ESSENTIAL OILS AND FOREST EXTRACTS

Why they are essential to our society, and why the European Union's "Green Deal" needs to support an age-old natural industry

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Every day, we wake up, live and fall asleep, often within a restricted perimeter. Yet these few square metres of our daily lives are overhung by an immense airspace in perpetual motion. This world of air is full of emanations from the millions of plants that surround us. We breathe in what the wind silently carries: the products of neighbouring forests, but also of vegetation far, far away. Every day, we breathe their essences.

In light of the EU Green Deal's laudable prospects for a cleaner and safer environment, this article presents a holistic approach to the world of natural scents and extracts, and essential oils in particular, from various angles such as their complexity, socio-economic importance and vulnerability, as well as various reflections on petrochemical alternatives to natural products.

Trees, the oldest perfumers...

Forests have always been appreciated for their beneficial effects on the human body. A walk through these large living organisms that produce sugars and cellulose is in fact a walk through a natural perfume factory. Trees are indeed perfume plants; they produce massive quantities of biogenic volatile organic compounds (VOCs). According to recent estimates, forests emit around 1 billion tonnes of VOCs every year[1,2], a thousand times more than all the perfumes created by man[3].

Biogenic VOCs are the volatile signs of life: a reflection of the metabolism of plants and animals, a continuous, uninterrupted system that only comes to an end when the organism dies. Human beings also emit hundreds of these VOCs, particularly through the skin and breathing, day and night. Our human odours are mainly shaped by the billions of bacteria and other micro-organisms that colonise our skin and populate numerous organs.

But it is above all the plant kingdom that constitutes the largest living biomass in the world, almost entirely masking animal odours: plant biomass is more than 200 times greater than that of the animal kingdom and more than 7,500 times greater than that of humankind. In other words, the odoriferous trace of all humans worldwide is insignificant. And that's without counting the bacteria buried in the soil, which breathe or exchange in one way or another: these bacteria have an impact 1,000 times greater than that of humans as a whole. Plants and bacteria are therefore, in a way, the masters of planetary odours, emitting billions of molecules into the atmosphere at every moment[4].

Plants and bacteria are ...the masters of planetary odours, emitting billions of molecules into the atmosphere at every moment

VOCs, the smell and taste of life and the afterlife

When a plant synthesises biochemical products from carbon dioxide, it generates substances that are released into the atmosphere, day and night, winter and summer. This is why forests smell like forests, tirelessly emitting their "VOCs", their olfactory signatures. The death of a plant or animal is a new lease of life for the bacteria and fungi that strip the dead biomass of its carbon and other substances. These micro-organisms thrive while enriching the soil and generating VOCs: the VOCs of bacteria and of microscopic fungi, such as yeast, partly define the taste of our cheeses, bread, beer and wine. Micro-organisms generate countless aromatic notes during fermentation by breaking down the biomass of milk, wheat, hops and grapes; they create ketones (giving notes of butter and caramel), esters (fruity, spicy, vegetal notes), alcohols (flower, rose), terpenes (ripe wheat, woody, spicy), and so on. Artisan producers of essental oils (EOs), just like talented cheese-makers, bakers, brewers and wine-growers, have developed the art of managing these VOCs for many centuries: culinary and perfumery traditions are deeply rooted in the cultures of many peoples, some going back over 7,000 years.

Smell and taste define a fundamental relationship between man and nature. If the bewitching aroma of the Alba truffle seems irresistible to you, it's not by chance: it's primarily a survival mechanism; the truffle - and the bacteria that inhabit it - generate numerous VOCs to attract the animal that will eat it, and which, after digesting it, will spread the thousands of spores contained in the famous mushroom[5].

Other VOCs have a protective function, such as those that regulate the temperature of trees. Certain messengers signal aggression to other plants, such as the smell of freshly cut grass which is nothing other than a VOC that warns of an attack: cis-3-hexenol. Only a few of these mechanisms are understood, and much remains to be discovered[6,7,8,9,10,11].

So how can it be so naively claimed that VOCs are pollutants? And, pollutants for whom? Some EU regulators see VOCs from forests as harmful, but can you really describe a system that has been self-regulating for millions of years as harmful? Biogenic VOCs are part of a natural game whose rules are beyond human understanding, at least for the time being. Before categorising these products as pollutants, it is essential to gain a better understanding of plant biomasses and their subtle but real interconnections with the rest of our world.

VOCs have complicated names

Plant VOCs are highly diverse, with over 1,000 different volatile chemicals released by plants and trees. These names may frighten some people, but this is 100% natural chemistry, the chemistry of the life cycle. Around 50% of all biogenic VOCs are isoprenes, major metabolic intermediates in plants, followed by methanol, acetaldehyde, alpha-pinene, beta-pinene, d-limonene, beta-ocimene, sabinene, myrcene, camphene, cineole, camphor, linalool, para-cymene, delta-3-carene, linalool oxide, borneol, bornyl acetate, terpinen-4-ol, copaene, humulene, alpha-phellandrene, beta-phellandrene, alpha-terpinene, alpha-terpineol, alpha-terpinolene, bergamotene, longifolene, methyl jasmonate, methyl salicylate, alpha thujene, beta farnesene, and hundreds of other molecules, many of which have probably yet to be detected[12].

These molecules, with their daunting names, are nature's signatures and have always been present in our environment and in our food, since the earliest of times. They are also basic ingredients for perfumers... the perfume industry uses some 150 different types of terpene, whereas nature contains more than 40,000.

The principle behind essential oils: simple and chemical-free

The principle behind essential oils is simple: to capture the VOC's, the scents of flowers, fruit, herbs, bark, wood and roots by distillation using water vapour. The aim is to extract the VOCs from the plants before they have a chance to leave the plant and enter the atmosphere. Distillation is a physical process in which water vapour passes through the plants: the passage of this hot fluid through the plant tissue causes the cells containing the volatile compounds to burst, taking them with it. Then, as it cools, the water vapour condenses and separates from the entrained VOCs. This separation is just as natural: by a simple density differential, a fragrant layer appears and tends to float above the water, or vice versa depending on the botanical; this layer is easy to recover, and we call it essential oil. The EOs therefore bear the natural and olfactory imprint of the plants.

Turpentine EO is a formidable resource for renewable alternatives to the world's growing demand across industries

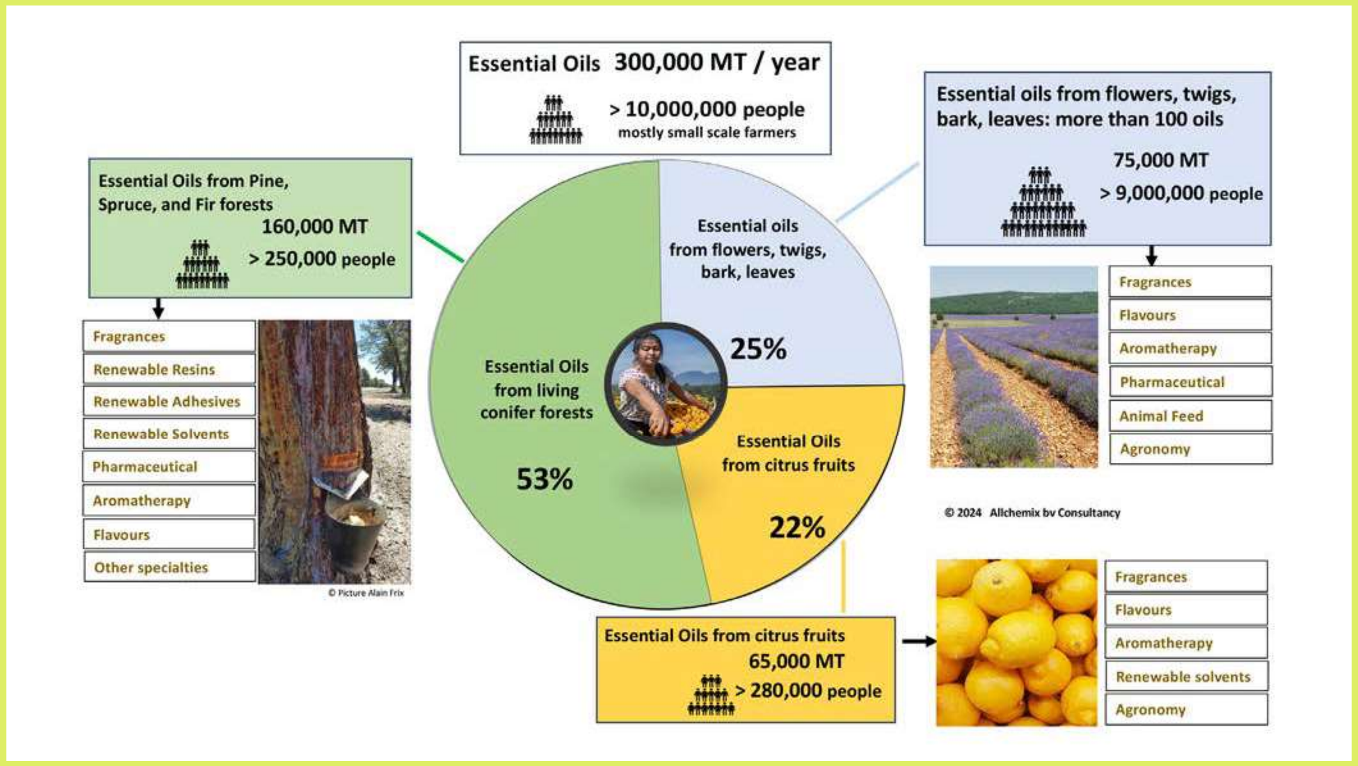

Figure 1: Essential oils: main segments and markets (in tonnes per year)

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Diversity and Essentiality: EO are key players in various industries, a genuine alternative to petrochemicals and an important basis for future food preservation and global health

There are over 200 different types of commercial essential oil used in perfumes, flavours and aromatherapy, but what many people don't know is that some essential oils have unique applications in other important sectors such as food preservation (rosemary EO, oregano EO, spearmint EO), or as specific solvents for the electronics industry (orange EO and its extracts such as limonene). One versatile EO covers many industries and represents a unique alternative to petrochemicals: turpentine EO, which has renewable applications in the automotive industry (polyterpene rubber resins in tyres), printing and adhesives. Many essential oils have human and animal health applications, such as oregano EO, which acts as a natural antibiotic. Recent research suggests that oregano EO and white thyme EO have the potential to modify ruminal fermentation and considerably reduce methane production in the rumen without adverse effects on feed digestibility in beef cattle[13]. This could make a major contribution to reducing greenhouse gas emissions from livestock. Other essential oils have antiviral, antifungal and antiparasitic properties, offering a natural and environmentally-friendly option for disinfection (lemon EO, tea tree EO, thyme EO, etc.)[14]. In agronomy, a variety of EOs are potential natural alternatives to synthetic pesticides and synthetic insect repellents (lemongrass EO, citronella EO, tea tree EO, rosemary EO, etc.), representing an important step towards new organic agronomic practices for the protection of food crops. EOs are also an essential aid in the fight against mosquitoes, the vectors of existing infectious diseases such as malaria, which kills a child every minute of every day[15]. Various EOs are also selective against ticks and ants, while having minimal impact on the environment, including the preservation of honey bees. Essential oils are definitely part of today's and tomorrow's solutions for a more environmentally-friendly world.

The author estimates annual world production of essential oils at 300,000 tonnes, broken down as follows (see Figure 1):

- 160,000 tonnes of turpentine EO (and other conifer extracts such as pine needle oils) obtained from living trees: tens of thousands of people around the world collect the resins from millions of conifers by hand. This age-old technique preserves trees and forests, providing work for many people living in rural areas, particularly in Asia and South America. It also encourages local populations to protect the surrounding forests. There are more than 250,000 tappers[16]. Derivatives of this turpentine EO are extremely important, and offer unique alternatives to replace petrochemical materials in wide applications such as adhesives, resins, rubbers.[3,17,18,19] Turpentine EO is a formidable resource for renewable alternatives to the world's growing demand across industries.

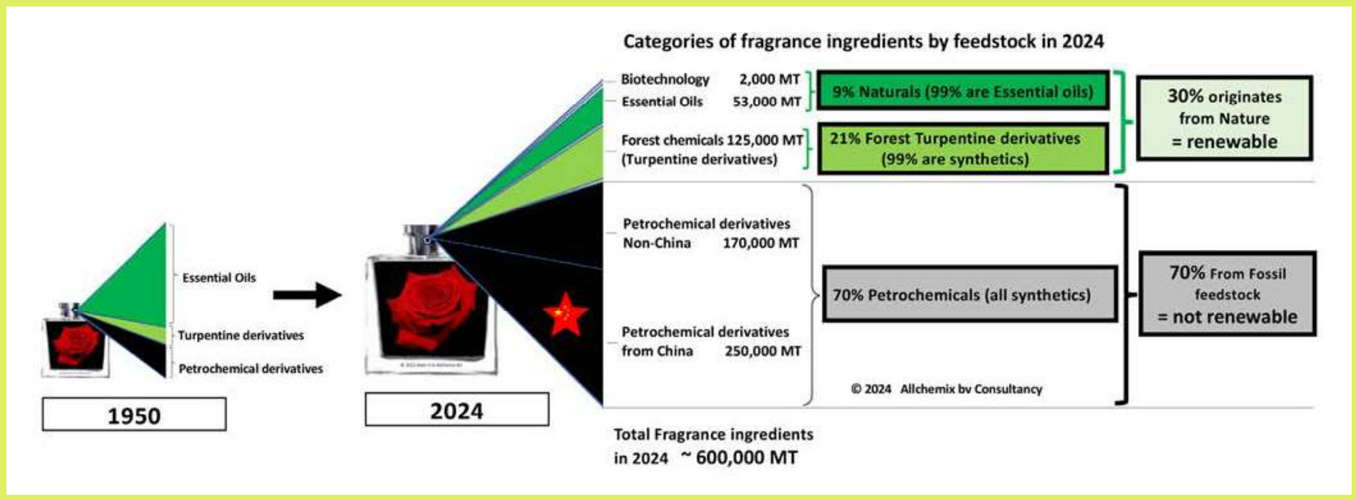

Figure 2: Industrial fragility of naturals: the example of perfumes.
The share of natural fragrance ingredients is declining, as the perfume industry becomes increasingly dependent on fossil raw materials, mainly petrochemicals manufactured in China.
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- 75,000 tonnes of EO from flowers, twigs, leaves, bark, wood and roots. These include more than one hundred most diverse EOs such as mint varieties, eucalyptus, clove, lavandin, lavender, lemongrass, patchouli, sage, citronella, vetiver, cinnamon, geranium, basil, verbena, chamomile, and around a hundred other EOs and other natural extracts, providing work for several million pickers and farmers, often smallholders.
- 65,000 tonnes of citrus EO. These are familiar EOs obtained mainly by cold pressing the peel of citrus fruits, such as orange, lemon, lime, mandarin, grapefruit, bergamot, yuzu, etc. They are also very important to many local communities around the world.

Industrial fragility of naturals: the example of perfumes

Perfumes are a good illustration of the problem encountered with natural products, in the face of an industry that is increasingly obsessed with cost, convenience and the standardisation of materials (ironically often by the same companies that claim to advocate biodiversity).

If all the world's man-made perfumes were placed in a large container, the author estimates that the fragrant mixture would weigh around 600,000 tonnes, of which only 9% are genuinely natural ingredients

There are 4 main categories of ingredients in fragrances (Figure 2.):

- **Petrochemical ingredients:** Aromatic chemicals derived from petroleum, gas and coal are widespread in fragrance ingredients; up to 70% or 420,000 tonnes per year are used in fragrances.

  Petrochemicals are the cheapest fragrance ingredients and the main driver of fragrance expansion worldwide. They guarantee wellbeing and hygiene for a huge proportion of the world's population. Many of them offer interesting and unique properties, such as very delicate notes, powerful effects and greater stability in detergents and cleaners, while meeting very strict toxicity standards.

  Petrochemical companies are launching initiatives to replace a (very small) proportion of their fossil raw materials with certified renewable raw materials, involving rigorous certification systems, and inspired by the concept of carbon credits. The question remains as to whether this practice meets the need to free ourselves from dependence on petrochemicals.

- **Turpentine derivatives:** These derivatives account for up to 125,000 tonnes per year in the perfume industry, or 21% of all perfume ingredients worldwide. They are obtained from two types of turpentine, both derived from coniferous trees: gum turpentine EO (GT), and crude sulphate turpentine (CST). GT is the world's largest essential oil and a by-product of the gum resin industry.

  CST is a by-product of the sawmill and paper industry. GT and CST will be fully fractionated into their individual constituents, in particular two precious molecules: alpha-pinene and beta-pinene. These pinenes will then be chemically transformed into major synthetic fragrance ingredients such as Dihydromyrcenol, Terpineol or Iso-E super, and others.

- **Essential oils and their natural extracts:** To the contrary of Gum Turpentine EO, most of the other EOs will not be chemically converted and they will appear in the final fragrance as real purveyors of naturality. These EOs carry

Tapping the pine tree… for gum resin and gum turpentine, a formidable forestry resource with multiple applications. Some 250,000 people around the world collect gum resin by hand from millions of conifers. This age-old technique preserves trees and forests and provides work for many people living in rural areas. Gum resins are versatile products and the source of 160,000 tonnes per year of turpentine EO, the world's largest EO and used by many industries as an important alternative to fossil-based materials.

familiar names, from lavender to patchouli and vetiver, they represent over two hundred EOs and are estimated to average 53,000 tonnes per year or some 9% of all fragrance ingredients worldwide. These EOs carry the most social footprint since EOs are the most important socio-economic contributors to the fragrance industry, providing work for millions of pickers and farmers around the world.

- **Biotechnology and natural chemicals:** These are aromatic molecules obtained for the most part from micro-organisms, mainly through fermentation by bacteria, or by fungi such as yeast. Some of these micro-organisms are genetically modified, but not all. Other natural chemicals can be produced without any micro-organisms, but by isolating certain natural molecules from biomass and applying mild chemistry in accordance with American or European protocols for natural chemicals. Their use in fragrances is currently extremely low due to their high price, generally in excess of 200 euros/kg of final material. At present, the total annual volume of biotechnological and other natural chemicals is expected to be around 2,000 tonnes, or 0.3% of fragrance ingredients, which is very limited. The majority of these natural chemicals are manufactured in China, most without clear evidence of compliance with US or European naturalness protocols.

This often unfair competition with Western European or American producers is aided and abetted by the complicity of many multinationals, which continue to buy questionable products, often with full knowledge of the facts, at a knock-down price well below the production costs of a genuine natural product.

The complacency of certain multinationals and the elaborate arsenal of dubious natural certificates have a very real impact: millions of consumers find themselves using, drinking or eating substances certified as EU or US natural when in fact they are not.

The appeal of petrochemicals at the expense of natural products

Today, many natural ingredients are on the verge of disappearing from the fragrance palette, as regulatory pressure on EOs continues to intensify at a frantic pace. Natural ingredients were already under threat, having lost a large part of their market share since the 1970s to petrochemical products: petrochemicals are much cheaper and much more abundant, with predictable prices and continuous, seasonless availability. These are the same principles that are driving multinationals to produce an increasing number of petrochemical ingredients themselves. And, over the last 20 years, many Western companies have relocated the sourcing of their synthetic ingredients, particularly to China which has become an impressive and sophisticated petrochemical hub. In addition to the distances and the geopolitical risk profile associated with this relocation, there is an environmental problem that is often forgotten: most of the energy used by Asian producers, particularly in China and to a lesser extent in India, comes from coal, while Western producers - of which there are fewer and fewer - mainly use gas and oil, with the latter emitting proportionately much less carbon dioxide than coal. The author estimates that more than 60% of current petrochemical ingredients in perfumery are derived from raw materials produced in China. For some specific petrochemical ingredients, the global market's dependence on China exceeds 90%. China has achieved undisputed supremacy in chemistry, a feat that deserves great respect but also the fear of imbalance.

Taking a step back: the proportional carbon requirements of various industries

The world extracts more than 5 billion tonnes of crude oil a year, or the equivalent of 16,000 gigantic tankers (VLCC type) with a capacity approaching 300,000 tonnes of crude oil per vessel.

The proportionality is quickly established by imagining that one single tanker as described above can transport all the EO produced in the world in one year (300,000 tonnes)… the EO market is therefore 16,000 times smaller than the crude oil market.

The author estimates that the fossil fuel market accounts for 14 billion tonnes of carbon per year, with energy being by far the largest consumer of coal, gas and oil, releasing an equivalent amount of carbon into the atmosphere. Fossil energy is therefore 45,000 times larger than the world's production of EOs.

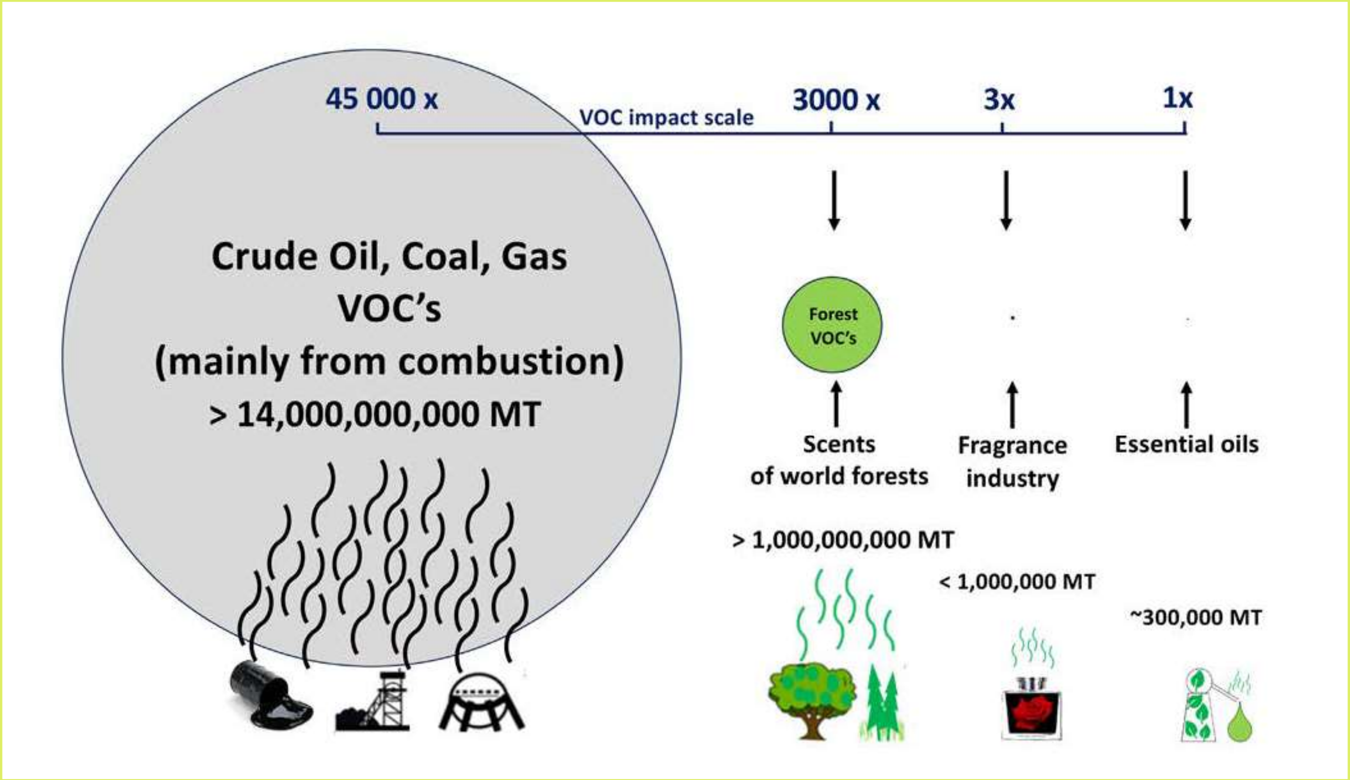

Figure 3 : The concept of proportionality: annual world production of VOC's (in tonnes/year)

Apart from the huge gap in volume, the VOC profile is fundamentally different: the combustion of this fossil energy generates highly toxic molecules, which have nothing in common with the EO world, as the EOs retain the footprint of biogenic VOCs - since the latter are not burnt, just like the biogenic VOCs produced by forests, estimated at over 1 billion tonnes a year[1,2].

The concept of proportionality illustrates the true minuscule size of the EO industry.

Humans evolved without petrochemical VOCs

Crude oil, or its composition, is a mixture extracted from underground geological formations and formed from large quantities of dead organisms under the effect of intense heat and pressure. Most of these petrogenic substances were buried for millions of years beneath the earth's surface, so unlike biogenic VOCs, there were probably few interactions between most living organisms and fossil VOCs. It is therefore not surprising that crude oil and many of its VOCs have been particularly toxic to humans and other living organisms since they were extracted and put into circulation only recently in the 19th century. This very different evolutionary history is another fundamental distinction between biogenic VOCs and petrogenic VOCs.

The carbon footprint and collective myopia

Industries sometimes short-sightedly reduce the sustainability equation to a 'carbon footprint' equation. Of course, carbon dioxide reduction is an important factor. But sustainability also means reducing toxic waste, increasing biodegradability, protecting biodiversity, preserving natural resources such as water and soil, and so on. Last but not least, sustainability encompasses people and their socio-economic culture: traditions, fair trade, profit-sharing, the rural economy, women's autonomy. Farmers, particularly smallholders, are by far the weakest link in the value chain of farm products.

These fundamental elements are often obscured, if not crushed, by the "carbon footprint" principle which is a far too reductive concept that often favours petrochemical groups.

The Sherpas of unconsciousness

The cultivation, harvesting and processing of aromatic materials have a significant impact on the well-being of rural populations, who often live in very remote areas. Experts from IFEAT have estimated that over 10 million farmers, gatherers and harvesters are lifted out of poverty by the aromatic crops they grow, often on their own small plots of land and sometimes using very old techniques. In recent years, requirements from multinationals such as traceability, sustainable development programmes, organic or vegan products and compliance with the rules of a myriad of other certification bodies have added a heavy and complex burden to their suppliers. At the end of the chain, farmers and pickers are most affected by the domino effect: most of these people live in poor countries, with few resources, and are now forced by their customers to become the sherpas of sustainability. Have we forgotten how unsustainable Western countries have been over the last 200 years? We shouldn't expect the whole planet to align itself with our new Western core values and impose on developing countries a model that didn't even exist in the Western world 50 years ago. Although working conditions are improving in developing countries, change is gradual and slow, as it encompasses the weight of tradition and is also limited by the prices offered for these natural products. Often, world prices do not allow these farmers to invest properly in better practices and implement new technologies. The gradual and worrying disappearance of small-scale farmers is leading to socio-economic degradation

upstream, standardisation of ingredients downstream, and a drift towards petrochemical alternatives[10].

Disinformation or ignorance

Some people often hastily claim that the EO industry has a negative impact on biodiversity and that it competes with food in terms of land use.

Of the 300,000 tonnes of EO, 60,000 tonnes of citrus EO are produced from by-products of the food industry (fruit juices). This leaves 240,000 tonnes of EO that could potentially compete with food crops, although most of this EO comes from coniferous forests in remote mountain areas where food production is not widespread. What's more, some previous estimates suggest that the cultivated area of EO crops compared with food crops is around a factor of 1 in 10,000[20,21]. The disproportion is such that one might understand that there is no existential competition between EOs and the food industry. In fact, the opposite is true: EO can be a complementary crop, supporting the farmer between two food crops. A good example is the Indian mint, *Mentha arvensis*, one of the largest EOs in the world with a production of almost 35,000 tonnes, and a good source of income for several million Indian farmers. Mint crops complement food crops on the same field, in between food harvest seasons. These EOs increase and diversify farmers' incomes, which is extremely important with climate change factors making crops less predictable.

New sandalwood forests

Some producers of bio-synthetics claim that they offer an excellent alternative to 'endangered' species, citing *Santalum album*, the East Indian sandalwood. It is true that this tree was almost wiped out by serious over-exploitation in India three decades ago. At the end of the 1990s, the West Australian Forestry Department began growing East Indian sandalwood as part of a worldwide conservation programme. *Santalum album* showed promising potential. Today, more than 10,000 hectares of arid savannah in Kununurra (Australia) have been transformed into a huge sandalwood plantation, creating a new ecosystem and providing income for the local population. Today, millions of *Santalum album* trees stand magnificently in Australia, as well as new plantations in other parts of the world. Nevertheless, some continue to spread the idea that the *Santalum album* species is almost "on the brink of extinction". Nothing could be further from the truth. Once again, a forest that offers recurring economic value through sustainable management is the best guarantee against deforestation. Sandalwood has a bright future ahead of it, and we should applaud and support such large-scale reforestation initiatives[22].

Essential oils and safety assessments: toxicology and policy

Regulators in the EU and other regions seem to be struggling to understand the complexity of naturals. The current mindset of safety assessment protocols - to assess natural complexes on the basis of their individual components - is worrying. This approach implies that NCS (Natural Complex Substances), such as essential oils, react as if each individual component behaved in isolation. It has been shown time and again that this is not really the case. For example, several studies carried out by the RIFM (Research Institute for Fragrance Materials) in collaboration with IFEAT indicate that the genotoxicity profile of whole oils containing chemicals of concern is often much better than would be expected on the basis of individual component analysis. For example, rose oil, which contains methyl eugenol, gave favourable results, in contrast to the results of similar tests carried out on methyl eugenol alone, which is considered dangerous in its own right.

EO can be a complementary crop, supporting the farmer between two food crops

The principle of absolute precaution, adopted by certain EU technocrats, advocates zero risk management, which is unrealistic. Clearly, toxic ingredients (most of them petrochemical, but some of them natural) must be banned, and excellent work has been done jointly by the authorities and industry over the last fifteen years.[23,24]

There are, however, positive signs: thanks to the combined efforts of various associations, from French lavender, Spanish and Italian citrus oil producers to Bulgarian rose growers, the active collaboration of EFEO and IFEAT, visits by European leaders to the farmers and the help of many responsible politicians across Europe, a genuine dialogue has gradually been possible with the various European Union bodies in Brussels. During this multi-year dialogue, the European Parliament was made aware of the fragility and complexity of the essential oils industry. Many MEPs understood that essential oils have been used for thousands of years in numerous applications, with proven benefits for mankind, and positive socio-economic impact in rural areas. Some also questioned the bureaucratic logic of separating lavender oil into its 85 components and assessing the behaviour of many of these components individually, when it is lavender oil as a whole that reaches the consumer.

On 23 April 2024 the European Parliament validated the agreement with the EU Council on the Classification, Labelling and Packaging of Chemicals (CLP), Regulation (EC) No. 1272/2008, which serves as the basis for many legal provisions in EU legislation and determines whether a substance or mixture must be classified and labelled as hazardous. Most importantly, the new CLP document approved on 23 April contains a derogation for essential oils: these will not be assessed as a mixture of chemicals, a relief for our industry which has been pleading for an exemption for many years. However, the derogation is provisional and valid for only 5 years: the EU is giving our industry the time it needs to submit solid scientific data and mechanistic understanding, by independent academic experts, to highlight the differences in behaviour between complete essential oils and the sum of their corresponding components (in particular for various environmental and human toxicology parameters: biodegradation, genotoxicity, endocrine disruption and skin sensitisation).

At the end of these five years, the Commission will present a summary scientific report, and if it is conclusive, the EU authorities will make the derogation permanent.

The science of olfaction is set to become an essential component of medical therapies and early diagnosis of various diseases by 2030

We all know that our nose detects smells. Indeed, our 400 different types of human olfactory receptors are mainly expressed, by the millions, in the very narrow olfactory epithelium of the nose. However, many people are unaware that olfactory receptors are also expressed in vast tissues outside the nose and are involved in a variety of biological processes, including sperm chemotaxis, muscle regeneration, bronchoconstriction and bronchodilation, inflammation, appetite regulation and energy metabolism. The elucidation of the physiological role of these receptors reveals potential therapeutic and diagnostic applications in wounds, hair loss, asthma, obesity and cancer, among other ailments.

Recently, a Belgian company has discovered one olfactory receptor expressed in skin cells and has found the way to modulate this receptor in order to increase natural melanin production and so increase the pigmentation of the skin[25]. This improves UV skin protection even before the skin is exposed to any sun. The new technology enables consumers to be naturally and better prepared for UV exposure, thus considerably reducing the incidence of UV-induced skin cancers. It also can substitute traditional self-tanning dihydroxyacetone (DHA) which provides a false sense of sun protection. The same company has found the way to reverse the skin pigmentation in a controlled way.

Another company, related to the previous one, designs the first medical diagnostic tools based on knowledge of canine DNA: as an example, dogs are capable of detecting certain types of cancer, Parkinson's disease and tuberculosis, and are even accurate in detecting many pathologies at an early stage, sometimes years before they manifest themselves. Many human pathologies are associated with olfactory biomarkers, more easily detected by dogs thanks to their 800 different types of olfactory receptors. Current technologies enable us to screen the activity of each olfactory receptor - expressed in vitro - when exposed to pathological biomarkers. The olfactory receptor protein, indicative of a disease, can be reproduced endlessly and linked to microelectronic components to create diagnostic tests: when a patient blows into these tools, they indicate the presence of possible diseases, enabling us to spot them at an early stage, when treatment is easiest to implement.
These olfactory receptor-based detection systems have a wide range of potential applications, from medicine (cancers, epilepsy, Parkinson's, viruses, etc.) to security (detection of explosives and drugs), to industry (early detection of engine fatigue) and also to agronomy with the detection of warning VOCs in fields.

More than ever, understanding odours and their perception plays an essential role in our society.

Final thoughts

You might wonder why there are so many misconceptions about the world of EOs. Every natural product inherits its own danger when used inappropriately. Water is the best and simplest example, killing thousands of people every year. So far, there have been no reports of deaths from inhaling the many fragrances on a walk in the woods, nor of casualties from a normal use of essential oils.

Fortunately, people are still free to walk in a forest and free to smell the trees. Let's not forget that our history has been closely linked to forests for millions of years. Palaeoanthropologists indicate that the first humans were already evolving in forests and *a fortiori* exposed to the hyper-complex abundance of natural chemicals, inhaling VOCs, chewing leaves, branches and bark. Our ancestors evolved in a world rich in biogenic VOCs.

The excess of regulatory constraints in the small EO market seems to be reaching strange and alarming proportions. It is worrying to note that the European Union approach is increasingly intransigent and disconnected from reality, based on an omnipresent, almost religious ideal of purity, a vision of a completely 'detox' world. This excessive vision would lead absurdly to the labelling of all the trees in the world, followed by the systematic destruction of forests, since trees are the biggest producers of "undesirable" VOCs.

Politicians would do well to understand the distinction between biogenic VOCs and those produced by the combustion of crude oil. These are two fundamentally different worlds in terms of toxicity and impact on the environment.

Regulators must be aware that the production of natural extracts is already extremely fragile and exposed to numerous economic, climatic and social uncertainties. If EO regulations become too strict, many multinationals will abandon using them altogether because the regulatory costs and burdens associated with their use will become excessive. And this is not a theoretical risk: it is the continuation of a reality focused on costs and control: over the last thirty years, natural products have been increasingly replaced by petrochemicals - mainly developed in-house by the same multinationals that buy or used to buy EOs from farmers.

Globalisation and the acquisition of many family-run companies by multinational compounders have profoundly changed the dynamics of the market: family-run companies were used to the seasonal and sometimes unpredictable dynamics of natural products; they knew how to manage crises and disburse funds to ensure the continuity of naturals, from generation to generation. Today, multinationals have imposed a dynamic of absolute predictability and lowest cost: ingredients must be cheap and readily available, and the vagaries of nature are no longer tolerated. Too bad for those millions of farmers and pickers, left out in the cold by many who will continue to use their photos for marketing purposes.

Petrochemicals predominate, and their dominance grows every year. This also strengthens the positions of their producers. As a result, it is not the compounding house that will suffer most from over-regulation of natural products, but consumers and a large number of small and medium-sized family businesses that have been growing, producing, processing, extracting and refining quality natural products, sometimes for centuries. And behind them, the millions of invisible and unheard-of farmers, pickers and gum producers. Many of them will see their lavender, patchouli, vetiver, agarwood and ylang-ylang gradually replaced by petrochemical derivatives of oil, gas and coal.

This certainly cannot be the objective of the EU's Green Deal, and we must be aware of the harmful effects of any unilateral decision - based on an overly narrow approach defined by a few purists - on millions of producers and consumers.

About the author

Alain Frix has devoted 33 years of his life to renewable materials, from forest products such as turpentine and its derivatives for perfumery to aromatic plants and essential oils. After chairing IFEAT for several years, he currently sits on the IFEAT Scientific Committee and is involved in various projects relating to the fragrance and flavour markets, natural and synthetic ingredients, biodiversity and climate change. In 2020, Alain Frix founded an independent consultancy company, Allchemix BV, of which he is the sole owner. He also set up BioM Consultancy, which is the consultancy arm working on biomass. Alain holds a master's degree in biology and management.

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