



Review

Compilation and analysis of types and concentrations of airborne chemicals measured in various indoor and outdoor human environments



J. Enrique Cometto-Muñiz^{a,*}, Michael H. Abraham^b

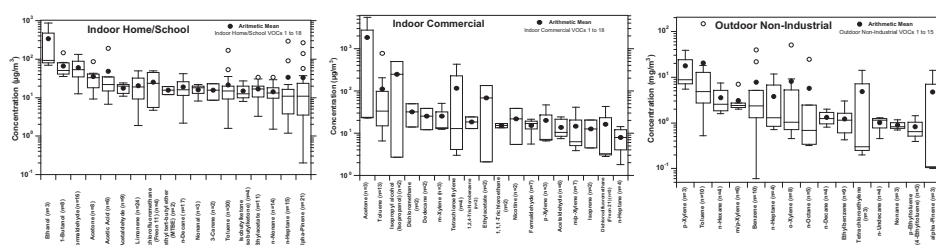
^aUniversity of California, San Diego, La Jolla, CA, USA

^bDepartment of Chemistry, University College London, London, UK

HIGHLIGHTS

- The literature was searched for airborne chemicals measured indoors and outdoors.
- Included were homes/schools, malls/stores, outdoors nonindustrial and industrial.
- Type and concentration of all compounds found are illustrated in graphs and tables.
- The concentration of compounds common to different environments is compared.
- The concentration spread of single compounds is presented in graphs and tables.

GRAPHICAL ABSTRACT



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ABSTRACT

The main purpose of this article is to summarize and illustrate the results of a literature search on the types, levels, relative concentrations, concentration spread of individual chemicals, and number of airborne compounds (mostly volatile organic compounds, VOCs) that have been found, measured, and reported both indoors and outdoors. Two broad categories of indoor environments are considered: (1) home/school, and (2) commercial spaces. Also, two categories of outdoor environments are considered: (1) non-industrial and (2) industrial (the latter represented by the vicinity of a pig farm and the vicinity of an oil refinery). The outcome is presented as a series of graphs and tables containing the following statistics: geometric mean, arithmetic mean, median, standard deviation, variance, standard error, inter-quartile distance, minimum value, maximum value, and number of data (data count) for the air concentration of each reported compound in a given environment. A [Supplementary Table](#) allows interested readers to match each single value included in this compilation with its corresponding original reference.

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* Corresponding author at: 8950 Villa La Jolla Drive, Suite C135, La Jolla, CA 92037, USA. Tel.: +1 (858) 622 5832.

E-mail address: ecometto@ucsd.edu (J.E. Cometto-Muñiz).

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1. Introduction

Humans are exposed to a wide variety of airborne chemicals both indoors and outdoors. Acute awareness of such exposures often arises from chemosensory sensations, principally odor, nasal chemesthesis (i.e., nasal pungency or irritation), and ocular chemesthesis (i.e., eye irritation). These human chemosensations are the focus of our research interest (Cometto-Muniz and Abraham,

2008, 2010a; Cometto-Muñiz et al., 2010), with special emphasis on the search for quantitative structure–activity relationships in terms of detection thresholds (Abraham et al., 2003, 2007, 2012, 2010; Cometto-Muniz and Abraham, 2010b; Cometto-Muniz et al., 2005). In general, no matter what the particular focus might be for the study of environmental chemical exposures, previous knowledge of the kind and levels of airborne compounds that have been found in different types of broad environments constitute an

Table 1

Comparison of vapor concentration levels for indoor volatile compounds common to home/school and commercial environments (ratios based on geometric means). Compounds are listed in descending magnitude of ratio. Bolded chemicals were higher in their respective environment by a ratio (i.e., factor) larger than 10.

Volatiles higher in home/school environments	Ratio	Volatiles higher in commercial environments	Ratio
1-Butanol	25	Tetrachloroethylene	68
Trichloroethene	12	1,2,4-Trichlorobenzene	58
Nonanal	6.0	Tetrahydrofuran	19
Methyl isobutyl ketone (MIBK)	4.6	1,3-Dichlorobenzene (m-Dichlorobenzene)	17
Methyl tert-butyl ether (MTBE)	3.9	1,3,5-Trimethylbenzene	13
Acetic acid	3.7	Trichloroethylene	9.7
Trichlorofluoromethane (Freon 11)	3.7	3-Ethenylpyridine (3-vinylpyridine)	8.2
Formaldehyde	3.6	1,2-Dibromoethane	7.1
<i>n</i> -Decane	3.3	1,1,1-Trichloroethane	6.2
Xylene(s)	2.8	Ethanol	5.2
Alpha-pinene	2.8	Acetone	5.1
Limonene	2.7	1,2-Dichlorobenzene (o-dichlorobenzene)	5.1
1,4-Dichlorobenzene (p-dichlorobenzene)	2.4	1,3-Butadiene	4.8
Naphthalene	2.3	1,1,2,2-Tetrachloroethane	4.8
<i>n</i> -Butyl acetate	2.2	3-Ethyltoluene (m-ethyltoluene)	4.4
1,1-Dichloroethene	2.2	Chloroform	4.1
<i>n</i> -Hexane	2.1	Bromomethane	3.9
Ammonia	2.0	Methyl ethyl ketone (MEK)	3.8
Methylcyclohexane	1.9	Toluene	3.0
<i>n</i> -Heptane	1.7	Isoprene	2.4
<i>n</i> -Undecane	1.7	Dodecane	2.3
Benzaldehyde	1.7	1,1-Dichloroethane	2.2
Propanal	1.5	<i>o</i> -Xylene	2.1
4-Ethyltoluene (p-ethyltoluene)	1.5	2-Butanone	2.0
Carbon tetrachloride	1.5	Benzene	1.9
Acetaldehyde	1.4	1,2-Dichloroethane	1.9
Hexanal	1.3	Vinyl chloride	1.9
<i>n</i> -Octane	1.2	<i>p</i> -Xylene	1.8
Dichlorodifluoromethane	1.1	Hexachlorobutadiene	1.8
Cyclohexane	1.1	<i>m/p</i> -Xylene	1.7
Phenol	1.1	Ethylbenzene	1.6
1,2,3-Trimethylbenzene	1.1	Styrene	1.6
Hexanoic acid	1.0	Benzyl chloride	1.6
		1,1,2-Trichloroethane	1.4
		Ethylacetate	1.3
		1,2,4-Trimethylbenzene	1.3
		Methylchloride (chloromethane)	1.3
		Chlorobenzene	1.2
		Methylene chloride	1.2
		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	1.2
Total: 33		Total: 40	

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