Intellectual Property & Technology Law Journal

Edited by the Technology and Proprietary Rights Group of Weil, Gotshal & Manges LLP

VOLUME 39 • NUMBER 1 • JANUARY 2027

Bioengineered Fragrances: When Trade Secrets Are Not Enough

By Robert C. Millonig, Gaby L. Longsworth and Matthew Swazer

More of the fragrance industry is moving from traditional methods to fermentation. Scent molecules that once came from plants or petrochemicals are now brewed in engineered yeast and bacteria. For a company built on bioengineered ingredients, the shift raises a practical question about how to protect intellectual property, as previous strategies may no longer work. The trade secrets that guarded formulas for a century are getting harder to maintain, and patent law will not let a company patent a molecule identical in structure and function to one found in nature. The value worth protecting has shifted from the formula towards an engineered organism, the process that makes the scent molecule, the formulation, or a genuinely new molecule, based on the timing of the first public disclosure. Patents in this area have been secured by fragrance houses (e.g., Firmenich), chemical companies (e.g., BASF), synthetic biology firms (e.g., Amyris and Conagen), and smaller specialists (e.g., Encapsys).[1] This article explains key intellectual property considerations for protecting bioengineered fragrances.

The authors, attorneys with Sterne, Kessler, Goldstein & Fox PLLC, may be contacted at bobm@sternekessler.com and glongs@sternekessler.com, respectively. Matthew Swazer is a former attorney at the firm.

The shift towards bioengineered molecules is already underway. In 2006, an MIT team engineered *E. coli* to produce scents of wintergreen or ripe banana, nicknaming it "Eau d'coli."[2] In the years since, far more fragrance molecules have come from engineered organisms.

Fragrance notes (e.g., vanillin, or grapefruit) no longer come only from flowers or petrochemical plants, but from engineered bacteria or yeast. For example, researchers have found that the use of squalene-hopene cyclase enzymes in prokaryotic cells can produce ambroxide, a molecule with a wood and amber odor.[3] Similarly, researchers have found it possible to genetically engineer baker's yeast to produce vanillin.[4] Bioengineered routes avoid the cost, sustainability, and supply problems of obtaining these molecules from natural and petrochemical sources. To extract vanillin from vanilla beans, it would take the pollination of thousands of vanilla orchid flowers to make 1 kg of natural vanillin.[5] Additional sources of vanillin include petrochemicals (guaiacol) or paper production byproducts (lignin), which carry sustainability problems.[6] Similar problems exist with other scents such as citrus, which is impacted by temperature instability, citrus greening and challenges with supply and demand.[7]

Driven by these sourcing pressures and rising consumer demand for sustainability, the bio-derived

fragrance market is expected to grow.[8] The wider flavors and fragrances market was worth roughly $36 billion in 2025 and is projected to reach about $52 billion by 2032.[9] Bio-based ingredients are estimated to grow faster than the broader market.[10] Growth is expected across several markets including North America and Asia.[11]

LIMITATIONS ON TRADE SECRETS

The fine fragrance industry has historically relied on trade secrets.[12] Trade secret protection can cover business, technical, and scientific information, including formulas, methods, and processes for as long as they are kept secret.[13] Formulas and the processes for making formulas can be protected, provided that the owner has taken reasonable measures to keep the information secret and the information derives independent economic value from not being known or readily knowable.[14] Additionally, trade secret protection carries an inherent risk of misappropriation because protection ultimately depends on maintaining secrecy, which can be compromised when departing employees take confidential information to a competitor.[15] Trade secrets must be closely guarded within a company or through agreements.[16] Analytical methods, such as gas chromatography and mass spectrometry can deconstruct a finished scent, so competitors can potentially identify the components and reconstruct a formula from the product itself, jeopardizing trade secret rights.[17]

The fragrance industry's long-standing reliance on trade secrets is also being challenged by new fragrance-allergen disclosure requirements.[18] Two regimes are driving the change.

At the federal level, the Modernization of Cosmetics Regulation Act of 2022 (MoCRA) directs the FDA to require disclosure of fragrance allergens on cosmetic labels, beyond the catch-all "parfum" or "fragrance."[19] The agency has not yet issued those requirements.[20] MoCRA also requires the FDA to consider international, state, and local disclosure requirements, including those of the European Union.[21]

California has already acted. However, California's Cosmetic Fragrance and Flavor Ingredient Right to Know Act (CFFIRKA) takes a different approach than the FDA.[22] Since 2022, California has required manufacturers to report the fragrance allergens that the European Union requires to be disclosed, along with other listed ingredients, to the state's Safe Cosmetics Program database rather than on the label.[23] Importantly, the European Union requires allergies to be named on the product label itself when they exceed set concentration thresholds; a 2023 amendment expended the list from 26 substances to about 80 substances.[24] CFFIRKA provides that a reportable fragrance allergen does not constitute a trade secret.[25] And it does not require disclosure of non-listed allergens or of ingredient quantities.[26] Both MoCRA and CFFIRKA result in the public disclosure of the molecule.

As these requirements take effect, fragrance makers must reveal more of what is in their products.[27] Each ingredient that appears on a label or in a public database makes reverse engineering easier.[28] Whether disclosed through manufacturing partners or to regulators, once a trade secret is disclosed it is no longer protectable. Because reverse engineering is permissible, there is no recourse against a competitor who reaches the same result by reverse engineering or independent discovery.[29] As a result of these public disclosures, the ability to rely on trade secrets for intellectual property protection is seriously compromised.

PATENT PROTECTION AND THE NATURAL PRODUCT PROBLEM

In the United States, a patent gives its owner the right to prevent others from making, using, selling, offering to sell, or importing their invention into the United States. The claims define what a patent protects. The exclusionary right lasts 20 years from the filing date. Obtaining a patent requires that an invention be novel and non-obvious. The invention also must be directed to eligible subject matter, which excludes a product of nature, a natural phenomenon, or an abstract idea, without markedly different characteristics.

Fragrances produced through fermentation raise unique considerations. A maker may want to market a molecule that is identical to one found in nature, produced through sustainable means or at a different scale. A molecule identical to one found in nature may not be patentable merely because it is isolated or made in a lab.[30] For natural products, proper patentable subject matter means the claims must show "markedly different characteristics," such as a different structure, purity, or function from what exists in nature.[31] A molecule secreted by engineered yeast

that is structurally identical to one produced by a plant may not meet the threshold of being markedly different. That is, the more natural a molecule is, the weaker patent claims to the molecule become.

However, if the molecule itself cannot be patented, protection may still be available for the engineered organism, the process used to make it, a novel analog, or a formulation containing the compound.

BIOENGINEERED FRAGRANCE PATENT CONSIDERATIONS

Assuming a claim can meet the requirements for patentability, four avenues are worth considering alone or in combination. Regardless of the avenue, the claims must also be supported by an adequate written description and enablement.

Bioengineered Strain

The engineered host organism itself may be an invention. A genetically modified cell does not exist in nature, so it may be a candidate for patent protection even if the molecule it produces cannot. The Supreme Court established this in *Diamond v. Chakrabarty*,[32] which courts today still apply to modified organisms that do not occur naturally.[33] A patent to a strain would, during the enforceable life of a patent, prohibit competitors from making or using the claimed production organism. One limit is that a competitor who reaches the same molecule with a different organism may fall outside the claim. Below is an example of such a claim.[34]

> A genetically modified microbial host cell comprising one or more heterologous nucleic acids encoding the enzymes of a biosynthetic pathway that converts [feedstock] to [target compound], wherein the cell produces [target compound] at a titer of at least [X] g/L.

Process of Making the Molecule

Another avenue includes protecting how the scent-producing molecule is made. A method claim can cover the fermentation route, the metabolic-engineering steps, the conversion, and the downstream purification. A process remains patent eligible even if it relies on a natural phenomenon, as long as the claim recites specific, concrete steps different from the phenomenon itself.[35] A method claim is valuable when the molecule is identical to a natural one and cannot be claimed on its own. A limitation of this avenue is that a competitor who reaches the same molecule by a different route can design around the claim or perform the steps of the method abroad. As such, the claim should capture the steps that set the process apart. A product-by-process claim can also help reach a molecule that is made abroad by the patented process before importation. Below are examples of such claims.[36]

> A method of producing [fragrance compound] comprising culturing the host cell under fermentation conditions and recovering [fragrance compound] from the culture.
>
> [Fragrance compound] obtained by the method above, wherein the [fragrance compound] comprises [a distinguishing impurity profile / enantiomeric purity / isotopic signature].

Novel, Non-Natural Analogs

One of the simplest avenues exists for a scent-producing molecule that is not natural. The problem with a product of nature can be remedied by developing a product that does not occur in nature. A designed analog avoids the subject matter eligibility problem and supports a claim to the compound itself. A challenge is that this avenue requires inventing a genuinely new molecule rather than reproducing a natural one. A novel captive odorant can be valuable as it can prevent others from even producing that molecule by a different means. Below is an example of such a claim.[37]

> A compound of Formula (I) [a structure not found in nature], and fragrance compositions comprising it.

Formulations and Delivery Systems

The formulation or delivery system of a fragrance can be patented separately from the molecule. For example, encapsulation, controlled release, and stabilization systems may be eligible for a patent as independent inventions separate from the molecule. A limitation is that only the formulation is protected, not the molecule itself. However, additional avenues of protection may be sought. Every new molecule may generate a new formulation filing. Below is an example of such a claim.[38]

A controlled-release fragrance composition comprising [fragrance compound] encapsulated in [a defined microcapsule system].

COMBINING PROTECTION AVENUES

A sophisticated intellectual property strategy can protect multiple avenues at the same time.

It may be tempting to keep processes as trade secrets and organisms as patents, but the lines can blur. Patents must be publicly disclosed, and that publication can destroy a related trade secret.[39] Arguments and references submitted during prosecution of a patent application may color the interpretation of whether a secret is truly secret.[40] Patents are also rarely the only tool worth employing. Trademarks protect a brand, including names, logos, and packaging shapes.[41] In some instances, a scent can be registered as a trademark, but requires a showing of acquired distinctiveness.[42] A scent usually cannot be registered as a trademark when the scent is the product itself (as a perfume), because a trademark cannot be functional.[43] The strongest strategies layer several of these tools and match them to the molecule, the product, and the market rather than following a single formula.

An additional consideration is time, because each IP protection tool runs on a different clock. A trade secret lasts as long as the information stays secret, a patent lasts 20 years from filing, and a trademark lasts as long as the mark is used in commerce.[44] A 20-year term would be a poor fit for a fine fragrance formulation, which may only last a few seasons. Short reformulation cycles and a short commercial life may not warrant patent protection in some cases.[45]

The full term of a patent can be measured against the persistence of an asset. A captive molecule, such as a synthetic musk or a fermentation-derived ambroxide, or a production process can appear across many products for decades.[46] The engineered strain and the production process behind the molecule can provide ingredients for a decade or more. Because patenting a finished fragrance formulation rarely makes economic sense, a patent on the durable molecule, organism, and process is what functionally protects the scent. A seasonal formula may be best protected as a trade secret or as a trademark for the brand, but the molecule, organism, and process behind it may be patent eligible.

The countries and regions in which protection is sought also matter. In Europe and China, a public disclosure before the filing date can destroy novelty, because there is no general grace period. A conference talk, a poster, or a published paper can forfeit patent rights at the time of disclosure. Filing at least a U.S. provisional application that describes the invention before any public disclosure can maintain protection. Patentability standards also differ from country to country, and as such, the global protection strategy should be set before the first disclosure.

CONCLUSION

Bioengineered fragrances are here to stay. Keeping such fragrances a secret is getting harder, in part due to analytical teardown and new disclosure rules putting more of the formula, and process of making it, in public view.

One alternative is patent protection. Importantly, the most durable patent protection may lie beyond the molecule itself,, extending to the engineered organism, methods of production, non-natural derivatives, and pharmaceutical formulations.

Notes

1. See, e.g., U.S. Pat. No. 12,480,101 (assigned to Amyris, Inc.); U.S. Appl. Pub. 2022/0325313 (Conagen Inc.); U.S. Pat. No. 10,053,703 (Firmenich SA and University of Copenhagen); U.S. Pat. No. 8,759,043 (BASF SE); U.S. Pat. No. 10,889,558 (Firmenich SA); U.S. Pat. No. 11,318,075 (RDJE Technologies LLC); U.S. Pat. No. 11,952,492 (Encapsys, LLC).
2. Eric Sawyer, Bacterial Odor Generators, Bio 2.0 (Mar. 21, 2011), https://www.nature.com/scitable/blog/bio2.0/bacterial_odor_generators/ (last accessed June 23, 2026).
3. Eric Eichhorn et al., Biotechnology – A Tool to Transform Givaudan's Fragrance Ingredients Palette, 77 Chimia 384-389 (2023), https://www.chimia.ch/chimia/article/view/2023_384/6235 (last accessed June 23, 2026).
4. Elaine Watson, Lux Research: Cost, Speed & Sustainability Benefits of Synthetic Biology will Make It a "Permanent and Growing Aspect" of Flavors Market, Food Navigator (last updated June 11, 2024), https://www.foodnavigator.com/Article/2015/08/27/Lux-Research-Synthetic-biology-will-drive-flavors-fragrances-market/.
5. Id.
6. Id.

7. Melody M. Bomgardner, Why the Flavor and Fragrance Industry is Embracing Biotechnology, C&EN (February 2, 2021), https://cen.acs.org/business/specialty-chemicals/flavor-fragrance-industry-embracing-biotechnology/99/i5.
8. Reformulation Demand and Biotech Innovations Drive Sustainable Growth, Rsch. & Mkts. (Apr. 14, 2026), https://finance.yahoo.com/markets/stocks/articles/flavors-fragrances-global-market-report-112600462.html.
9. Reformulation Demand and Biotech Innovations Drive Sustainable Growth, Rsch. & Mkts. (Apr. 14, 2026), https://finance.yahoo.com/markets/stocks/articles/flavors-fragrances-global-market-report-112600462.html.
10. Reformulation Demand and Biotech Innovations Drive Sustainable Growth, Rsch. & Mkts. (Apr. 14, 2026), https://finance.yahoo.com/markets/stocks/articles/flavors-fragrances-global-market-report-112600462.html.
11. Bio-based Flavors and Fragrances Market, KD Mkt. Insights, https://www.kdmarketinsights.com/reports/bio-based-flavors-and-fragrances-market/7300 (last accessed June 23, 2026).
12. See John H. Cox, Protecting Intellectual Property in the Age of Transparency, 36 Perfumer & Flavorist 26–27 (2011), https://img.perfumerflavorist.com/files/base/allured/all/document/2011/10/pf.PF_36_11_026_02.pdf; Charles Cronin, Lost and Found: Intellectual Property of the Fragrance Industry; From Trade Secret to Trade Dress, 5 N.Y.U. J. Intell. Prop. & Ent. L. 256–305 (2016), https://jipel.law.nyu.edu/vol-5-no-1-6-cronin/.
13. 18 U.S.C. § 1839(3); see Unif. Trade Secrets Act (amended 1985), 14 U.L.A. 433 (1990).
14. 18 U.S.C. § 1839(3).
15. See 18 U.S.C. § 1839(5) (defining misappropriation); Unif. Trade Secrets Act § 1(2).
16. 21 C.F.R. § 720.8(b) (2026).
17. Carla Villa et al., High-Performance Liquid Chromatographic Method for the Simultaneous Determination of 24 Fragrance Allergens to study Scented Products, 44 J. Pharm. & Biomedical Analysis 755–762 (2007), https://www.sciencedirect.com/science/article/abs/pii/S073170850700194X.
18. See 21 C.F.R. §§ 701.3(a) ("[F]ragrance or flavor shall be listed as fragrance or flavor . . . . An ingredient which is both fragrance and flavor shall be designated by each of the functions it performs unless such ingredient is identified by name.").
19. Federal Food Drug and Cosmetics Act (FFDCA) § 609(b).
20. HHS/FDA Unified Agenda RIN 0910-AI90, https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202504&RIN=0910-AI90 (last accessed June 24, 2026).
21. FFDCA § 609(b).
22. Cal. Health & Safety Code § 111792.6 (West 2025).
23. Cal. Health & Safety Code § 111792.6 (West 2025).
24. See Regulation (EC) No 1223/2009, Annex III; Commission Regulation (EU) 2023/1545 (expanding the fragrance allergens that must be individually labeled on cosmetic products).
25. Cal. Health & Safety Code § 111792.6(b)(2)(A) (West 2025).
26. Cal. Health & Safety Code § 111792.6(b)(2)(A) (West 2025).
27. Aleksandra Crapanzano, The Next Trend in 'Clean' Beauty Is in Your Perfume Bottle, Wall St. J. (Jan. 6, 2023, 3:00 PM), https://www.wsj.com/articles/clean-perfume-next-trend-in-clean-beauty-11673034990 ("Historically, most brands have been studiously opaque in their labeling, listing little more than 'parfum'–a catchall term for a formulation that might contain hundreds of ingredients (and is exempt from FDA rules because it is designated as a 'trade secret'). That's changing, however, as younger consumers demand more transparency.").
28. See, e.g., Carla Villa et al., High-Performance Liquid Chromatographic Method for the Simultaneous Determination of 24 Fragrance Allergens to study Scented Products, 44 J. Pharm. & Biomedical Analysis 755–762 (2007), https://www.sciencedirect.com/science/article/abs/pii/S073170850700194X.
29. Kewanee Oil Co. v. Bicron Corp. et al., 416 U.S. 470, 476 (1974) ("A trade secret law, however, does not offer protection against discovery by fair and honest means, such as by independent invention, accidental disclosure, or by so-called reverse engineering, that is by starting with the known product and working backward to divine the process which aided in its development or manufacture.").
30. Assoc. for Molecular Pathology v. Myriad Genetics, Inc., 569 U.S. 576, 580 (2013) ("[W]e hold that a naturally occurring DNA segment is a product of nature and not patent eligible merely because it has been isolated, but that cDNA is patent eligible because it is not naturally occurring.").
31. Diamond v. Chakrabarty, 447 U.S. 303, 310 (1980) ("Here, by contrast, the patentee has produced a new bacterium with markedly different characteristics from any found in nature and one having the potential for significant utility. His discovery is not nature's handiwork, but his own; accordingly it is patentable subject matter under § 101."); see also Manual of Patent Examination Procedures 9th ed. (MPEP) § 2106.04(c).
32. Diamond v. Chakrabarty, 447 U.S. 303, 307–16.
33. See, e.g., REGENXBIO Inc. v. Sarepta Therapeutics, Inc., 167 F.4th 1206, 1216 (Fed. Cir. 2026).

34. See, e.g., U.S. Pat. No. 12,480,101 (Titled: Modified host cells for high efficiency production of vanillin); U.S. Pat. No. 10,053,703 (Titled: Heterologous production of patchoulol, β-santalene, and sclareol in moss cells); U.S. Appl. Pub. 2022/0325313 (Titled: Biosynthesis of alpha-ionone and beta-ionone).
35. See generally Illumina, Inc. v. Ariosa Diagnostics, Inc., 967 F.3d 1319 (Fed. Cir. 2020); Illumina, Inc. v. Ariosa Diagnostics, Inc., 967 F.3d 1319, 1326 (Fed. Cir. 2020) ("We conclude that the claims are not directed to that natural phenomenon but rather to a patent-eligible method that utilizes it. The claims in this case are directed to methods for preparing a fraction of cell-free DNA that is enriched in fetal DNA. The methods include specific process steps—size discriminating and selectively removing DNA fragments that are above a specified size threshold—to increase the relative amount of fetal DNA as compared to maternal DNA in the sample.").
36. U.S. Pat. No. 8,759,043 (Titled: Biocatalytic production of ambroxan); U.S. Pat. No. 12,252,725 (Titled: Method for producing vanillin).
37. U.S. Pat. No. 10,766,850 (Titled: Fruity odorant); U.S. Pat. No. 10,889,558 (Titled: Amber odorant); U.S. Pat. No. 11,639,483 (Titled: Macrocyclic musk lactones and uses thereof).
38. U.S. Pat. No. 11,318,075 (Titled: Controlled release polymer encapsulated fragrances); U.S. Pat. No. 11,952,492 (Titled: Biodegradable, controlled release microcapsules); U.S. Pat. No. 12,492,358 (Titled: Liquid composition with encapsulated fragrance and alcohol ethoxylate suitable for use with unit dose packages).
39. BondPro Corp. v. Siemens Power Generation, Inc., 463 F.3d 702, 706–707 (7th Cir. 2006) ("Publication in a patent destroys the trade secret, because patents are intended to be widely disclosed—that is the quid for the quo of the patentee's exclusive right to make and sell the patented device. But patent applications are not patents, and they used to be secret.").
40. See, e.g., Olaplex, Inc. v. L'Oreal USA, Inc., 855 F. App'x 701 (Fed. Cir. 2021) (explaining that references surfacing during patent prosecution can demonstrate that a secret was generally known or readily ascertainable).
41. See 15 U.S.C. § 1127.
42. Trademark Manual of Examining Procedure (TMEP), May 2026, § 1202.13.
43. TMEP §§ 1202.02(a)–1202.02(a)(viii).
44. See 18 U.S.C. §1839(3) (trade secret is limited by duration of secrecy); 35 U.S.C. § 154(a)(2) (patent); 15 U.S.C. §§ 1058–1059 (trademark).
45. See, e.g., Kristina Plevova, A Holistic Vision for a Sustainable Fragrance Industry, 4 RSC Sustainability 21–27 (2026), https://pubs.rsc.org/en/content/articlehtml/2025/su/d5su00680e.
46. See Sabrina Carlier, Why Do Fragrance Companies Develop Captive Molecules?, Osmetheca (last updated May 30, 2026), https://osmetheca.be/en/faq/industry-b2b/why-do-fragrance-companies-develop-captive-molecules.

Copyright © 2027 CCH Incorporated. All Rights Reserved.
Reprinted from *Intellectual Property & Technology Law Journal*, January 2027, Volume 39, Number 1, pages 18–23, with permission from Wolters Kluwer, New York, NY, 1-800-638-8437, www.WoltersKluwerLR.com

