRA could be applicable for risk assessment of new substances for which data is not available. They suggested aggregated exposures should be incorporated in the QRA model, as well as a validation

employing a broad range of chemicals and clinical data. In their opinion of 2011[5] the SCCS reiterated this opinion. Following this evaluation, a new QRA methodology has been developed (and named QRA 2), which reviews uncertainty factors and introduces dermal aggregate exposure data. In March 2017, the SCCS was requested an opinion on the new methodology. The draft opinion is expected for October 2017, which is the deadline set up in the opinion request.

The CLP Regulation and Expected Amendments to the Cosmetics Regulation

Although it does not directly address cosmetics, the provisions of Regulation 1272/2008 (the CLP Regulation)[15] do have an impact on these products. According to Article 15 of the Cosmetics Regulation, the use in cosmetic products of substances classified under Annex VI to the CLP Regulation as CMR (carcinogenic, mutagenic or reprotoxic) is prohibited.

Category 1A and 1B CMR substances ('known' or 'assumed' human CMRs) may still be used in cosmetics only if they comply with the EU food safety requirements[16], there are no suitable alternative substances available, an application is made for a particular use of a product category with a known exposure and they have been evaluated and found to be safe by the SCCS for use in cosmetic products. Category 2 CMR substances ('suspected' human CMRs) may be used in cosmetic products if they have been evaluated by the SCCS and considered to be safe for use.

In July 2017, a draft Commission Regulation was published which explicitly prohibits or restricts the use in cosmetics of substances classified as CMR (in any category) according to the CLP Regulation as at 1 January 2017, by including them in Annex II or III of the Cosmetics Regulation. The deadline for comments on this draft Regulation was 28 August 2017. After this, the regulation is expected to be voted and published in the OJ by the end of 2017. There will be no adaptation period to the regulatory changes.

Some fragrance ingredients have been included in this draft regulation:

Furfural (2-furaldehyde), which is used as a fragrance ingredient in cosmetic products, is listed in Annex VI of the CLP Regulation as a CMR substance in Category 2. As the SCCS concluded in its opinion

of 2012 that furfural is safe for use in cosmetics at concentrations of up to 0.001%,[17] the ingredient will not be banned, but restricted. The draft regulation lists furfural in Annex III of the Cosmetics Regulation in order to restrict its use in line with the SCCS opinion. It should be noted that furfural is restricted by the IFRA Code of Practice to concentrations ranging between 0.001 and 0.05% depending on the product type. Nevertheless, changes to the Cosmetics Regulation are legally binding.

Musk xylene, which is currently listed in entry 96 of Annex III of the Cosmetics Regulation, is classified as a Category 2 carcinogen in Annex VI of the CLP Regulation. Although the last published scientific opinion, dated 2004, considered musk xylene is safe at the currently permitted concentration levels,[18] as there has been no additional assessment by the SCCS regarding the safety of this ingredient in cosmetic products, musk xylene will be included in entry 1389 of Annex II of the Cosmetics Regulation and deleted from Annex III, and thus banned from use in cosmetic products. In line with this, musk xylene is prohibited in fragrances according to the IFRA Code of Practice, and its concentration limited below 0.1% in musk ketone preparations.

Conclusion

The safety of cosmetic products containing fragrances marketed in the EU is accomplished through the application of both voluntary and legally binding measures (the IFRA Code of Practice and the EU Cosmetics Regulation, respectively). Restrictions on the usage of fragrance ingredients stated in both texts do not always coincide, with the (legally binding) Cosmetics Regulation often being more restrictive than the IFRA Code of Practice. Therefore, following the IFRA recommendations, although intended to ensure product safety, does not fully guarantee regulatory compliance of a fragrance in the EU, as fragrance houses wishing to sell their products in the EU must also ensure full compliance with the provisions of the Cosmetics Regulation.

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Organoleptic Characteristics of Flavor Materials

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Many thanks to FONA for again graciously hosting this evaluation session!

Coffee Absolute

Supplier: Bontoux, Inc.
GRAS, CAS# 8001-67-0, natural, *Coffea arabica*, natural
Odor: @ 100%. Coffee, slightly smoky, ashy, burnt, roasted and brown.
Taste: @ 10 ppm. Coffee, ashy, roasted and slightly woody with a low, nutty undertone.
Taste: @ 20 ppm. Coffee, ashy, roasted, smoky, bitter, slightly chocolate-like and slightly nutty.
Possible applications: It is no surprise all flavors and blends of thereof like mocha will be graced by this material. Other flavors where it will be used efficiently are dark chocolate, caramel, maple, butterscotch, barbecue, tobacco, chicory, roast beef and red eye gravy.
➤**Bontoux, Inc.:** *www.bontoux.com*

Wormwood Oil American

Supplier: Vigon International, Inc.
FEMA# 3116, CAS# 8003-93-3, natural, *Artemisia absinthium*
Odor: @ 100%. Sweet, green, slightly floral, minty and spicy with a hint of tarragon.
Taste: @ 5 ppm. Green, minty, astringent, herbal and slightly woody.
Taste: @ 10 ppm. Sweet, minty, cooling, spicy, herbal and slightly woody.
Possible applications: Infamous for its use in absinthe, this essential oil with its herbal, minty notes will complement the profiles of peppermint, spearmint, wintergreen, licorice, anise, sensen and root beer flavors. Alcoholic flavors like ouzo, chartreuse and the like are also effective uses for it.
➤**Vigon International, Inc.:** *www.vigon.com*

Hexyl isobutyrate natural

Supplier: Advanced Biotech
FEMA# 3172, CAS# 2349-07-7, natural
Natural occurrence: Apple, beer, brandy, grape, hops, lavender, quince and strawberry.
Odor: @ 1%. Green, fresh, slightly floral, waxy, fruity and sweet.
Taste: @ 2 ppm. Sweet, green, fruity and waxy.
Taste: @ 5 ppm. Waxy, green, slightly vegetable-like, grassy and fruity.
Possible applications: Most fruit flavors with a fresh, green top note are good candidates for this ester including, apple, pear, strawberry, guava, melon and green banana. At higher levels it will take on green vegetable notes and will be useful in celery and green pepper.
➤**Advanced Biotech:** *www.adv-bio.com*

Rose Oil Bulgarian

Supplier: Berjé
FEMA# 2989, CAS# 8007-01-0, natural, *Rosa damascena*
Odor: @ 1%. Sweet, floral, rose, green and perfumey.
Taste: @ 0.5 ppm. Floral, rose, slightly green, slightly soapy and perfumey.
Taste: @ 1 ppm. Sweet, rose, floral, fresh, slightly berry-like, powdery and tea-like.
Possible applications: At very low levels, this costly essential oil will deepen the profiles of many berry flavors including raspberry, strawberry, blueberry and blackberry. Tropicals like lychee, rambutan and citrus like orange and lemon will also benefit, as well as floral flavors. It should also be considered for fantasy notes in flavors for alcoholic applications.
➤**Berjé:** *www.berjeinc.com*

6-Methyl-5-hepten-2-ol natural (synonym – coriander heptenol)

Supplier: Natural Advantage
GRAS (FEMA# 4884 pending), CAS# 1569-60-4, natural
Natural occurrence: Citrus fruits, lychee, macadamia nut and tomato.
Odor: @ 1%. Waxy, earthy, green and fungal.
Taste: @ 5 ppm. Creamy, waxy, green, slightly fruity and earthy.
Taste: @ 10 ppm. Waxy, earthy, slightly cheesy and creamy.
Possible applications: Dairy flavors are the main application of this soon-to-be FEMA material. Milk, butter, cream, sour cream, cream cheese, mozzarella and aged and mold-ripened cheeses like cheddar, blue, gorgonzola, brie and camembert are all good targets for its use. A touch in mushroom and coconut flavors will enliven the profiles.
➤**Natural Advantage:** *www.natural-advantage.net*

6-Methyl-3,5-heptadien-2-one, 10% in EtOH, natural

Supplier: Alfrebro
FEMA# 3363, CAS# 1604-28-0, natural
Natural occurrence: Hazelnut, tomato, wormwood, tea, grape, lavender and rice bran.
Odor: @ 10%. Sweet, creamy, coconut-like, waxy and lactonic.
Taste: @ 2 ppm. Creamy, coconut-like and slightly plastic.
Taste: @ 5 ppm. Coconut-like, creamy, lactonic, slightly green and coumarin-like.

Possible applications: The sweet, coconut-like notes of this material will add depth to coconut and coumarin-type flavors. Its creamy notes will enhance sweet dairy flavors like milk and cream as well as brown flavors like caramel, maple, nut and vanilla.
➤**Alfrebro:** *www.alfrebro.com*

Ethyl levulinate natural

Supplier: Sigma Aldrich
FEMA# 2442, CAS# 539-88-8, natural
Natural occurrence: Bread, cocoa, vanilla and wine.
Odor: @ 100%. Slightly solvent-like and slightly fruity with a hint of leather.
Taste: @ 20 ppm. Astringent and lightly fruity.
Taste: @ 40 ppm. Astringent, slightly fresh, fruity and brown.
Possible applications: Although this ester will probably never play the leading role in a flavor, it will help freshen the profiles of rum, apple, pineapple, melon and other fruit flavors where astringency and general lift is appreciated.
➤**Sigma Aldrich:** *www.sigmaaldrich.com*

3-Octyl acetate

Supplier: Sigma Aldrich
FEMA# 3583, CAS# 4864-61-3
Natural occurrence: Bergamot, cornmint, mushroom, lavandin, peppermint and spearmint.
Odor: @ 1%. Waxy, woody, rosy, slightly citrus, earthy and fungal.
Taste: @ 5 ppm. Slightly floral, waxy, rosy, fatty and mushroom-like.
Taste: @ 10 ppm. Floral, bergamot-like, waxy, slightly fruity and mushroom-like.
Possible applications: The earthy, rosy nature of this ester will fit well in rose, lychee, rambutan, peach, apricot, cantaloupe and honeydew melon flavors as well as in citrus, especially lime and bergamot.
➤**Sigma Aldrich:** *www.sigmaaldrich.com*

2-Methoxy pyrazine

Supplier: Sigma Aldrich
FEMA# 3302, CAS# 3149-28-8
Natural occurrence: Beef, cocoa and krill.
Odor: @ 1%. Nutty, peanut-like, toasted, roasted, cocoa-like, brown and earthy.
Taste: @ 2 ppm. Nutty, toasted, peanut-like and roasted.
Taste: @ 2 ppm. Nutty, peanut-like, roasted, brown and cocoa-like.
Possible applications: Most roasted nut flavors will benefit with the addition of this material especially peanut, pecan, almond and hazelnut. Its toasted nature will also lend character to grain flavors like corn, oats, rice and graham as well as brown flavors like cocoa, coffee, caramel, pie crust, pretzel and beurre noisette.
➤**Sigma Aldrich:** *www.sigmaaldrich.com*

Sclareol

Source: Berjé
FEMA# 2029, CAS# 515-03-7
Natural occurrence: Clary sage, nutmeg and thyme.
Odor: @ 100%. Aromatic, dry, labdanum-like, slightly spicy, woody, clean and incense-like.
Taste: @ 2 ppm. Powdery, woody and perfumey.
Taste: @ 5 ppm. Powdery, woody, labdanum-like and incense-like.
Possible applications: More associated with men's fragrances, the unique qualities of this complex molecule will add fantasy notes to liqueur flavors, spice and herbal flavors like anise, tarragon, nutmeg and cinnamon and to fruits like apple, raspberry and strawberry.
➤**Berjé:** *www.berjeinc.com*

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BY BRIAN M. LAWRENCE
Consultant

Progress in Essential Oils: Thymol-rich *Thymus vulgaris* oils – Part 1

A derivative of thyme oil, thymol contains antibacterial, anti-inflammatory and antioxidant properties, among others. Part 1 discusses the various constituents of thymol-rich thyme oils.

It is well-known that various chemical forms or chemotypes are found in the oils of *Thymus vulgaris* L. However, the most commonly encountered oil form is that which is rich in thymol.

The composition of the oils of one of the clonal stock lines (a thymol-rich clone) of *T. vulgaris* grown in Sainte Fey (Quebec, Canada) was analyzed using GC/MS only by Bhaskara Reddy et al. (1998), and found to be as follows:

α-pinene (2.6%)
α-thujene (0.9%)
α-camphene (0.4%)
β-pinene (0.2%)
sabinene (0.1%)
δ-3-carene (7.1%)
myrcene (0.9%)
α-terpinene (0.4%)
limonene (1.2%)
1,8-cineole (1.1%)

γ-terpinene (0.2%)
p-cymene (20.8%)
terpinolene (0.2%)
p-cymenene (0.1%)
1-octen-3-ol (0.4%)
α-copaene (0.3%)
camphor (0.3%)
cis-p-menth-1-en-1-ol (0.2%)
linalool (13.3%)
β-caryophyllene (1.4%)
bornyl acetate (0.5%)
terpinen-4-ol (5.1%)
trans-p-menth-2-en-1-ol (0.2%)
isoborneol (0.4%)
verbenol* (0.5%)
α-terpineol (2.5%)
α-muurolene (0.2%)
δ-cadinene (0.7%)
anethole†(0.1%)
caryophyllene oxide (1.1%)
cumin alcohol† (0.1%)
thymol (18.1%)
carvacrol (8.9%)

*correct isomer not identified
†incorrect identification or oil contaminant

Two commercial samples of thyme oil (*T. vulgaris*) that were purchased in Greece were found by Manou et al. (1998) to contain the following major constituents:

α-pinene (2.0–2.4%)
myrcene (1.2–1.5%)
p-cymene (23.1–28.7%)
γ-terpinene (5.9–9.1%)
linalool (5.1–5.8%)
thymol (38.6–43.0%)
carvacro l (2.2–9.8%)
β-caryophyllene (1.5–1.6%)

A number of oils obtained from *T. vulgaris* that were collected from different habitats in the Languedoc region (France) were determined by Thompson et al. (2003) to possess the following range of major constituents:

1,8-cineole (0–3.8%)
p-cymene (0–29.0%)
γ-terpinene (0–23.5%)
linalool (0.1–13.4%)
sabinene hydrate (0–3.3%)
terpinen-4-ol (0.1–5.0%)
α-terpineol (0–6.1%)
myrcen-8-ol (0–1.7%)
geraniol (0–8.9%)
thymol (21.4–72.9%)
carvacrol (0.8–26.8%)
β-caryophyllene (0.2–7.8%)

The thymol-rich chemotype of *T. vulgaris* that was collected in full flower from an experimental garden in Campinas (Brazil) was screened for its antimicrobial activity by Sartoratto et al. (2004). Analysis of this oil (produced in 0.56% yield) using GC-FID and GC/MS revealed that it possessed the following composition:

1-octen-3-ol (0.8%)
p-cymene (3.3%)
γ-terpinene (2.6%)
linalool (1.6%)
borneol (2.3%)
terpinen-4-ol (1.2%)
methyl thymol (0.8%)
thymol (79.2%)
carvacrol (4.6%)
β-caryophyllene (2.3%)
germacrene D (0.4%)

Seven commercially available thyme oils (*T. vulgaris*) from France and Italy were analyzed by GC-FID for known constituents. The constituents were found by Zamborelli et al. (2004) to quantitatively range as follows:

α-pinene (0.9–2.9%)
camphene (0.3–1.3%)
β-pinene (0.7–2.2%)
myrcene (1.2–2.4%)
δ-3-carene (0.5–2.0%)
p-cymene (21.5–44.9%)
limonene (0.5–1.3%)
γ-terpinene (0–17.3%)
linalool (1.9–3.7%)
borneol (0.6–2.2%)
terpinen-4-ol (0.6–4.5%)
thymol (22.1–38.5%)
carvacrol (1.1–1.9%)
β-caryophyllene (1.9–5.6%)

Dried thyme leaves (ex *T. vulgaris*) were purchased locally at a market in Davis (Northern California) and subjected to steam distillation under pressure for 3 hr. The oil, which was analyzed by a combination of GC-FID and GC/MS by Lee et al. (2005), was found to contain the following constituents:

α-terpinene (0.1%)
1,8-cineole (2.5%)
γ-terpinene (0.1%)
3-methyl-3-buten-1-ol†(0.1%)
3-octanone (0.1%)
p-cymene (0.1%)
hexanol (0.2%)
(Z)-3-hexenol (0.1%)
cis-linalool oxide[f] (0.2%)
1-octen-3-ol (0.5%)
trans-sabinene hydrate (0.3%)
trans-linalool oxide[f] (0.2%)
camphor (1.5%)
linalool (4.8%)
terpinen-4-ol (1.1%)
menthol† (0.1%)
trans-pinocarveol (0.1%)
δ-terpineol (0.4%)
trans-verbenol (0.1%)
α-terpineol (2.9%)
borneol (2.4%)
verbenone (0.9%)
dihydrocarveol (0.1%)
carvone (0.9%)
cis-linalool oxide[P] (0.1%)
citronellol (0.1%)
p-methyl acetophenone† (0.1%)
cumin aldehyde (0.1%)
myrtenol (0.1%)
(E)-anethole† (0.3%)
trans-carveol (0.1%)
p-cymen-8-ol (0.5%)
geraniol (0.3%)
guaiacol† (0.1%)
2-phenethyl alcohol†(0.2%)
caryophyllene oxide (0.4%)
1,1-dimethyl-2-phenethyl alcohol† (1.6%)
(E)-cinnamaldehyde† (0.2%)
elemol† (0.1%)
cuminyl alcohol† (0.2%)
spathulenol (0.4%)
eugenol (0.9%)
thymol (85.5%)
carvacrol (6.8%)
α-eudesmol (0.1%)
δ-selinene† (0.1%)
methyl jasmone† (0.1%)
caryophylla-4(12), 8(13)-dien-5β-ol (0.1%)
dihydroactinodiolide† (0.1%)
caryophylla-3, 8(13)-dien-5-ol* (0.1%)

*collect isomer not identified
†incorrect identification or oil contaminant
f = furanoid form
P = pyranoid form

In addition, trace amounts (20.05%) of 1-penten-3-ol, (E)-2-hexenal, (E,Z)-2,4-heptadienal, (E,E)-2,4-heptadienal, methyl

2-methylbutyrate, 5,6-epoxy-(E)-β-ionone, butyric acid, octanoic acid, decanoic acid, terpinolene, *trans*-p-menth-2-en-1-ol, bornyl acetate, methyl carvacrol, exo-methylcamphenilol, *cis*-dihydrocarvone, terpinen-1-ol, lavandulol, p-mentha-1,8-dien-4-ol, exo-2-hydroxy-1,8-cineole, *trans*-piperitol, *trans*-linalool oxide pyranoid form, piperitenone, perillyl alcohol, viridiflorol, T-muurolol, isospathulenol, methyl eugenol, p-cresol, 5-isopropyl-3-methylphenol and dillapiole were also listed as being found in this oil. Many of these trace constituents listed by the authors have never been previously found in a thymol-rich *T. vulgaris* oil so their purported characterization requires corroboration.

Ground thyme leaves that were purchased from a Spanish market were homogenized and subjected either to simultaneous distillation-extraction using methylene chloride as the solvent, or supercritical fluid CO_2 extraction (for 25 mins at 40°C, 120 bar and CO_2 density of 0.72 g/mL). Both the oil and extract were analyzed using GC/MS and GC-FID by Diaz-Maroto et al. (2005). The respective compositions of the oil and extract can be seen in **T-1**.

An oil of *Thymus vulgaris* produced from Italian grown plants was analyzed by Tognolini et al. (2006) using GC-FID and GC/MS. It was found to possess the following composition:

tricyclene (0.1%)
α-thujene (0.6%)
α-pinene (2.3%)
camphene (1.8%)
β-pinene (0.6%)
3-octanone (0.6%)
3-octanol (0.3%)
myrcene (1.6%)
α-phellandrene (0.2%)
α-terpinene (1.6%)
p-cymene (15.3%)
limonene (2.0%)
1,8-cineole (1.9%)
(Z)-β-ocimene (0.1%)

T-1. Comparative percentage composition of the oil and supercritical fluid CO_2 extract of ground thyme leaves

Compound	Oil	Extract
α-thujene	0.5	t
α-pinene	2.1	0.2
camphene	1.5	0.1
verbenone	0.1	–
1-octen-3-ol	0.2	0.1
1-octen-3-one[a]	0.1	–
sabinene	0.1	–
β-pinene	0.2	–
myrcene	0.5	t
α-phellandrene	0.1	–
δ-3-carene	t	–
α-terpinene	0.8	0.2
p-cymene	33.0	8.5
1,8-cineole + limonene	2.8	2.3
(E)-β-ocimene	t	–
γ-terpinene	4.8	1.6
cis-sabinene hydrate	1.0	0.6
cis-linalool oxide[f]	0.1	t
p-cymenene + trans-linalool oxide[f]	0.2	t
terpinolene	0.1	t
linalool	3.6	3.3
camphor	0.7	1.4
trans-verbenol	0.5	0.2
borneol	3.6	4.0
p-cymen-8-ol	0.3	0.2
terpinen-4-ol	1.0	1.1
α-terpineol	0.9	1.0
verbenone	1.7	1.4
methyl thymol	0.7	0.4
methyl carvacrol	0.6	0.4
linalyl acetate	0.2	1.0
thymol	31.1	60.9
carvacrol	5.2	8.9
β-caryophyllene	0.5	0.9
β-gurjunene	t	t
γ-cadinene	t	t
δ-cadinene	t	0.1
caryophyllene oxide	0.6	0.5
T-cadinol	0.1	0.1

t = trace (<0.05%)
f = furanoid form
[a]should be 3-octanone

(E)-β-ocimene (0.2%)
γ-terpinene (5.6%)
cis-sabinene hydrate (0.7%)
terpinolene (1.0%)
trans-sabinene hydrate (0.1%)
α-thujone† (7.3%)
allo-ocimene* (0.1%)
β-thujone† (0.7%)
camphor (3.1%)
borneol (2.7%)
terpinen-4-ol (1.3%)
p-cymen-8-ol (0.1%)
α-terpineol (1.3%)
cis-dihydrocarvone (0.1%)
trans-dihydrocarvone (0.1%)
methyl thymol (0.6%)
methyl carvacrol (1.5%)
geraniol (8.3%)
geranial (0.6%)
bornyl acetate (0.8%)
thymol (6.8%)
carvacrol (8.0%)
α-terpinyl acetate (1.1%)
piperitenone oxide† (0.1%)
geranyl acetate (3.9%)
β-bourbonene (0.1%)
isocaryophyllene† (0.1%)
α-gurjunene† (0.1%)
β-caryophyllene (3.2%)
β-humulene† (1.5%)
allo-aromadendrene (0.2%)
γ-amorphene† (0.3%)
viridiflorene† (0.3%)
β-bisabolene (1.4%)
δ-amorphene† (0.3%)
spathulenol (0.1%)
caryophyllene oxide (0.4%)
†incorrect identification

Thymus vulgaris that was grown in the Botanic Garden of the University of Pécs (Pécs, Hungary) was harvested, air-dried and treated to hydrodistillation to produce an oil in 0.49% yield. Using GC-FID and GC/MS Horváth et al. (2006) determined that the oil possessed the following composition:

α-pinene (0.7%)
camphene (0.2%)
β-pinene (0.1%)
limonene (0.3%)
p-cymene (32.2%)
γ-terpinene (1.3%)
cis-linalool oxide[f] (0.9%)
linalool (1.9%)
borneol (1.6%)
β-caryophyllene (0.7%)
thymol (45.6%)
carvacrol (4.6%)
caryophyllenol* (1.2%)

[f] = furanoid form
*correct isomer not identified

An oil produced from *Thymus vulgaris* L. grown in Serbia was determined by Bozin et al. (2006) to possess the following composition:

α-pinene (0.2%)
camphene (0.4%)
β-pinene (0.2%)
p-cymene (0.8%)
limonene (0.2%)
1,8-cineole (1.9%)
γ-terpinene (8.3%)
2-nonanone (0.8%)
linalool (2.2%)
α-thujone (1.0%)
β-thujone (0.2%)
camphor (1.7%)
menthone (2.2%)
borneol (2.6%)
neomenthol (2.8%)
menthol (1.3%)
terpinen-4-ol (1.0%)
α-terpineol (0.6%)
pulegone (1.1%)
methyl thymol (0.3%)
piperitone (1.4%)
bornyl acetate (0.4%)
thymol (47.9%)
carvacrol (5.9%)
geranyl acetate (0.2%)
β-cubebene (3.4%)
β-caryophyllene (0.7%)
α-seliinene (0.3%)
γ-cadinene (0.5%)
myristicin† (0.7%)
cis-calamenene (0.7%)
ledol(1.4%)
spathulenol (1.0%)
cadalene (1.8%)
apiole (0.4%)

†incorrect identification or oil contaminant

As shown above,it would appear to this reviewer that the characterization of 2-nonanone, α-thujone, β-thujone, menthone, neomenthol, menthol, pulegone, piperitone, myristicin, ledol, cadalene and apiole may have arisen from some cross contamination either with the plant material or the oil as these are not normal constituents of thymol-rich oils of *T. vulgaris*.

Pavela (2007) screened the housefly against thyme oil. The oil used in this study possessed the following main components:

α-pinene (0.3%)
p-cymene (12.7%)
γ-terpinene (1.0%)
trans-sabinene hydrate (<0.1%)
linalool (4.3%)
α-terpineol (0.2%)
thymol (77.7%)
carvacrol (3.2%)

He found that thymol-rich *T. vulgaris* oil decreased the longevity of adult-flies and their larvae, as well as having a marked negative effect on the fecundity of both sexes. This means that the oil affected the reproduction cycle of adult flies and their larvae which would lead to a reduction of offspring when the oil was used.

An oil of *T. vulgaris* that was screened against two rice fungi by Nguefach et al. (2007) was determined to possess the following composition:

α-thujene (1.2%)
α-pinene (1.0%)
camphene (1.2%)
sabinene (0.4%)
β-pinene (0.3%)
myrcene (1.7%)
α-phellandrene (0.2%)
p-cymene (23.6%)
limonene (1.5%)
γ-terpinene (22.7%)
trans-sabinene hydrate (1.0%)
linalool (5.2%)
camphor (1.9%)
terpinen-4-ol (1.3%)
α-terpineol (0.3%)
thymol (27.2%)
carvacrol (3.3%)
β-caryophyllene (3.5%)
germacrene D (0.6%)
δ-cadinene (0.3%)
caryophyllene oxide (0.6%)
T-muurolol (0.4%)
T-cadinol (0.1%)

An oil of a thymol-rich clone of *T. vulgaris* produced from plants

collected in Serbia was screened for its antibacterial activity (Sokovic et al. 2007) and antifungal activity (Sokovic et al. 2009). The oil was found to possess the following composition:

α-thujene (1.8%)
α-pinene (1.2%)
camphene (0.8%)
sabinene (0.6%)
β-pinene (0.4%)
myrcene (1.1%)
α-terpinene (0.7%)
p-cymene (19.0%)
limonene (0.5%)
1,8-cineole (0.7%)
(E)-β-ocimene (1.3%)
γ-terpinene (4.1%)
linalool (0.7%)
camphor (0.2%)
borneol (1.7%)
terpinen-4-ol (1.8%)
methyl thymol (0.2%)
methyl carvacrol (1.7%)
thymol (48.9%)
carvacrol (3.5%)
β-caryophyllene (3.5%)
α-humulene (0.3%)
germacrene D (0.3%)
α-cadinene (2.2%)

A sample of ground thyme (*T. vulgaris*) that was purchased in Poland was subjected to hydrodistillation to produce an oil that was analyzed using GC-FID and GC/MS by Kowalski and Wawrzkowski (2008). The constituents characterized in this oil were as follows:

α-pinene (0.8%)
camphene (0.6%)
sabinene (<0.1%)
myrcene (0.7%)
α-terpinene (0.8%)
p-cymene (22.3%)
1,8-cineole (0.7%)
γ-terpinene (3.6%)
linalool (2.5%)
camphor (0.5%)
borneol (1.5%)
terpinen-4-ol (0.7%)
methyl thymol (1.2%)
methyl carvacrol (0.8%)
piperitone (0.1%)
thymol (44.3%)
carvacrol (3.6%)
β-bourbonene (0.1%)
β-caryophyllene (2.2%)
(Z)-β-farnesene (<0.1%)
α-humulene (0.1%)
spathulenol (0.1%)
caryophyllene oxide (0.9%)
viridiflorol (0.3%)
humulene epoxide II (0.1%)
α-bisabolol oxide B† (0.2%)
α-bisabolol oxide A† (0.1%)

†contaminant not a constituent of *T. vulgaris* oil

A thymol-rich commercial oil of *T. vulgaris* that was obtained in Germany which was analyzed by GC-FID and GC/MS, was determined by Stoilova et al. (2008) to contain the following constituents:

α-thujene (2.0%)
α-pinene (2.1%)
camphene (0.9%)
1-octen-3-ol (0.1%)
β-pinene (0.4%)
myrcene (1.7%)
α-phellandrene (0.2%)
p-cymene (16.4%)
α-terpinene (1.5%)
limonene (0.7%)
β-phellandrene (0.6%)
1,8-cineole (0.4%)
γ-terpinene (8.0%)
cis-sabinene hydrate (0.1%)
terpinolene (0.1%)
trans-sabinene hydrate (0.3%)
linalool (4.6%)
terpinen-4-ol (1.1%)
α-terpineol (0.5%)
methyl carvacrol (0.5%)
thymol (49.6%)
carvacrol (4.0%)
β-caryophyllene (0.1%)
α-humulene (0.1%)
δ-cadinene (0.1%)
caryophyllene oxide (0.1%)
spathulenol (0.1%)

In addition trace amounts (<0.05%) of 3-octanol, carvone and thymol acetate were also characterized in this oil.

An oil produced from the fresh leaves of *T. vulgaris* that was produced from plants collected in Petrópolis (Rio de Janeiro, Brazil) was the subject of analysis by Porte and Godoy (2008). The constituents characterized in this oil were:

1,3-octadiene† (0.3%)
1,7-octadiene† (0.1%)
2,4-dimethyl-2,4-heptadiene† (1.5%)
α-pinene (0.8%)
camphene (0.3%)
sabinene (0.1%)
p-menth-1-ene† (1.8%)
p-menth-3-ene† (0.1%)
myrcene (2.4%)
α-phellandrene (0.3%)
α-terpinene (1.8%)
p-cymene (18.6%)
limonene (0.8%)
(Z)-β-ocimene (0.1%)
(E)-β-ocimene (0.1%)
γ-terpinene (16.5%)
p-mentha-3,8-diene† (0.4%)
terpinolene (0.2%)
p-cymenene (0.1%)
borneol (0.5%)
trans-dihydrocarvone (0.2%)
methyl thymol (0.1%)
thymol (44.7%)
carvacrol (2.4%)
β-caryophyllene (0.8%)
δ-cadinene (0.1%)

†incorrect identification or oil contaminant

Trace amounts of carvacrol and an isomer of calamenene were also found in this oil.

Thyme leaves ex *T. vulgaris* (presumed to be rich in thymol) were found by Wood et al. (2008) to contain 5 µg/kg of rotundone, a spicy compound with a low threshold.

A sample of thyme oil that was produced in the laboratory from commercially available thyme leaves (ex *T. vulgaris*) was examined by GC-FID and GC/MS (Chizzola et al. 2008). It was found to possess the following composition:

α-pinene (0.6%)
camphene (0.2%)
sabinene (0.2%)
β-pinene (0.5%)
myrcene (0.7%)
α-terpinene (1.1%)
p-cymene (13.1%)
limonene (0.4%)
1,8-cineole (0.6%)
γ-terpinene (5.6%)
cis-sabinene hydrate (0.5%)
linalool (2.2%)
camphor (0.3%)
terpinen-4-ol (0.7%)
α-terpineol (0.2%)

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thymol (66.5%)
carvacrol (4.2%)
β-caryophyllene (1.2%)

The same authors also found that the oils produced from *T. vulgaris* leaves of various origins possessed compositions that ranged as follows:

α-thujene (0.5–1.1%)
α-pinene (0.8–1.3%)
camphene (0.6–1.2%)
sabinene (0–0.5%)
β-pinene (0.7–1.2%)
1-octen-3-ol (0–0.5%)
myrcene (1.2–2.2%)
α-terpinene (0.7–1.8%)
p-cymene (14.6–27.7%)
limonene (0–1.4%)
1,8-cineole (1.7–2.8%)
γ-terpinene (6.4–19.6%)
cis-sabinene hydrate (0.7–4.4%)
trans-sabinene hydrate (0–0.5%)
linalool (1.8–18.8%)
camphor (0.5–0.9%)
borneol (0.9–1.9%)
terpinen-4-ol (0.4–1.1%)
α-terpineol (0–0.7%)
nerol (0–0.4%)
methyl thymol (0–0.7%)
neral (0–0.2%)
methyl carvacrol (0–0.7%)
geraniol (0–2.0%)
geranial (0–0.3%)
bornyl acetate (0–0.3%)
thymol (20.4–36.6%)
carvacrol (2.6–5.9%)
β-caryophyllene (0.8–1.5%)
germacrene D (0.1–0.3%)

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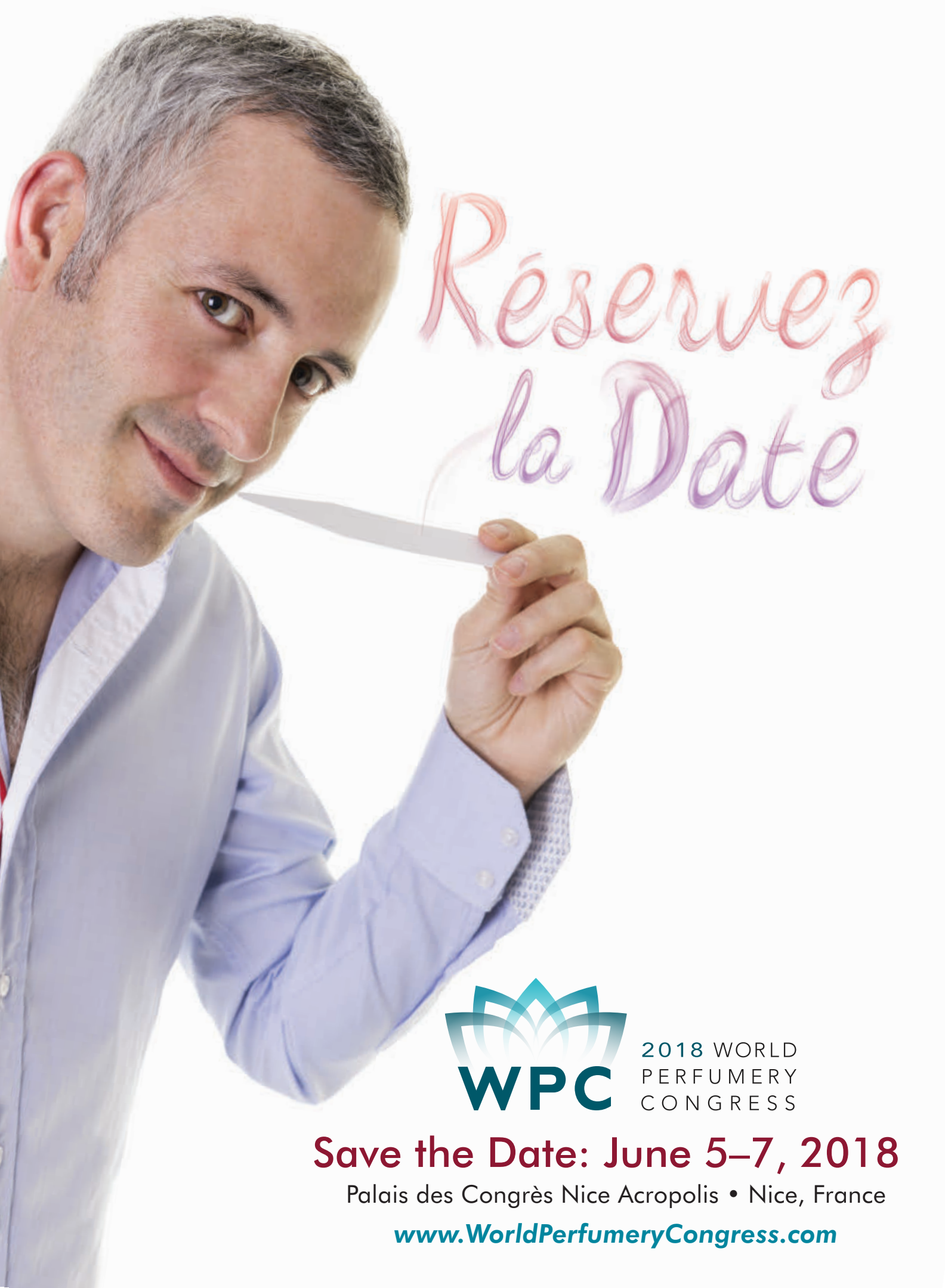

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B. *Paid and/or Requested circulation:*		
1. *Mailed outside county*	741	1,100
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3. *Distribution outside the mail*	589	744
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C. *Total paid and/or requested distribution*	1,330	1,844
D. *Nonrequested distribution*		
1. *Outside county*	192	466
2. *Inside county*	0	0
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4. *Distribution outside the mail*	148	1,000
E. *Total nonrequested distribution*	340	1,466
F. *Total distribution*	1,671	3,310
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Endpoint.

Safety for All Means Accounting for Human Nature

Safety and toxicity testing in F&F.

RACHEL GRABENHOFER, Managing Editor, *Cosmetics & Toiletries*

Scientifically, it's well-known you can't entirely prove the absence of something. As the philosophical argument goes, "the absence of evidence is not the evidence of absence." So when it comes to testing the safety of chemistries for consumers, the closest we can get is a strong generalization for how an ingredient behaves in typical individuals, under typical use levels and conditions. So much for the precautionary principle.

In most cases, testing can accurately assess the safety of materials for a majority of the population. But there will always be cases where atypical use conditions or individuals will experience atypical results. Allergies and sensitivities to components in cosmetics, fragrances, food or other products are perfect examples, which is why labeling is crucial to warn sensitive consumers of known potential reactions.

How, then, does a product developer know if there is potential for reaction? Many employ standard toxicity and irritation testing for topical ingredients, or look to historical data for chemicals that are generally recognized as safe. More recently, predictive models have been developed to determine the probability for reaction. Here, we look to the literature to review recent work toward improving the safety testing of F&F materials.

QRA Done Right

According to Kimber et al.,[1] recent epidemics of contact allergy, especially to preservatives such as methylisothiazolinone, have raised questions of whether longstanding safety/risk assessment processes are working. These authors therefore reviewed the fundamental model by which toxicology and skin sensitization are tested: quantitative risk assessment (QRA). This assessment is led by the tenet "the dose makes the poison."

In short, skin sensitization QRA was found to function adequately but only if two essential criteria are met: 1. that QRA is applied rigorously—i.e., to identify levels of exposure below what are required to induce skin sensitization; and 2. that potential exposure to the sensitizing substance is assessed adequately.

Regarding the latter, this means accounting for, as much as possible, inter-individual susceptibilities due to: age, sex, race, genetic factors and compromised skin; product matrix, including other formula

components that cause skin irritation or enhanced skin penetration; and product use patterns such as frequency, occlusion and dermal integrity.[1]

Taken together, the authors concluded the use of QRA is useful since, at the very least, it can provide essential feedback that can further refine the QRA process itself.

Thiol Reaction Profiling

Carvone is an example of an α,β-unsaturated cyclic ketone commonly used in F&F that acts as a Michael acceptor; it can also be a skin sensitizer. In relation, a new study[2] shows how a fragment-based thiol reactivity profiler can calculate the skin sensitivity potential and toxicity against *Tetrahymena pyriformis* for such Michael acceptors.

Here, the reactivity parameter -log RC_{50}(calc) was used to predict the toxicity for both end points, i.e., skin sensitivity and toxicity, with excellent accuracy, as compared with the LLNA. However, the authors noted the importance of well-defined applicability domains for each end point.

For example, assessments with *T. pyriformis* were defined in terms of the speed with which the Michael acceptor reacts with thiol; this produced two different quantitative models for faster and slower reactions. The first, for fast-reacting chemicals, required only the -log RC_{50}(calc) descriptor. But the second required an added descriptor for hydrophobicity. Overall, the results demonstrated the results from fragment-based thiol reactivity profiling could be used to develop structure-activity relationship models for potential toxicity when thiol reactivity is the driver.

Doubling Up

Two heads are better than one, as they say, and the same argument could be made for doubling up tests to prove safety from different angles. This is the approach Otsubo et al.[3] used in a study integrating two strategies to assess skin sensitization: the KeratinoSens gene assay and the h-CLAT in vitro sensitization test, whose paired capabilities were compared with the LLNA assay and human data.

In this study, a dataset of 203 chemicals was tested. In cases where two negative results indicated a non-sensitizer, the binary test battery matched the assessment at a sensitivity level of 93.4% or 94.4%, according to the LLNA or human data. Taking predictive limitations into account, the authors concluded the binary test battery had high sensitivity, and therefore could be used as part of a bottom-up approach to predict the potential of a material to cause skin sensitization.

Does In silico Compare?

How well do in silico tools measure up against actual sensitization tests? Authors Verheyen et al.[4] wanted to find out. They assessed public domain and commercial in silico tools that were either statistically based or rule-based. According to the authors, in silico tools are often used for gap-filling and read-across functions but here, these tools were limited to making predictions based on the presence or absence of structural features associated with sensitization.

The researchers started with the top 400 substances of the ATSDR 2011 Priority List of Hazardous Substances,[5] and experimental information was identified for 160 chemically diverse substances (82 positive and 78 negative). In silico predictions were compared with experimental data.

Results indicated that rule-based tools performed slightly better than statistical tools, although as would be expected, combining the models increased accuracy. All in all, however, the total number of substances that were predicted for positive or negative skin sensitization in both models was low. The authors noted that adding more substances to the dataset would increase confidence in the conclusions they reached.

Conclusions

Progressive modeling and Big Data are moving safety testing in an in silico direction. However, it appears only some models can approximate chemical behavior. Once you add "typical" biology and human nature to the equation, calculations become more difficult and dynamic; thus, predicted behaviors must be combined and redefined.

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Scent and Spirit:

Fragrances in the Vedic Tradition

The correlation between scent and spirit was first said to be discovered and documented by the ancient Indian scriptures, the 'Vedas' that date back nearly 8,000 years.

BY KRISHNARAJ IYENGAR

All photos courtesy of the author.

Fragrance Vedic paraphernalia: traditional incense stick, attar and pure sandalwood powder.

Nature's bounties have connected the human spirit to its universal source and creator since the very beginning. Known to be the world's oldest civilization, modern-day India was once a vaster region that cradled humanity's very first cultures.

The ancient science of Ayurveda, originating in the Vedas which pillared this ancient civilization, speaks about the deeper holistic science behind the exhilaration of senses when individuals come in contact with fragrances and experience its healing properties. The comfort of heart, gladdening of the spirit and rejoicing of the senses that fragrances in all their incarnations cause us to experience can be described as spiritual, healing and liberating from egoic trappings. It is the momentary experience of 'nirvana' or perfect wholeness and the highest spiritual state.

The significance of fragrance in worship, as a vehicle of spiritual connection has been explained in classical Indian texts. It is believed that the art of honing the magic of scent through creating perfumes and incense was first pioneered in ancient India.

A Hindu woman offering pure sandalwood incense to the idol of Ganesha during the Ganesha festival.

Vedic Wisdom

Mainly consisting of four comprehensive scriptural texts, the *Sama Veda*, *Rig Veda*, *Atharva Veda* and *Yajur Veda* written in the classical 'Sanskrit' language, the Vedas as they are collectively called, are said to be divinely revealed to Veda Vyas, one of the earliest prophetic figures in Indic theological history. Considered an ocean of wisdom, they speak about both, spiritual and material worlds, love, truth and compassion as fundamental divine virtues.

Apart from many western scholars including prominent Germans who have extensively researched the Vedas, their wisdom even inspired the likes of legendary Mughal prince and devout Sufi Dara Shikoh to spend nearly a lifetime studying them in utmost detail!

The Vedas teach us to revere fragrances as divine gifts and agents of spiritual connection. The Vedic 'Maha Mrutyunjaya' verse speaks of God as the 'enhancer of life's fragrance' with the words "Aum, triambakam yajaamahe sugandhim pushtivardhanam."

'Aum' the name of the Supreme, the three-eyed one (he who can see the past, present and future), thee do we worship, the enhancer of life's fragrance.

Even later classical texts like the Bruhat Samhita of sage Varahamihira speak of several fascinating traditional perfume formulas and recipes.

Navin Gundhi is among the upholders of the 200 year-old Gulab Singh Johrimal, one of India's most ancient fragrant traditions, and an acknowledged scholar of traditional fragrance science. He explains how eight sublime natural fragrant substances are part of the Vedic 'Ashtagandha' (treasure house of eight fragrances) with a poetic 'doha' verse.

"Agar tagar chandan yugal, kesar aur kapoor
Gaurochan aur mrigmida, ashtagandh bharpoor"

Breaking down each word, he expounds on the translation:

Agar: oud or agarwood; *tagar*: turmeric-like fragrant root; *chandan yugal*: sandalwood pair, namely red and white sandalwood, the latter being more fragrant; *kesar*: saffron; *kapoor*: camphor; *gaurochan;* cow spleen; *mrigmida*: musk; *ashtagandha bharpoor*: the ashtagandha through all eight materials, becomes complete and whole.

The 'Ayurveda' ancient Indian science of medicine is also said to speak about the holistic significance of fragrances and fragrant substances. The sages or *'Rushis'* of old were known to have highly advanced knowledge of botany, chemistry and medical science. Their insights into the qualities and properties of each natural fragrant substance led them to develop the holistic and aesthetic science of fragrance thousands of years ago.

Traditional non-alcoholic concentrates used in Hindu worship stored in old-style Belgian-cut bottles.

The Sandalwood Saga

Among the eight magical Vedic fragrant substances, sandalwood or 'chandan' can be called the backbone of Vedic spirituality and fragrance, as well as the key ingredient in Vedic ritual even today. Although Gundhi believes that at one time 'agar' or agarwood that is extracted from the forests of Assam in eastern India, must have also been offered to the sacred fire during the 'Agnihotra Havan' ceremony, its prices later sky-rocketed due to its high demand in the Arab market causing its scarcity and decline in usage. Agarwood has also been synonymous with its aphrodisiacal properties.

Indian sandalwood (*Santalum album)* with its formidable 95% santalol content is considered among the world's most superior varieties. Rigid government restrictions and regulations have however, made it difficult to easily acquire it in pure form.

Sandalwood trees grow in southern India in regions like Karnataka and pure sandalwood chips and sticks are offered to the sacred fire and even in powdered form to idols of various deities throughout India. Although 'Hinduism' as the Vedic religion or 'Sanaatana Dharma' is commonly called, is said to be essentially monotheistic, idol worship and polytheism are considered later inclusions. Sandalwood incense sticks (agarbatti) and even tiny incense cones (dhoop) are offered to different deities. Sandalwood is rightly believed to be incredibly healing, calming and spiritually inspiring.

Sandalwood paste is also applied on the forehead by many spiritual preachers. Making a small sandalwood 'tilak' mark in the center of the forehead is a common practice among Hindus and even Jains, followers of another great Indic faith, Jainism. Due to its cooling effect, many also include sandalwood in nourishing herbal facial skin packs and soaps.

Camphor is also another popular and exotic fragrant ingredient that graces Vedic rituals. 'Loban' resin and also the gummy, resinous Indian Bedellium called 'gugal' play (both lobal and gugal, so 'their' role)its roles in scenting Hindu worship.

Incense-The Ritualistic Essence

Among the most important forms of fragrance in Hindu or Vedic spirituality is incense. Commonly called 'agarbatti' or 'light of agar,' Navin Gundhi explains that in the olden days, only pure powdered agarwood was used to make incense sticks, hence the name. Today because of its exorbitant costs, these are a rarity, with several synthetic innovations of varied aromas filling markets.

Agarbattis and dhoops are offered to deities during all rituals and religious festivals. They also fragrance Hindu households as members of the family light one or more sticks around the home (they walk around the home with the incense sticks as they recite prayers and then place them before the deity alongside oil lamps), often reciting prayers and then placing them before the idols or images of the deities alongside oil lamps. Agarbatti purifies the atmosphere dispelling negative energy, enlivens the home with blissful aromas and, as many believe, symbolizes prayers rising up to God with the rising smoke. Incense forms an indispensible part of various religious ceremonies, temples and even Hindu funerals.

Flowers are also the worshipper's best friends. Apart from roses, a large variety of indigenous flowers including those from the jasmine family are offered individually, in bunches or as garlands of various sizes to idols of deities. They reflect the love and admiration of the devotee and create a perfectly spiritual atmosphere in the home or the temple. Women in many parts of India even wear smaller jasmine garlands in their hair buns.

Perfuming The Spirit

The tradition of non-alcoholic pure perfume concentrates was pioneered in India. Commonly recognized by the Arabic name 'attar,' these concentrates have been a part of religious ritual since time immemorial, especially in northern India.

'Pooja' is basically an adoration ceremony of deities, for which various essentials include fragrance. 'Sugandh' (cent), 'dhoop' (incense), 'deep' (oil lamps), 'naivedhyam' (sacred food offering), 'pungi falam' (betel leaf and betel nut offering) to name few, constitute the elaborate ceremony of 'avahan' or welcoming the deities.

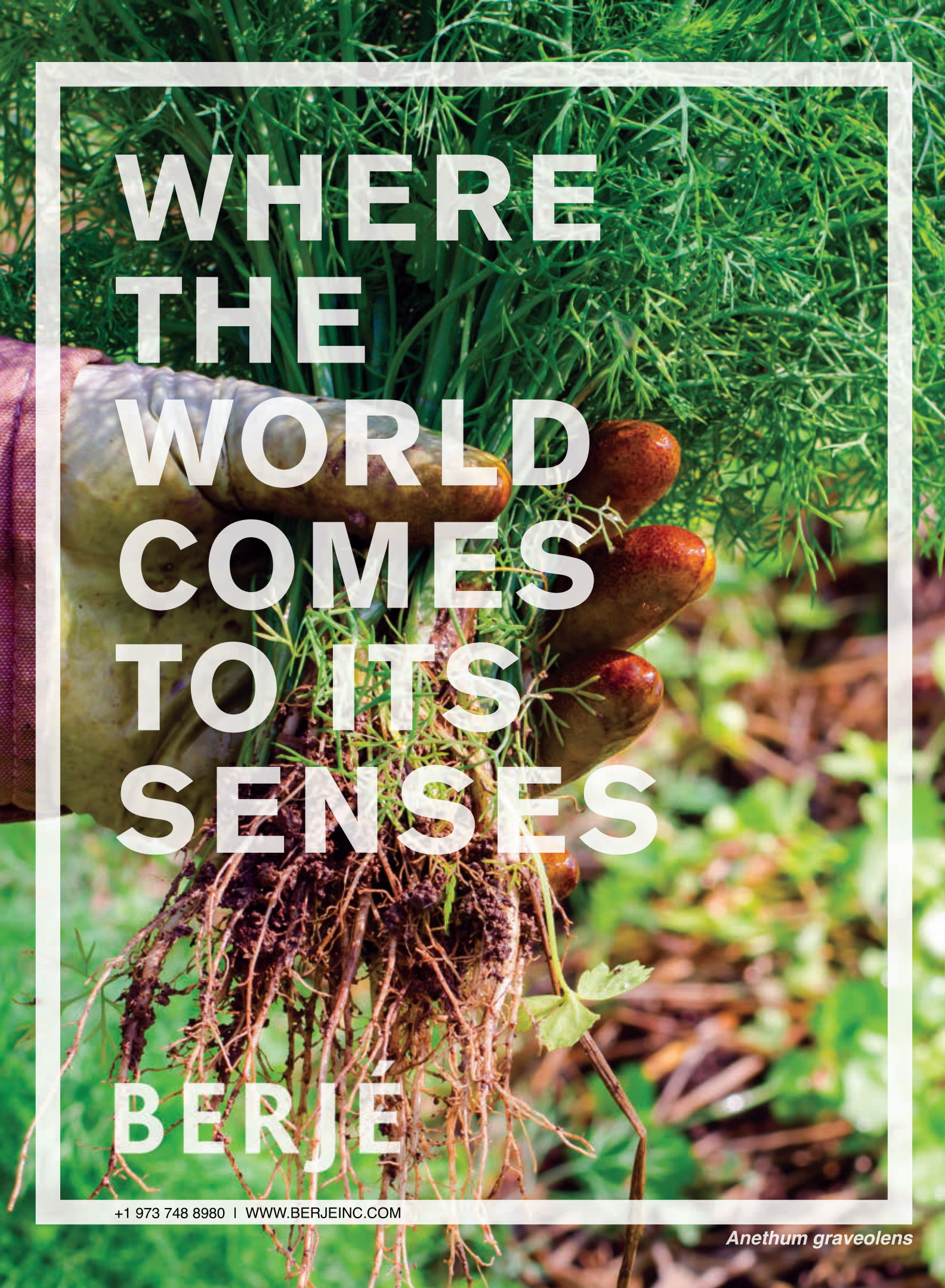
"Various attars are offered to different deities. During the 'nava griha pooja' when all nine planets are worshiped, or during the worship of different deities at one time, each is offered a different fragrance or 'sugandhi tailam' (fragrant liquid)," Gundhi explains. His rose and jasmine attars are widely chosen to be smeared on the clothes of the deities or on cotton buds placed at the deity's feet and then distributed among worshippers as 'bhog' or sacred offering.

While many offer his deep, dark and evocative 'madan mast', a labdanum blend to the deity Shankar. Shankar contains Pure rose extract or 'ruh gulab,' a favorite of worshippers of 'Shyam Baba,' a local deity in the north-western state of Rajasthan. Rose water is also a part of many auspicious ceremonies. A few other Indic faiths also are said to incorporate the practice of employing attars and incense for religious rituals.

There is no worship without the charm of scent, faith and fragrance being partners in salvation for the Indian soul! Like sun and light, worship and fragrance are unspoken synonyms in the Indic spiritual thought process. Be it praying before grand sacred fires or daily household 'pooja' rituals, fragrance is the soul of spiritual expression, silently transporting the worshipper to the realm of divine grace!.

Krishnaraj Iyengar is a musician, composer, international lifestyle and culture writer and multilinguist from Mumbai-India. His keen interest in cultures, mystic poetry and traveling has led him to discover fascinating colors of the world. Krishnaraj has a fierce passion for fragrances which he calls 'angels of spiritual connection' and apart from learning about diverse fragrance traditions, he even blends his own unique scents that are symbols of his personality and soul.

p&f



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- Fema 4554 Cis-6-Nonenyl Acetate
- Fema 4556 2,3,3-Trimethylindanone
- Fema 4559 Magnolia Bark Extract
- Fema 4561 3-Methylthiopropyl Mercaptoacetate
- Fema 4573 Methyl Octyl Sulfide
- Fema 4575 Diisoamyl Disulfide
- Fema 4581 Dodecanethiol
- Fema 4582 2-Hydroxyethanethiol
- Fema 4586 Methyl Isobutanethioate
- Fema 4587 3-Mercaptopropionic Acid
- Fema 4595 Melon Acetal
- Fema 4596 Cinnamic Aldehyde Propylene Glycol Acetal
- Fema 4599 Ocean Propanal
- Fema 4600 D-Trehalose Dihydrate
- Fema 4612 2-Ethyl-2-Hexenal
- Fema 4616 2-Hexylidene Hexanal
- Fema 4617 Trans-2-Tridecenol
- Fema 4618 Phenoxyethyl Propionate
- Fema 4620 2-Phenoxyethanol
- Fema 4622 Piperonal Propylene Glycol Acetal
- Fema 4623 Benzyl Levulinate
- Fema 4624 P-Methylbenzyl Alcohol
- Fema 4626 Benzyl Nonanoate
- Fema 4627 Anisaldehyde Propylene Glycol Acetal
- Fema 4630 2-Ethylhexyl Benzoate
- Fema 4631 2-Ethyl-3-Methylthiopyrazine
- Fema 4632 2-Ethoxy-3-Isopropyl pyrazine
- Fema 4635 Phenylethyl Isoamylether
- Fema 4639 2-Methoxypyridine
- Fema 4640 6-Methoxyquinoline
- Fema 4642 2-Thienylmethanol
- Fema 4643 2-Acetyl-5-Methylthiophene
- Fema 4648 Cyclotene Butyrate
- Fema 4649 3-Methylthio propylamine
- Fema 4651 1-Nonene
- Fema 4654 Methyl Beta-Phenyl Glycidate
- Fema 4659 2,3-Epoxydecanal
- Fema 4660 Vanilmandelic Acid
- Fema 4663 Tobacco Cyclohexenone
- Fema 4666 Alpha-Bisabolol
- Fema 4673 Delta-Hexadecalactone
- Fema 4675 L-Isoleucine
- Fema 4676 1-(2-Furfurylthio)-Propanone
- Fema 4679 Arachidonic Acid
- Fema 4685 Delta-Tridecalactone
- Fema 4686 2-Methyl-3-Thioacetoxytetrahydrofuran
- Fema 4699 Ferrous-L-Lactate
- Fema 4702 Dimethyl Dihydrocyclopentapyrazine
- Fema 4703 Cinnamyl Benzoate
- Fema 4710 L-Threonine
- Fema 4712 L-Alanyl-L-Glutamine
- Fema 4724 Trans-4-Tert-Butylcyclohexanol
- Fema 4745 6-Methoxy-2,6-Dimethyl Heptanal
- Fema 4750 Cis-3-Hexenyl Salicylate
- Fema 4752 N-Acetyl-L-Glutamic Acid
- Fema 4753 1,3-Propanediol
- Fema 4757 Mangosteen Distillate
- Fema 4775 Sandal Pentenol
- Fema 4759 Sassafras Acetate

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