George H. Russell

1401 19th Street
Huntsville, Texas 77340
936.295.5767 Telephone 936.294.0233 Fax
ghr@cyberclone.net

21 April 2014

To: Mailing List

Subject: Third response to Steely Lumber's "APPLICANT'S FORMAL RESPONSE TO REQUEST FOR RECONSIDERATION" and First Response to Executive Director's "SUPPLEMENTAL RESPONSE TO REQUEST FOR RECONSIDERATION".

Reference: RENEWAL OF TPDES PERMIT NO. WQ0004249000

Discussion:

COVER LETTER

In the last paragraph of the cover letter from the Commission it is made clear that Steely is NOT granted the right to discharge waste water other than through alleged "waters of the State" and although we dispute the State's definition to include a crossing over a dirt road and the flow of waste water through an "unnamed ditch" as well as clearly NON-NAVIGABLE WATERS in Shepherd Creek in its passage through our private properties.

The fact that the permit ONLY allows the discharge of the waste water during rainfall events is in fact a permit to allow wastewater to flow through and over our FEMA mapped floodplains that even the State does not define as "waters of the State"

We therefore believe that the permit on face is ILLEGAL and allows a "taking" of private property for private industrial uses by third parties which have zero public benefit but on the contrary have a potentially negative public benefit.

PERMIT CONDITIONS

1. a. It seems obvious to us that Steely has been aware of "incorrect information" in its application and it appears at this point that Steely has failed to take corrective action or submit the objective and correct facts to the Executive Director.

b. 2. It would appear that Steely obtained this permit "by misrepresenting or failure to disclose fully all relevant facts…" and thus should be required to reapply for the permit based on the true and relevant facts.

2. d. We believe that Steely has not and will not take steps to "minimize" a "reasonable likelihood of adversely affecting human health or the environment" and thus the permit should be denied until Steely can show proof of steps to protect aquatic organisms and terrestrial organism from any harm from toxins such as alpha and beta pinenes and terpenes plus any and all waste compounds that may be associated with nursery operations and "junk yards".

3.b. We hereby invite the commission to enter our private properties and take water samples as well as conduct scientific studies from time to time to insure that there are no chemicals or other compounds from Steely operations of any kind that may harm native organisms.

7. We do not find any evidence that wastewater from Steely lands or operations has been "treated" in any way to remove any potentially harmful agents.

8. "A permit does not convey any property rights of any sort, or any exclusive privilege." This statement runs counter to the very real fact that the permit DOES INDEED grant Steely the right to dump untreated waste water through our private properties without benefit of any legal easement to do so.

OTHER REQUIREMENTS

1.b. ii and 2. This is very confusing to me. If I read the paragraphs correctly it would seem that Steeley is indeed allowed to dump "process waste water" through our private properties and onto our flood plains during the type of rain events that causes the waste pond to overflow onto the dirt road and into the ditch and thence into Shepherd Creek. In any event it seems to me that the permit does not permit the kinds of things that the permit seems to permit. Please clarify including the water that flows from the obviously dark, almost black waste water pond.

8&9. This requirement seems to also be conflicting with apparent reality when this paragraph states: "Wastewater shall be maintained and treated to prevent nuisance conditions in ponds and the receiving stream". First of all there is NO TREATMENT of the wastewater. It is merely contained in a "pond" until the next rain event causes the pond to overflow over the dirt road and into the ditch and thence through our private properties.

PROJECT DESCRIPTION AND LOCATION

The ditch and we assume the dirt road over which the wastewater travels to reach Shepherd Creek is said to "have minimal aquatic life use for the unnamed ditch." We have no problem with the ditch being devoid of aquatic life but we do have a serious problem with any pollutants that arrive from the "dead" ditch and directly into Shepherd Creek that is an area of "high aquatic life use". We want to know in provable scientific terms and documentation just exactly how a ditch filled with waste water including terpenes and alpha and beta-pinenes suddenly becomes non-toxic to acquatic life upon dumping into Shepherd Creek.

STATEMENT OF BASIS ETC.

The permit states that 'the effluent limits in the draft permit will maintain and protect the existing instream uses. All determinations are preliminary and subject to additional review and revisions."

We do not believe that releasing untreated potentially toxic waste water through our properties can possibly "protect the existing instream uses" and thus request that scientific studies be conducted to determine exactly what impacts the waste water has on the biology of our properties that may come in contact with Steely wastewater.

DRAFT PERMIT CONDITIONS

"Calculations of water quality-based effluent limitations for the protection of aquatic life and human health are presented in Appendix A."

We believe this statement to be fatally flawed in that we found no evidence that some of the chemicals most likely to have a negative impact on aquatic life are not mentioned, to wit, terpenes and alpha and beta pinenes.

TECHNICAL SUMMARY

"Biomonitoring requirements are not included in the draft permit at Outfall 001." We believe that biomonitoring is ESSENTIAL and CRITICAL in this case and that biomonitoring should be included as mandatory during both periods of drought for the water in the waste water pond itself and during rain events with samples taken from the ditch.

3. The wastewater pond is now specified as a "storage and settling pond." This to us means that there is zero treatment of the potentially toxic water other than allowing some solids to settle to the bottom of the pond which in no way eliminates anything other than heavy metals and silt from overflowing the dirt road and into the ditch and thence into sensitive waters.

CRITICAL FAILURE AND FATAL FLAW IN THE PERMIT

By failing to address the environmental impacts from the very chemical elements and volatiles associated with pine trees the permitting analysis is FATALLY FLAWED.

There are numerous scientific papers and other evidence that indicate that there may be negative impacts from contact with pine tree associated chemicals to aquatic life.

We hereby incorporate by reference several documents that we request that TCEQ scientists study and that any permit that the TCEQ may issue now and in the future in regard to pine tree processing include an analysis of the impacts associated with contact by aquatic and other forms of life with TERPENOIDS, TERPENES, ALPHA-PINENES AND BETA-PINENES.

Wikipedia definition and discussion of "Terpene"

Wikipedia definition and discussion of "Pinene"

Abstract from Aqueous Leachate from Western Red Cedar: Effects on Some Aquatic Organisms

Abstract from Mechanisms of membrane toxicity of hydrocarbons.

Extracts from THE ESSENTIAL OIL OF TURPENTINE AND ITS MAJOR VOLATIVE FRACTON ALPHA AND BETA PINENES: A REVIEW

Ecotoxicity for Pinene from www.pesticideinfo.org

Product comment in reference to D-ALPHA-PINENE
"Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment."

The literature suggests that these pine tree associated chemicals may be harmful and fatal to certain forms of aquatic and other forms of life.

Please keep in mind that terpenes are hydrocarbons and many hydrocarbons can severely negatively impact the environment if introduced in threshold quantities which should be measured both in the waste water pond and in the ditch as well as in Shepherd Creek.

As matters of reference we are submitting excerpts of various studies and documentation in regard to the chemicals emitted into "waters of the State" as well as private flood plains.

We encourage the TCEQ staff to read, study, and evaluate said studies and incorporate these chemicals into the data base of chemicals that need to be analyzed for their impacts and effects on aquatic and other organisms.

PRAYER

We are in favor of and promote the production of finished products from our East Texas forests but said production needs to have no negative environmental impacts. We believe that if required to improve Steely Lumber's waste water "treatment" facilities to actually treat the wastewater and remove any toxic agents there should be little if any negative impact to organisms that we attempt to protect on our private properties.

However we concur that Steely has no legal right to transport said wastes through our private properties without an easement whether or not Shepherd Creek is somehow considered by some parties to be "waters of the State" and our FEMA delineated floodplains over which the wastewater often flows and settles during rain events in no way has ever been considered "waters of the State".

Therefore we pray that Steely Lumber be required to submit an application that is not misleading in any way and that the TCEQ not grant a permit that may harm aquatic life in any way on flood or other waters on our downstream private properties.

Respectfully submitted

George H. Russell

Terpene

From Wikipedia, the free encyclopedia

Many terpenes are derived commercially from conifer resins, such as those made by this pine.

Terpenes (/ˈtɜrpiːn/ ***TUR**-peen*) are a large and diverse class of organic compounds, produced by a variety of plants, particularly conifers,[1] though also by some insects such as termites or swallowtail butterflies, which emit terpenes from their osmeteria. They are often strong-smelling, and thus may protect the plants that produce them by deterring parasites. Many terpenes are aromatic hydrocarbons and thus may have had a protective function. The difference between terpenes and terpenoids is that terpenes are hydrocarbons, whereas terpenoids contain additional functional groups.

They are the major components of resin, and of turpentine produced from resin. The name "terpene" is derived from the word "turpentine". In addition to their roles as end-products in many organisms, terpenes are major biosynthetic building blocks within nearly every living creature. Steroids, for example, are derivatives of the triterpene squalene.

When terpenes are modified chemically, such as by oxidation or rearrangement of the carbon skeleton, the resulting compounds are generally referred to as terpenoids. Some authors will use the term terpene to include all terpenoids. Terpenoids are also known as isoprenoids.

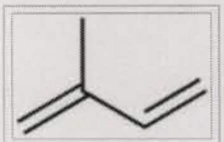
Terpenes and terpenoids are the primary constituents of the essential oils of many types of plants and flowers. Essential oils are used widely as natural flavor additives for food, as fragrances in perfumery, and in traditional and alternative medicines such as aromatherapy. Synthetic variations and derivatives of natural terpenes and terpenoids also greatly expand the variety of aromas used in perfumery and flavors used in food additives. Vitamin A is a terpene.

Terpenes are released by trees more actively in warmer weather, acting as a natural form of cloud seeding. The clouds reflect sunlight, allowing the forest to regulate its temperature.[2]

The aroma and flavor of hops, highly desirable in some beers, comes from terpenes. Of the terpenes in hops myrcene, β-pinene, β-caryophyllene, and α-humulene are found in the largest quantities.[3]

Contents

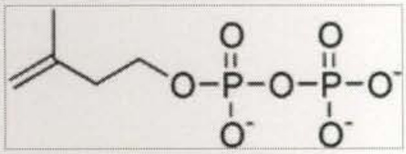
Structure and biosynthesis



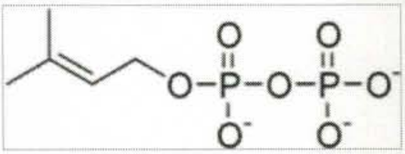
Isoprene

Terpenes are derived biosynthetically from units of isoprene, which has the molecular formula C_5H_8. The basic molecular formulae of terpenes are multiples of that, $(C_5H_8)_n$ where n is the number of linked isoprene units. This is called the **isoprene rule** or the *C5 rule*. The isoprene units may be linked together "head to tail" to form linear chains or they may be arranged to form rings. One can consider the isoprene unit as one of nature's common building blocks.

Isoprene itself does not undergo the building process, but rather activated forms, isopentenyl pyrophosphate (IPP or also isopentenyl diphosphate) and dimethylallyl pyrophosphate (DMAPP or also dimethylallyl diphosphate), are the components in the biosynthetic pathway. IPP is formed from acetyl-CoA via the intermediacy of mevalonic acid in the HMG-CoA reductase pathway. An alternative, totally unrelated biosynthesis pathway of IPP is known in some bacterial groups and the plastids of plants, the so-called MEP(2-Methyl-D-erythritol-4-phosphate)-pathway, which is initiated from C5-sugars. In both pathways, IPP is isomerized to DMAPP by the enzyme isopentenyl pyrophosphate isomerase.



Isopentenyl pyrophosphate



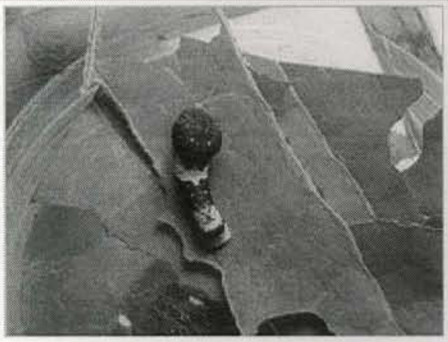
Dimethylallyl pyrophosphate

As chains of isoprene units are built up, the resulting terpenes are classified sequentially by size as hemiterpenes, monoterpenes, sesquiterpenes, diterpenes, sesterterpenes, triterpenes, and tetraterpenes. Essentially, they are all synthesised by Terpene synthase.

Types

Terpenes may be classified by the number of isoprene units in the molecule; a prefix in the name indicates the number of terpene units needed to assemble the molecule.

- **Hemiterpenes** consist of *a single isoprene* unit. Isoprene itself is considered the only hemiterpene, but oxygen-containing derivatives such as prenol and isovaleric acid are hemiterpenoids.
- **Monoterpenes** consist of *two isoprene* units and have the molecular formula $C_{10}H_{16}$. Examples of monoterpenes are: geraniol, limonene and terpineol.
- **Sesquiterpenes** consist of *three isoprene* units and have the molecular formula $C_{15}H_{24}$. Examples of sesquiterpenes are: humulene, farnesenes, farnesol. (The *sesqui-* prefix means one and a half.)



Second or third instar caterpillars of *Papilio glaucus* emit terpenes from their osmeterium.

- **Diterpenes** are composed of *four isoprene* units and have the molecular formula $C_{20}H_{32}$. They derive from geranylgeranyl pyrophosphate. Examples of diterpenes are cafestol, kahweol, cembrene and taxadiene (precursor of taxol). Diterpenes also form the basis for biologically important compounds such as retinol, retinal, and phytol. They are known to be antimicrobial and antiinflammatory.
- **Sesterterpenes**, terpenes having 25 carbons and *five isoprene* units, are rare relative to the other sizes. (The *sester-* prefix means half to three, i.e. two and a half.) An example of a sesterterpene is geranylfarnesol.
- **Triterpenes** consist of *six isoprene* units and have the molecular formula $C_{30}H_{48}$. The linear triterpene squalene, the major constituent of shark liver oil, is derived from the reductive coupling of two molecules of farnesyl pyrophosphate. Squalene is then processed biosynthetically to generate either lanosterol or cycloartenol, the structural precursors to all the steroids.
- **Sesquarterpenes** are composed of *seven isoprene* units and have the molecular formula $C_{35}H_{56}$. Sesquarterpenes are typically microbial in their origin. Examples of sesquarterpenes are ferrugicadiol and tetraprenylcurcumene.
- **Tetraterpenes** contain *eight isoprene* units and have the molecular formula $C_{40}H_{64}$. Biologically important tetraterpenes include the acyclic lycopene, the monocyclic gamma-carotene, and the bicyclic alpha- and beta-carotenes.
- **Polyterpenes** consist of long chains of *many isoprene* units. Natural rubber consists of polyisoprene in which the double bonds are cis. Some plants produce a polyisoprene with trans double bonds, known as gutta-percha.
- **Norisoprenoids**, such as the C_{13}-norisoprenoids 3-oxo-α-ionol present in Muscat of Alexandria leaves and 7,8-dihydroionone derivatives, such as megastigmane-3,9-diol and 3-oxo-7,8-dihydro-α-ionol found in Shiraz leaves (both grapes in the species *Vitis vinifera*)[4] or wine[5][6] (responsible for some of the spice notes in Chardonnay), can be produced by fungal peroxydases[7] or glycosidases.[8]

Other uses

Research into terpenes has found that many of them possess qualities that make them ideal active ingredients as part of natural agricultural pesticides.[*citation needed*]

Terpin hydrate is a derivative of turpentine. An expectorant and humectant, it is commonly used in the treatment of acute or chronic bronchitis and related conditions.

Terpenes are used by termites of the Nasutitermitinae family to attack enemy insects, through the use of a specialized mechanism called a fontanellar gun.[9]

References

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2. ^ Adam, David (October 31, 2008). "Scientists discover cloud-thickening chemicals in trees that could offer a new weapon in the fight against global warming" (http://www.guardian.co.uk/environment/2008/oct/31/forests-climatechange). *The Guardian*.
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7. ^ Zelena, Kateryna; Hardebusch, Björn; HüLsdau, BäRbel; Berger, Ralf G.; Zorn, Holger (2009). "Generation of Norisoprenoid Flavors from Carotenoids by Fungal Peroxidases". *Journal of Agricultural and Food Chemistry* **57** (21): 9951–5. doi:10.1021/jf901438m (http://dx.doi.org/10.1021%2Fjf901438m). PMID 19817422 (//www.ncbi.nlm.nih.gov/pubmed/19817422).
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External links

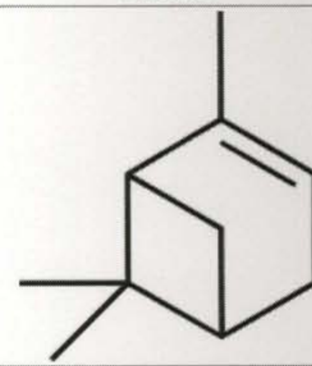
- Institute of Chemistry - terpenes (http://www.chemie.fu-berlin.de/chemistry/oc/terpene/terpene_en.html)
- Structures of alpha pinene and beta pinene (http://www.chem.qmul.ac.uk/iubmb/enzyme/glossary/pinene.html)
- Terpenes (//www.nlm.nih.gov/cgi/mesh/2011/MB_cgi?mode=&term=Terpenes) at the US National Library of Medicine Medical Subject Headings (MeSH)

Retrieved from "http://en.wikipedia.org/w/index.php?title=Terpene&oldid=594468476"
Categories: Terpenes and terpenoids

Pinene

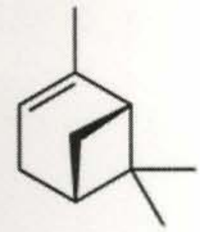
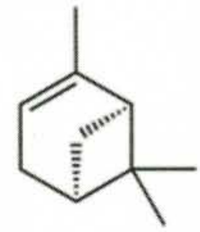
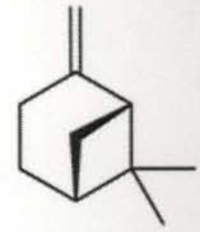
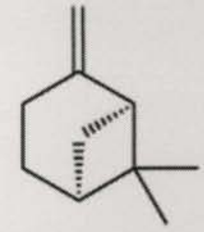
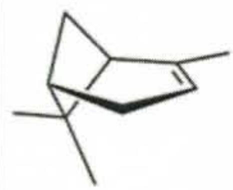
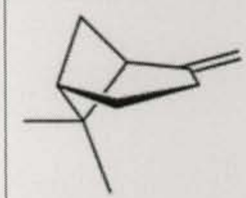
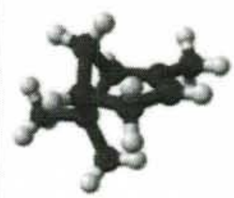
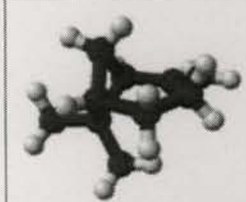
From Wikipedia, the free encyclopedia

Pinene ($C_{10}H_{16}$) is a bicyclic monoterpene chemical compound.[1] There are two structural isomers of pinene found in nature: α-pinene and β-pinene. As the name suggests, both forms are important constituents of pine resin; they are also found in the resins of many other conifers, as well as in non-coniferous plants such as big sagebrush (*Artemisia tridentata*). Both isomers are used by many insects in their chemical communication system.

Pinene	
	
IUPAC name (1*S*,5*S*)-2,6,6-trimethylbicyclo[3.1.1]hept-2-ene or (1*S*,5*S*)-6,6-dimethyl-2-methylenebicyclo[3.1.1]heptane	
Identifiers	
CAS number	80-56-8 ✓, (unspecified) [7785-70-8] (1*R*-α) [7785-26-4] (1*S*-α) [2437-95-8] ((±)-α) [18172-67-3] (β)
Properties	
Molecular formula	$C_{10}H_{16}$
Molar mass	136.24 g/mol
Appearance	Liquid
Density	0,86 g·cm^{-3} (alpha, 15 °C)[1][2]
Melting point	−62–−55 °C (alpha)[1]
Boiling point	155–156 °C (alpha)[1]
Solubility in water	Practically insoluble in water
Except where noted otherwise, data are given for materials in their standard state (at 25 °C (77 °F), 100 kPa)	
✓ (verify) (what is: ✓/✗?)	
Infobox references	

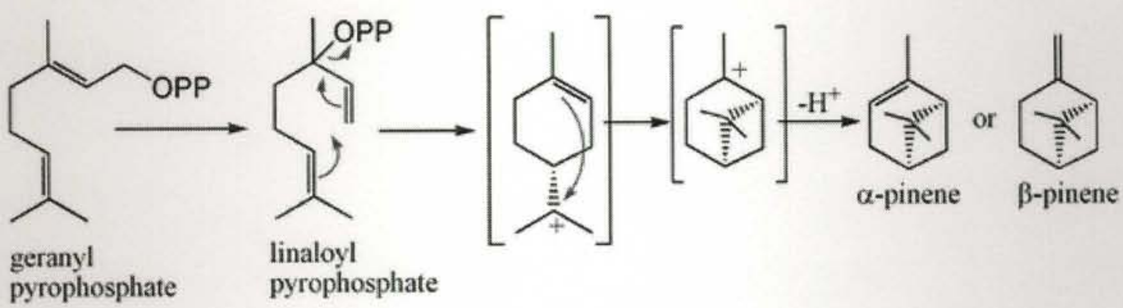
Contents

Isomers

skeletal formula				
perspective view	X		X	
ball-and-stick model	X		X	
name	(1*R*)-(+)-α-pinene	(1*S*)-(−)-α-pinene	(1*R*)-(+)-β-pinene	(1*S*)-(−)-β-pinene
CAS number	7785-70-8	7785-26-4	19902-08-0	18172-67-3

Biosynthesis

α-Pinene and β-pinene are both produced from geranyl pyrophosphate, via cyclisation of linaloyl pyrophosphate followed by loss of a proton from the carbocation equivalent.



Plants

Alpha-pinene is the most widely encountered terpenoid in nature[3] and is highly repellant to insects.[4]

Alpha-pinene appears in conifers and numerous other plants.[5] Pinene is a major component of the essential oils of *Sideritis* spp. (ironwort)[6] and *Salvia* spp. (sage).[7] *Cannabis* also contains alpha-pinene.[5] Resin from *Pistacia terebinthus* (commonly known as terebinth or turpentine tree) is rich in pinene. Pine nuts produced by pine trees contain pinene.[5]

Usage

In chemical industry, selective oxidation of pinene with some catalysts gives many compounds for perfumery, such as artificial odorants. An important oxidation product is verbenone, along with pinene oxide, verbenol and verbenyl hydroperoxide. [8]

Pinenes are the primary constituents of turpentine.

References

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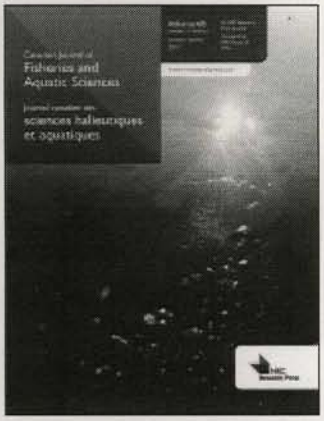

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Aqueous Leachate from Western Red Cedar: Effects on Some Aquatic Organisms

G. B. Peters, H. J. Dawson, B. F. Hrutfiord, R. R. Whitney

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ABSTRACT

Water-soluble extractives from western red cedar heartwood, bark, and foliage were ir for their toxicity to aquatic organisms. The heartwood lignans and bark extractives wer moderately toxic, but the foliage terpenes and heartwood tropolones were more toxic, mortality to coho salmon (*Oncorhynchus kisutch*) fry at 0.33 and 2.7 mg/liter, respectiv Tropolones were significantly less toxic to invertebrates than to free-swimming stages tested. Fry were found to be the stage of development of coho salmon (*O. kisutch*) mo to the tropolones, and eyed eggs the least sensitive. Sensitivity of the coho fry to tropc moderated by previous sublethal exposure or the presence of a chelatable cation. Res field studies and a leaching study indicate that directly releasing cedar leachate from la allowing logging debris to enter streams should be avoided.

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Mechanisms of membrane toxicity of hydrocarbons.

J Sikkema, J A de Bont, and B Poolman

Department of Food Science, Wageningen Agricultural University, The Netherlands.

ABSTRACT

Microbial transformations of cyclic hydrocarbons have received much attention during the past thı Interest in the degradation of environmental pollutants as well as in applications of microorganisn catalysis of chemical reactions has stimulated research in this area. The metabolic pathways of vari aromatics, cycloalkanes, and terpenes in different microorganisms have been elucidated, and the g several of these routes have been clarified. The toxicity of these compounds to microorganisms is v important in the microbial degradation of hydrocarbons, but not many researchers have studied th mechanism of this toxic action. In this review, we present general ideas derived from the various re mentioning toxic effects. Most importantly, lipophilic hydrocarbons accumulate in the membrane l bilayer, affecting the structural and functional properties of these membranes. As a result of accum hydrocarbon molecules, the membrane loses its integrity, and an increase in permeability to protoı has been observed in several instances. Consequently, dissipation of the proton motive force and ir of intracellular pH homeostasis occur. In addition to the effects of lipophilic compounds on the lipi the membrane, proteins embedded in the membrane are affected. The effects on the membrane-en proteins probably result to a large extent from changes in the lipid environment; however, direct ef lipophilic compounds on membrane proteins have also been observed. Finally, the effectiveness of membrane lipid composition, modification of outer membrane lipopolysaccharide, altered cell wall constituents, and active excretion systems in reducing the membrane concentrations of lipophilic c is discussed. Also, the adaptations (e.g., increase in lipid ordering, change in lipid/protein ratio) th compensate for the changes in membrane structure are treated.

FULL TEXT

The Full Text of this article is available as a PDF (519K).

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THE ESSENTIAL OIL OF TURPENTINE AND ITS MAJOR VOLATILE FRACTION (α- AND β-PINENES): A REVIEW

BEATRICE MERCIER[1], JOSIANE PROST[1], and MICHEL PROST[2]

[1] Université de Bourgogne, Dijon, France
Faculté des Sciences de la Vie
[2] Lara-Spiral SA, Couternon, France

Abstract
This paper provides a summary review of the major biological features concerning the essential oil of turpentine, its origin and use in traditional and modern medicine. More precisely, the safety of this volatile fraction to human health, and the medical, biological and environmental effects of the two major compounds of this fraction (α- and β-pinenes) have been discussed.

Key words:
Spirits of turpentine, α-pinene, β-pinene

ORIGIN OF TURPENTINE

The term "essential oil of turpentine" designates the terpenic oil, obtained by hydrodistillation of the gem pine. It is also named the "spirits of turpentine", "pine tree terpenic", "pine oleoresin", "gum turpentine", "terpenes oil" or "turpentine from Bordeaux". Due to its pleasant fragrance, the terpenic oil is used in the pharmaceutical industry, perfume industry, food additives and other chemical industries (household cleaning products, paintings, varnishes, rubber, insecticides, etc.) [1].

TRADITIONAL MEDICINE AND TURPENTINE

The eminent doctors of antiquity, Hippocrates, Dioscoride or Galien, used the terpenic oil for its properties against lung diseases and biliary lithiasis. In France, Thillenius, Pitcairn, Récamier and Martinet recommended it against the blennorrhoea and cystitis. Chaumeton, Peschiez, Kennedi, Mérat prescribed it against the neuralgias. It was also used in the treatment of rheumatism, sciatica, nephritis, drop, constipation and mercury salivation.

Those scientists also recognized that the terpenic oil may be a booster at an average dose and may have a paralyzing activity at high doses. In Germany, (Rowachol and Rowatinex), Slovenia (Uroterp) and Poland (Terpichol and Terpinex), the traditional drugs for renal and hepatic diseases (especially against cholesterol stones in the gall bladder and the bile duct) contain α- and β-pinenes [2].

Modern phytotherapy describes the following properties of the terpenic oil: antiparasitic, analgesic, revulsive, disinfectant (external use); balsamic, active on bronchial secretion and pulmonary and genito-urinary tract infections, haemostatic, dissolving gallstones, diuretic, antispasmodic, antirheumatic, deworming, being an antidote for poisonings caused by phosphorus [3] and improving the ciliary and secretory activity in patients who present chronic obstructive bronchitis (internal use) [4].

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Address reprint request to B. Mercier, UPRES EA 4183 "Lipides & Signalisation Cellulaire", Faculté des Sciences de la Vie, Université de Bourgogne 6, Boulevard Gabriel, F-21000 Dijon (e-mail: beamercier@laposte.net).

containing α-pinenes [63]. Mercier [12] showed in *in vivo* and *ex vivo* studies a decrease in the rate of glycated haemoglobin after inhalation of oxidised turpentine vapours. Some studies investigating the effect of various terpenes, including α-pinenes, documented that the level of induced CYP2B, as measured by immunoassay, increased several times. Furthermore, CYP2B activity increased when laboratory rats were given an oral dose of α-pinene [64]. There is no evidence for induction of CYP3A with α-pinene [65]. Several essential oils are used for their memory-enhancing effects in the European folk medicine. Among the components, α-pinenes were found to inhibit AChE in an uncompetitive and reversible manner when they acted synergistically. They were responsible for the inhibitory effect of the essential oil of the *Salvia* species. Thus, when in synergy with other compounds, they could be beneficial in the treatment of cognitive impairments, due to their multifarious activities related to Alzheimer's disease [65].

It has also been shown that α-pinenes do not exhibit an oestrogenic activity [60] or a behavioural effect [63].

Table 2. Summary of the properties of α-pinenes, alone or in synergy with other pinenes, reported in scientific litterature

α-pinenes
Lipophilic
Bactericidal
Fungicidal
Insecticidal
Pesticidal
Anticarcinogenic (cytotoxic on cancer cells)
Diuretic
Antioxidant
Immunostimulant
Anti-inflammatory
Anti-convulsive
Sedative
Anti-stress
Hypoglycaemic
Capable of expelling xenobiotics
Anticholinesterase activity

Beta-pinenes

According to literature reports, β-pinenes generally accompany α-pinenes in low quantities in the volatile extracts, essential oleoresins and oils, *i.e.* all the pine extracts which were tested for their biological properties. Some specific studies show that β-pinenes, along with α-pinenes and other terpenes, are cytotoxic on cancer cells [55]. They represent a great part of essential oils with sedative properties [66]. When α- and β-pinenes are the major constituents of an essential oil, they warrant the anti-inflammatory and analgesic activity [67].

The β-pinenes also show antifungal properties [68], especially on *Candida* spp. [36]. When acting on yeast, they were found to inhibit mitochondrial respiration, the proton pump activity and K+ transport, and to increase membrane fluidity [69]. They also exhibit pest-destroying properties against the protozoon *Plasmodium berghei* (malaria vector [70]), insecticidal properties against lice [71] and the mosquito *Aedes aegypti* [51] as well as an antiseptic effect on oral bacterial flora [50]. In general, they exert a considerable antibacterial effect, especially on a methicilline-resistant *S. aureus* and other Gram-positive and Gram-negative bacteria [43].

Without α-pinenes, but with other terpenes, β-pinenes present antiradical activity (DPPH system [72] and elimination of the superoxide anion [73]). They belong to the essential oils used against the osteoclast activity (they thus play a protective role against osteoporosis [74]).

Beta-pinenes, when administered alone, exhibit moderate antimicrobial activity [68]; they are sometimes ineffective on specific strains like *Pseudomonas* spp. [75]. As the major or important components of essential oils, they are particularly powerful on fungus, like *Tricoderma* spp. [76]. Takikawa et al. [77] showed that β-pinenes acted on a pathogenic strain of *Escherichia coli*, but this activity is less pronounced against the non-pathogenic strains. Besides, β-pinenes show an insecticidal activity against the third larval stage of the fly *Musca domestica* [78]. In a synergistic activity with other terpenes, they act against the fruit fly, *Bemisia argentifolii* [79]. In competition with α-pinenes, they seem more active as antifungal agents (on *Fusarium culmorum*, *F. solani* and

F. poae, fungal phytopathogens [80]) and as inhibitors of *Brassica campestris* germination (colza), in a dose-dependant manner [81]. Beta-pinenes showed a better effectiveness than did α-pinenes in fighting against cockroaches [82].

In addition, the compounds are active on the smooth muscles of the ileum part of rat intestine. They act by inhibiting the 5-HT3 receptors of the serotoninergic system of the murine intestinal cells [83].

In rats, β-pinenes exert an antinoxious effect on the supra spinal parts, but not on the spinal cord itself [28].

Table 3. Summary of the properties of β-pinenes, alone or in synergy with other pinenes, reported in scientific literature

β-pinènes
Lipophilic
Bactericidal
Fungicidal
Insecticidal
Acting against osteoclasts
Anticarcinogenic (cytotoxic on cancer cells)
Pesticidal
Antioxidant
Sedative

Harmlessness of the turpentine vapours

Some turpentine varieties, especially those originating from the Scandinavian countries, Switzerland, Germany or Italy, generate various types of allergies. Monoterpenes are released in the form of gas during the sawing and processing of fresh wood. They pose a potential health hazard for workers at sawmills [84]. They cause irritation to the skin, eyes and mucous membrane. They may be associated with the development of contact dermatitis (allergic or non-allergic) [85].

Turpentine inhalation increased resistance of the upper airways and induced chronic irritation, but did not generate acute respiratory problems [86].

Foussereau [85] observed 12 cases of eczema following the use of the Swedish turpentine instead of the French turpentine. Likewise, 14 other people were cured of eczema by using turpentine without δ-3-carene (cases observed between 1967 and 1969 in Strasbourg).

In fact, the greatest danger related to turpentine use seem to be the δ-3-carenes, a variety of terpenes.These chemical compounds were at the origin of dermatitis and respiratory problems as they induced broncho-constriction [87], and there is a dose-dependent relationship between the viability of alveolar macrophages and the concentration of δ-3-carenes. They appear to have provoked a stronger reaction than did α-pinenes [88].

For the α- and β-pinenes (the main volatiles monoterpenes), many authors have a moderate opinion regarding their irritant capacity. First of all, a significant quantity is needed for the product to produce adverse health effects: as reported by Menezes et al. [89], the toxic effect for the mice starts at 5 g/kg. Kasanen et al. [90] postulated that it is highly unlikely that monoterpenes alone can cause irritation under normal conditions ("all pinenes possess sensory irritation properties and also induced sedation and sign of anaesthesia but had no pulmonary irritation effects"). Fransman et al. [91] observed that the respiratory problems referring to laminated wood workers were associated with the presence of formaldehyde among all the agents that these people inhaled at work (dust, bacterial endotoxins, abietic acid, formaldehyde and terpenes). Dutkiewicz et al. [92] found out that dermatitis among Polish workers resembled that characteristic of exposure to oak and pine wood dusts, and concluded that the presence of this pathology was due to dust inhalation rather that the composition of these dusts.

Thus, to paraphrase Paracelse, "Sola dosis facit venenum", which translates as "the dose makes the poison". The rate of irritation from terpene exposure correlates with exposure level. Accordingly, monoterpenes become pro-oxidants at higher doses [93]. At a low dose, they are included in the composition of pharmaceuticals used for the kidney and liver disorders [2]. At high-level exposure, they are hepato- and nephrotoxic. They can also cause nervous system disorders (convulsions, disorders of balance [26]).

U.S. EPA Registered	No
U.S. EPA Hazardous Air Pollutant	Not Listed
U.S. EPA Minimum Risk Pesticide (25b list)	No
CA Registered	No
CA Groundwater Contaminant	Not Listed
CA Toxic Air Contaminant	Not Listed

Maximum Tolerance and Residue Levels

Codex Alimentarius (UN FAO Maximum Residue Limits)	Go to web site
U.S. Maximum Tolerance Levels	Go to web site
European Union Maximum Residue Levels	Go to web site

Ecotoxicity for Pinene

Top

Note! Information for many chemicals is incomplete and may not be fully representative of effects on the environment. Why? Click on underlined terms for definitions and additional information.

Aquatic Ecotoxicity

All Toxic Effects for Organism Group

Organism Group	Effects Noted
Fish	Behavior, Development, Growth, Mortality
Fish	Development, Growth, Histology, Mortality, No Effect Coded
Insects	Mortality
Insects	Mortality
Phytoplankton	Accumulation, Population
Zooplankton	Mortality
View All Aquatic Ecotoxicity Studies and References	

Summary of Acute Toxicity for Organism Group

Organism Group	Average Acute Toxicity	Acute Toxicity Range
Insects	Not Acutely Toxic	Not Acutely Toxic to Slightly Toxic
Zooplankton	Slightly Toxic	Slight Toxicity
Fish	Moderately Toxic	Moderate Toxicity
Insects	Not Acutely Toxic	Not Acutely Toxic
Fish	Very Highly Toxic	Very Highly Toxic

R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
R65: Harmful: may cause lung damage if swallowed.

2.2 Label elements

Labeling (REGULATION (EC) No 1272/2008)

Hazard pictograms :

Signal Word : Danger

Hazard Statements :

H226	Flammable liquid and vapor.
H304	May be fatal if swallowed and enters airways.
H317	May cause an allergic skin reaction.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary Statements :

Prevention:	
P210	Keep away from open flames/hot surfaces. - No smoking.
P243	Take precautionary measures against static discharge.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P273	Avoid release to the environment.
Response:	
P301 + P330 + P331	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P310	Immediately call a POISON CENTER or doctor/ physician.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
Storage:	
P404	Store in a closed container.
P403 + P235	Store in a well-ventilated place. Keep cool.
Disposal:	
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Other hazards

3. Composition/information on ingredients

3.2 Mixtures