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## **Volatile Chemical Emissions from Car Air Fresheners**

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### Abstract

Air fresheners, used in a variety of indoor environments, emit a range of volatile chemicals, including some classified as hazardous. However, little is known about the emissions from air fresheners designed for use in cars. This study investigates the volatile organic compounds emitted from car air fresheners, identifies potentially hazardous compounds, compares emissions between so-called natural and regular versions, and assesses whether ingredients are disclosed. Using gas chromatography/mass spectrometry, 12 car air fresheners were analysed for their volatile emissions. Air freshener types included car vent clips, wraps, hanging ornaments, cans, and spray. Results reveal that the air fresheners collectively emitted 546 VOCs with 30 VOCs classified as potentially hazardous. All air freshener types emitted one or more potentially hazardous compounds. Comparing regular air fresheners with so-called natural or green air fresheners, no significant difference was found in the emissions of hazardous compounds. Notably, all products emitted at least one VOC classified as potentially hazardous. Among all of the 546 compounds emitted, fewer than 2% of all VOCs, and none of the potentially hazardous VOCs, were disclosed on any product label or safety data sheet. This study reveals that car air fresheners can be a source of exposure to numerous volatile compounds, including potentially hazardous VOCs, most of which are undisclosed. Of particular concern for human exposure is the small and enclosed breathing space within vehicles, as well as involuntary exposure in commercial vehicles such as taxi cabs and rideshares.

## **Introduction**

Air fresheners are pervasive within indoor environments, from public and private buildings to forms of transportation. Although air fresheners may be used with the intent to enhance environments, studies reveal that these products generally impair rather than improve indoor air quality.

Chemical analyses of air fresheners have found they emit a range of volatile organic compounds (VOCs), such as terpenes (e.g., limonene, linalool, alpha-pinene, beta-pinene), including some VOCs classified as hazardous, such as acetaldehyde (Steinmann 2017). In addition, primary emissions of common air freshener chemicals (terpenes) can readily react with ozone to generate additional and increased concentrations of hazardous pollutants, such as formaldehyde (Nazaroff and Weschler 2004).

Although prior research has investigated emissions from air fresheners used primarily in buildings (e.g., Steinmann 2017, Goodman et al. 2019, Uhde and Shulz 2015, Nematollahi et al. 2019), little prior work has analysed emissions from air fresheners used in cars. These types of air fresheners include car vent wraps and clips, hanging ornaments such as trees, cans, and sprays, which can comprise aromatic solids, liquids, gels, or oils. Sources of exposure include not only privately owned vehicles, but also publicly available vehicles such as rental cars, rideshares, and taxi cabs. Within the small and enclosed space in cars, exposures may be of particular concern, both for the driver and passengers.

Air freshener exposures have been associated with a range of adverse health effects, including asthma symptoms, breathing difficulties, migraine headaches, and dizziness (Weinberg et al. 2017, Steinmann 2019a, 2019b, 2018, 2017, Steinmann and Nematollahi 2020, Steinmann and Goodman 2019). Reducing risks from air freshener exposures is vital not only for occupant health but also for public safety. For instance, car drivers and passengers may experience acute effects while in the car, as well as longer term effects after leaving the car. Further, air freshener chemicals can continue to be emitted within interior spaces, such as within cars, even after the air fresheners are removed (Goodman et al. 2019, Yoshida et al. 2006).

The purpose of this study was to investigate emissions from a range of common air fresheners used in cars. It pursues four primary objectives: (a) to analyse the volatile ingredients emitted from car air fresheners, (b) to identify the compounds classified as potentially hazardous, (c) to compare emissions between so-called natural and regular air fresheners, and (d) to assess whether compounds emitted are disclosed on product labels or safety data sheets. Findings from this study offer a new body of data and increased understanding of our exposure to volatile compounds from car air fresheners, and point to the importance of reducing exposure to reduce potential health and safety risks.

## Methods

For this study, 12 car air fresheners were a convenience sample randomly selected from the automotive supply or air freshener section of stores in California. However, the same brands and types of products are available across the United States and internationally. In this paper, the term "natural" refers to products that make the claim of being "natural" or related terms, such as "organic," "no chemicals," "good for the environment," or "healthier and cleaner fragrance." The term "regular" refers to products other than those in the "natural" category. The types of air fresheners sampled were 6 car vent air fresheners (2 natural, 4 regular), 3 hanging air fresheners (3 regular), 2 can air fresheners (2 natural), and 1 spray air freshener (1 regular). For each air freshener, the product was maintained in its original packaging until the time of analysis, and a sample of approximately 2 g was placed inside a 10 mL amber vial.

The volatile emissions were analysed by headspace gas chromatography/mass spectrometry (GC/MS), using a Shimadzu GC/MS-QP2010 Plus instrument equipped with a BPX-VOL capillary column and coupled to an automated Shimadzu AOC-500 sample injection system. The chromatogram for each air freshener was scanned to identify the highest concentration VOCs and the potentially hazardous compounds. Compound identification was based on the mass spectral library of the National Institute of Standards and Technology NIST Version 2.0. For additional details on the GC/MS method and compound identification procedure, see Nematollahi et al. (2018).

Potentially hazardous VOCs were identified according to their classification as (i) Hazardous Air Pollutants, HAPs (EPA 2017) including carcinogenic HAPs (EPA 2018), (ii) California Proposition 65 chemicals (OEHHA 2020), or (iii) asthmagens (AOEC 2020). This analysis was performed to identify ingredients of the air fresheners studied that are classified as

potentially hazardous under one or more of these laws or guidelines mentioned above. However, this analysis does not imply that the entire product is potentially hazardous. It also does not imply that the VOCs identified are the only potentially hazardous compounds contained in the air fresheners studied.

## **Results**

### *VOCs emitted and most prevalent VOCs*

A summary of VOCs emitted across the 12 air fresheners, and from the subsets of "regular" and "natural" car air fresheners, is provided in Table 1. In this paper, the term "VOC occurrences" refers to the number of individual VOCs emitted from each car air freshener. The term "VOC identities" refers to the number of uniquely named VOCs emitted from one or more of the car air fresheners. Thus, a VOC occurrence is an individual ingredient emitted from one product, and a VOC identity is a VOC that occurs in one or more of the products.

Across the 12 car air fresheners, 546 VOCs were emitted (occurrences), representing 275 unique VOCs (identities). The most prevalent VOCs (in at least 75% of all car air fresheners) were limonene, benzyl acetate, acetone, ethanol, linalool, 2-methylbutyl acetate, acetaldehyde, and methanol (Table 2 and Supplementary Table 2). In "regular" car air fresheners, the most prevalent VOC was limonene. In "natural" car air fresheners, the most prevalent VOC was benzyl acetate.

### *Potentially hazardous emissions*

To identify potentially hazardous emissions, three classifications (HAPs, Prop 65, asthmagens) were used to assess the emitted VOCs (see Tables 1 and 3).

For the 275 VOCs (identities) emitted across the 12 products, 9 VOCs are classified as potentially hazardous: methanol, acetaldehyde, beta-myrcene, 3-carene, o-xylene, hexane, tetracarbonylnickel, toluene, and propanal.

For the 546 VOCs (occurrences) emitted collectively from the 12 products, 30 VOCs are classified as potentially hazardous, representing approximately 6% of all VOC ingredients. All products emitted at least one VOC classified as potentially hazardous.

### *Comparison of VOCs emitted from regular and natural products*

Among the most prevalent VOCs, no significant difference was found in VOC occurrences between the regular and natural products ( $p = 0.12$ , t test). In addition, among the potentially hazardous VOCs, no significant difference was found in VOC occurrences between regular and natural products ( $p = 0.16$ , t test). This comparison followed the convention of previously published work (e.g., Steinemann 2015, Nematollahi et al. 2019).

### *Comparison of VOCs emitted and ingredients disclosed*

Among the 546 VOCs (occurrences) emitted from the products, 10 were listed on any product label or safety data sheet. In addition, none of the 30 VOCs classified as potentially hazardous were listed on any product label or safety data sheet. Thus, fewer than 2% of all VOCs, and none of the potentially hazardous VOCs, were disclosed to the public on product labels or safety data sheets.

## **Discussion**

This study found that car air fresheners of all types, including both regular and natural versions, emit numerous volatile chemicals, some of which are classified as hazardous, and few of which are disclosed to the public. Car air freshener emissions are of particular concern, given that car interiors are small and enclosed spaces that can be subject to air pollutants from both outdoor and indoor sources, and thus air fresheners represent an additional source of pollutants and health risks. In addition, air fresheners, which add a chemical mixture into the air space, are designed to impart a scent or mask an odor, rather than to reduce air pollutants or health risks. Further, vent clips, because they attach directly to the car air vent, turn the ventilation system, which could be a source of fresher air, into a source for dispensing potentially hazardous VOCs into the enclosed space.

Our findings are consistent with prior studies of car air freshener emissions. Lamorena and Lee (2008), in their analysis of a car air freshener, found terpenes (alpha-pinene, beta-pinene, p-cymene, and limonene) as primary constituents, and their ozone-initiated reaction products (including formaldehyde, acetaldehyde, acrolein, acetone, and propionaldehyde), deemed to affect the health of passengers. Yoshida et al. (2006), in their analysis of 25 car air fresheners,

found terpenes (limonene, beta-pinene, 1,8-cineole, linalool, and dihydromyrcenol) and esters (ethylacetate, ethylbutyrate, and isopentylacetate) as major volatile components. Importantly, even after air fresheners were removed from vehicles, their volatile components continued to adversely affect air quality.

Our results are also consistent with broader findings on air fresheners. First, in prior studies of air freshener emissions (e.g., Steinemann 2017, 2015, Nematollahi et al. 2019, Uhde and Schulz 2015, Kim et al. 2015), terpenes and esters were also among the most common compounds. Second, all air freshener types, including so-called organic and natural essential oils, emitted potentially hazardous VOCs (e.g., Steinemann 2017, 2015, Nematollahi et al. 2018, 2019). Third, in comparisons of natural and regular air fresheners, no significant difference was found in emissions of potentially hazardous pollutants (Steinemann 2015, Nematollahi 2019). Fourth, in comparisons of VOCs emitted and ingredients listed (e.g., Steinemann 2015, Nematollahi et al. 2019, Uhde and Schulz 2015), fewer than 10% of volatile ingredients in air fresheners were disclosed.

To note, the GC/MS headspace analysis identified compounds that are individual ingredients in the product, without interactions with external constituents. With this focus on individual compounds and primary emissions, the analysis did not examine mixtures of compounds or the generation of secondary pollutants that could contribute to the overall risk. However, our results provide an important foundation for a more complete assessment to determine exposure situations and quantify associated risks.

Finally, as studies have revealed, people prefer fragrance-free rather than fragranced indoor environments. In nationally representative population-based surveys in five countries (the United States, Australia, United Kingdom, Sweden, and Germany), a majority of the general public prefers hotels, airplanes, and workplaces that are fragrance-free rather than fragranced, and will choose options without a scent rather than with a scent (Steinemann 2019a, 2019b, Steinemann and Klaschka 2019). An even greater percentage of vulnerable individuals, such as those with asthma, autism, or chemical sensitivity, prefer fragrance-free to fragranced indoor environments (Steinemann 2019a, 2019b, 2018). Thus, people may similarly prefer indoor car environments that are without a fragranced product rather than with a fragranced product such as an air freshener. Drivers of taxi cabs and rideshares may thus be mistakenly assuming that their passengers prefer the use of air fresheners.

## **Conclusions**

Our study found that car air fresheners emit numerous volatile chemicals, including potentially hazardous air pollutants. Given that air freshener emissions are associated with health risks, that air fresheners are not intended to reduce pollutants, that driver health is imperative to public safety, that passenger risks may often be involuntary, and that people generally prefer fragrance-free to fragranced indoor environments, it would seem reasonable to rethink the pervasive use of air fresheners within cars.

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Table 1: VOCs emitted from the car air fresheners studied\*

Type	Number of car air fresheners	Emitted		Listed (on product label or safety data sheet)	
		All emitted VOCs	Potentially Hazardous VOCs	All listed VOCs	Potentially Hazardous VOCs
Regular	8	389 occurrences 232 identities	23 occurrences 8 identities	5 occurrences 5 identities	0 occurrences 0 identities
Natural	4	157 occurrences 114 identities	7 occurrences 4 identities	5 occurrences 5 identities	0 occurrences 0 identities
Total	12	546 occurrences 275 identities	30 occurrences 9 identities	10 occurrences 10 identities	0 occurrences 0 identities

\*"VOC occurrences" refers to the number of individual VOCs emitted from each car air freshener.

"VOC identities" refers to the number of unique VOCs emitted from one or more of the car air fresheners.

Table 2: Most prevalent VOCs emitted from the car air fresheners studied

Compound	CAS #	Prevalence (# of car air fresheners)		
		Total (n=12)	Regular (n=8)	Natural (n=4)
<u>All car air fresheners (n=12)</u>				
Limonene	138-86-3	10	8	2
Benzyl acetate	140-11-4	9	5	4
Acetone	67-64-1	9	7	2
Ethanol	64-17-5	9	6	3
Linalool	78-70-6	8	6	2
2-Methylbutyl acetate	624-41-9	8	4	4
Acetaldehyde*	75-07-0	8	7	1
Methanol*	67-56-1	8	5	3
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7	7	4	3
beta-Myrcene*	123-35-3	7	5	2
Dihydromyrcenol	18479-58-8	7	5	2
Isoamyl acetate	123-92-2	7	4	3
Neryl acetate	141-12-8	7	6	1
4-tert-Butylcyclohexyl acetate	32210-23-4	6	4	2
Eucalyptol	470-82-6	6	4	2
Sabinene	3387-41-5	6	4	2
Verdyl acetate	5413-60-5	6	5	1
<u>Regular car air fresheners (n=8)</u>				
Limonene	138-86-3	8		
Acetone	67-64-1	7		
Acetaldehyde*	75-07-0	7		
Ethanol	64-17-5	6		
Linalool	78-70-6	6		
Neryl acetate	141-12-8	6		
Benzyl acetate	140-11-4	5		
Methanol*	67-56-1	5		
beta-Myrcene*	123-35-3	5		
Dihydromyrcenol	18479-58-8	5		
Verdyl acetate	5413-60-5	5		
alpha-Terpineol	98-55-5	5		
<u>Natural car air fresheners (n=4)</u>				
Benzyl acetate	140-11-4	4		

2-Methylbutyl acetate	624-41-9	4
Ethanol	64-17-5	3
Methanol*	67-56-1	3
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7	3
Isoamyl acetate	123-92-2	3
Ethyl butyrate	105-54-4	3
Benzaldehyde	100-52-7	3
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7	3

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\*Classified as potentially hazardous

Table 3: Potentially hazardous VOCs emitted from the car air fresheners studied

Compound	CAS #	Prevalence (# of Products)	HAPs	Prop65	Asthmagens
Methanol	67-56-1	8	✓	✓	
Acetaldehyde <sup>c</sup>	75-07-0	8	✓	✓	
beta-Myrcene	123-35-3	7		✓	
3-Carene	13466-78-9	2			✓
o-Xylene	95-47-6	1	✓		
Hexane	110-54-3	1	✓	✓	
Tetracarbonylnickel	13463-39-3	1		✓	✓
Toluene	108-88-3	1	✓	✓	
Propanal	123-38-6	1	✓		

HAPs: United States Environmental Protection Agency (EPA) - Hazardous Air Pollutants (EPA 2017)

Prop65: California Proposition 65 (OEHHA 2020)

Asthmagens: Association of Occupational and Environmental Clinics (AOEC 2020)

<sup>c</sup>Classified as possibly carcinogenic (2B) (EPA 2018)

**Supplementary Table 1: VOCs emitted from each of the car air fresheners studied**

***1. Car spray air freshener***

<b>Compounds</b>	<b>CAS#</b>
Isopropyl alcohol	67-63-0
Butane	106-97-8
Limonene	138-86-3
Isoamyl acetate	123-92-2
Eucalyptol	470-82-6
D,L-isobornyl acetate	92618-89-8
Isopentane	78-78-4
alpha-Pinene	80-56-8
Acetone	67-64-1
Pentane	109-66-0
2-Methylbutyl acetate	624-41-9
Ethanol	64-17-5
Camphene	79-92-5
beta-Pinene	127-91-3
Acetaldehyde*	75-07-0
Propylene glycol	57-55-6
Methyl salicylate	119-36-8
beta-Myrcene*	123-35-3
beta-Citral	106-26-3
Terpinolene	586-62-9
Diisopropyl ether	108-20-3
Isopropyl formate	625-55-8
(E)-citral	141-27-5
N-butylbenzenesulfonamide	3622-84-2
Benzyl acetate	140-11-4
gamma-Terpinene	99-85-4
Sabinene	3387-41-5
Cyclofenchene	488-97-1
1-Propanol	71-23-8
Hexane*	110-54-3
2-Methylpentane	107-83-5
gamma-Terpineol	586-81-2
Triethylene glycol	112-27-6
beta-Phellandrene	555-10-2
o-Cymene	527-84-4

\*Compound classified as potentially hazardous

## 2. Car can air freshener<sup>N</sup>

<b>Compounds</b>	<b>CAS#</b>
Benzaldehyde	100-52-7
Ethyl butyrate	105-54-4
Isoamyl acetate	123-92-2
Benzyl acetate	140-11-4
o-Tolualdehyde	529-20-4
2-Methylbutyl acetate	624-41-9
Amyl acetate	628-63-7
4-tert-Butylcyclohexyl acetate	32210-23-4
Ethanol	64-17-5
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4
Dimethyl succinate	106-65-0
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
Methyl anthranilate	134-20-3
Methanol*	67-56-1
trans-Ethyl 3-Methyl-3-phenylglycidate	19464-92-7
10-(oxan-2-yloxy)decan-1-ol	43047-93-4
cis-Ethyl 3-methyl-3-phenylglycidate	19464-95-0
Acetone	67-64-1
Ethyl isobutyrate	97-62-1
p-Tolualdehyde	104-87-0
Benzaldehyde	100-52-7
Ethyl butyrate	105-54-4
Isoamyl acetate	123-92-2
Benzyl acetate	140-11-4
o-Tolualdehyde	529-20-4

\*Compound classified as potentially hazardous

<sup>N</sup> Product with the claim of being "natural" or a related term.



### 3. Car can air freshener<sup>N</sup>

<b>Compounds</b>	<b>CAS#</b>
Benzaldehyde	100-52-7
Ethyl butyrate	105-54-4
Amyl acetate	628-63-7
Benzyl acetate	140-11-4
o-Tolualdehyde	529-20-4
2-Methylbutyl acetate	624-41-9
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
Ethanol	64-17-5
N-butylbenzenesulfonamide	3622-84-2
trans-Ethyl 3-Methyl-3-phenylglycidate	19464-92-7
Methanol*	67-56-1
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7
Methyl anthranilate	134-20-3
cis-Ethyl 3-methyl-3-phenylglycidate	19464-95-0
o-Xylene*	95-47-6
p-Tolualdehyde	104-87-0
1-Methyl-alpha-ionone	7779-30-8
1-Pentanol	71-41-0

\*Compound classified as potentially hazardous

<sup>N</sup> Product with the claim of being "natural" or a related term.

#### 4. Car hanging air freshener

Compounds	CAS#
Allyl hexanoate	123-68-2
Limonene	138-86-3
Isoamyl butylate	106-27-4
Allyl heptanoate	142-19-8
Triacetin	102-76-1
gamma-Nonanolactone	104-61-0
Isoamyl acetate	123-92-2
Dipentyl ether	693-65-2
Verdyl acetate	5413-60-5
Ethyl lactate	97-64-3
$\gamma$ -Undecalactone	104-67-6
2-Methylbutyl acetate	624-41-9
o-Cymene	527-84-4
Allyl cyclohexanepropionate	2705-87-5
p-Anisaldehyde	123-11-5
Ethyl hexanoate	123-66-0
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7
beta-Pinene	127-91-3
$\gamma$ -Decalactone	706-14-9
2,6-Di-tert-butyl-4-methylphenol	128-37-0
Diethyl malonate	105-53-3
Neryl acetate	141-12-8
Isopropyl alcohol	67-63-0
$\alpha,\alpha$ -Dimethylphenethyl butyrate	10094-34-5
Allyl alcohol	107-18-6
beta-Myrcene*	123-35-3
Ethyl butyrate	105-54-4
Methanol*	67-56-1

\*Compound classified as potentially hazardous

## 5. Car hanging air freshener

Compounds	CAS#
Linalyl acetate	115-95-7
Linalool	78-70-6
Dihydromyrcenol	18479-58-8
Verdyl acetate	5413-60-5
Benzyl acetate	140-11-4
Isobornyl acetate	125-12-2
4-tert-Butylcyclohexyl acetate	32210-23-4
Nopyl acetate	128-51-8
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4
Eucalyptol	470-82-6
2,9-Dimethylundecane	17301-26-7
3-Methyl-5-propylnonane	31081-18-2
Limonene	138-86-3
2,2,11,11-Tetramethyldodecane	127204-12-0
2,2-Dimethyltetradecane	59222-86-5
Ethyl acetate	141-78-6
6-Methyltridecane	13287-21-3
3,8-Dimethyldecane	17312-55-9
2-Bromotetradecane	74036-95-6
Terpinyl acetate	80-26-2
4,6-Dimethyldodecane	61141-72-8
2,6,6-Trimethyloctane	54166-32-4
2,2,4-Trimethylhexane	16747-26-5
2,5-Dimethylundecane	17301-22-3
2,2,6-Trimethyldecane	62237-97-2
3-Methylundecane	1002-43-3
4-Terpineol	562-74-3
Acetone	67-64-1
2,3,6-Trimethyldecane	62238-12-4
alpha-Pinene	80-56-8
alpha-Terpineol	98-55-5
Phytane	638-36-8
Methyl phenylcarbinyl acetate	93-92-5
Heneicosane	629-94-7
2,2,7,7-Tetramethyloctane	1071-31-4
3,3-Dimethylundecane	17312-65-1
4,4-Dimethylundecane	17312-68-4
beta-Pinene	127-91-3
2,5-Dimethyltridecane	56292-66-1
Heptadecane	629-78-7
Ethanol	64-17-5
Methanol*	67-56-1
Dicyclopentenyl alcohol	37275-49-3
2,2,9-Trimethyldecane	62238-00-0
10-Methylnonadecane	56862-62-5
2,4-Dimethyl-3-pentanol	600-36-2
beta-Myrcene*	123-35-3

Camphene	79-92-5
1-(2-Methoxypropoxy)propan-2-ol	13429-07-7
2,2,3-Trimethylnonane	55499-04-2
Neryl acetate	141-12-8
beta-Terpinyl acetate	10198-23-9
Acetaldehyde*	75-07-0
1,2,3,6-Tetramethylbicyclo[2.2.2]octane	62338-45-8
2,6-Di-tert-butyl-4-methylphenol	128-37-0
(-)-menthyl benzoate	6284-35-1
3,3,6-Trimethyldecane	62338-14-1
2,2,6,6-Tetramethylheptane	40117-45-1
2-Methyl-1-butene	563-46-2
Hexyl methyl ether	4747-07-3
1-Octen-3-yl-acetate	2442-10-6
2-(4-tert-Butylbenzyl)propionaldehyde	80-54-6
Sabinene	3387-41-5
2-Methyl-1-propene	115-11-7
alpha-Phellandrene	99-83-2
Isovaleraldehyde	590-86-3
1-Vinylheptanol	21964-44-3
beta-Ionone	14901-07-6
1-Hexanol	111-27-3

\*Compound classified as potentially hazardous

## 6. Car hanging air freshener

Compounds	CAS#
alpha-Pinene	80-56-8
Limonene	138-86-3
3-Carene*	13466-78-9
beta-Pinene	127-91-3
Camphene	79-92-5
Bornyl acetate	76-49-3
6-[(1E)-1-Propenyl]bicyclo[3.1.0]hexan-2-one	75283-46-4
Isobornyl acetate	125-12-2
beta-Phellandrene	555-10-2
Linalool	78-70-6
Tricyclene	508-32-7
Eucalyptol	470-82-6
Linalyl acetate	115-95-7
alpha-Terpineol	98-55-5
2,7-Dimethyl-1-octanol	15250-22-3
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
Acetone	67-64-1
1,3,3-Trimethylbicyclo[2.2.1]hept-2-yl acetate	76109-40-5
(+)-Camphor	464-49-3
gamma-Terpineol	586-81-2
Terpinolene	586-62-9
iso-Bornyl methacrylate	7534-94-3
Acetaldehyde*	75-07-0
Methanol*	67-56-1
beta-Terpinyl acetate	10198-23-9
2-Phenethyl acetate	103-45-7
alpha-Phellandrene	99-83-2
4-Carene	29050-33-7
Benzyl alcohol	100-51-6
Sabinene	3387-41-5
Piperonal	120-57-0
p-Anisaldehyde	123-11-5
Geranyl acetate	105-87-3
Neryl acetate	141-12-8
Propanal*	123-38-6
1-Methyl-alpha-ionone	7779-30-8
Isopropyl alcohol	67-63-0
3,7-Dimethyl-1-octanol	106-21-8
Ethanol	64-17-5
(Z)-sabinene hydrate	15537-55-0
beta-Terpineol	138-87-4
Phenethyl butyrate	103-52-6
(-)- $\alpha$ -Cedrene	469-61-4
N-butylbenzenesulfonamide	3622-84-2
gamma-Terpinene	99-85-4
1-Butanol	71-36-3

Caryophyllene	87-44-5
2-Methyl-3-(p-isopropylphenyl)propionaldehyde	103-95-7
2-Carene	554-61-0
Ethyl butyrate	105-54-4
Toluene*	108-88-3
1-Terpinenol	586-82-3
Octanal	124-13-0
Cyclopropylidenecyclohexane	14114-06-8
Thujopsene	470-40-6
2-Methyl-1-propene	115-11-7
Butylbenzene	104-51-8
Hexanal	66-25-1
1,5-Dimethyl-1,4-cyclohexadiene	4190-06-1
Bicyclopentyl	1636-39-1
Tetracarbonylnickel*	13463-39-3
2-methylundecanal	110-41-8

\*Compound classified as potentially hazardous

## 7. Car vent air freshener<sup>N</sup>

<b>Compounds</b>	<b>CAS#</b>
Limonene	138-86-3
Benzyl acetate	140-11-4
Allyl hexanoate	123-68-2
p-Anisaldehyde	123-11-5
Allyl heptanoate	142-19-8
gamma-Nonanolactone	104-61-0
Dihydromyrcenol	18479-58-8
Ethyl 2-methylpentanoate	39255-32-8
2,6-Dimethyl octane	2051-30-1
2,9-Dimethylundecane	17301-26-7
3-Methyl-5-propylnonane	31081-18-2
Isoamyl acetate	123-92-2
2-Isopropyl-5-methylhexanol	2051-33-4
3,8-Dimethyldecane	17312-55-9
Heptadecyl acetate	822-20-8
3,6-Dimethylundecane	17301-28-9
γ-Decalactone	706-14-9
Terpinolene	586-62-9
gamma-Terpinene	99-85-4
5-Ethyl-2,2,3-trimethylheptane	62199-06-8
2,6-Dimethyl-5-heptenal	106-72-9
3,3,5-Trimethylheptane	7154-80-5
cis-3-Hexene-1-ol	928-96-1
2,5-Dimethylundecane	17301-22-3
beta-Myrcene*	123-35-3
2-methyl-6-methylene-7-octen-2-ol	14314-21-7
Eucalyptol	470-82-6
Linalool	78-70-6
2,2-Dimethyloctane	15869-87-1
3,3,8-Trimethyldecane	62338-16-3
beta-Pinene	127-91-3
2,2,4,6,6-Pentamethylheptane	13475-82-6
Allyl cyclohexanepropionate	2705-87-5
2,2,3,3,5,6,6-Heptamethylheptane	7225-67-4
1-Iododecane	2050-77-3
3-Methyltetradecane	18435-22-8
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7
cis-3-Hexenyl methoxy formate	67633-96-9
3,9-Dimethylundecane	17301-31-4
2-(4-tert-Butylbenzyl)propionaldehyde	80-54-6
2-Methyl-5-propylnonane	31081-17-1
2H-1-Benzopyran-2-one	91-64-5
4,4-Dimethylundecane	17312-68-4
2-Methylbutyl acetate	624-41-9
Benzyl alcohol	100-51-6
Piperonal	120-57-0
2,2,11,11-Tetramethyldodecane	127204-12-0

2,2-Dimethyltetradecane	59222-86-5
Cyclopropane, 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)-	68998-21-0
Hexyl salicylate	6259-76-3
3-Methylundecane	1002-43-3
1,4-Cineole	470-67-7
6-Methyltridecane	13287-21-3
beta-trans-Ocimene	3779-61-1
3,3,6-Trimethyldecane	62338-14-1
Allyl alcohol	107-18-6
3,4,5,6-Tetramethyloctane	62185-21-1
Sabinene	3387-41-5
2,2,3,4-Tetramethylpentane	1186-53-4
6-Methyl-5-hepten-2-one	110-93-0
Acetaldehyde*	75-07-0
Decanal	112-31-2
Octanal	124-13-0
Methyl dihydrojasmonate	24851-98-7
4-Ethyl-2,2,6,6-tetramethylheptane	62108-31-0

\*Compound classified as potentially hazardous

<sup>N</sup> Product with the claim of being "natural" or a related term.



## 8. Car vent air freshener

Compounds	CAS#
3,5,5-Trimethylhexyl acetate	58430-94-7
Benzyl acetate	140-11-4
Dihydromyrcenol	18479-58-8
4-tert-Butylcyclohexyl acetate	32210-23-4
Limonene	138-86-3
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4
Linalool	78-70-6
4-tert-Butylcyclohexanol	98-52-2
Ethyl 2-methylbutyrate	7452-79-1
Ethyl 2-methylpentanoate	39255-32-8
Acetaldehyde*	75-07-0
Glutaric acid dimethyl ester	1119-40-0
p-Anisaldehyde	123-11-5
Verdyl acetate	5413-60-5
Phenylethyl alcohol	60-12-8
(1R)-(-)-Nopol benzyl ether	74851-17-5
Ethanol	64-17-5
(R)-(+)- $\beta$ -Citronellol	1117-61-9
2-tert-Butylcyclohexanol	13491-79-7
2-Methoxynaphthalene	93-04-9
Isoamyl acetate	123-92-2
2,6-Dimethyl-5-heptenal	106-72-9
Methyl phenylcarbinyl acetate	93-92-5
alpha-Terpineol	98-55-5
cis-Pinocampheol	473-61-0
Dimethyl adipate	627-93-0
4-Methylanisole	104-93-8
cis- $\alpha$ -Bisabolene	29837-07-8
3,5,5-Trimethyl-1-hexanol	3452-97-9
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
$\alpha,\alpha$ -Dimethylphenethyl acetate	151-05-3
Decanal	112-31-2
3-Phenylbutyraldehyde	16251-77-7
1,2,3,4-tetrahydro-1,4-methanonaphthalene	4486-29-7
Methyl benzoate	93-58-3
Acetylmethylcyclohexene,4-acetyl-1-methyl-1-cyclohexene	70286-20-3
alpha-Ionone	127-41-3
Acetone	67-64-1
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7
2-Methylbutyl acetate	624-41-9
Isoamyl butylate	106-27-4
Methanol*	67-56-1
Cyclofenchene	488-97-1
Camphene	79-92-5
beta-Myrcene*	123-35-3

Dodecanal	112-54-9
6-Methyl-5-hepten-2-one	110-93-0
Carane	554-59-6
4-tert-Butylcyclohexene	2228-98-0
2,5,5-Trimethyl-1-hexene	62185-56-2
Caryophyllene	87-44-5
(Z)-rose oxide	16409-43-1
2-Methyl-1-propene	115-11-7
beta-Ionone	14901-07-6
Neryl acetate	141-12-8

\*Compound classified as potentially hazardous

## 9. Car vent air freshener

Compounds	CAS#
Dihydromyrcenol	18479-58-8
Linalool	78-70-6
3,5,5-Trimethylhexyl acetate	58430-94-7
Benzyl acetate	140-11-4
3,4-Dimethylhex-4-en-2-one	53252-21-4
Benzyl propionate	122-63-4
Linalyl acetate	115-95-7
(Z+E)-2-methyl-2-(4-methyl-3-pentenyl) cyclopropane carbaldehyde	97231-35-1
2-Acetylcyclopentanone	1670-46-8
Prenyl acetate	1191-16-8
3,7-Dimethyl-6-octenoic acid	502-47-6
4-tert-Butylcyclohexyl acetate	32210-23-4
Verdyl acetate	5413-60-5
2-Cyclohexene-1-Acetaldehyde, 3-methyl-	129993-40-4
Menthyl acetate	89-48-5
Isomenthol acetate	20777-45-1
Ethanol	64-17-5
(1R)-(-)-Nopol benzyl ether	74851-17-5
2-Isopropyl-5-methylcyclohexyl acetate	20777-36-0
Methyl benzoate	93-58-3
DL-menthyl acetate	16409-45-3
Acetylmethylcyclohexene,4-acetyl-1-methyl-1- cyclohexene	70286-20-3
1,5-Diethyl-2,3-dimethylcyclohexane	74663-66-4
Limonene	138-86-3
3,4,5-Trimethyl-1-hexene	56728-10-0
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4
3-Ethyl-2-hexene	620-00-8
1-tert-Butoxy-3-Methylcyclohexene	40648-24-6
1-tert-Butoxy-3-Methylcyclohexene	40648-24-6
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen- 1-yl)	114933-28-7
(Z)-rose oxide	16409-43-1
Acetaldehyde*	75-07-0
7-Methyl-3-(1-methylethyl)-1,5-octadiene	74630-12-9
Phenyl cyclobutanecarboxylate	30466-31-0
2,3-Dimethyl-2,3-diphenylbutane	1889-67-4
2,5-Dimethyl-2-undecene	49622-16-4
2-methylundecanal	110-41-8
Acetone	67-64-1
4-Ethyl-2-hexene	19780-46-2
Dicyclopentenyl alcohol	37275-49-3
1,2,3,4-tetrahydro-1,4-methanonaphthalene	4486-29-7
Bornyl acetate	76-49-3
alpha-Terpineol	98-55-5
2-methyl-dec-3-en-5-one	32064-75-8

2,5,5-Trimethyl-1-hexene	62185-56-2
Isopropyl alcohol	67-63-0
2-Methyl-4-propyl-1,3-oxathiane	67715-80-4
1-Methyl-alpha-ionone	7779-30-8
beta-Ionone	14901-07-6
Nonyl 2-methylpropanoate	10522-34-6
2-Methoxynaphthalene	93-04-9
2-Methyl-1-propene	115-11-7
Isopentane	78-78-4
Neryl acetate	141-12-8

\*Compound classified as potentially hazardous

### 10. Car vent air freshener

Compounds	CAS#
Limonene	138-86-3
Dihydromyrcenol	18479-58-8
Glutaric acid dimethyl ester	1119-40-0
Linalool	78-70-6
Dimethyl adipate	627-93-0
Eucalyptol	470-82-6
Ethanol	64-17-5
Linalyl acetate	115-95-7
Methanol*	67-56-1
beta-Myrcene*	123-35-3
(+)-Camphor	464-49-3
alpha-Terpineol	98-55-5
Cedrol	77-53-2
beta-Citral	106-26-3
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
Allyl (isopentyloxy)acetate	67634-00-8
Isobornyl acetate	125-12-2
gamma-Terpineol	586-81-2
2-Isopropenyl-5-methylhex-4-enal	75697-98-2
1-Isopropyl-2-methyl-3-(1-methylethylidene)cyclopropane	24524-51-4
Caryophyllene	87-44-5
Acetone	67-64-1
beta-Phellandrene	555-10-2
alpha-Pinene	80-56-8
beta-Terpinyl acetate	10198-23-9
3-Isopropyl-5-methyl-4-hexen-2-one	77142-85-9
Sabinene	3387-41-5
2,9-Dimethylundecane	17301-26-7
Ethyl safranate	35044-59-8
Allyl butyrate	2051-78-7
Citronellyl formate	105-85-1
2,4-Dimethylheptane	2213-23-2
3-Carene*	13466-78-9
Dimethyl succinate	106-65-0
Octanal	124-13-0
beta-Terpineol	138-87-4
2,4-Dimethyl-1-heptene	19549-87-2
Neryl acetate	141-12-8
1,3-Hexadiene,3-ethyl-2,5-dimethyl	62338-07-2
2,3,3-Trimethylpentane	560-21-4
1-Methyl-alpha-ionone	7779-30-8
2-Methyl-1-pentene	763-29-1
trans-2-Octene	13389-42-9
beta-trans-Ocimene	3779-61-1
2-Methylpentane	107-83-5

1-Octene	111-66-0
Borneol	10385-78-1
4-Methyloctane	2216-34-4
1,1-Dimethylallyl alcohol	115-18-4
4-methylheptane	589-53-7
(+)-trans,trans-5-Caranol	6909-22-4
(E)-3,3-DimethylcyclohexylideneAcetaldehyde	26532-25-2
Acetaldehyde*	75-07-0
2-Octene	111-67-1
7-Hydroxycitronellal	107-75-5
trans-4-Octene	14850-23-8

\*Compound classified as potentially hazardous

## 11. Car vent air freshener<sup>N</sup>

Compounds	CAS#
Ethanol	64-17-5
Limonene	138-86-3
Benzyl alcohol	100-51-6
Ethyl 2-methylbutyrate	7452-79-1
Hexyl acetate	142-92-7
Ethyl butyrate	105-54-4
Isoamyl acetate	123-92-2
Linalool	78-70-6
Methyl phenylcarbinyl acetate	93-92-5
Dihydromyrcenol	18479-58-8
D,L-isobornyl acetate	92618-89-8
Ethyl hexanoate	123-66-0
Verdyl acetate	5413-60-5
Benzyl acetate	140-11-4
Allyl hexanoate	123-68-2
Benzaldehyde	100-52-7
2-Methyl-3-(p-isopropylphenyl)propionaldehyde	103-95-7
2-Methylbutyl acetate	624-41-9
Phenylethyl alcohol	60-12-8
Eucalyptol	470-82-6
Ethyl 2-methyl-1,3-dioxolane-2-acetate	6413-10-1
(4E)-4-Hexenyl acetate	72237-36-6
Benzyl propionate	122-63-4
PhenylAcetaldehyde dimethyl acetal	101-48-4
4-tert-Butylcyclohexyl acetate	32210-23-4
$\alpha,\alpha$ -Dimethylphenethyl acetate	151-05-3
gamma-Nonanolactone	104-61-0
alpha-Pinene	80-56-8
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4
cis-3-Hexene-1-ol	928-96-1
Linalyl acetate	115-95-7
Allyl (isopentyloxy)acetate	67634-00-8
2-(phenylmethyl)-1,3-dioxolane	101-49-5
(-)- $\alpha$ -Cedrene	469-61-4
cis-1,2-Dimethylcyclopropane	930-18-7
Methanol*	67-56-1
2-Methyl-2-propanol	75-65-0
Allyl cyclohexanepropionate	2705-87-5
Allyl heptanoate	142-19-8
Neryl acetate	141-12-8
Sabinene	3387-41-5
2-tert-Butylcyclohexanol	13491-79-7
beta-Myrcene*	123-35-3
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7
1-Isopropyl-2-methyl-3-(1-	24524-51-4

methylethylidene)cyclopropane	
Methyl dihydrojasmonate	24851-98-7
Acetone	67-64-1
1,3-Hexadiene,3-ethyl-2,5-dimethyl	62338-07-2
Allyl alcohol	107-18-6
L-menthol	2216-51-5
Ethyl acetate	141-78-6
2-Phenoxyethyl isobutyrate	103-60-6
2-Methyl-1-propene	115-11-7

\*Compound classified as potentially hazardous

<sup>N</sup> Product with the claim of being "natural" or a related term.



## 12. Car vent air freshener

<b>Compounds</b>	<b>CAS#</b>
Tetrahydrolinalool	57706-88-4
Benzyl acetate	140-11-4
Isoamyl butylate	106-27-4
Linalool	78-70-6
Methyl phenylcarbinyl acetate	93-92-5
Limonene	138-86-3
Hexyl acetate	142-92-7
Allyl hexanoate	123-68-2
Ethyl heptanoate	106-30-9
Dihydromyrcenol	18479-58-8
4-tert-Butylcyclohexyl acetate	32210-23-4
Phenylethyl alcohol	60-12-8
Allyl heptanoate	142-19-8
2,6-Di-tert-butyl-4-methylphenol	128-37-0
Verdyl acetate	5413-60-5
Isozonarol	39707-55-6
Benzaldehyde	100-52-7
2-tert-Butylcyclohexanol	13491-79-7
Allyl (isopentyloxy)acetate	67634-00-8
Diphenyl ether	101-84-8
Methyl benzoate	93-58-3
p-Anisaldehyde	123-11-5
Allyl 2-ethyl butyrate	7493-69-8
2-Methylbutyl acetate	624-41-9
1,2-Dihydrolinalool	18479-51-1
Isoamyl acetate	123-92-2
Acetaldehyde*	75-07-0

\*Compound classified as potentially hazardous

**Supplementary Table 2: All emitted VOCs from all of the car air fresheners studied**

Compound	CAS #	Prevalence (# of Products)		
		Total	Regular (n=8)	Natural (n=4)
Limonene	138-86-3	10	8	2
Benzyl acetate	140-11-4	9	5	4
Acetone	67-64-1	9	7	2
Ethanol	64-17-5	9	6	3
Linalool	78-70-6	8	6	2
2-Methylbutyl acetate	624-41-9	8	4	4
Acetaldehyde*	75-07-0	8	7	1
Methanol*	67-56-1	8	5	3
3-Penten-2-one, 4-(2,6,6-trimethyl-2-cyclohexen-1-yl)	114933-28-7	7	4	3
beta-Myrcene*	123-35-3	7	5	2
Dihydromyrcenol	18479-58-8	7	5	2
Isoamyl acetate	123-92-2	7	4	3
Neryl acetate	141-12-8	7	6	1
4-tert-Butylcyclohexyl acetate	32210-23-4	6	4	2
Eucalyptol	470-82-6	6	4	2
Sabinene	3387-41-5	6	4	2
Verdyl acetate	5413-60-5	6	5	1
2-Methyl-1-propene	115-11-7	5	4	1
alpha-Pinene	80-56-8	5	4	1
alpha-Terpineol	98-55-5	5	5	0
beta-Pinene	127-91-3	5	4	1
Ethyl butyrate	105-54-4	5	2	3
Linalyl acetate	115-95-7	5	4	1
p-Anisaldehyde	123-11-5	5	4	1
p-tert-Butyl cyclohexyl-acetate cis	10411-92-4	5	3	2
1-Methyl-alpha-ionone	7779-30-8	4	3	1
Allyl heptanoate	142-19-8	4	2	2
Allyl hexanoate	123-68-2	4	2	2
Benzaldehyde	100-52-7	4	1	3
Camphene	79-92-5	4	4	0
Isopropyl alcohol	67-63-0	4	4	0
Methyl phenylcarbinyl acetate	93-92-5	4	3	1
o-Cymene	527-84-4	4	4	0
2,6-Di-tert-butyl-4-methylphenol	128-37-0	3	3	0

2,9-Dimethylundecane	17301-26-7	3	2	1
2-tert-Butylcyclohexanol	13491-79-7	3	2	1
4,4'-Isopropylidenebis(2,6-dimethylphenol)	5613-46-7	5	2	3
Allyl (isopentyloxy)acetate	67634-00-8	3	2	1
Allyl alcohol	107-18-6	3	1	2
Allyl cyclohexanepropionate	2705-87-5	3	1	2
Benzyl alcohol	100-51-6	3	1	2
beta-Ionone	14901-07-6	3	3	0
beta-Phellandrene	555-10-2	3	3	0
beta-Terpinyl acetate	10198-23-9	3	3	0
Caryophyllene	87-44-5	3	3	0
gamma-Nonanolactone	104-61-0	3	1	2
gamma-Terpinene	99-85-4	3	2	1
gamma-Terpineol	586-81-2	3	3	0
Isoamyl butylate	106-27-4	3	3	0
Isobornyl acetate	125-12-2	3	3	0
Methyl benzoate	93-58-3	3	3	0
N-butylbenzenesulfonamide	3622-84-2	3	2	1
Octanal	124-13-0	3	2	1
Phenylethyl alcohol	60-12-8	3	2	1
Terpinolene	586-62-9	3	2	1
(-)- $\alpha$ -Cedrene	469-61-4	2	1	1
(+)-Camphor	464-49-3	2	2	0
(1R)-(-)-Nopol benzyl ether	74851-17-5	2	2	0
(Z)-rose oxide	16409-43-1	2	2	0
1,2,3,4-tetrahydro-1,4-methanonaphthalene	4486-29-7	2	2	0
1,3-Hexadiene,3-ethyl-2,5-dimethyl	62338-07-2	2	1	1
1-Isopropyl-2-methyl-3-(1-methylethylidene)cyclopropane	24524-51-4	2	1	1
1-tert-Butoxy-3-Methylcyclohexene	40648-24-6	2	2	0
2-(4-tert-Butylbenzyl)propionaldehyde	80-54-6	2	1	1
2,2,11,11-Tetramethyldodecane	127204-12-0	2	1	1
2,2-Dimethyltetradecane	59222-86-5	2	1	1
2,5,5-Trimethyl-1-hexene	62185-56-2	2	2	0
2,5-Dimethylundecane	17301-22-3	2	1	1
2,6-Dimethyl-5-heptenal	106-72-9	2	1	1
2-Methoxynaphthalene	93-04-9	2	2	0

2-Methyl-3-(p-isopropylphenyl)propionaldehyde	103-95-7	2	1	1
2-Methylpentane	107-83-5	2	2	0
2-methylundecanal	110-41-8	2	2	0
3,3,6-Trimethyldecane	62338-14-1	2	1	1
3,5,5-Trimethylhexyl acetate	58430-94-7	2	2	0
3,8-Dimethyldecane	17312-55-9	2	1	1
3-Carene*	13466-78-9	2	2	0
3-Methyl-5-propylnonane	31081-18-2	2	1	1
3-Methylundecane	1002-43-3	2	1	1
4,4-Dimethylundecane	17312-68-4	2	1	1
6-Methyl-5-hepten-2-one	110-93-0	2	1	1
6-Methyltridecane	13287-21-3	2	1	1
Acetylmethylcyclohexene,4-acetyl-1-methyl-1-cyclohexene	70286-20-3	2	2	0
alpha-Phellandrene	99-83-2	2	2	0
Amyl acetate	628-63-7	2	0	2
Benzyl propionate	122-63-4	2	1	1
beta-Citral	106-26-3	2	2	0
beta-Terpineol	138-87-4	2	2	0
beta-trans-Ocimene	3779-61-1	2	1	1
Bornyl acetate	76-49-3	2	2	0
cis-3-Hexene-1-ol	928-96-1	2	0	2
cis-Ethyl 3-methyl-3-phenylglycidate	19464-95-0	2	0	2
Cyclofenchene	488-97-1	2	2	0
D,L-isobornyl acetate	92618-89-8	2	1	1
Decanal	112-31-2	2	1	1
Dicyclopentenyl alcohol	37275-49-3	2	2	0
Dimethyl adipate	627-93-0	2	2	0
Dimethyl succinate	106-65-0	2	1	1
Ethyl 2-methylbutyrate	7452-79-1	2	1	1
Ethyl 2-methylpentanoate	39255-32-8	2	1	1
Ethyl acetate	141-78-6	2	1	1
Ethyl hexanoate	123-66-0	2	1	1
Glutaric acid dimethyl ester	1119-40-0	2	2	0
Hexyl acetate	142-92-7	2	1	1
Isopentane	78-78-4	2	2	0
Methyl anthranilate	134-20-3	2	0	2
Methyl dihydrojasmonate	24851-98-7	2	0	2
o-Tolualdehyde	529-20-4	2	0	2
Piperonal	120-57-0	2	1	1

p-Tolualdehyde	104-87-0	2	0	2
trans-Ethyl 3-Methyl-3-phenylglycidate	19464-92-7	2	0	2
$\alpha,\alpha$ -Dimethylphenethyl acetate	151-05-3	2	1	1
$\gamma$ -Decalactone	706-14-9	2	1	1
(-)-menthyl benzoate	6284-35-1	1	1	0
(+)-trans,trans-5-Caranol	6909-22-4	1	1	0
(4E)-4-Hexenyl acetate	72237-36-6	1	0	1
(E)-3,3-Dimethylcyclohexylideneacetaldehyde	26532-25-2	1	1	0
(E)-citral	141-27-5	1	1	0
(R)-(+)- $\beta$ -Citronellol	1117-61-9	1	1	0
(Z)-sabinene hydrate	15537-55-0	1	1	0
(Z+E)-2-methyl-2-(4-methyl-3-pentenyl) cyclopropane carbaldehyde	97231-35-1	1	1	0
1-(2-Methoxypropoxy)propan-2-ol	13429-07-7	1	1	0
1,1-Dimethylallyl alcohol	115-18-4	1	1	0
1,2,3,6-Tetramethylbicyclo[2.2.2]octane	62338-45-8	1	1	0
1,2-Dihydrolinalool	18479-51-1	1	1	0
1,3,3-Trimethylbicyclo[2.2.1]hept-2-yl acetate	76109-40-5	1	1	0
1,4-Cineole	470-67-7	1	0	1
1,5-Diethyl-2,3-dimethylcyclohexane	74663-66-4	1	1	0
1,5-Dimethyl-1,4-cyclohexadiene	4190-06-1	1	1	0
Tricyclene	508-32-7	1	1	0
10-(oxan-2-yloxy)decan-1-ol	43047-93-4	1	0	1
10-Methylnonadecane	56862-62-5	1	1	0
1-Butanol	71-36-3	1	1	0
1-Hexanol	111-27-3	1	1	0
1-Iododecane	2050-77-3	1	0	1
1-Octen-3-yl-acetate	2442-10-6	1	1	0
1-Octene	111-66-0	1	1	0
1-Pentanol	71-41-0	1	0	1
1-Propanol	71-23-8	1	1	0
1-Terpinenol	586-82-3	1	1	0
1-Vinylheptanol	21964-44-3	1	1	0

2-(phenylmethyl)-1,3-dioxolane	101-49-5	1	0	1
2,2,3,3,5,6,6-Heptamethylheptane	7225-67-4	1	0	1
2,2,3,4-Tetramethylpentane	1186-53-4	1	0	1
2,2,3-Trimethylnonane	55499-04-2	1	1	0
2,2,4,6,6-Pentamethylheptane	13475-82-6	1	0	1
2,2,4-Trimethylhexane	16747-26-5	1	1	0
2,2,6,6-Tetramethylheptane	40117-45-1	1	1	0
2,2,6-Trimethyldecane	62237-97-2	1	1	0
2,2,7,7-Tetramethyloctane	1071-31-4	1	1	0
2,2,9-Trimethyldecane	62238-00-0	1	1	0
2,2-Dimethyloctane	15869-87-1	1	0	1
2,3,3-Trimethylpentane	560-21-4	1	1	0
2,3,6-Trimethyldecane	62238-12-4	1	1	0
2,3-Dimethyl-2,3-diphenylbutane	1889-67-4	1	1	0
2,4-Dimethyl-1-heptene	19549-87-2	1	1	0
2,4-Dimethyl-3-pentanol	600-36-2	1	1	0
2,4-Dimethylheptane	2213-23-2	1	1	0
2,5-Dimethyl-2-undecene	49622-16-4	1	1	0
2,5-Dimethyltridecane	56292-66-1	1	1	0
2,6,6-Trimethyloctane	54166-32-4	1	1	0
2,6-Dimethyl octane	2051-30-1	1	0	1
2,7-Dimethyl-1-octanol	15250-22-3	1	1	0
2-Acetylcyclopentanone	1670-46-8	1	1	0
2-Bromotetradecane	74036-95-6	1	1	0
2-Carene	554-61-0	1	1	0
2-Cyclohexene-1-acetaldehyde, 3-methyl-	129993-40-4	1	1	0
2H-1-Benzopyran-2-one	91-64-5	1	0	1
2-Isopropenyl-5-methylhex-4-enal	75697-98-2	1	1	0
2-Isopropyl-5-methylcyclohexyl acetate	20777-36-0	1	1	0
2-Isopropyl-5-methylhexanol	2051-33-4	1	0	1
2-Methyl-1-butene	563-46-2	1	1	0
2-Methyl-1-pentene	763-29-1	1	1	0
2-Methyl-2-propanol	75-65-0	1	0	1
2-Methyl-4-propyl-1,3-oxathiane	67715-80-4	1	1	0
2-Methyl-5-propylnonane	31081-17-1	1	0	1
2-methyl-6-methylene-7-octen-2-ol	14314-21-7	1	0	1

2-methyl-dec-3-en-5-one	32064-75-8	1	1	0
2-Octene	111-67-1	1	1	0
2-Phenethyl acetate	103-45-7	1	1	0
2-Phenoxyethyl isobutyrate	103-60-6	1	0	1
3,3,5-Trimethylheptane	7154-80-5	1	0	1
3,3,8-Trimethyldecane	62338-16-3	1	0	1
3,3-Dimethylundecane	17312-65-1	1	1	0
3,4,5,6-Tetramethyloctane	62185-21-1	1	0	1
3,4,5-Trimethyl-1-hexene	56728-10-0	1	1	0
3,4-Dimethylhex-4-en-2-one	53252-21-4	1	1	0
3,5,5-Trimethyl-1-hexanol	3452-97-9	1	1	0
3,6-Dimethylundecane	17301-28-9	1	0	1
3,7-Dimethyl-1-octanol	106-21-8	1	1	0
3,7-Dimethyl-6-octenoic acid	502-47-6	1	1	0
3,9-Dimethylundecane	17301-31-4	1	0	1
3-Ethyl-2-hexene	620-00-8	1	1	0
3-Isopropyl-5-methyl-4-hexen-2-one	77142-85-9	1	1	0
3-Methyltetradecane	18435-22-8	1	0	1
3-Phenylbutyraldehyde	16251-77-7	1	1	0
4,6-Dimethyldodecane	61141-72-8	1	1	0
4-Carene	29050-33-7	1	1	0
4-Ethyl-2,2,6,6-tetramethylheptane	62108-31-0	1	0	1
4-Ethyl-2-hexene	19780-46-2	1	1	0
4-Methylanisole	104-93-8	1	1	0
4-methylheptane	589-53-7	1	1	0
4-Methyloctane	2216-34-4	1	1	0
4-Terpineol	562-74-3	1	1	0
4-tert-Butylcyclohexanol	98-52-2	1	1	0
4-tert-Butylcyclohexene	2228-98-0	1	1	0
5-Ethyl-2,2,3-trimethylheptane	62199-06-8	1	0	1
6-[(1E)-1-Propenyl]bicyclo[3.1.0]hexan-2-one	75283-46-4	1	1	0
7-Hydroxycitronellal	107-75-5	1	1	0
7-Methyl-3-(1-methylethyl)-1,5-octadiene	74630-12-9	1	1	0
Allyl 2-ethyl butyrate	7493-69-8	1	1	0
Allyl butyrate	2051-78-7	1	1	0
alpha-Ionone	127-41-3	1	1	0
Bicyclopentyl	1636-39-1	1	1	0
Borneol	10385-78-1	1	1	0

Butane	106-97-8	1	1	0
Butylbenzene	104-51-8	1	1	0
Cedrol	77-53-2	1	1	0
cis-1,2-Dimethylcyclopropane	930-18-7	1	0	1
cis-3-Hexenyl methoxy formate	67633-96-9	1	0	1
cis-Pinocampheol	473-61-0	1	1	0
cis- $\alpha$ -Bisabolene	29837-07-8	1	1	0
Citronellyl formate	105-85-1	1	1	0
Cyclopropane, 1,1-dimethyl-2-(3-methyl-1,3-butadienyl)-	68998-21-0	1	0	1
Cyclopropylidenecyclohexane	14114-06-8	1	1	0
Diethyl malonate	105-53-3	1	1	0
Diisopropyl ether	108-20-3	1	1	0
Dipentyl ether	693-65-2	1	1	0
Diphenyl ether	101-84-8	1	1	0
DL-menthyl acetate	16409-45-3	1	1	0
Dodecanal	112-54-9	1	1	0
Ethyl 2-methyl-1,3-dioxolane-2-acetate	6413-10-1	1	0	1
Ethyl heptanoate	106-30-9	1	1	0
Ethyl isobutyrate	97-62-1	1	0	1
Ethyl lactate	97-64-3	1	1	0
Ethyl safranate	35044-59-8	1	1	0
Geranyl acetate	105-87-3	1	1	0
Heneicosane	629-94-7	1	1	0
Heptadecane	629-78-7	1	1	0
Heptadecyl acetate	822-20-8	1	0	1
Hexanal	66-25-1	1	1	0
Hexane*	110-54-3	1	1	0
Hexyl methyl ether	4747-07-3	1	1	0
Hexyl salicylate	6259-76-3	1	0	1
iso-Bornyl methacrylate	7534-94-3	1	1	0
Isomenthol acetate	20777-45-1	1	1	0
Isoprene (stabilised)	78-79-5	1	1	0
Isopropyl formate	625-55-8	1	1	0
Isovaleraldehyde	590-86-3	1	1	0
Isozonarol	39707-55-6	1	1	0
L-menthol	2216-51-5	1	0	1
Menthyl acetate	89-48-5	1	1	0
Methyl salicylate	119-36-8	1	1	0
Nonyl 2-methylpropanoate	10522-34-6	1	1	0
Nopyl acetate	128-51-8	1	1	0



o-Xylene*	95-47-6	1	0	1
Pentane	109-66-0	1	1	0
Phenethyl butyrate	103-52-6	1	1	0
Phenyl cyclobutanecarboxylate	30466-31-0	1	1	0
Phenylacetaldehyde dimethyl acetal	101-48-4	1	0	1
Phytane	638-36-8	1	1	0
Prenyl acetate	1191-16-8	1	1	0
Propanal*	123-38-6	1	1	0
Propylene glycol	57-55-6	1	1	0
Terpinyl acetate	80-26-2	1	1	0
Tetracarbonylnickel*	13463-39-3	1	1	0
Tetrahydrolinalool	57706-88-4	1	1	0
Thujopsene	470-40-6	1	1	0
Toluene*	108-88-3	1	1	0
trans-2-Octene	13389-42-9	1	1	0
trans-4-Octene	14850-23-8	1	1	0
Triacetin	102-76-1	1	1	0
Triethylene glycol	112-27-6	1	1	0
$\alpha,\alpha$ -Dimethylphenethyl butyrate	10094-34-5	1	1	0
$\gamma$ -Undecalactone	104-67-6	1	1	0

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\*Compound classified as potentially hazardous