Preliminary Screening of Polycyclic Aromatic Hydrocarbons (PAHs) as a Class and Chloroxylenol

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Presentation to the Scientific Guidance Panel
November 16, 2026

OEHHA

BIOMONITORING CALIFORNIA

Purpose of agenda item

Obtain Panel and public input on future consideration of the following chemicals or chemical classes as potential designated chemicals:

- Polycyclic aromatic hydrocarbons (PAHs) as a class
- Chloroxylenol

Background: Criteria for recommending designated chemicals

1.	**Exposure or potential exposure** to the public or specific subgroups.
2.	The **known or suspected health effects** resulting from some level of exposure based on peer reviewed scientific studies
3.	The **need to assess the efficacy of public health actions** to reduce exposure to a chemical
4.	The **availability of a biomonitoring analytical method** with adequate accuracy, precision, sensitivity, specificity, and speed
5.	The **availability of adequate biospecimen samples**
6.	The **incremental analytical cost** to perform the biomonitoring analysis for the chemical

https://biomonitoring.ca.gov/sites/default/files/downloads/ChemicalSelectionOverview.pdf

Polycyclic Aromatic Hydrocarbons (PAHs) as a Class

PAH exposures and health effects

Exposure Sources:



Tobacco Smoking



Incomplete Combustion



Wildfires



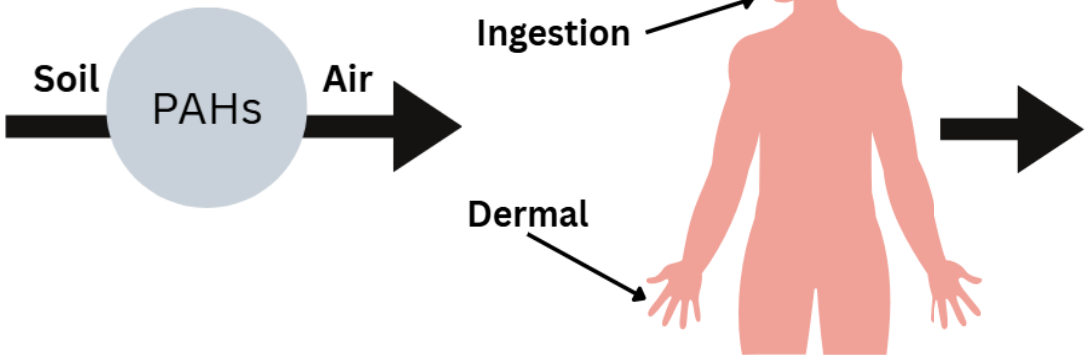
Fossil Fuel Industry



Consumer products



High temperature Cooking



Exposure Routes:

Health Effects:



Carcinogenic/mutagenic



Respiratory irritation, asthma, bronchitis,



Teratogenic



Neurodegenerative diseases



Gastrointestinal diseases



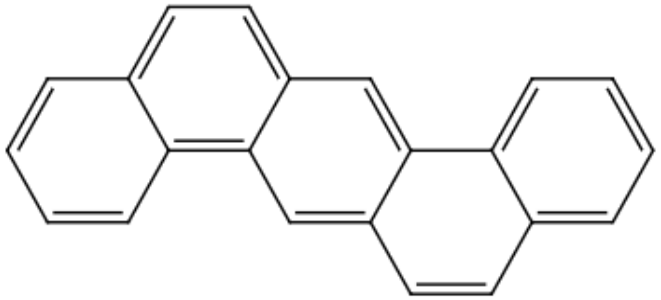
Immunological damage



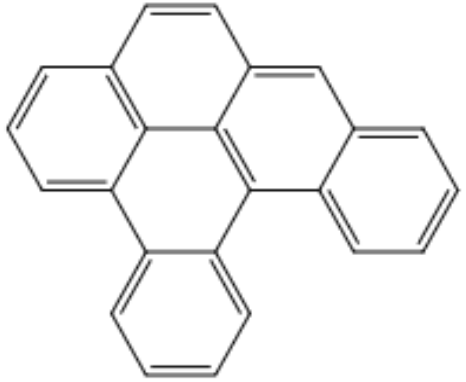
Cardiovascular diseases

16 PAHs identified as Priority Pollutants by US EPA	PAHs on the Program's list of designated chemicals
Acenaphthene	
Acenaphthylene	
Anthracene	
Benzo[a]anthracene →	1. Benzo[a]anthracene
Benzo[a]pyrene →	2. Benzo[a]pyrene
Benzo[b]fluoranthene	
Benzo[g,h,i]perylene	
Benzo[k]fluoranthene	
Chrysene →	3. Chrysene
Dibenz[a,h]anthracene	
Fluoranthene →	4. Fluoranthene
Fluorene →	5. Fluorene
Indeno[1,2,3-c,d]pyrene	
Naphthalene →	6. Naphthalene
Phenanthrene →	7. Phenanthrene
Pyrene →	8. Pyrene
	9. Benzo[c]phenanthrene

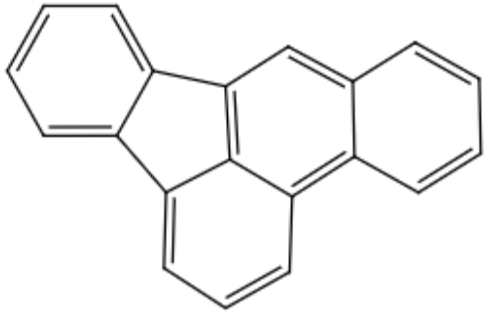
Examples of carcinogenic PAHs that are NOT on the Program's list of designated chemicals



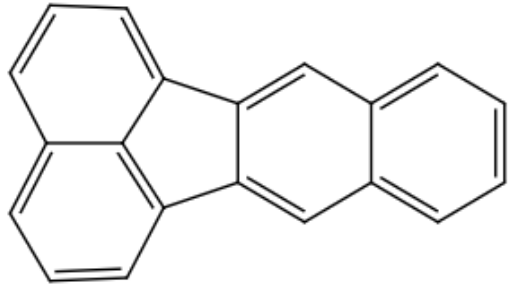
Dibenz[a,h]anthracene



Dibenzo[a,l]pyrene

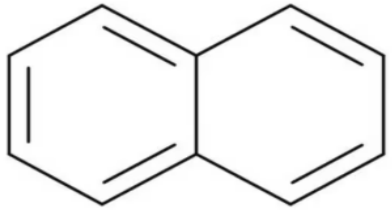


Benzo[b]fluoranthene

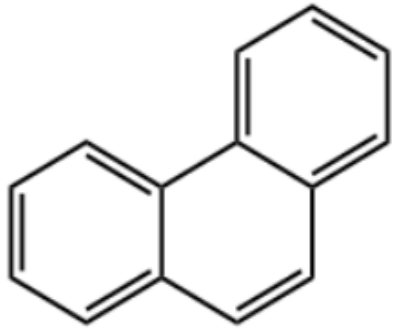


Benzo[k]fluoranthene

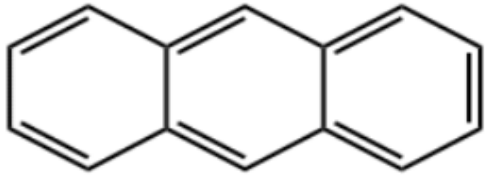
Unsubstituted PAHs: composed **strictly of carbon and hydrogen** atoms arranged in two or more fused aromatic rings.



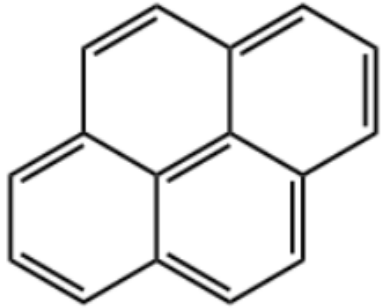
Naphthalene



Phenanthrene

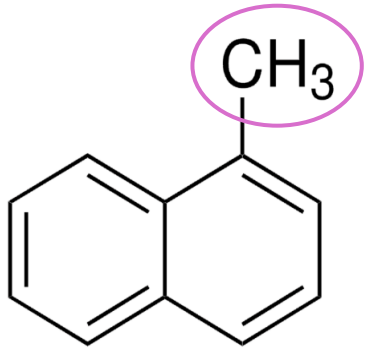


Anthracene

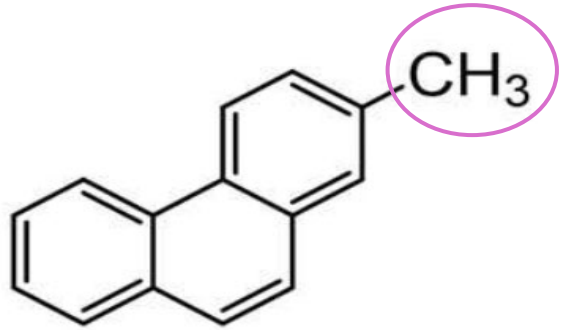


Pyrene

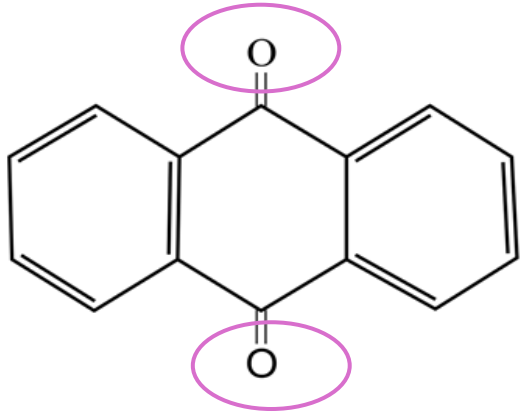
Substituted PAHs: PAH derivatives where **one or more hydrogen atoms are replaced** by functional groups.



1-Methylnaphthalene



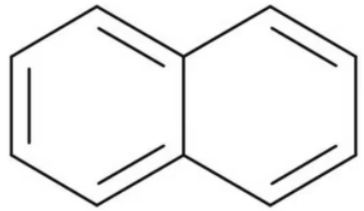
2-Methylphenanthrene



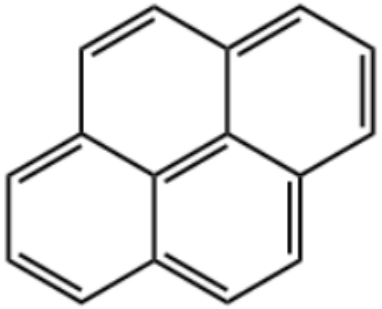
Anthraquinone

Examples of unsubstituted PAHs measured in Biomonitoring California studies

Unsubstituted PAHs

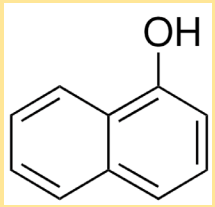


Naphthalene

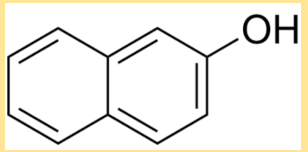


Pyrene

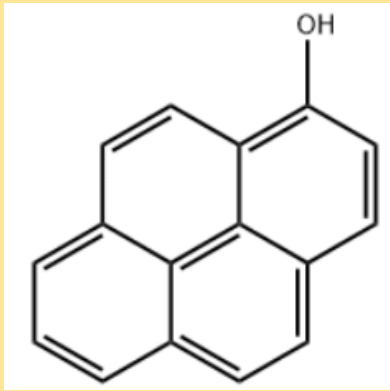
Metabolites



1-Hydroxynaphthalene



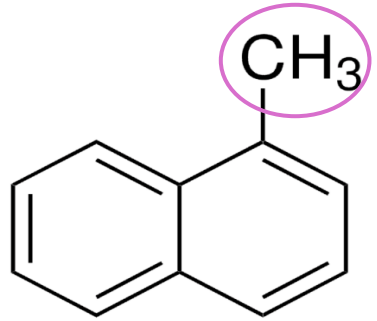
2-Hydroxynaphthalene



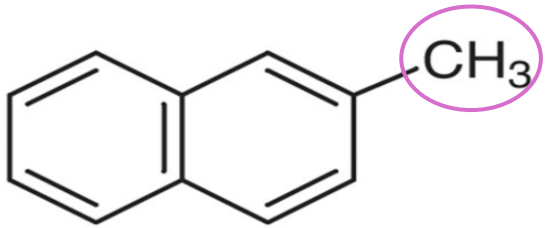
1-Hydroxypyrene

(Hurley et al. 2026)
(Reddam et al. 2026)

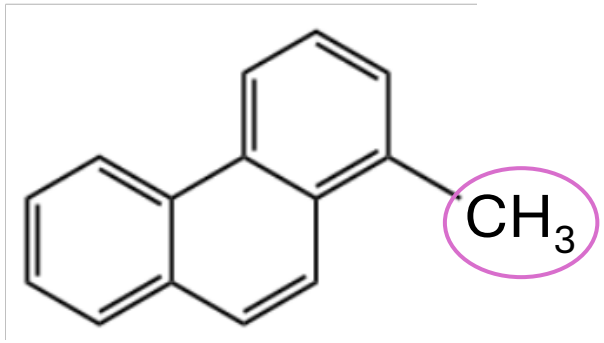
Examples of substituted PAHs, NONE of which are on the Program's list of designated chemicals



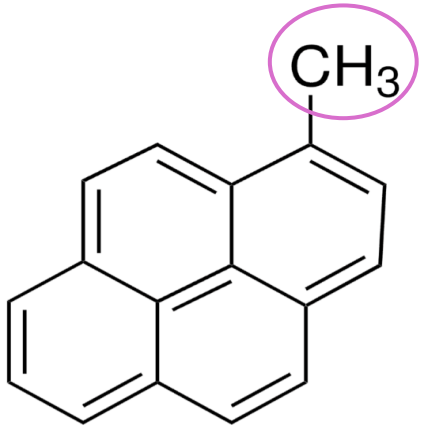
1-Methylnaphthalene



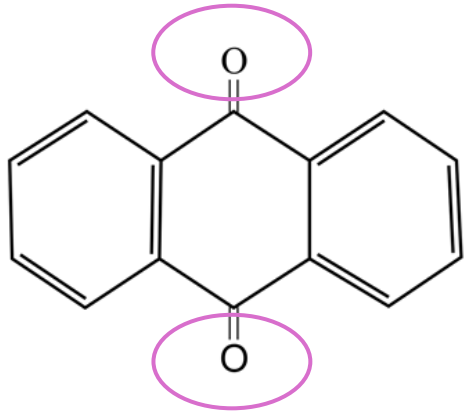
2-Methylnaphthalene



1-Methylphenanthrene



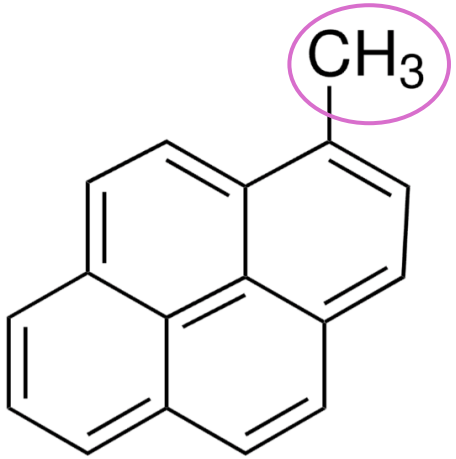
1-Methylpyrene



Anthraquinone

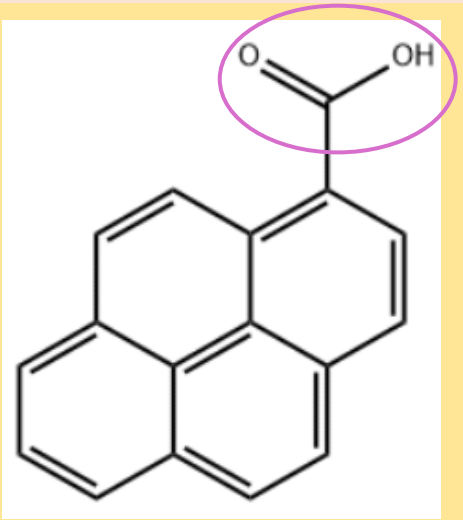
Metabolites of substituted PAHs can be measured in urine

Substituted PAH



1-Methylpyrene

Metabolite

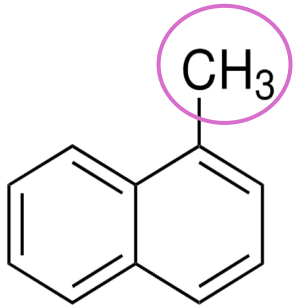


1-Pyrenecarboxylic acid (1-PYRCA)

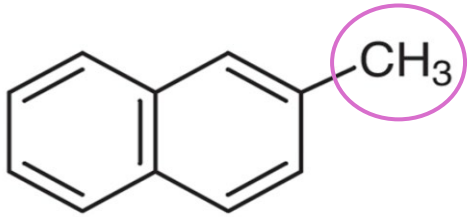
(Wang et al. 2025)

Metabolites of substituted PAHs can be measured in urine (cont'd)

Substituted PAHs



1-Methylnaphthalene



2-Methylnaphthalene

Metabolites

4-Methyl-1-naphthol
5-Methyl-1-naphthol
4-Methyl-2-naphthol
5-Methyl-2-naphthol
8-Methyl-2-naphthol

3-Methyl-1-naphthol
6-Methyl-1-naphthol
7-Methyl-1-naphthol
3-Methyl-2-naphthol
6-Methyl-2-naphthol
7-Methyl-2-naphthol

(Li et al. 2014)

Use of diagnostic ratios to determine PAH exposure sources

Pyrogenic Sources

Cooking at high temperatures





Burning of organic material





Incomplete combustion

- Diagnostic ratios have been used to distinguish between petrogenic and pyrogenic sources of exposure

Petrogenic Sources





Unburned petroleum and crude oil

- For example, the ratio below has been used to identify PAH exposure sources in both environmental and biomonitoring studies

$$\frac{\textbf{alkylated (substituted) PAHs}}{\textbf{unsubstituted PAHs}}$$

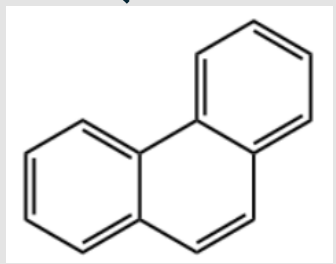
- The Program could use these ratios to identify PAH exposure sources (e.g., the CHAIRS-LA study)
- This approach can help the Program and policy makers identify tailored exposure reduction strategies and interventions

Use of diagnostic ratios in biomonitoring studies



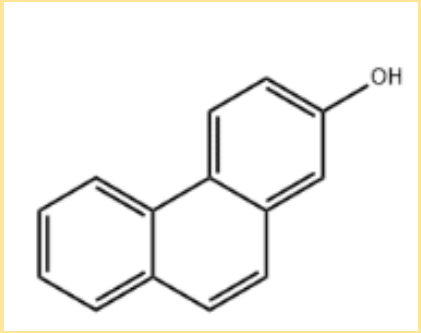
Pyrogenic sources
(in Beijing)

Air



Phenanthrene
(PHE)

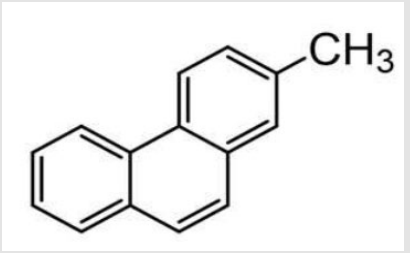
Urine Metabolite



Hydroxylated-phenanthrene
(ΣOH-PHEs)

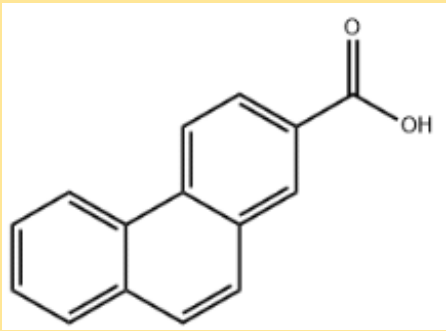
2-PHECA
ΣOH-PHEs

Air



2-Methylphenanthrene
(2-MePHE)

Urine Metabolite



2-Phenanthrenecarboxylic acid
(2-PHECA)



Petrogenic sources
(in Los Angeles)

(Lin et al. 2021, Lin et al. 2022)

PAHs summary

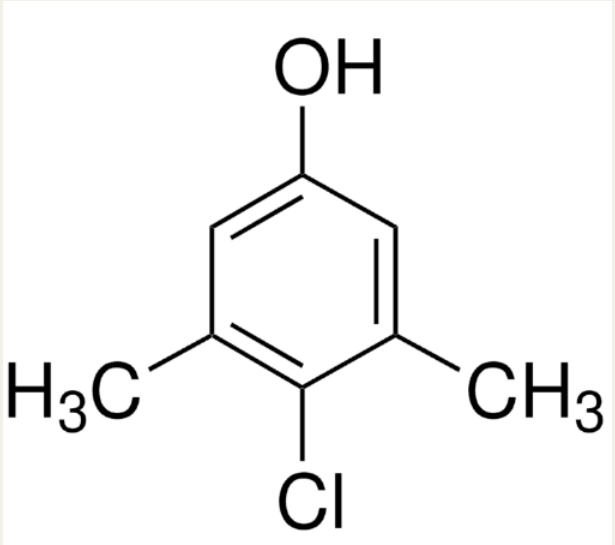
- Californians are exposed to hundreds of PAHs, including substituted PAHs
- Only 9 unsubstituted PAHs are on Biomonitoring California's list of designated chemicals and can be included in our biomonitoring studies
- There are hundreds of PAHs that the Program cannot currently include in biomonitoring studies
- There are analytical methods to measure metabolites of substituted PAHs in biological samples
- The ratio of substituted vs unsubstituted PAHs can be used to distinguish between petrogenic and pyrogenic sources of exposures

Chloroxylenol

Chloroxylenol

(PCMX = parachlorometaxylenol)

- Chlorine-substituted phenol compound
- Anti-microbial
- National aggregate production volume*
  - 250,000 - 1,000,000 lbs



CAS#: 88-04-0

*2020-2023 Chemical Data Reporting (CDR) data

Chloroxylenol: A potential regrettable substitute

- In 2016, the US FDA banned 19 active antimicrobial chemicals (including triclosan and triclocarban).

- In Biomonitoring California studies (BEST, CARE-LA, CARE-2 and CARE-3), triclosan and triclocarban detection frequencies (DFs) decreased over time

	BEST - Expanded		CARE-LA		CARE-2		CARE-3	
	2013		2018		2019		2020	
	N	**DF**	**N**	**DF**	**N**	**DF**	**N**	**DF**
Triclocarban	341	-	404	14%	151	11%	90	6%
Triclosan	341	99%	404	52%	151	45%	90	19%

- Triclosan and triclocarban were detected less frequently in CARE-LA than nationally (NHANES)

	CARE-LA (2018) DF	**NHANES (2017-2018) DF**
Triclocarban	14%	29%
Triclosan	39%	45%

Chloroxylenol: A potential regrettable substitute (cont'd)

FDA's **Final Rule: Sept 2016**
Banned 19 antimicrobial chemicals (including triclosan and triclocarban)

Delayed action on three chemicals:
- **Benzalkonium chloride and benzethonium chloride (QACs)**
- **Chloroxylenol**

Quaternary Ammonium Compound (QACs)

- Added to Biomonitoring California's lists of:
  - Designated chemicals (2020)
  - Priority chemicals (2021)
- Currently under review by DTSC's Safer Consumer Products Program

Chloroxylenol

- Currently no action in California
- Use may increase if QAC use is limited

Regulation of antimicrobials at the federal level

US FDA

- When it is applied directly to human or animal skin or used as an active pharmaceutical ingredient.
  - Currently permitted in over-the-counter consumer antiseptic washes and healthcare antiseptic products.

US EPA

- When it is used as an antimicrobial pesticide or environmental disinfectant.
  - Chloroxylenol is a registered pesticide, disinfectant, and sanitizer.
  - Not applied to food or feed crops.

Examples of consumer products with chloroxylenol



Industrial and household cleaning products

- Antiseptic liquids, 4.8% chloroxylenol (concentrated formula to dilute)



Acne treatments, surgical scrubs and healthcare antiseptics

- First aid antiseptic (0.5-3.75% chloroxylenol)

Examples of consumer products with chloroxylenol





Personal care products

- Hand soaps (typically 0.5-1.0%)
- Sanitizers
- Shampoo
- Body wash
- Cosmetics (0.5% max)



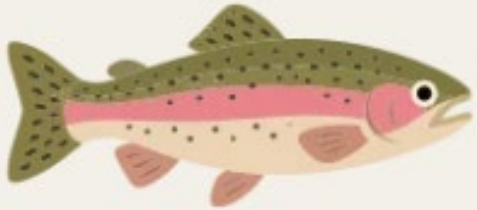




Chloroxylenol has been measured in biological samples

- Chloroxylenol has been detected in urine samples of children, pregnant women, and young adults in China (Tan et al., 2021, Zhang et al., 2025)
- It was also detected in human breastmilk in Canada and South Africa (Chi et al., 2025)
- Chloroxylenol has not been measured in human studies in the US

Some toxicity information and other concerns for human health



Rainbow Trout

- Altered expression of genes involved in:
  - Reproduction
  - Cell growth/proliferation
  - Amino acid metabolism
  - Cellular stress response
  - DNA repair
  - Hormone metabolism
  - Blood coagulation/hemostasis



Zebrafish

- Delayed embryonic development
- Reduced hatching and survival rates
- Induced ocular and other morphological abnormalities
- Altered spinal neuron development and behavior

Some toxicity information and other concerns for human health (cont'd)



- Induces reproductive toxicity, causing significant reductions in testosterone and estradiol levels in rats



- Causes irritation and allergic contact dermatitis following sensitization in humans



- Emerging evidence suggests chloroxylenol contributes to antimicrobial resistance

Chloroxylenol summary

- Chloroxylenol may be a potential regrettable substitute for triclosan, triclocarban, and possibly QACs
- There are analytical methods to measure chloroxylenol in biological samples
- There is evidence of chloroxylenol exposure to humans
- Concerns for public health:
  - Reports of irritation and allergic contact dermatitis in humans
  - Causes endocrine disruption, developmental and reproductive toxicity in animals
  - Evidence suggests that the use of chloroxylenol contributes to antimicrobial resistance

Reminder: Criteria for recommending designated chemicals

1.	**Exposure or potential exposure** to the public or specific subgroups.
2.	The **known or suspected health effects** resulting from some level of exposure based on peer reviewed scientific studies
3.	The **need to assess the efficacy of public health actions** to reduce exposure to a chemical
4.	The **availability of a biomonitoring analytical method** with adequate accuracy, precision, sensitivity, specificity, and speed
5.	The **availability of adequate biospecimen samples**
6.	The **incremental analytical cost** to perform the biomonitoring analysis for the chemical

https://biomonitoring.ca.gov/sites/default/files/downloads/ChemicalSelectionOverview.pdf

Considerations for the Panel

The SGP could:

1. Recommend that the Office of Environmental Health Hazard Assessment (OEHHA) prepare potential designated chemical documents on:
   - both PAHs as a class **and** chloroxylenol
   - only PAHs as a class
   - only chloroxylenol
2. Advise no further action on either of these chemicals or chemical classes
3. Suggest other chemicals or chemical classes for possible consideration

Questions?