# Biomonitoring California
# Designated Chemicals
# June 2020

The following is a list of designated chemicals for Biomonitoring California.[a] Designated chemicals consist of those substances that are included in the Centers for Disease Control and Prevention's (CDC's) biomonitoring studies[b] and additional chemicals that are recommended by the Scientific Guidance Panel (SGP) for Biomonitoring California. Designated chemicals are the pool of chemicals from which the SGP can recommend priority chemicals for biomonitoring.

Targets for measurement in biomonitoring studies could include the parent chemical, metabolites and other chemical products formed in the body or the environment (e.g., hemoglobin adduct; environmental degradation product). The approach for biomonitoring a chemical may change as methods development proceeds. For some of the parent chemicals listed below, metabolites or other targets for measurement are shown indented underneath. Chemicals are grouped into categories (like "metals" and "pesticides"); some are included in more than one category. The Program determines the chemicals that are actually biomonitored and the appropriate targets for measurement. To jump to each footnote referenced in the list below, click on the relevant number.

## Acrylamide

- Acrylamide hemoglobin adducts
- Glycidamide hemoglobin adducts
- *N*-Acetyl-*S*-(2-carbamoyl-2-hydroxyethyl)-L-cysteine
- *N*-Acetyl-*S*-(2-carbamoylethyl)-L-cysteine

## Antimicrobials used in Food Production [1]

## Brominated and Chlorinated Organic Compounds used as Flame Retardants [1]

- Allyl 2,4,6-tribromophenyl ether (ATE)
- 2,2-Bis(bromomethyl)-1,3-propanediol
- Bis(2-chloroethyl) (2-chloroethyl)phosphonate
- 2,2-Bis(chloromethyl)trimethylene bis[bis(2-chloroethyl)phosphate]
- Bis(2-ethyl-1-hexyl)tetrabromophthalate (TBPH)
- Bis(hexachlorocyclopentadieno)cyclooctane (Dechlorane Plus)
- 1,2-Bis(2,4,6-tribromophenoxy)ethane (BTBPE)
- 2-Bromoallyl 2,4,6-tribromophenyl ether (BATE)
- Chlorendic acid
- Chlorinated paraffins
- Decabromodiphenylethane (DBDPE)
- 1,2-Dibromo-4-(1,2-dibromoethyl)cyclohexane (TBECH)
- 2,4-Dibromophenol
- 2,3-Dibromopropyl-2,4,6-tribromophenyl ether (DPTE)
- 2-Ethyl-1-hexyl-2,3,4,5-tetrabromobenzoate (TBB)
  - 2,3,4,5-Tetrabromobenzoic acid (TBBA)
- *N*,*N*′-Ethylenebis(tetrabromophthalimide)
- Hexabromobenzene (HBB)
- 2,2′,4,4′,5,5′-Hexabromobiphenyl (BB 153)
- Hexabromocyclododecane (HBCD)
- Hexachlorocyclopentadienyl-dibromocyclooctane
- 2-Hydroxypropyl 2-(2-hydroxyethyl)ethyl tetrabromophthalate
- Isobutoxypentabromocyclododecanes (iBPBCDs)
- Octabromotrimethylphenylindane (OBIND)
- Pentabromoethylbenzene (PBEB)
- Pentabromophenol (PBP)
- Pentabromotoluene (PBT)
- 1,1'-Sulfonylbis[3,5-dibromo-4-(2,3-dibromopropoxy) benzene
- Tetrabromobisphenol A (TBBPA)
- Tetrabromobisphenol A bis(2,3-dibromopropyl) ether (TBBPA-DBPE)
- Tetrabromobisphenol A bis(2-hydroxyethyl) ether
- Tetrabromobisphenol A diallyl ether
- Tetrabromophthalic acid, mixed esters
- Tetrabromophthalic anhydride
- 2,3,5,6-Tetrabromo-*p*-xylene
- Tetrachlorophthalic anhydride
- 2,4,6-Tribromophenol
- Tribromoneopentylalcohol
- Tris(2-chloroethyl)phosphate (TCEP)
  - Bis(2-chloroethyl)phosphate (BCEP)
- Tris(1-chloro-2-propyl)phosphate (TCPP)
  - Bis(1-chloro-2-propyl)phosphate (BCPP)

a. California Environmental Contaminant Biomonitoring Program, codified at Health and Safety Code section 105440 et seq.
b. Known collectively as the National Reports on Human Exposure to Environmental Chemicals program.

Tris(2,3-dibromopropyl) isocyanurate
Tris(2,3-dibromopropyl)phosphate (TDBPP)
Tris(1,3-dichloro-2-propyl)phosphate (TDCPP)
Bis(1,3-dichloro-2-propyl)phosphate (BDCPP)
Tris(2,3-dichloro-1-propyl)phosphate
Tris(tribromoneopentyl)phosphate
2,4,6-Tris(2,4,6-tribromophenoxy)-1,3,5-triazine

**Polybrominated diphenyl ethers (PBDEs)**

2,2′,4-Tribromodiphenyl ether (BDE 17)
2,4,4′-Tribromodiphenyl ether (BDE 28)
2,2′,4,4′-Tetrabromodiphenyl ether (BDE 47)
2,3′,4,4′-Tetrabromodiphenyl ether (BDE 66)
2,2′,3,4,4′-Pentabromodiphenyl ether (BDE 85)
2,2′,4,4′,5-Pentabromodiphenyl ether (BDE 99)
2,2′,4,4′,6-Pentabromodiphenyl ether (BDE 100)
2,2′,4,4′,5,5′-Hexabromodiphenyl ether (BDE 153)
2,2′,4,4′,5,6′-Hexabromodiphenyl ether (BDE 154)
2,2′,3,4,4′,5′,6-Heptabromodiphenyl ether (BDE 183)
2,2′,3,3′,4,4′,5,6′-Octabromodiphenyl ether (BDE 196)
2,2′,3,3′,4,4′,6,6′-Octabromodiphenyl ether (BDE 197)
2,2′,3,3′,4,5′,6,6′-Octabromodiphenyl ether (BDE 201)
2,2′,3,3′,5,5′,6,6′-Octabromodiphenyl ether (BDE 202)
2,2′,3,4,4′,5,5′,6-Octabromodiphenyl ether (BDE 203)
2,2′,3,3′,4,4′,5,5′,6-Nonabromodiphenyl ether (BDE 206)
2,2′,3,3′,4,4′,5,6,6′-Nonabromodiphenyl ether (BDE 207)
2,2′,3,3′,4,5,5′,6,6′-Nonabromodiphenyl ether (BDE 208)
2,2′,3,3′,4,4′,5,5′,6,6′-Decabromodiphenyl ether (BDE 209)

**Hydroxy-PBDEs (Metabolites of PBDEs)**

4′-Hydroxy-BDE 17
4-Hydroxy-BDE 42
3-Hydroxy-BDE 47
5-Hydroxy-BDE 47
6-Hydroxy-BDE 47
4′-Hydroxy-BDE 49
2′-Hydroxy-BDE 68
4-Hydroxy-BDE 90
5′-Hydroxy-BDE 99
6′-Hydroxy-BDE 99
3-Hydroxy-BDE 100
5′-Hydroxy-BDE 100
4′-Hydroxy-BDE 101
4′-Hydroxy-BDE 103

## Cyclosiloxanes [1]

Decamethylcyclopentasiloxane (D5)
Dodecamethylcyclohexasiloxane (D6)
Octamethylcyclotetrasiloxane (D4)

## Diesel Exhaust [2]

1-Nitropyrene
6-Hydroxy-1-nitropyrene
8-Hydroxy-1-nitropyrene

## Diglycidyl Ethers of *p,p′*-Bisphenols [1]

Bisphenol A diglycidyl ether (BADGE)
Bisphenol F diglycidyl ether (BFDGE)

## Disinfection By-Products (Trihalomethanes) [3]

Bromodichloromethane
Dibromochloromethane
Tribromomethane (Bromoform)
Trichloromethane (Chloroform)

## Environmental Phenols [3]

Benzophenone-3
4-*t*-Octylphenol
*o*-Phenylphenol

***p,p′*-Bisphenols** [1]

Bisphenol A
Bisphenol AF (BPAF)
Bisphenol B (BPB)
Bisphenol F (BPF)
Bisphenol S (BPS)
4,4′-Sulfonylbis[2-(2-propen-1-yl)phenol] (TGSA)

**Brominated phenols** [3, 4]

2,4-Dibromophenol
Pentabromophenol (PBP)
Tetrabromobisphenol A (TBBPA)
2,4,6-Tribromophenol

**Chlorinated phenols** [3, 5]

2,4-Dichlorophenol
2,5-Dichlorophenol
Pentachlorophenol
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Triclosan

**Parabens** [3]

Butylparaben [6]
Ethylparaben
Methylparaben
*n*-Propylparaben

**Related chemicals**

Triclocarban [7]

## Heterocyclic Amines [3]

3-Amino-1,4-dimethyl-5*H*-pyrido[4,3-b]indole (Trp-P-1)
2-Aminodipyrido[1,2-a:3',2'-d] imidazole (Glu-P-2)

2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole (Glu-P-1)
2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)
2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP)
2-Amino-3-methyl-9*H*-pyrido[2,3-b]indole (MeA-α-C)
2-Amino-9*H*-pyrido[2,3-b]indole (A-α-C)
1-Methyl-3-amino-5*H*-pyrido[4,3-b]indole (Trp-P-2)
1-Methyl-9*H*-pyrido[3,4-b]indole (Harman)
9*H*-Pyrido[3,4-b]indole (Norharman)

## Metals [3]

Antimony
Arsenic
- Arsenic (V) acid
- Arsenobetaine
- Arsenocholine
- Arsenous (III) acid
- Dimethylarsinic acid
- Monomethylarsonic acid
- Trimethylarsine oxide

Barium
Beryllium
Cadmium
Cesium
Chromium
Cobalt
Copper
Lead
Manganese
Mercury
- Ethyl mercury
- Methyl mercury

Molybdenum
Platinum
Selenium
Strontium
Thallium
Tin
Tungsten
Uranium
Zinc

## Non-Halogenated Aromatic Phosphates [1]

Bisphenol A bis(diphenyl phosphate)
Butylated triphenyl phosphate
Butyldiphenyl phosphate
*t*-Butylphenyl diphenyl phosphate
Dibutylphenyl phosphate
2-Ethylhexyl diphenyl phosphate
Isodecyl diphenyl phosphate
Isopropyl phenyl diphenyl phosphate
Isopropylated triphenyl phosphate
Resorcinol bis(diphenyl phosphate)
Tribenzyl phosphate (TBzP)
- Dibenzyl phosphate (DBzP)

Tricresyl phosphate (TCP)
Tri-*o*-cresylphosphate (ToCP)
- Di-*o*-cresylphosphate (DoCP)

Tri-*p*-cresylphosphate (TpCP)
- Di-*p*-cresylphosphate (DpCP)

Triphenyl phosphate (TPP)
- Diphenyl phosphate (DPhP)

## Organophosphate Flame Retardants (OPFRs) [3]

Tri-*n*-butyl phosphate (TBuP)
- Dibutyl phosphate (DBuP)

*Additional OPFRs are listed under the categories "Brominated and Chlorinated Organic Compounds used as Flame Retardants" and "Non-Halogenated Aromatic Phosphates."*

## Perchlorate and Other Anions [8]

Perchlorate

**Other Anions**

Nitrate
Thiocyanate

## Perfluoroalkyl and Polyfluoroalkyl Substances (PFASs) [1, 9]

Ammonium 4,8-dioxa-3H-perfluorononanoate (ADONA)
Bis(perfluorohexyl)phosphinic acid (6:6 PFPiA)
Bis(perfluorooctyl)phosphinic acid (8:8 PFPiA)
6:2 Chlorinated polyfluorinated ether sulfonic acid (F-53B major)
8:2 Chlorinated polyfluorinated ether sulfonic acid (F-53B minor)
*N*-Ethyl-*N*-(2-hydroxyethyl)perfluoro-octanesulfonamide phosphate diester
*N*-Ethyl-*N*-(2-hydroxyethyl)perfluoro-octanesulfonamide phosphate monoester
*N*-Ethyl-perfluorooctane sulfonamido acetic acid (Et-PFOSA-AcOH)
6:2 Fluorotelomer acetate
8:2 Fluorotelomer acetate
10:2 Fluorotelomer acetate
6:2 Fluorotelomer acrylate
8:2 Fluorotelomer acrylate
10:2 Fluorotelomer acrylate
5:3 Fluorotelomer carboxylic acid (5:3 FTCA)
6:2 Fluorotelomer carboxylic acid (6:2 FTCA)
7:3 Fluorotelomer carboxylic acid (7:3 FTCA)
8:2 Fluorotelomer carboxylic acid (8:2 FTCA)
10:2 Fluorotelomer carboxylic acid (10:2 FTCA)
6:2 Fluorotelomer phosphate diester (6:2 diPAP)
8:2 Fluorotelomer phosphate diester(8:2 diPAP)
6:2 Fluorotelomer phosphate monoester (6:2 PAP)
8:2 Fluorotelomer phosphate monoester (8:2 PAP)

4:2 Fluorotelomer sulfonic acid (4:2 FTS)
6:2 Fluorotelomer sulfonic acid (6:2 FTS)
8:2 Fluorotelomer sulfonic acid (8:2 FTS)
6:2 Fluorotelomer unsaturated carboxylic acid (6:2 FTUCA)
8:2 Fluorotelomer unsaturated carboxylic acid (8:2 FTUCA)
10:2 Fluorotelomer unsaturated carboxylic acid (10:2 FTUCA)
*N*-Methyl-perfluorooctane sulfonamido acetic acid (Me-PFOSA-AcOH)
Perfluorobutane sulfonic acid (PFBS)
Perfluorobutanoic acid (PFBA)
Perfluorodecane sulfonic acid (PFDS)
Perfluorodecanoic acid (PFDeA)
Perfluorodecylphosphonic acid
Perfluoro-3,6-dioxaheptanoic acid
Perfluoro-3,6-dioxa-4-methyl-7-octene sulfonic acid
Perfluorododecanoic acid (PFDoA)
Perfluoro(2-ethoxyethane) sulfonic acid
Perfluoroethylcyclohexane sulfonic acid
Perfluoroheptane sulfonic acid (PFHpS)
Perfluoroheptanoic acid (PFHpA)
Perfluorohexadecanoic acid
Perfluorohexane sulfonic acid (PFHxS)
Perfluorohexanoic acid (PFHxA)
Perfluorohexylperfluorooctylphosphinic acid (6:8 PFPiA)
Perfluorohexylphosphonic acid (PFHxPA)
Perfluoro-4-methoxybutanoic acid
Perfluoro-3-methoxypropanoic acid
Perfluoro-2-methyl-3-oxahexanoic acid (GenX)
Perfluorononane sulfonic acid (PFNS)
Perfluorononanoic acid (PFNA)
Perfluorooctadecanoic acid
Perfluorooctane sulfonamide (PFOSA)
Perfluorooctane sulfonic acid (PFOS), including linear and branched isomers
Perfluorooctanoic acid (PFOA), including linear and branched isomers
Perfluorooctylphosphonic acid (PFOPA)
Perfluoropentane sulfonic acid (PFPeS)
Perfluoropentanoic acid (PFPeA)
Perfluorotetradecanoic acid (PFTeDA)
Perfluorotridecanoic acid
Perfluoroundecanoic acid (PFUA)

## Pesticides [3, 10]

### Carbamate Insecticides [3]

Benfuracarb
- Carbofuranphenol

Carbaryl
- 1-Hydroxynaphthalene [11]
- 2-Hydroxynaphthalene [11]

Carbofuran
- Carbofuranphenol

Carbosulfan
- Carbofuranphenol

Furathiocarb
- Carbofuranphenol

Propoxur
- 2-Isopropoxyphenol

### Fungicides [3]

Captafol
- Tetrahydrophthalimide

Captan
- Phthalimide
- Tetrahydrophthalimide

Chlorothalonil
Dichloran
Folpet
- Phthalimide

Iprodione
Mancozeb
- Ethylene thiourea

Maneb
- Ethylene thiourea

Metalaxyl
Metiram
- Ethylene thiourea

Nabam
- Ethylene thiourea

Pentachlorophenol
*o*-Phenylphenol
Propineb
- Propylene thiourea

Thiram
- Ethylene thiourea

Ziram
- Ethylene thiourea

### Herbicides - Substituted Ureas [3]

Bensulfuron-methyl
Chlorimuron-ethyl
Chlorsulfuron
Diuron
Ethametsulfuron-methyl
Foramsulfuron
Halosulfuron
Iodosulfuron
Linuron
Mesosulfuron-methyl
Metsulfuron-methyl
Nicosulfuron
Oxasulfuron
Primisulfuron-methyl
Prosulfuron
Rimsulfuron
Sulfometuron-methyl
Sulfosulfuron
Thifensulfuron-methyl
Triasulfuron
Triflusulfuron-methyl
Non-specific metabolites
- Dimethoxy pyrimidine
- Dimethyl pyrimidine
- Methyl methoxytriazine

**Neonicotinoid Insecticides** [3]

Acetamiprid
- N-Desmethyl-acetamiprid

Clothianidin
Imidacloprid
- 5-Hydroxy-imidacloprid

Thiacloprid

**Organochlorine Pesticides** [3]

Aldrin
- Dieldrin

Chlordane
- *trans*-Nonachlor
- Oxychlordane

Dichlorodiphenyltrichloroethane (DDT) (including *p,p'*-DDT and *o,p'*-DDT)
- *p,p'*-Dichlorodiphenyldichloroethene (*p,p'*-DDE)

Dieldrin
Endosulfan
- Endosulfan-ether
- Endosulfan-lactone
- Endosulfan-sulfate

Endrin
Heptachlor
- Heptachlor epoxide

Hexachlorobenzene
- Pentachlorophenol
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol

Hexachlorocyclohexanes (HCH) (including *beta*-HCH and *gamma*-HCH [lindane])
- Pentachlorophenol
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol

Methoxychlor
- Dihydroxy methoxychlor
- Monohydroxy methoxychlor

Mirex
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

**Organophosphorus Pesticides** [1]

Acephate
Azinphos methyl
- Dimethyldithiophosphate
- Dimethylphosphate
- Dimethylthiophosphate

Bensulide
Chlorethoxyphos
- Diethylphosphate
- Diethylthiophosphate

Chlorpyrifos
- Diethylphosphate
- Diethylthiophosphate
- 3,5,6-Trichloro-2-pyridinol (TCPy)

Chlorpyrifos methyl
- Dimethylphosphate
- Dimethylthiophosphate
- 3,5,6-Trichloro-2-pyridinol (TCPy)

Coumaphos
- 3-Chloro-7-hydroxy-4-methyl-2H-chromen-2-one/ol
- Diethylphosphate
- Diethylthiophosphate

Diazinon
- Diethylphosphate
- Diethylthiophosphate
- 2-Isopropyl-4-methyl-6-hydroxypyrimidine (IMPY)

Dichlorvos (DDVP)
- Dimethylphosphate

Dicrotophos
- Dimethylphosphate

Dimethoate
- Dimethyldithiophosphate
- Dimethylphosphate
- Dimethylthiophosphate
- Omethoate

Disulfoton
- Diethyldithiophosphate
- Diethylphosphate
- Diethylthiophosphate

Ethion
- Diethyldithiophosphate
- Diethylphosphate
- Diethylthiophosphate

Ethoprop
Fenitrothion
- Dimethylphosphate
- Dimethylthiophosphate

Fenthion
- Dimethylphosphate
- Dimethylthiophosphate

Glufosinate-ammonium
- 3-Methylphosphinicopropionic acid (3-MPPA)

Glyphosate
- Aminomethylphosphonic acid (AMPA)

Isazophos-methyl
- 5-Chloro-1,2-dihydro-1-isopropyl-[3H]-1,2,4-triazol-3-one
- Dimethylphosphate
- Dimethylthiophosphate

Malathion
- Dimethyldithiophosphate
- Dimethylphosphate
- Dimethylthiophosphate
- Malathion dicarboxylic acid

Methamidophos
Methidathion
- Dimethyldithiophosphate
- Dimethylphosphate
- Dimethylthiophosphate

Methyl parathion
- Dimethylphosphate
- Dimethylthiophosphate
- *p*-Nitrophenol

Naled
- Dimethylphosphate

Oxydemeton-methyl
- Dimethylphosphate
- Dimethylthiophosphate

Parathion (Ethyl parathion)
- Diethylphosphate
- Diethylthiophosphate
- p-Nitrophenol

Phorate
- Diethyldithiophosphate
- Diethylphosphate
- Diethylthiophosphate

Phosmet (Imidan)
- Dimethyldithiophosphate
- Dimethylphosphate
- Dimethylthiophosphate

Pirimiphos-methyl
- 2-(Diethylamino)-6-methylpyrimidin-4-ol/one
- Dimethylphosphate
- Dimethylthiophosphate

Sulfotep
- Diethylphosphate
- Diethylthiophosphate

Temephos
- Dimethylphosphate
- Dimethylthiophosphate

Terbufos
- Diethyldithiophosphate
- Diethylphosphate
- Diethylthiophosphate

Tetrachlorvinphos
- Dimethylphosphate

Tribufos

**Quaternary Ammonium Herbicides and Pesticides** [1]

*Refer to the category Quaternary Ammonium Compounds (QACs) for the QA herbicides and other members of this class, some of which are registered as pesticides for antimicrobial applications.*

**Pyrethroid Pesticides** [1]

Allethrin
- *cis/trans*-Dimethylvinylcyclopropane carboxylic diacid

Bifenthrin

Cyfluthrin
- *cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
- *trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
- 4-Fluoro-3-phenoxybenzoic acid

Cyhalothrin (including *lambda*- and *gamma*-)
- 3-Phenoxybenzoic acid (3-PBA)

Cypermethrin (including *cis*- and *trans*-)
- *cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
- *trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
- 3-Phenoxybenzoic acid (3-PBA)

Cyphenothrin

Deltamethrin
- *cis*-3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid
- 3-Phenoxybenzoic acid (3-PBA)

Esbiothrin

Esfenvalerate

Etofenprox

Fenpropathrin
- 3-Phenoxybenzoic acid (3-PBA)

Fenvalerate

Imiprothrin

Metofluthrin

Permethrin (including *cis*- and *trans*-)
- *cis*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*cis*-DCCA)
- *trans*-3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (*trans*-DCCA)
- 3-Phenoxybenzoic acid (3-PBA)

Phenothrin (Sumithrin)

Prallethrin

Pyrethrin 1
- *cis/trans*-Dimethylvinylcyclopropane carboxylic diacid

Resmethrin
- *cis/trans*-Dimethylvinylcyclopropane carboxylic diacid

Tetramethrin

Tralomethrin
- 3-Phenoxybenzoic acid (3-PBA)

**Other Herbicides**

Acetochlor
- Acetochlor mercapturate

Alachlor
- Alachlor mercapturate

Atrazine
- Atrazine mercapturate
- Diaminochlorotriazine
- Desethylatrazine
- Desisopropylatrazine
- Hydroxyatrazine

Dacthal

2,4-Dichlorophenoxyacetic acid (2,4-D), salts and esters
- 2,4-Dichlorophenoxyacetic acid
- 2,4-Dichlorophenol

Metolachlor
- Metolachlor mercapturate

Pendimethalin

2,4,5-Trichlorophenoxyacetic acid (2,4,5-T), salts and esters
- 2,4,5-Trichlorophenoxyacetic acid

Trifluralin

**Other Pesticides**

1,4-Dichlorobenzene (*p*-Dichlorobenzene)
  2,5-Dichlorophenol
*N*,*N*-Diethyl-3-methylbenzamide (DEET)
  3-Diethylcarbamoyl benzoic acid (DCBA)
  *N*,*N*-Diethyl-3-(hydroxymethyl) benzamide (DHMB)
Fipronil
Octhilinone

## *ortho*-Phthalates [1]

Benzylbutyl phthalate (BzBP)
  Mono-benzyl phthalate (MBzP)
  Mono-*n*-butyl phthalate (MnBP)
Diallyl phthalate
Di-*n*-butyl phthalate (DnBP)
  Mono-*n*-butyl phthalate (MnBP)
  Mono-3-hydroxybutyl phthalate (MHBP)
Di-isobutyl phthalate (DIBP)
  Mono-isobutyl phthalate (MIBP)
  Mono-2-methyl-2-hydroxypropyl phthalate
Dicyclohexyl phthalate (DCHP)
  Mono-cyclohexyl phthalate (MCHP)
Diethyl phthalate (DEP)
  Mono-ethyl phthalate (MEP)
Di-2-ethylhexyl phthalate (DEHP)
  Mono-(2-carboxymethylhexyl) phthalate
  Mono-(2-ethyl-5-carboxypentyl) phthalate (MECPP)
  Mono-2-ethylhexyl phthalate (MEHP)
  Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)
  Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)
Di-*n*-hexyl phthalate
Di-isodecyl phthalate (DIDP)
  Mono-(carboxynonyl) phthalate (MCNP)
Di-isoheptyl phthalate
Di-isononyl phthalate (DINP)
  Mono-(carboxyoctyl) phthalate (MCOP)
  Mono-(hydroxyisononyl) phthalate
  Mono-isononyl phthalate (MINP)
  Mono-(oxoisononyl) phthalate
Dimethyl phthalate (DMP)
  Mono-methyl phthalate (MMP)
Di-*n*-octyl phthalate (DnOP)
  Mono-(3-carboxypropyl) phthalate (MCPP)
  Mono-*n*-octyl phthalate (MnOP)
Di-*n*-pentyl phthalate
Di-2-propylheptyl phthalate
Diundecyl phthalate
Di-isoundecyl phthalate
Di-isotridecyl phthalate

## Phthalate Alternatives [3]

1,2-Cyclohexane dicarboxylic acid, diisononyl ester (DINCH)
  Cyclohexane-1,2-dicarboxylic acid mono carboxyisooctyl ester (MCOCH)
  Cyclohexane-1,2-dicarboxylic acid-mono (hydroxy-isononyl ester) (MHNCH)
Di-2-ethylhexyl terephthalate (DEHTP)
  Mono-2-ethyl-5-carboxypentyl terephthalate (MECPTP)
  Mono-2-ethyl-5-hydroxyhexyl terephthalate (MEHHTP)

## Phytoestrogens [3]

Daidzein
  *O*-Desmethylangolensin
  Equol
Enterodiol
Enterolactone
Genistein

## Polychlorinated Biphenyls (PCBs), Dioxin-Like [3]

**Coplanar PCBs** [3]

3,4,4′,5-Tetrachlorobiphenyl (PCB 81)
3,3′,4,4′,5-Pentachlorobiphenyl (PCB 126)
3,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB 169)

**Mono-*ortho*-Substituted PCBs** [3]

2,3,3′,4,4′-Pentachlorobiphenyl (PCB 105)
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)
2,3′,4,4′,5-Pentachlorobiphenyl (PCB 118)
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)
2,3,3′,4,4′,5-Hexachlorobiphenyl (PCB 156)
2,3,3′,4,4′,5′-Hexachlorobiphenyl (PCB 157)
2,3′,4,4′,5,5′-Hexachlorobiphenyl (PCB 167)
2,3,3′,4,4′,5,5′-Heptachlorobiphenyl (PCB 189)

## Polychlorinated Biphenyls (PCBs), Non-Dioxin-Like [3]

2,2′,5-Trichlorobiphenyl (PCB 18)
2,4,4′-Trichlorobiphenyl (PCB 28)
2,2′,3,5′-Tetrachlorobiphenyl (PCB 44)
2,2′,4,5′-Tetrachlorobiphenyl (PCB 49)
2,2′,5,5′-Tetrachlorobiphenyl (PCB 52)
2,3′,4,4′-Tetrachlorobiphenyl (PCB 66)
2,4,4′,5-Tetrachlorobiphenyl (PCB 74)
2,2′,3,4,5′-Pentachlorobiphenyl (PCB 87)
2,2′,4,4′,5-Pentachlorobiphenyl (PCB 99)
2,2′,4,5,5′-Pentachlorobiphenyl (PCB 101)
2,3,3′,4′,6-Pentachlorobiphenyl (PCB 110)
2,2′,3,3′,4,4′-Hexachlorobiphenyl (PCB 128)
2,2′,3,4,4′,5′-Hexachlorobiphenyl (PCB 138)
2,2′,3,4′,5,5′-Hexachlorobiphenyl (PCB 146)
2,2′,3,4′,5′,6-Hexachlorobiphenyl (PCB 149)
2,2′,3,5,5′,6-Hexachlorobiphenyl (PCB 151)
2,2′,4,4′,5,5′-Hexachlorobiphenyl (PCB 153)
2,3,3′,4,4′,6-Hexachlorobiphenyl (PCB 158)
2,2′,3,3′,4,4′,5-Heptachlorobiphenyl (PCB 170)
2,2′,3,3′,4,5,5′-Heptachlorobiphenyl (PCB 172)
2,2′,3,3′,4,5′,6′-Heptachlorobiphenyl (PCB 177)
2,2′,3,3′,5,5′,6-Heptachlorobiphenyl (PCB 178)

2,2′,3,4,4′,5,5′-Heptachlorobiphenyl (PCB 180)
2,2′,3,4,4′,5′,6-Heptachlorobiphenyl (PCB 183)
2,2′,3,4′,5,5′,6-Heptachlorobiphenyl (PCB 187)
2,2′,3,3′,4,4′,5,5′-Octachlorobiphenyl (PCB 194)
2,2′,3,3′,4,4′,5,6-Octachlorobiphenyl (PCB 195)
2,2′,3,3′,4,4′,5,6′-Octachlorobiphenyl (PCB 196)
2,2′,3,3′,4,5,5′,6-Octachlorobiphenyl (PCB 199)
2,2′,3,4,4′,5,5′,6-Octachlorobiphenyl (PCB 203)
2,2′,3,3′,4,4′,5,5′,6-Nonachlorobiphenyl (PCB 206)
2,2′,3,3′,4,4′,5,5′,6,6′-Decachlorobiphenyl (PCB 209)

## Polychlorinated Biphenyls (PCBs)

**Hydroxy-PCBs (Metabolites of PCBs)** [12]

4-Hydroxy-PCB 107
4-Hydroxy-PCB 120
4′-Hydroxy-PCB 130
3′-Hydroxy-PCB 138
4-Hydroxy-PCB 146
3-Hydroxy-PCB 153
4′-Hydroxy-PCB 172
3′-Hydroxy-PCB 180
4-Hydroxy-PCB 187
4′-Hydroxy-PCB 193

## Polychlorinated Dibenzo-*p*-dioxins [3]

1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin
1,2,3,4,6,7,8,9-Octachlorodibenzo-*p*-dioxin
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD)

## Polychlorinated Dibenzofurans [3]

1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8,9-Heptachlorodibenzofuran
1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8,9-Hexachlorodibenzofuran
2,3,4,6,7,8-Hexachlorodibenzofuran
1,2,3,4,6,7,8,9-Octachlorodibenzofuran
1,2,3,7,8-Pentachlorodibenzofuran
2,3,4,7,8-Pentachlorodibenzofuran
2,3,7,8-Tetrachlorodibenzofuran

## Polycyclic Aromatic Hydrocarbons (PAHs) [3]

Benz[a]anthracene
- 1-Hydroxybenz[a]anthracene
- 3-Hydroxybenz[a]anthracene
- 9-Hydroxybenz[a]anthracene

Benzo[a]pyrene
- 3-Hydroxybenzo[a]pyrene

Benzo[c]phenanthrene
- 1-Hydroxybenzo[c]phenanthrene
- 2-Hydroxybenzo[c]phenanthrene
- 3-Hydroxybenzo[c]phenanthrene

Chrysene
- 1-Hydroxychrysene
- 2-Hydroxychrysene
- 3-Hydroxychrysene
- 4-Hydroxychrysene
- 6-Hydroxychrysene

Fluoranthene
- 3-Hydroxyfluoranthene

Fluorene
- 2-Hydroxyfluorene
- 3-Hydroxyfluorene
- 9-Hydroxyfluorene

Naphthalene
- 1-Hydroxynaphthalene
- 2-Hydroxynaphthalene

Phenanthrene
- 1-Hydroxyphenanthrene
- 2-Hydroxyphenanthrene
- 3-Hydroxyphenanthrene
- 4-Hydroxyphenanthrene
- 9-Hydroxyphenanthrene

Pyrene
- 1-Hydroxypyrene

## Quaternary Ammonium Compounds (QACs) [1]

**Alkyltrimethyl ammonium compounds (ATMACs)** [1]

C20-22-Alkyltrimethyl ammonium chlorides
Behentrimonium chloride
Cetrimonium bromide
Cetrimonium chloride

**Benzylalkyldimethyl ammonium compounds (BACs)** [1]

Alkyl(60%C14, 30%C16, 5%C18, 5%C12) dimethylbenzyl ammonium chloride
C12-14-Alkyl(ethylbenzyl)dimethyl ammonium chlorides
Benzalkonium chloride [13]
Benzyl-C12-18-alkyldimethyl ammonium chlorides
Cetalkonium chloride

**Dialkyldimethyl ammonium compounds (DADMACs)** [1]

Di-C14-18-alkyldimethyl ammonium chlorides
Didecyldimethyl ammonium carbonate
Didecyldimethyl ammonium chloride
Dioctyldimethyl ammonium chloride
Quaternium 18
Quaternium 24
Quaternium 34

**Esterquats** [1]

Esterquat 1

**Polyquaternium compounds (Polyquats)** [1]

Polyquaternium 42

**QA Herbicides** [1]

Diquat dibromide
Paraquat dichloride

**Other QACs** [1]

Benzethonium chloride
Cetylpyridinium chloride
(Oxydi-2,1-ethanediyl)bis(coco alkyl)dimethyl ammonium dichlorides
Quaternium 15

## Synthetic Hormones used in Food Production [1]

Melengestrol acetate
Trenbolone acetate
Zeranol

## Synthetic Polycyclic Musks [1]

4-Acetyl-1,1-dimethyl-6-tert-butylindan (ADBI)
6-Acetyl-1,1,2,3,3,5-hexamethylindane (AHMI)
7-Acetyl-1,1,3,4,4,6-hexamethyl-tetrahydronaphthalene (AHTN)
5-Acetyl-1,1,2,6-tetramethyl-3-isopropylindan (ATII)
Acetylethyltetramethyltetralin (AETT)
6,7-Dihydro-1,1,2,3,3-pentamethyl-4[5H]indanone (DPMI)
1,3,4,6,7,8-Hexahydro-4,6,6,7,8,8-hexamethyl-cyclopenta[g]-2-benzopyran (HHCB)

## Tetramethyl Acetyloctahydronaphthalenes [1]

1-(1,2,3,4,6,7,8,8a-Octahydro-2,3,8,8-tetramethyl-2-naphthalenyl)ethanone (alpha isomer)
1-(1,2,3,4,5,6,7,8-Octahydro-2,3,8,8-tetramethyl-2-naphthalenyl)ethanone (beta isomer; OTNE)
1-(1,2,3,5,6,7,8,8a-Octahydro-2,3,8,8-tetramethyl-2-naphthalenyl)ethanone (gamma isomer)
1-(1,2,3,4,5,6,7,8-Octahydro-2,3,5,5-tetramethyl-2-naphthalenyl)ethanone

## Tobacco Smoke

Nicotine
- Cotinine
- Hydroxycotinine

NNK (4-[Methylnitrosamino]-1-[3-pyridyl]-1-butanone)
- NNAL (4-[Methylnitrosamino)-1-(3-pyridyl)-1-butanol)

## Volatile Organic Compounds [3]

Acrolein
- *N*-Acetyl-*S*-(2-carboxyethyl)-L-cysteine
- *N*-Acetyl-*S*-(3-hydroxypropyl)-L-cysteine

Acrylonitrile
- *N*-Acetyl-*S*-(2-cyanoethyl)-L-cysteine
- *N*-Acetyl-*S*-(2-hydroxyethyl)-L-cysteine

Benzene
- *N*-Acetyl-*S*-(phenyl)-L-cysteine
- *t*,*t*-Muconic acid

Benzonitrile
1-Bromopropane
- *N*-Acetyl-*S*-(*n*-propyl)-L-cysteine

1,3-Butadiene
- *N*-Acetyl-*S*-(3,4-dihydroxybutyl)-L-cysteine
- *N*-Acetyl-*S*-(2-hydroxy-3-butenyl)-L-cysteine
- *N*-Acetyl-*S*-(4-hydroxy-2-butenyl)-L-cysteine
- *N*-Acetyl-*S*-(1-hydroxymethyl-2-propenyl)-L-cysteine

Carbon disulfide
- 2-Thioxothiazolidine-4-carboxylic acid

Carbon tetrachloride
Chlorobenzene
Chloroethane
Crotonaldehyde
- *N*-Acetyl-*S*-(3-hydroxypropyl-1-methyl)-L-cysteine

Cyanide
- 2-Aminothiazoline-4-carboxylic acid

Cyclohexane
Dibromomethane
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane
1,2-Dichlorobenzene (*o*-Dichlorobenzene)
1,3-Dichlorobenzene (*m*-Dichlorobenzene)
1,4-Dichlorobenzene (*p*-Dichlorobenzene)
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
*cis*-1,2-Dichloroethene
*trans*-1,2-Dichloroethene
Dichloromethane (Methylene chloride)
1,2-Dichloropropane
Diethylether
*N*,*N*-Dimethylformamide
- *N*-Acetyl-*S*-(N-methylcarbamoyl)-L-cysteine

2,5-Dimethylfuran
Ethyl acetate
Ethylbenzene
- Phenylglyoxylic acid

Ethylene oxide
- *N*-Acetyl-*S*-(2-hydroxyethyl)-L-cysteine

Furan
Hexachloroethane
Heptane
Isobutyronitrile
Isopropylbenzene (Cumene)
Methyl-*t*-butyl ether (MTBE)
Methylcyclopentane
Nitrobenzene
Nitromethane
Octane

Propylene oxide
    *N*-Acetyl-*S*-(2-hydroxypropyl)-L-cysteine
Styrene
    *N*-Acetyl-*S*-(1-phenyl-2-hydroxyethyl)-L-cysteine
    *N*-Acetyl-*S*-(2-phenyl-2-hydroxyethyl)-L-cysteine
    Mandelic acid
    Phenylglyoxylic acid
1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
Tetrachloroethene (Perchloroethylene)
    *N*-Acetyl-*S*-(trichlorovinyl)-L-cysteine
Tetrahydrofuran
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene (Trichloroethylene)
    *N*-Acetyl-*S*-(1,2-dichlorovinyl)-L-cysteine
    *N*-Acetyl-*S*-(2,2-dichlorovinyl)-L-cysteine
1,2,3-Trichloropropane
$\alpha,\alpha,\alpha$-Trifluorotoluene
Toluene
    *N*-Acetyl-*S*-(benzyl)-L-cysteine
Vinyl bromide
Vinyl chloride
    *N*-Acetyl-*S*-(2-hydroxyethyl)-L-cysteine
*m*-Xylene
    *N*-Acetyl-*S*-(dimethylphenyl)-L-cysteine
    3-Methylhippuric acid
*o*-Xylene
    *N*-Acetyl-*S*-(dimethylphenyl)-L-cysteine
    2-Methylhippuric acid
*p*-Xylene
    *N*-Acetyl-*S*-(dimethylphenyl)-L-cysteine
    4-Methylhippuric acid

**Notes**

[1] All members of the chemical group are designated chemicals, including, but not limited to, the chemicals shown.

[2] Diesel exhaust is a complex mixture that contains many components, one or more of which may be useful as an indicator for biomonitoring.

[3] All members of the chemical group are not designated chemicals; only the specific chemicals listed are designated chemicals.

[4] These brominated phenols are part of the chemical group "brominated and chlorinated organic chemicals used as flame retardants", which are listed as designated chemicals. The brominated phenols are also included in the category "environmental phenols" because the laboratory measures them with other environmental phenols.

[5] These chlorinated phenols, with the exception of triclosan, are metabolites of certain pesticides that are listed as designated chemicals. These chlorinated phenols are also included in the category "environmental phenols" because the laboratory measures them with other environmental phenols.

[6] Includes *n*-butylparaben and isobutylparaben.

[7] Triclocarban is not a phenol but can be analytically measured with environmental phenols. When it is released into the environment, it is commonly found in the same environmental media as triclosan.

[8] CDC measures nitrate and thiocyanate along with perchlorate, because all three anions can affect iodine uptake by the thyroid.

[9] PFASs are fluorinated aliphatic substances that contain the moiety $C_nF_{2n+1}$. In a perfluoroalkyl substance, all carbon atoms, except for carbon atoms associated with functional groups (such as an aldehyde group), are fully fluorinated. In a polyfluoroalkyl substance, at least one (but not all) of the carbon atoms is fully fluorinated.

[10] Fungicides, herbicides, and insecticides are grouped under the general heading of "Pesticides."

[11] 1-Hydroxynaphthalene is the metabolite of both carbaryl and naphthalene. To determine the percent of 1-hydroxynaphthalene attributable to carbaryl alone, 2-hydroxynaphthalene (which is only a metabolite of naphthalene) must also be measured.

[12] Hydroxy-PCBs are measured as biomarkers of exposure to the listed PCBs.

[13] Benzalkonium chloride can also be referred to as alkyldimethylbenzyl ammonium chloride (ADBAC).