Right to Know: Just How Hazardous are Fragrances?

A Deep Dive into the Toxicity of Fragrance Ingredients

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Breast Cancer Prevention Partners | Campaign for Safe Cosmetics

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About Us

Breast Cancer Prevention Partners (BCPP) is the leading national science-based policy and advocacy organization working to prevent breast cancer by eliminating exposures to toxic chemicals and other environmental links to the disease. Over the past three decades, BCPP has achieved much, including passing critical state and federal legislation, issuing over 30 major scientific reports, and influencing multi-national corporations such as Unilever, Proctor & Gamble, and Johnson & Johnson to voluntarily disclose their secret fragrance ingredients.

The Campaign for Safe Cosmetics, a program of BCPP, leads the movement to make beauty and personal care products safer for all. The Campaign's mission is to protect people and the planet from toxic chemicals by educating the public; transforming the beauty industry to make products safer; and advocating for health-protective laws that benefit everyone regardless of where they live, work, or shop. As the original trailblazer for safe cosmetics, we focus on eliminating dangerous chemicals linked to cancer and other serious health concerns from beauty and personal care products once and for all.

Executive Summary

Breast Cancer Prevention Partnership (BCPP) wrote this report in partnership with Habitable to investigate the health hazards associated with fragrance chemicals. From our own research over the past 15 years, we knew the potential health effects associated with exposure to fragrance chemicals included cancer, genetic mutations, reproductive / developmental toxicity, hormone disruption, respiratory harm and more. However, what we also wanted to know was the chemical hazard profile of the International Fragrance Association (or IFRA) Transparency List — a compilation of chemicals used by fragrance companies from around the world. IFRA is the trade association for the world's largest fragrance suppliers, and the Transparency List represents the majority of the fragrance ingredients in use by the conventional cosmetics industry. We used Habitable's Pharos database, which aggregates chemical hazard data from over 70 different hazard lists, to analyze the adverse health effects associated with the 3,619 chemicals on the IFRA Transparency List.

We were alarmed to find that for over half (1,665 or 56%) of the fragrance ingredients we analyzed – which translates into over half of the fragrance ingredients used in conventional cosmetic products – there was minimal or no hazard data available. For the remaining 1,324 (or 44%) fragrance ingredients with some available hazard data, 48 (almost 4%) chemicals were of high concern because they were directly linked to cancer, mutagenicity, reproductive/ developmental harm, or endocrine effects. Of these 48 high concern chemicals, the large majority (36 or 75%) are used not to impart scent in the fragrance formulation, but instead as functional ingredients, such as UV stabilizers, solvents and preservatives.

While functional ingredients may sound unimportant or innocuous, we know that SOME chemicals USED AS FUNCTIONAL INGREDIENTS such as alkanes, NONYLPHENOLS, and avabenzone are linked to serious health concerns including cancer. And alarmingly these functional ingredients were not evaluated in IFRA's Safety Assessment of its Transparency List.

The 48 IFRA fragrance chemicals with an overall hazard score of "high" are summarized in Table 1. These include:

- 26 chemicals that show evidence for carcinogenic/mutagenic/genotoxic effects including benzophenone, acetaldehyde, methyl isobutyl ketone, and known mammary gland carcinogens styrene and methyleugenol.
- 23 chemicals that show evidence for endocrine activity including p-cresol, lilial, nonylphenols, butylparaben, and ethylene glycol.

Chemicals with potentially high hazards

Many of the IFRA chemicals (42% or 1,248) fell into the potentially high (LT-P1) GreenScreen hazard score, which indicates there is some evidence the chemical is a high concern but the information is based on screening lists and/or there is some uncertainty about the hazard classification for key endpoints. This finding is also particularly concerning, because even without a full GreenScreen assessment, there is already enough evidence to indicate these chemicals are harmful to human health or the environment based on at least one endpoint. Regardless of these data gaps, IFRA continues to allow these ingredients in fragranced products.

> Over 98% of fragrance chemicals either have significant gaps in hazard data or are considered high/potentially high concern.

Table 1: Fragrance Chemicals with the Highest Hazards

Chemical Name	CAS Number	GreenScreen Score	Functional Ingredient	Carcinogenicity	Mammary Carcinogen	Mutagenicity/ Genotoxicity	Reproductive Toxicity	Developmental Toxicity incl. developmental neurotoxicity	Endocrine Activity	Neurotoxicity	Skin Irritation	Respiratory	Aquatic Toxicity
1-Methylnaphthalene	90-12-0	BM-1	●	◇		◇				◇	◇	◇	◇
Avobenzone	70356-09-1	BM-1	●	◇					◇				◇
Galaxolide	1222-05-5	BM-1							◇		◇		◇
C.I. Solvent Red 179	6829-22-7	BM-1	●	◇		◇							◇
2-Methylnaphthalene	91-57-6	BM-1	●	◇						◇	◇		◇
Octinoxate	5466-77-3	BM-1	●	◇			◇	◇	◇		◇		
2,4-imidazolidinedione, 1,3-bis(hydroxymethyl)-5,5-dimethyl-	6440-58-0	BM-1	●	◇		◇					◇	◇	◇
Enzacamene	36861-47-9	BM-1	●				◇	◇	◇				◇
Acetaldehyde	75-07-0	BM-1		◇		◇	◇	◇		◇	◇		◇
Alkanes, C12-14-ISO-	68551-19-9	BM-1	●	◇						◇	◇		◇
Butylated hydroxyanisole	25013-16-5	BM-1	●	◇		◇	◇	◇	◇				◇
Decamethylcyclopentasiloxane (D5)	541-02-6	BM-1	●	◇									
Bis(2,2,6,6-tetramethyl-4-piperidinyl) sebacate	52829-07-9	BM-1	●							◇			◇
C9-11 alkane/cycloalkane	64742-48-9	BM-1	●	◇		◇		◇		◇	◇		◇
p-Cresol, 2,2'-methylenebis(6-tert- butyl-	119-47-1	BM-1	●				◇	◇	◇				
Quaternary ammonium compounds, benzyl-C12-16-alkyldimethyl, chlorides	68424-85-1	BM-1	●							◇	◇	◇	◇
Silicon dioxide	7631-86-9	BM-1	●										
Styrene	100-42-5	BM-1	●	◇	◇	◇		◇	◇	◇	◇	◇	◇
Xylenes	1330-20-7	BM-1						◇	◇	◇	◇		◇
Zinc oxide	1314-13-2	BM-1	●			◇	◇		◇	◇		◇	◇
Polyoxyethylene branched C9 alkylphenol ether	68412-54-4	BM-1tp	●					◇	◇	◇	◇		◇

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Polyethylene glycol mono(branched p-nonylphenyl) ether	127087-87-0	BM-1tp	●					◇	◇	◇	◇		◇
Polyethylene glycol nonylphenyl ether	9016-45-9	BM-1tp	●					◇	◇	◇	◇		◇
1,3-Dioxane, 2-(2,4-dimethyl-3-cyclohexen-1-yl)-5-methyl-5-(1-methylpropyl)	117933-89-8	LT-1											◇
Methyl isobutyl ketone	108-10-1	LT-1		◇				◇		◇			
Benzophenone	119-61-9	LT-1		◇					◇				◇
Butylparaben	94-26-8	LT-1	●						◇				
Cobaltate(1-), bis[4-hydroxy-3-[(2-hydroxy- 1-naphthalenyl)azo] benzenesulfonamidato(2-)]-, hydrogen, compd. with 3-[(2-ethylhexyl)oxy]-1-propanamine (1:1)	84912-04-9	LT-1		◇		◇							
Pulegone	89-82-7	LT-1		◇									
Distillates (Petroleum), Acid-treated light	64742-14-9	LT-1	●	◇							◇		
Distillates (Petroleum), Hydrotreated (Mild) Heavy Naphthenic (9CI)	64742-52-5	LT-1	●	◇				◇			◇		
1-Methoxy-4-(2-propenyl)benzene	140-67-0	LT-1		◇									
Ethylene glycol	107-21-1	LT-1	●				◇	◇	◇		◇		
Methyleugenol*	93-15-2	LT-1		◇	◇	◇							◇
Myrcene	123-35-3	LT-1		◇			◇				◇		
Naphtha, Petroleum, Heavy Alkylate	64741-65-7	LT-1	●	◇		◇					◇		
Lilial*	80-54-6	LT-1					◇		◇		◇		◇
C13-15 alkane	64742-46-7	LT-1	●	◇							◇		
2-(2H-Benzotriazol-2-yl)-4,6-di-tert-pentylphenol	25973-55-1	LT-1	●										
n-Nonylphenol	25154-52-3	LT-1	●				◇	◇	◇		◇		◇

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Chemical Name	CAS Number	GreenScreen Score	Functional Ingredient	Carcinogenicity	Mammary Carcinogen	Mutagenicity/ Genotoxicity	Reproductive Toxicity	Developmental Toxicity incl. developmental neurotoxicity	Endocrine Activity	Neurotoxicity	Skin Irritation	Respiratory	Aquatic Toxicity Respiratory
4-Nonylphenol (branched)	84852-15-3	LT-1	●				◇	◇	◇		◇		◇
Octoxynol 9	9002-93-1	LT-1	●						◇		◇		◇
Ammonium nonoxynol-4-sulfate	9051-57-4	LT-1	●				◇	◇	◇		◇		◇
Polyethylene glycol mono(octylphenyl) ether	9036-19-5	LT-1	●						◇		◇		◇
Pyridine	110-86-1	LT-1		◇							◇		
Sulfur dioxide	7446-09-5	LT-1	●				◇	◇	◇		◇	◇	
Sulfuric acid	7664-93-9	LT-1	●	◇				◇			◇	◇	◇
Titanium dioxide	13463-67-7	LT-1	●	◇				◇	◇				◇

- ● Indicates chemical is a functional ingredient
- ◇ Indicates chemical is linked to health concern listed in column header

This report highlights the multiple problems that plague the over $50 billion[1] self-regulated fragrance industry, including: 1) significant data gaps exist regarding the safety of fragrance chemicals; 2) chemicals that have carcinogenic, mutagenic, reproductive/developmental, or endocrine effects are commonly used in perfumes, beauty products, personal care products and cleaning products without the knowledge or consent of consumers; 3) many fragrance chemicals including the "functional ingredients" are not included in IFRA's safety assessments even though some have toxic effects; and 4) the lack of peer-reviewed data could lead to significant biases and calls into question the quality, reporting and trustworthiness of the industry's safety data.

[1] https://www.grandviewresearch.com/horizon/outlook/perfume-market-size/global

Introduction

There are thousands of natural and synthetic chemicals around the world that are used to create enchanting fragrances that make our favorite beauty and personal care products smell good. These span a wide spectrum, from perfumes, body lotions, and hair products to household items like laundry detergents, candles, and cleaning products. Further, these products are often marketed with captivating scents and smells. Most of the compounds found in synthetic fragrances are derived from petroleum sources.

Whereas natural fragrances or botanicals – which tend to be perceived as being safer and more natural than synthetic fragrances — are generally derived from plant-based raw materials such as essential oils, isolates, and extracts.[2] However, nature is anything but simple: Most botanical ingredients are composed of dozens of individual chemicals, also known as "constituent ingredients." Mounting scientific evidence suggests that certain synthetic and even some natural fragrance chemicals can negatively impact human health, indoor air quality, and the environment.

How is it that consumers can be exposed to so many potentially harmful chemicals without even knowing it? What is creating this "buyer beware" situation? A gaping federal labeling loophole combined with a self-regulated fragrance industry allows for dozens — sometimes even hundreds — of chemicals to hide under the words, "fragrance", "parfum"," aroma" or "flavor" on the product labels of beauty and personal care products.

In 2018, Breast Cancer Prevention Partners (BCPP) set out to investigate the presence of unlabeled harmful chemicals in personal care products through non-targeted, time of flight product testing. BCPP, along with non-profit environmental health and justice partners from around the country, tested 140 personal care and cleaning products, revealing the presence of 338 fragrance chemicals. Of these, 99 were found to have chronic health concerns, and some fragrance chemicals lacked hazard data altogether. Furthermore, out of all the chemicals that were detected and linked to chronic health effects, 75% of them were fragrance chemicals.[3] The presence of unlabeled chemicals linked to a broad array of health concerns should raise a red flag for consumers.

[2] Cosmetics & Toiletries, "Comparatively Speaking: Natural vs Synthetic Fragrance. December 2011. Accessed August 3, 2023. https://www.cosmeticsandtoiletries.com/cosmetic-ingredients/sensory/article/21834851/comparatively-speaking-natural-vs-synthetic-fragrance

[3] Breast Cancer Prevention Partners (BCPP), "Right-to-Know." September 2018. Accessed August 3, 2023. https://www.bcpp.org/wp-content/uploads/2018/09/BCPP_Right-To-Know-Report_Secret-Toxic-Fragrance-Ingredients_9_26_2018.pdf

Health and Environmental Implications of Using Fragrance

Previous testing by BCPP in 2018 revealed that many fragrance chemicals in personal care and beauty products are linked to cancer, asthma, reproductive toxicity, and endocrine disruption. Fragrance chemicals linked to cancer we found include beta-myrcene, benzophenone, naphthalene, pyridine, di-ethylhexyl phthalate (DEHP), benzophenone, methyleugenol and styrene.

Even though most household exposures to fragrance chemicals are in small amounts, small exposures don't ensure their safety. Most chemical safety studies look at the toxic effects of higher doses of chemicals and then assume decreasing toxicity with lower doses. Yet substances that disrupt the body's own hormones — known as endocrine-disrupting compounds (EDCs) — can exert significant biological effects especially at low doses.

Another cause for concern is the cumulative health effects of being exposed to many fragrance chemicals on a daily basis over a number of years. For example, if one fragrance has ten ingredients, and a typical consumer uses ten different fragranced products, that adds up to 100 chemicals the consumer is exposed to, just from fragrances. Thus, the sheer number of fragrance chemicals present in multiple products used daily by an average consumer adds up quickly. IFRA should move toward a hazard-based approach where chemicals linked to serious health effects are not used unless there is sufficient evidence proving they are no concern or low concern across all endpoints.

Vulnerable or Highly Exposed Populations

Certain communities are especially vulnerable to unsafe chemical exposures, including children, women of color, and specific occupational groups such as janitors, domestic workers, and cosmetologists. For example, scientific studies from researchers at the Silent Spring Institute indicate that products marketed to women of color often contain more harmful chemicals (including fragrances) compared with products marketed to other groups.[4] In addition, girls today are experiencing puberty earlier than a generation ago.[5] This trend may be due to exposures to EDCs such as those present in fragrances. Pregnant women are also highly susceptible to exposures as research shows EDCs even at very low levels can affect fetal development[6]. Finally, occupational exposure is of concern because workers may be exposed to higher levels of chemicals (and for longer durations) in the workplace compared to their home.

Fragrance Sensitization and Allergens

Contact with fragrance ingredients can result in sensitization, which is the process by which an individual develops an allergy to specific chemicals through repeated exposure.[7] Fragrance allergies affect 2% to 11% of the global population.[8,9] In the United States alone, this translates to 6.5 million to 35.8 million people (about twice the population of New York), and globally up to 836 million people adversely affected by fragrance. Studies suggest this chemical sensitivity is on the rise – for example, according to the American Academy of Dermatology (AAD), fragrances are considered the leading cause of cosmetic contact dermatitis.[10]

[4] Jessica S. Helm, Marcia Nishioka, Julia Green Brody, Ruthann A. Rudel, Robin E. Dodson. 2018. Measurement of endocrine disrupting and asthma-associated chemicals in hair products used by Black women, Environmental Research, Volume 165, ISSN 0013-9351. Accessed August 3, 2023. Available online: https://doi.org/10.1016/j.envres.2018.03.030.

[5] Giovanni Farello, Carla Altieri, Maristella Cutini, et al. 2019. Review of the Literature on Current Changes in the Timing of Pubertal Development and the Incomplete Forms of Early Puberty. Front. Pediatr., Volume 7, Accessed April 7, 2025. Available online: https://doi.org/10.3389/fped.2019.00147

[6] Yan Yan, Fengjun Guo, Kexin Liu, et al. 2023. The effect of endocrine-disrupting chemicals on placental development. Front. Endocrinol, Volume 14. Accessed April 7, 2025. Available online: https://doi.org/10.3389/fendo.2023.1059854

[7] Scientific Committee on Consumer Safety. (2012). Opinion on Fragrance Allergens in Cosmetic Products. European Commission. pp. 11-12.

[8] Schnuch, A., Lessmann, H., Geier, J., Frosch, P.J.and Uter, W. (2004) Contact allergy to fragrances: Frequencies of sensitization from 1996 to 2002. Results of the IVDK. Contact Dermatitis. Vol. 50. pp. 65-76. 2004. Schafer, T., Bohler, E., Ruhdorfer, S., Weigl, L., Wessner, D., Filipiak, B., Wichmann, H.E. and Ring, J. (2001) Epidemiology of contact allergy in adults. Allergy. Vol. 56. pp: 19992-1996. 2001.

[9] Cheng J, Zug K. (2014). Fragrance Allergic Contact Dermatitis. Dermatitis, 25(5), pp. 232-245.

[10] Contact dermatitis [internet]. American Academy of Dermatology. [cited 2018 Jun 18]. Available from: https://www.aad.org/public/ diseases/eczema/contact-dermatitis

Environmental Impacts

Fragranced products have been linked to many detrimental environmental health outcomes in air and water. For example, synthetic fragrances are persistent chemicals that contaminate water. Once in the water supply, synthetic musk impacts aquatic life and have high acute toxicity to fish, especially in the early life stages.[11]

Fragrances are volatile organic compounds (VOCs) that add to indoor and outdoor air pollution.[12] In a 2010 study of 25 fragranced consumer products, each product emitted VOCs that were identified as toxic or hazardous under federal law. Despite releasing toxic compounds such as chloromethane and methylene chloride into the air, fragrance remains largely unregulated.[13]

The presence of toxic chemicals in fragrances underscores the need for stricter regulation of the entities that manufacture, supply and use fragrance chemicals in beauty and personal care products.

Despite releasing toxic compounds such as chloromethane and methylene chloride into the air, fragrance remains largely unregulated.

Goals of this Project

Generate chemical hazard profiles for the fragrance ingredients on the IFRA Transparency List — a compilation of chemicals used by fragrance companies from around the world.

Provide scientific, public and industry information about hazards in fragrance chemicals.

Make the case for federally mandated fragrance ingredient disclosure and stricter regulation of the safety of fragrance ingredients.

Generate recommendations for voluntary market-based actions needed by IFRA and other supply chain entities to ensure more hazard data is generated and shared, and fragrances ingredients are tested for safety.

[11] Yamauchi R, Ishibashi H, Hirano M, Mori T, Kim JW, Arizono K. Effects of synthetic polycyclic musks on estrogen receptor, vitellogenin, pregnane X receptor, and cytochrome P450 3A gene expression in the livers of male medaka (Oryzias latipes). Aquatic toxicology. 2008 Dec 11;90(4):261-8.

[12] Bridges, B (2002). Fragrance: emerging health and environmental concerns. Flavour and Fragrance Journal, 17, pp. 361-371.

[13] Steinemann AC, et al. (2010). Fragranced consumer products: Chemicals emitted, ingredients unlisted. Environ Impact Asses Rev, doi:10.1016/j. eiar.2010.08.002.

The Political Landscape

Fragrance, as defined by the FDA, is a combination of chemicals that gives each perfume or cologne (including those used in other products) its distinct scent.[14] Companies that manufacture perfume or cologne purchase fragrance mixtures from fragrance houses (companies that specialize in developing fragrances) to develop their own proprietary blends. In addition to "scent" chemicals that create the fragrance, perfumes and colognes also contain solvents, stabilizers, UV absorbers, preservatives and dyes. These additives are frequently, but not always, listed on product labels. In contrast, the chemical components in fragrance itself are often protected as trade secrets and described on the label with words like as "fragrance" or "parfum."

For decades, the personal care and beauty product industry trade associations have spent hundreds of millions of dollars and countless hours lobbying against mandated ingredient disclosure at both the state and federal levels. Despite the vast and rapidly growing size of the fragrance industry, it remains self-regulated, with little state or federal oversight. This self-regulation extends to 1) the safety of fragrance chemicals; 2) the disclosure of fragrance ingredients from fragrance suppliers to manufacturers, or from manufacturers to regulatory agencies or consumers; and 3) the practices of entities that make up the supply chain itself (raw material providers, fragrance houses, individual perfumers, and so on).

One consequence of the fragrance industry's self-regulation is that even the companies that manufacture beauty and personal care products themselves are often denied access — or are only granted limited access — to information about the constituent ingredients of the fragrances they purchase, even though they bear responsibility for the safety of all the ingredients in products that bear their label.

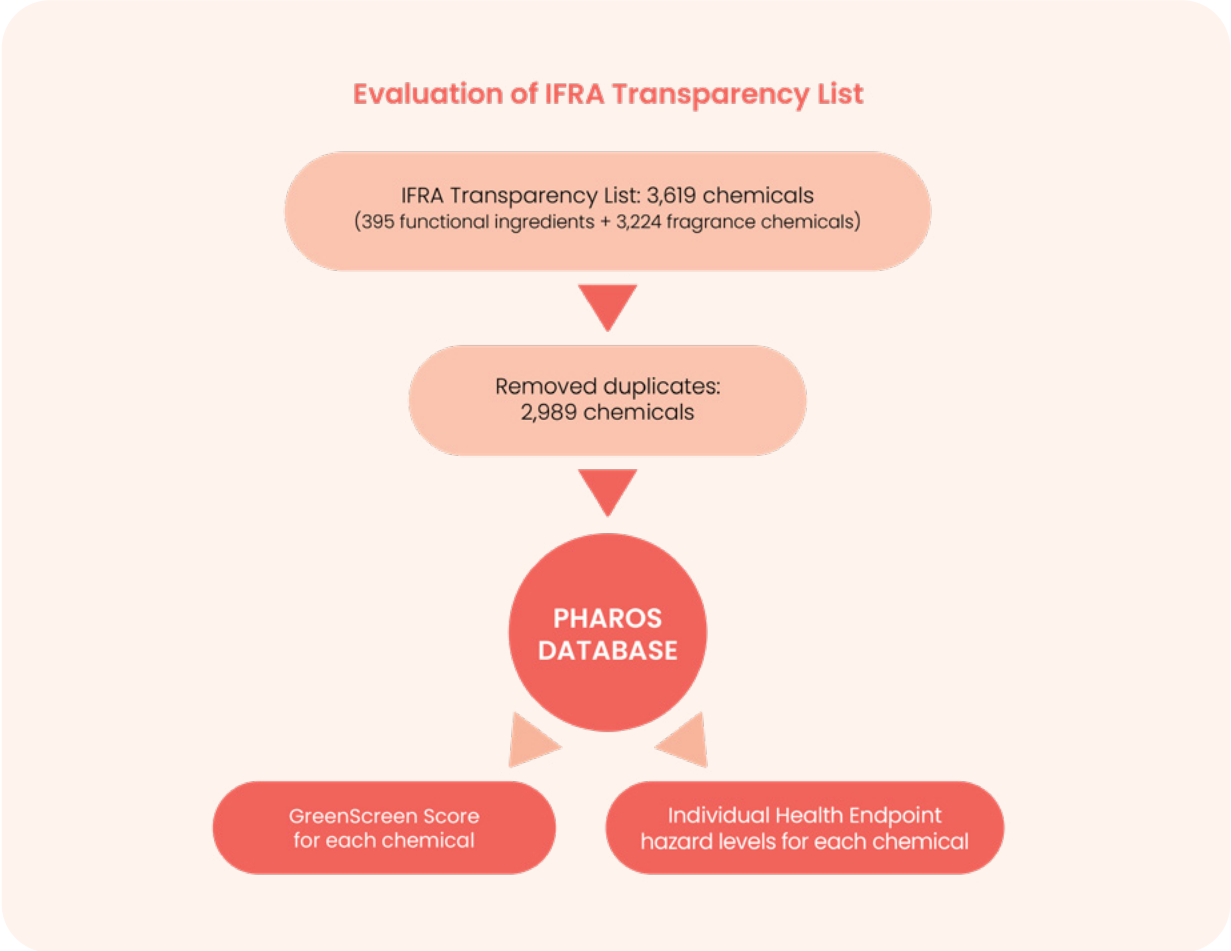
The fragrance industry's trade association is IFRA, which was founded in 1973 in Geneva to represent the collective interests of the fragrance industry and is estimated to represent 90% of fragrance suppliers. IFRA's membership includes both regional fragrance associations (e.g., The Fragrance Creators Association, IFRA UK) and fragrance houses such as Firmenich, Givaudan, IFF, Robertet, Symrise, Takasago International, Drom Fragrances and BASF. IFRA develops its own, voluntary safety guidelines which make up its "IFRA Code of Practice," which all of its members are expected to follow IFRA's scientific arm, the Research Institute for Fragrance Materials (RIFM), was formed in 1966 to generate and evaluate safety data on fragrance ingredients used in the composition of fine fragrance, personal care and household products.

[14] FDA (2017). Fragrances in Cosmetics. [internet]. [cited 2018Jun19]. Available online: https://www.fda.gov/cosmetics/productsingredients/ ingredients/ucm388821.htm

Methods

The IFRA Transparency List is a compilation of chemicals used by individual perfumers and fragrance companies around the world and is publicly available on the IFRA website.[15] Chemicals are reported by IFRA members approximately every five years through a confidential survey.

Figure 1: Methodology for the Evaluation of the IFRA Transparency List



The latest IFRA Transparency List was published in 2022 and contains 3,619 ingredients. This includes 395 functional ingredients, which are used to enhance a product's usability or shelf life, and 3,224 fragrance compounds, which react with olfactory receptors in our nose and allow us to smell the fragrance. After deleting duplicate chemicals and chemical abstract service registry numbers (CASRN), the total chemicals remaining that we analyzed for hazard information was 2,989 (refer to Figure 1 above).

In partnership with Habitable, we used the Pharos database to obtain hazard information for the 2,989 chemicals. Pharos (created by Habitable) is a database tool that aggregates over 70 lists of hazardous chemicals including lists created by authoritative scientific bodies and state, federal and international governmental entities with the goal of identifying safer alternatives[16]. Pharos uses the GreenScreen for Safer Chemicals as a framework to characterize chemical hazards[17].

[15] International Fragrance Association (IFRA). IFRA Transparency List. Accessed August 7, 2023. Available Online: https://ifrafragrance.org/priorities/ingredients/ifra-transparency-list
[16] Pharos System Description. https://pharos.habitablefuture.org/files/pharos-cml-system-description.
[17] Overview of GreenScreen Method. https://pharos.habitablefuture.org/overview-of-greenscreen-method

Pharos generated two types of output for the IFRA chemicals: a "GreenScreen Score" and "Individual Endpoint Hazard Levels" which are discussed in detail below. The full Pharos output with GreenScreen scores and individual health hazards are provided in the appendix of this report.

1) GREENSCREEN SCORE. As summarized in the table below, the GreenScreen scores give an overall picture of whether a chemical is a known hazard to human health or the environment. The GreenScreen for Safer Chemicals (GS) and GreenScreen List Translator (GSLT) are hazard assessment methods developed by Clean Production Action[18]. Habitable is a GreenScreen Public Access Provider, so hazards are evaluated using the GS and GSLT approaches:

- GS is a comprehensive, standardized hazard approach where a licensed GreenScreen Profiler with expertise in toxicology, chemistry, environmental sciences, ecotoxicology, industrial hygiene, and epidemiology performs an in-depth analysis of a chemical across 18 human health and environmental hazard endpoints using literature, information from various hazard data sources, modeling tools, and analogous chemicals if needed. An overall hazard score is provided for each chemical based on aggregating individual endpoint hazards.
- GSLT is an automated, list-based, abbreviated version of the GS and is a good tool for screening large numbers of chemicals. GSLT determines hazard levels using information developed by authoritative scientific bodies, representing international, national, state agencies, as well as intergovernmental agencies and NGOs. Pharos uses these endpoint hazard levels and the GSLT method to calculate an overall GSLT score for each chemical. Because GSLT scores are only based on hazard lists, they are not as complete as a full GreenScreen assessment.

Table 2: GreenScreen Scores and Definitions

GREENSCREEN SCORE*	LEVEL OF CONCERN	DEFINITION
BM-1	High	Benchmark 1: Chemical of high concern
BM-1tp	High	Benchmark 1: Transformation product: will naturally degrade into a chemical of high concern
LT-1	High	List Translator Likely Benchmark 1, known chemical of high concern
LT-P1	Potentially High	List Translator Possible Benchmark, 1, possible chemical of high concern
BM-2	Moderate	Benchmark 2: Use but Search for Safer Substitutes
BM-3	Moderate	Benchmark 3: Use but Still Opportunity for Improvement
BM-4	Low	Benchmark 4: Prefer- Safer Chemical
BM-U	Unknown	Benchmark U: Unspecified Due to Insufficient Data
LT-UNK	Unknown	List Translator Unknown. Hazard listings found are insufficient to determine if chemical may be LT-1 or LT-P1
NoGS	Unknown	The chemical is not on any GSLT hazard list.

*based on Greenscreen for Safer Chemicals and Greenscreen List Translator approaches

[18] Clean Production Action. https://www.cleanproduction.org/programs/greenscreen.

2) INDIVIDUAL ENDPOINT HAZARDS. In addition to a chemical's overall score, individual health and environmental endpoints for each chemical were also reviewed. This was especially important for those chemicals with data gaps. For example, chemicals with a GreenScreen score of BM-U or LT-UNK often lack data for Group 1 Human endpoints such as carcinogenicity, mutagenicity, reproductive/developmental effects, or endocrine effects, but may have hazard data for other endpoints such as acute toxicity, skin sensitization or eye irritation, or ecotoxicity. These "other" endpoints are important if a consumer or company strives to avoid specific chemicals linked to these health effects.

The following is a list of endpoints that were evaluated for this project:

- Carcinogenicity/Mutagenicity/Genotoxicity
- Endocrine Activity
- Persistence, bioaccumulation, and toxicity (PBT)
- Reproductive/Developmental Toxicity
- Neurotoxicity
- Skin/Eye irritation
- Sensitization (skin, respiratory)
- Other noncancer (acute mammalian, systemic toxicity, single and repeated exposure)
- Other Ecotoxicity (terrestrial)
- Aquatic Ecotoxicity

A chemical was linked to an endpoint from the list above if the Pharos output indicated a moderate, high or very high hazard level for that endpoint. As described above, the hazard levels are determined by the GreenScreen List Translator™ for most lists and by Habitable for the remainder. If multiple hazard levels were found for one endpoint, the hazard level displayed in the Pharos output represents the highest for the most authoritative category of lists.

Results

As described above, the hazard data were evaluated by their GreenScreen score, as well as the individual health endpoint information. The results from both evaluations are described below.

GreenScreen Hazard Scores

Out of the 2,989 chemicals evaluated, 1,665 chemicals (56%) had minimal or no hazard data with GreenScreen scores of BM-U, LT-UNK, or NoGS (Figure 2 below). This is an alarming data gap, as it means that over half of fragrance chemicals have not been sufficiently studied or well tested to determine if they are harmful to human health or the environment.

The remaining 1,324 chemicals (or 44% of all IFRA chemicals) had enough hazard information to determine a GreenScreen score (BM-1, BM-1tp, BM-2, BM-3, BM-4, LT-1, or LT-P1). Only 54 of 1,324 chemicals had full Greenscreen Assessments (BM-1, BM-1tp, BM-2, BM-3 or BM-4), meaning that some data gaps still exist for the remaining chemicals.

Chemicals with the highest hazards

The 48 IFRA chemicals with the highest GreenScreen scores (BM-1, BM-1tp, LT-1) are shown in Figure 2 below. According to the GreenScreen approach, chemicals with high hazard scores should be avoided, as described in Table 1. Of these 48 chemicals of high concern, only 12 (25%) are actually fragrance chemicals, while the remaining 36 (75%) are functional ingredients, such as UV stabilizers, solvents and preservatives. Surprisingly, IFRA does not even consider functional ingredients in their safety assessments. In other words, chemicals with the highest hazard concerns (as well as those with unknown hazards) are freely used in fragrance mixtures, because IFRA does not evaluate them for safety.

These 48 high hazard chemicals are linked to various health effects including:

- 26 chemicals that show evidence for carcinogenic/mutagenic/genotoxic effects including benzophenone, acetaldehyde, and methyl isobutyl ketone.
- 2 mammary carcinogens (styrene and methyleugenol).
- 23 chemicals that show evidence for endocrine activity including p-cresol, lilial, nonylphenols, butylparaben, and ethylene glycol.
- Over half (29) of the chemicals are linked to skin irritation.

> Over half of fragrance chemicals have not been sufficiently studied or well tested to determine if they are harmful to human health or the environment.

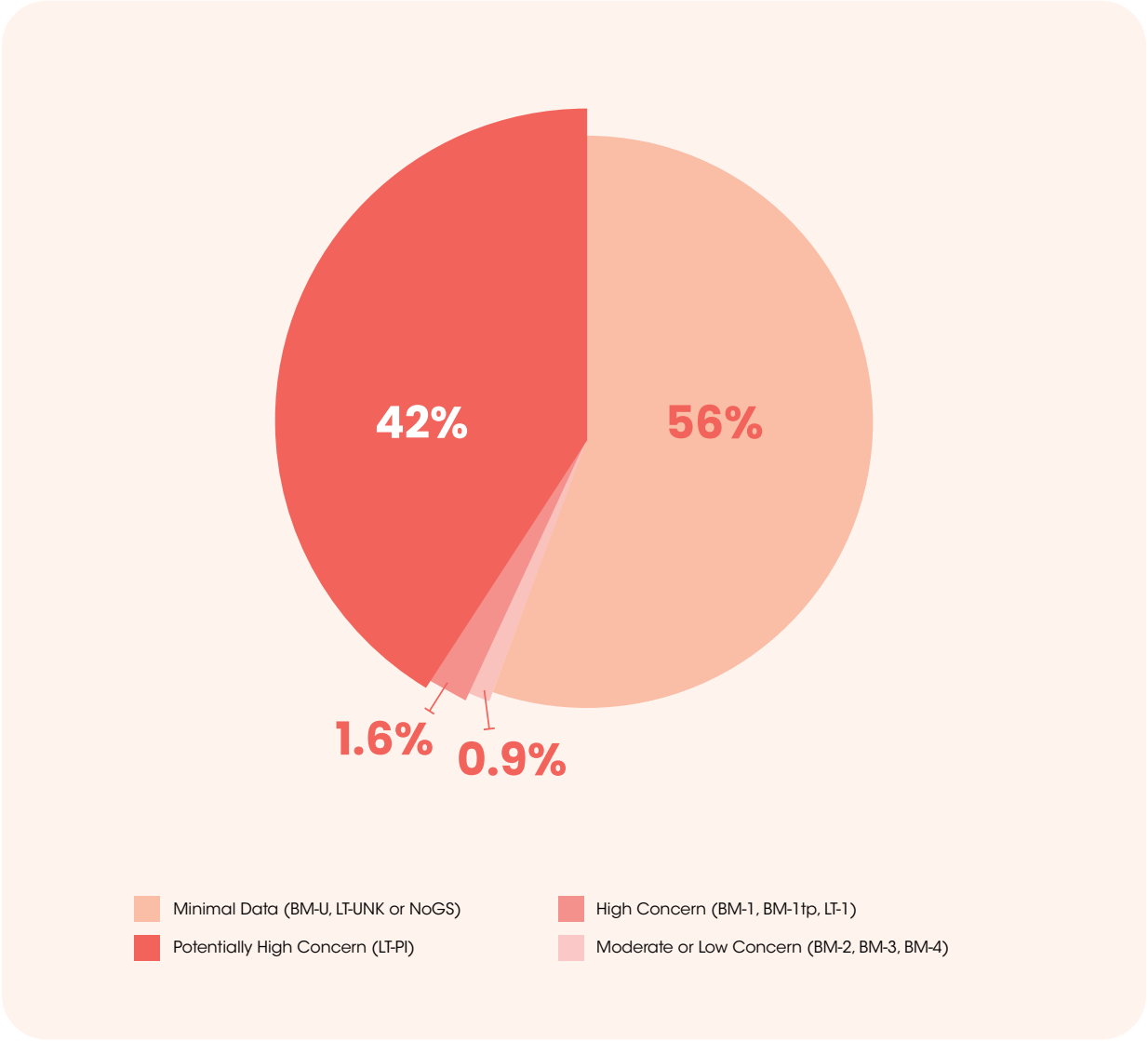
Chemicals with potentially high hazards

Many of the IFRA chemicals (42% or 1,248) fell into the potentially high (LT-P1) GreenScreen hazard score, which indicates there is some evidence the chemical is a high concern but the information is based on screening lists and/or there is some uncertainty about the hazard classification for key endpoints. This finding is also particularly concerning, because even without a full GreenScreen assessment, there is already enough evidence to indicate these chemicals are harmful to human health or the environment based on at least one endpoint. Regardless of these data gaps, IFRA continues to allow these ingredients in fragranced products.

Chemicals with moderate to low hazards

As shown in Figure 2 below, only 28 chemicals (<1%) had hazard scores of BM-2, BM-3, BM-4, which are moderate to low concern (see definitions in Table 1 above). This indicates that the majority of chemicals on the IFRA list either have significant data gaps (shown in gray in Figure 2) or are high/potentially high concern (shown in red and orange in Figure 2).

Figure 2: GreenScreen Scores for IFRA Fragrance Chemicals (n=2,989)



Summary of Health Concerns Linked to IFRA Fragrance Chemicals

All 2,989 IFRA chemicals were screened for individual health hazard endpoints in Pharos. Each endpoint had a range of hazards, low, moderate, or high and sometimes very low or very high. Chemicals were linked to a health hazard endpoint if the Pharos output indicated a moderate, high or very high hazard level for that endpoint. Based on our evaluation, we found:

87	chemicals linked to carcinogenicity/mutagenicity/genotoxicity
104	chemicals linked to endocrine disruption
401	chemicals linked to persistence, bioaccumulation, and toxicity (PBT)
131	chemicals linked to reproductive/developmental toxicity
56	chemicals linked to neurotoxicity
762	chemicals linked to skin/eye irritation
276	chemicals linked to sensitization (skin, respiratory)
103	chemicals linked to other noncancer effects (acute mammalian, systemic toxicity, single and repeated exposure)
347	chemicals linked to other terrestrial ecotoxicity
281	chemicals linked to aquatic ecotoxicity

> We shouldn't have to worry about toxic chemicals when using our favorite products, but evaluation of fragrances revealed that 87 fragrance chemicals are linked to cancer, mutagenicity, or genotoxicity. And hundreds more are linked to other serious health concerns.

We found significant data gaps within each health hazard endpoint. For example, out of 2,989 chemicals, only 371 had available hazard information for carcinogenicity, 113 had hazard information for endocrine activity, 444 had data for persistence/bioaccumulation/toxicity (PBT), 371 had data for reproductive/developmental effects, and 141 had data for neurotoxicity. For other health hazard endpoints such as skin/eye irritation, sensitization, and other non-cancer effects, 1,583, 902, and 443 chemicals had hazard information, respectively. Two of the fragrance chemicals (styrene and methyleugenol) are classified as mammary gland carcinogens[19], but there may be many more if the chemicals were adequately studied.

These hazard data gaps create a buyer beware situation, because the majority of chemicals in fragrances have unknown health hazards, yet more than 95% of shampoos, conditioners, and styling products contain fragrance.[20]

> Over a quarter (25.5%) of fragrance chemicals are linked to skin or eye irritation, and according to the American Academy of Dermatology (AAD), fragrances are considered the leading cause of cosmetic contact dermatitis.

[19] Kay, J.E., J.G. Brody, M. Schwarzman, R.A. Rudel. 2024. "Application of the Key Characteristics framework to identify potential breast carcinogens using publicly available *in vivo*, *in vitro*, and *in silico data*." *Environmental Health Perspectives*. DOI: 10.1289/EHP13233

[20] Scheman, A., Jacob, S., Katta, R., Nedorost, S., Warshaw, E., Zirwas, M. and Bhinder, M. (2011). Hair products: Trends and Alternatives: Data from the American Contact Alternatives Group. Journal of Clinical and Aesthetic Dermatology, 4(7), pp. 42– 46.

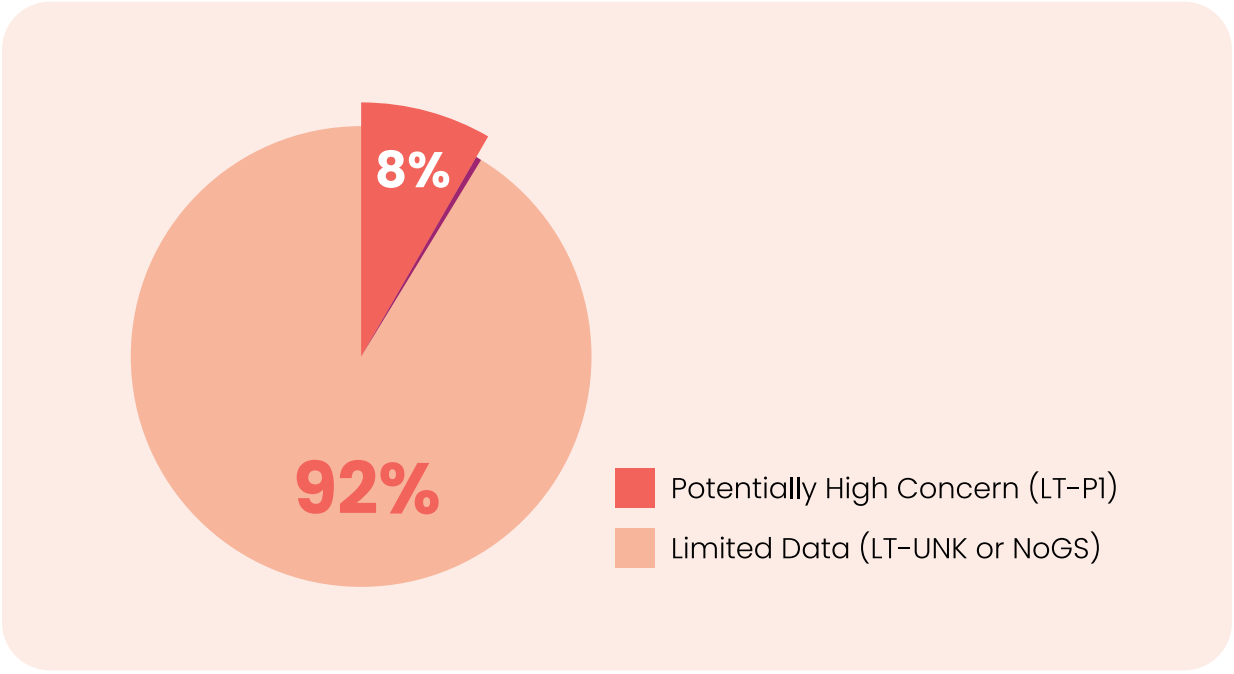
> Mammary gland carcinogens such as styrene and methyleugenol are used in fragranced products.

Botanicals

We often think of "natural" or "plant-based" fragrances as safe and non-toxic. However, this is not always the case, as most botanicals aren't evaluated for safety at all! Botanicals used for fragrances are often mixtures of multiple chemicals (rather than a pure substance) which can make it challenging to evaluate their safety. Further, botanicals can vary in composition depending on where they are sourced, how they are extracted/processed/stored, and how concentrated they are. Individual chemicals or constituents in a botanical mixture could have different hazard properties depending on how they interact with other chemicals in the mixture. Additionally, some botanicals may not pose a hazard when eaten but do result in adverse effects when applied on the skin. For example, citrus fruits are not considered hazardous to consume; however citrus oils used in skincare can react to UV light and cause skin irritation.

The 2022 IFRA list contains 380 unique natural complex substances (NCS) meaning they are derived from plant materials. We investigated the NCS list and found that only 8% of these chemicals have hazard information in the Pharos database, which is a significant data gap (see Figure 3 below). Very limited human health data were listed; however a few were classified as carcinogenic (carrageenan and terpenes/terpenoids), endocrine disruptors (hibawood oil), skin irritants (lemongrass oil, sandalwood oil, lemon oil, anise oil) or were linked to other adverse health effects.

Figure 3: Data Gaps for Hazards of Botanicals



Limitations/Data Gaps

Out of the 2,989 chemicals evaluated, we found that 1,665 chemicals (56%) had inadequate hazard information in Pharos. In other words, there is little to no information about the safety of the majority of fragrance chemicals that are currently used in thousands of consumer products. This is a shocking number that should sound the alarm for federal regulators, cosmetic companies and the public – all of whom have a right to know and a responsibility to know that the fragrances in the beauty and personal care products they regulate, make, sell and/or buy and use are safe. Although RIFM does have a fragrance toxicology database, it is subscription- based and not freely available to the public. The majority of the information in the database is company research that has not been published in peer-reviewed journals. Further, IFRA does not consider functional ingredients in their safety assessments, even though other authoritative sources indicate these functional chemicals are linked to serious health effects such as cancer and reproductive harm. This is a major omission in IFRA's safety process to not consider functional chemicals such as quaternary ammonium compounds, butylated hydroxyanisole (BHA), avobenzone, and methylnaphthalene in fragrance safety assessments.

Policy Solutions

Consumers and workers have the right to know what's in the products they use. Federal legislation requiring full disclosure of the fragrance ingredients in personal care and beauty products provides everyone with the information they need to bring safer products into their homes and their workplaces. The reality has been, however, that efforts to federally mandate fragrance ingredient disclosure in personal care products have been consistently blocked by industry trade associations lobbying against ingredient transparency. These trade associations have not kept pace with their industry's best practices around ingredient disclosure and instead cater to their membership's lowest common denominator. In fact a new industry trade association made up of 4 of the world's biggest fragrance houses called the Fragrance Science and Advocacy Council (FSAC) was created in 2018 just to oppose legislatively mandated fragrance transparency — they were even able to get a congressional fragrance caucus created to lobby on their issues! According to a recent press release: "The Congressional Fragrance Caucus gives our members an active platform to empower Congressional decisionmakers with high quality information including our best-in-class science, growing research on the important well-being benefits fragrance delivers, and other positive contributions our industry delivers for people, perfume, and the planet."

Federal Fragrance Disclosure Legislation

Advocates continue to push, however, for federally mandated fragrance ingredient disclosure for retail consumer and professional salon products. The Cosmetic Hazardous Ingredient Right to Know Act of 2025, introduced by Reps. Jan Schakowsky and Doris Matsui, would require companies selling beauty and personal care products to publicly disclose all fragrance and flavor ingredients on product labels and company websites. This legislation also requires brand owners to provide a website link to any of the 21 authoritative hazard lists (a.k.a. lists of chemicals of concern) referenced by the bill, for any ingredient in their cosmetic product that is linked to a serious negative impact on human health.

In addition, the Cosmetic Supply Chain Transparency Act of 2025, also introduced by Rep. Jan Schakowsky, would require fragrance suppliers to provide brand owners with full fragrance ingredient disclosure – upon request - as well as fragrance toxicity and safety data and any other testing results that brand owners need to ensure they are selling safe beauty and personal care products.

Together, these two bills would provide consumers, professional salon workers and brand owners with the fragrance transparency they need, want and deserve.

State Fragrance Disclosure Laws

Federal law preempts states from being able to require the disclosure of fragrance ingredients on cosmetic product labels. But states can gather this information and make it available to the public, which is what California did through the enactment of the California Cosmetic Fragrance and Flavor Ingredient Right to Know Act of 2020 (CFFIRKA). This law requires companies selling retail cosmetic and professional salon products in California to report to the California Department of Public Health any fragrance and flavor ingredients present in beauty or personal care products they are selling in California that are listed on any of the 23 authoritative hazard lists referenced in the law. The associated hazards include carcinogens, reproductive and developmental toxicants, fragrance allergens, mutagens, neurotoxicants, endocrine disruptors, respiratory toxicants, and persistent, bioaccumulative, and chemicals that can be otherwise harmful to human health or the environment. The California Safe Cosmetics Program (CSCP) is responsible for making this information accessible through an online database, providing the general public including professional nail, beauty and hair salon workers with the information they need to avoid potentially harmful fragrance and flavor ingredients.

The CSCP database helps consumers and professional salon workers make more informed choices and encourages cosmetic companies to reformulate their products with safer ingredients. The database makes utilization of the data collected possible through web and mobile applications. For example, Clearya is a free application that utilizes CSCP's makes its hazardous fragrance and flavor ingredient information viewable to consumers when shopping in stores or online. The database can be found at Public Search - Safe Cosmetics. The CSCP reporting first began in 2009, through April 2025, there have been more than 340 unique Prop. 65 carcinogens, reproductive toxicants, and other hazardous ingredients reported in over 140,000 cosmetic products reported by over 1,100 companies. The California Fragrance and Flavor Ingredient Right to Know Act (CFFIRKA) greatly expanded the number of products in the program's database – reporting increased from an average of about 5,300 products per year in the 10 years prior to CFFIRKA to 25,186 products reported in 2022 when CFFIRKA commenced, a nearly 5-fold increase. Following the implementation of CFFIRKA, the database grew substantially. Since its commencement in 2022, 462 new companies registered and reported products, the largest growth since reporting began in 2009-2010 under the CSCA (Figure 1). There were 55,995 products reported since January 2022; 84 percent (46,736 products) contained ingredients newly reportable under CFFIRKA[21].

- Carcinogens were reported in 13,224 products (19 percent of all products) since CFFIRKA.
- Developmental or reproductive toxicants were reported in 2,160 products (3 percent) since CFFIRKA.
- Persistent, bioaccumulative, or otherwise toxic chemicals were reported in 1,049 products (1.5 percent) since CFFIRKA.

[21] Data were queried on April 15, 2025.

Market-Based Solutions

Cosmetic companies can and should be a part of the solution. The good news is that some of the world's biggest multinational cosmetic companies have adopted voluntary policies to better manage their use and disclosure of fragrance ingredients down to 100 ppm. Additionally, hundreds of clean cosmetic companies have raised the fragrance transparency bar even higher by fully disclosing their fragrance ingredients. However, many companies are not choosing to be a part of the solution.

Cosmetic companies should fully disclose ALL fragrance ingredients and adopt policies and practices that include these measures:

- Require full fragrance ingredient disclosure from their fragrance suppliers.
- Provide full disclosure of fragrance ingredients, regardless of concentration, to consumers. This is especially important for endocrine-disrupting compounds, which can harm human health at extremely low levels of exposure.
- Disclose throughout the company's entire cosmetic product portfolio and global market. Ingredients should be disclosed on the website of the cosmetic brand, or on the parent company's website if there is a direct link from the brand's website. Fragrance ingredients should also be disclosed on e-commerce retail sites where the company's products are being sold (e.g., Drugstore.com, Amazon.com, etc.).
- Disclose fragrance chemicals in the company's professional salon-use products as well as cosmetic products marketed to consumers.
- Include a restricted substances list of fragrance chemicals of concern for companies that formulate their own fragrance and/or to be given to a fragrance supplier or independent perfumer, to ensure unsafe chemicals are not being used to formulate fragrances being supplied to the company.
- Avoid any chemicals on the Campaign for Safe Cosmetics RED LIST "do not use list" of toxic chemicals, which includes some fragrance chemicals.

What You Can Do (Personally and Politically)

Support Federal Fragrance Ingredient Disclosure Legislative Initiatives

- Consumers can and should make better, more informed purchases to protect themselves and their families, but at the end of the day, we can't and shouldn't have to shop our way out of the problems created by the lack of fragrance ingredient disclosure. That's why consumers should support state and federal laws requiring full fragrance ingredient disclosure for beauty and personal care products.

Pressure Your Favorite Cosmetic Companies to Make Safer and More Transparent Products

- Given the current lack of federal or state mandates for fragrance ingredient disclosure, consumers should patronize those companies that voluntarily disclose fragrance ingredients because knowing which ingredients to look for and reading labels is key to protecting yourself and your family from unsafe chemical exposures. Vote with your pocketbook, and let your favorite brands know you will be shopping for a new favorite brand if they don't clean up their act. Write to the CEO, call the customer service line, and use the Facebook, Instagram and Twitter accounts of industry laggards to demand that they disclose the secret fragrance ingredients hiding in their products. Let companies that do provide full ingredient disclosure know they have a new customer as a result of their transparency. Share the identities of both the leaders and the laggards with your friends and family members.

Educate Yourself — Become a Smart Shopper!

- For beauty and personal care, educate yourself and then start reading labels! Table 1 in this report is a starting point for avoiding fragrance chemicals with the highest hazards.
- BCPP also offers a Glossary of Exposures for chemicals you should avoid that are related to breast cancer. Our Campaign for Safe Cosmetics website also provides information on chemicals of concern in cosmetics — and the product categories they are most frequently found in — that you should avoid.
- Utilize the free app Clearya which reviews ingredient labels and flags chemicals of concern – including toxic fragrance ingredients – when you shop online and/or if you snap a photo of your cosmetic product label (just beware of chemicals with data gaps).

Conclusions

This report demonstrates several important concepts regarding the safety of fragrance chemicals:

1. the fragrance industry is responsible for significant data gaps regarding the health hazards of fragrance chemicals;

2. even chemicals that have carcinogenic, mutagenic, reproductive/developmental, or endocrine effects are used in fragrances, which is an unacceptable practice;

3. many chemicals used in fragrances are considered "functional ingredients" and are not evaluated for safety by IFRA;

4. because the data informing fragrance hazards are not peer-reviewed, this may lead to bias in the analysis and the reporting of this information;

5. consumers and professional salon workers cannot protect themselves or their clients against unsafe fragrance ingredient exposures if they do not know that toxic fragrance chemicals are hiding in the beauty and personal care products they are bringing into their homes or workplaces.

Full fragrance ingredient disclosure will allow consumers to make safer and more informed decisions, enable professional salon workers to protect themselves and their clients, encourage cosmetic manufacturers to remove toxic chemicals from their products, benefit cosmetic companies who want a higher level of transparency from their supply chain, and provide regulators with the information they need to more effectively assess and regulate the safety of beauty and personal care products.

Appendix

IFRA Transparency List 2022 Hazard Summary Table (Snapshot of Pharos Output)

Chemical Name	GS Score	Carcinogenicity	Silent Spring	Mutagenicity/Genotoxicity	Reproductive Toxicity	Developmental Toxicity incl. developmental	Endocrine Activity
1-METHYLNAPHTHALENE	BM-1	M		M	L	L	DG
Avobenzone	BM-1	M		L	DG	L	M
Galaxolide	BM-1	L		L	DG	L	M
C.I. Solvent Red 179	BM-1	M		M	DG	DG	DG
2-METHYLNAPHTHALENE	BM-1	M		L	L	L	DG
Octinoxate	BM-1	M		L	M	H	H
2,4-IMIDAZOLIDINEDIONE, 1,3-BIS(HYDROXYMETHYL)-5,5-	BM-1	H		M	L	L	DG
Enzacamene	BM-1	DG		L	M	H	H
ACETALDEHYDE	BM-1	H		H	M	M	DG
ALKANES, C12-14-ISO-	BM-1	M		L	L	L	DG
Butylated hydroxyanisole	BM-1	H		M	M	M	M
DECAMETHYLCYCLOPENTASILOXANE (D5)	BM-1	M		L	L	L	DG
Bis(2,2,6,6-tetramethyl-4-piperidinyl) sebacate	BM-1	L		L	L	L	DG
C9-11 alkane/cycloalkane	BM-1	H		H	L	M	DG
p-Cresol, 2,2'-methylenebis(6-tert- butyl-	BM-1	L		L	H	H	H
Quaternary ammonium compounds, benzyl-C12-16-	BM-1	L		L	L	L	DG
Silicon dioxide	BM-1	L		L	L	L	DG
Styrene	BM-1	H	YES	M	L	M	M
Xylenes	BM-1	L		L	L	H	M
Zinc oxide	BM-1	DG		M	M	L	M
Polyoxyethylene branched C9 alkylphenol ether	BM-1tp	L		L	DG	M	M
Polyethylene glycol mono (branched p-nonylphenyl)	BM-1tp	L		L	DG	M	M
Polyethylene glycol nonylphenyl ether	BM-1tp	L		L	DG	M	M
3-(2-ETHYLHEXYLOXY) PROPANE-1,2-DIOL	BM-2	L		L	M	L	DG
Undecylenic acid	BM-2	L		L	L	L	DG
2-Ethyl-1-hexanol	BM-2	L		L	DG	M	DG
2-methyl-4-isothiazolin-3-one	BM-2	L		L	L	L	DG
Phenoxyethanol	BM-2	L		L	L	M	DG
Acetic acid	BM-2	L		L	DG	L	DG

Download the full appendix here.

The full Pharos output is available here.

Breast Cancer Prevention Partners

Campaign for Safe Cosmetics