



Polycyclic Aromatic Hydrocarbons (PAHs) Factsheet

4th edition

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DISCLAIMER:

Efforts have been made to provide the most comprehensive/up-to-date information regarding official documents, standards and guidelines, suppliers, methods, general information, etc. These lists will be updated on a regular basis, as new information becomes available. These lists shall not, however, be considered as exhaustive.

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Chemical structure of PAHs

Table 1: Names and structures of PAHs frequently monitored according to recommendations by the EU Scientific Committee for Food (SCF), the European Union (EU), and the US Environmental Protection Agency (EPA)

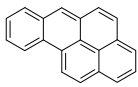
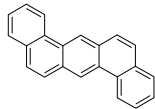

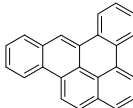

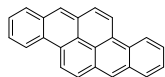
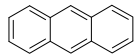
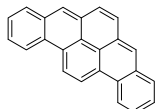
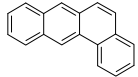
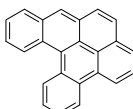
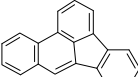
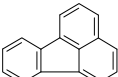
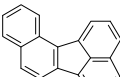
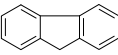
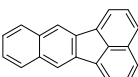
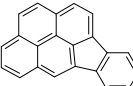
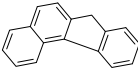
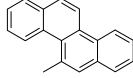
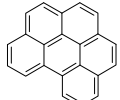

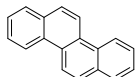
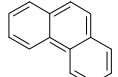
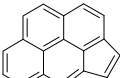
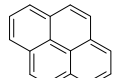
| List | Common Name | Structure | List | Common Name | Structure |
|--------------|----------------------|---|--------------|------------------------|---|
| EPA, SCF, EU | Benzo[a]pyrene |  | EPA, SCF, EU | Dibenz[a,h]anthracene |  |
| EPA | Acenaphthene |  | EU+SCF | Dibenzo[a,e]pyrene |  |
| EPA | Acenaphthylene |  | EU+SCF | Dibenzo[a,h]pyrene |  |
| EPA | Anthracene |  | EU+SCF | Dibenzo[a,i]pyrene |  |
| EPA, SCF, EU | Benz[a]anthracene |  | EU+SCF | Dibenzo[a,l]pyrene |  |
| EPA, SCF, EU | Benzo[b]fluoranthene |  | EPA | Fluoranthene |  |
| SCF, EU | Benzo[j]fluoranthene |  | EPA | Fluorene |  |
| EPA, SCF, EU | Benzo[k]fluoranthene |  | EPA, SCF, EU | Indeno[1,2,3-cd]pyrene |  |
| EU | Benzo[c]fluorene |  | EU+SCF | 5-Methylchrysene |  |
| EPA, SCF, EU | Benzo[ghi]perylene |  | EPA | Naphthalene |  |
| EPA, SCF, EU | Chrysene |  | EPA | Phenanthrene |  |
| SCF, EU | Cyclopenta[cd]pyrene |  | EPA | Pyrene |  |

Table 2: General informative links for PAHs

| Compound (common name) | CAS Name | CAS n. | References |
|-----------------------------------|-----------------------------|---------------|---|
| Polycyclic aromatic hydrocarbons | NA ⁽¹⁾ | | NIST special publication 922 "Polycyclic Aromatic Hydrocarbon Structure Index" |
| | | | Australian Government - Factsheet |
| | | | JINNO Laboratory - PAHs database (Physical properties and HPLC chromatograms) |
| | | | ATSDR document |
| | | | Wikipedia - PAHs |
| Benzo[a]pyrene (BaP) | Benzo[a]pyrene | 00050-32-08 | NIST database |
| | | | National Center for Biotechnology Information (NCBI) - Public Chemical Database (PubChem) |
| | | | JINNO database |
| | | | Spectrum Laboratories (SpecLab) - Chemical fact sheet |
| | | | Wikipedia - Benzo [a]pyrene |
| Acenaphthene | Acenaphthylene | 000083-32-9 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| | | | Wikipedia - Acenaphthene |
| Acenaphthylene | Acenaphthylene, 1,2-dihydro | 000208-96-8 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| | | | Wikipedia – Acenaphthylene |
| Anthracene | Anthracene | 000120-12-7 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |

| Compound (common name) | CAS Name | CAS n. | References |
|-----------------------------------|--------------------------|---------------|--|
| | | | Wikipedia - Anthracene |
| Benz[a]anthracene (BaA) | Benz[a]anthracene | 000056-55-3 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| Benzo[b]fluoranthene (BbF) | Benz[e]acephenanthrylene | 000205-99-2 | NIST database |
| | | | NCBI – Pubchem |
| | | | SpecLab database |
| | | | Wikipedia - Benzo[b]fluoranthene |
| Benzo[j]fluoranthene (BjF) | Benzo[j]fluoranthene | 000205-82-3 | NIST database |
| | | | NCBI – Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| Benzo[k]fluoranthene (BkF) | Benzo[k]fluoranthene | 000207-08-9 | NIST database |
| | | | NCBI – Pubchem |
| | | | SpecLab database |
| | | | Wikipedia - Benzo[k]fluoranthene |
| Benzo[c]fluorene (BcL) | 7H-Benzo[c]fluorene | 000205-12-9 | NIST database |
| | | | NCBI – Pubchem |
| Benzo[ghi]perylene (BgP) | Benzo[ghi]perylene | 000191-24-2 | NIST database |
| | | | NCBI – Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| Chrysene (CHR) | Chrysene | 000218-01-9 | NIST database |
| | | | NCBI – Pubchem |
| | | | JINNO database |
| | | | SpecLab database |

| Compound (common name) | CAS Name | CAS n. | References |
|------------------------------------|----------------------------------|---------------|---|
| | | | Wikipedia – Chrysene |
| Cyclopenta [cd]pyrene (CPP) | Cyclopenta [cd]pyrene | 027208-37-3 | NIST databse NCBI – Pubchem |
| Dibenz[a,h] anthracene (DhA) | 1,2,5,6- Dibenzanthracene | 000053-70-3 | NIST databse NCBI - Pubchem JINNO database SpecLab database Wikipedia - Dibenz[a,h]anthracene |
| Dibenzo [a,e]pyrene (DeP) | Naphtho[1,2,3,4- def]chrysene | 000192-65-4 | NIST database NCBI - Pubchem SpecLab database |
| Dibenzo[a,h]pyrene (DhP) | Dibenzo[b,def] chrysene | 000189-64-0 | NIST database NCBI - Pubchem JINNO database |
| Dibenzo [a,l]pyrene (DiP) | Benzo[rsf] pentaphene | 000189-55-9 | NIST database NCBI - Pubchem |
| Dibenzo [a,l]pyrene (DIP) | Dibenzo[def,p] chrysene | 000191-30-0 | NIST database NCBI - Pubchem |
| Fluoranthene | Fluoranthene | 000206-44-0 | NIST database NCBI - Pubchem JINNO database SpecLab database Wikipedia - Fluoranthene |
| Fluorene | 9H-Fluorene | 000086-73-7 | NIST database NCBI - Pubchem JINNO database SpecLab database Wikipedia - Fluorene |
| Indeno[1,2,3- | Indeno[1,2,3-cd] | 000193-39-5 | NIST database |

| Compound (common name) | CAS Name | CAS n. | References |
|-----------------------------------|--------------------|---------------|--|
| cd]pyrene (IcP) | pyrene | | NCBI - Pubchem |
| 5-Methyl Chrysene (5MC) | Chrysene, 5-Methyl | 003697-24-3 | NCBI - Pubchem |
| Naphthalene | Naphthalene | 000091-20-3 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| | | | Wikipedia - Naphthalene |
| Phenanthrene | Phenanthrene | 000085-01-8 | NIST database |
| | | | NCBI - Pubchem |
| | | | JINNO database |
| | | | SpecLab database |
| | | | Wikipedia - Phenanthrene |
| Pyrene | Pyrene | 000129-00-0 | NIST database |
| | | | JINNO database |
| | | | SpecLab database |
| | | | NCBI - Pubchem |
| | | | Chemicaland21 - product identification |
| | | | Wikipedia - Pyrene |

(1) Not available

PAHs included in EU legislation

[Eur-lex: direct access to European Law](#) (Regulations, Directives, Decisions plus Commission staff working documents, Reports, Proposals for new legislation, Recommendations, etc.)

Table 3: EU legislation concerning PAHs in food and environment

| Legislative Reference | Matrix | ML⁽¹⁾ (Y/N) | Compound |
|--|---------------|-----------------------------------|--|
| Commission Regulation (EC) No 1881/2006 Amended by Commission Regulation (EU) No 835/2011 | Food | N ⁽²⁾ | 16 EPA PAHs (mentioned as generic carcinogenic PAHs at point 58). Not included in other lists: Acenaphthene, Acenaphthylene, Anthracene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene, Pyrene 15+1 EU PAHs: Benzo[<i>a</i>]anthracene, Benzo[<i>b</i>]fluoranthene, Benzo[<i>j</i>]fluoranthene, Benzo[<i>k</i>]fluoranthene, Benzo[<i>c</i>]fluorene, Benzo[<i>ghi</i>]perylene, Chrysene, Cyclopenta[<i>cd</i>]pyrene, Dibenzo[<i>a,h</i>]anthracene, Dibenzo[<i>a,e</i>]pyrene, Dibenzo[<i>a,h</i>]pyrene, Dibenzo[<i>a,i</i>]pyrene, Dibenzo[<i>a,l</i>]pyrene, Indeno[1,2,3- <i>cd</i>]pyrene, 5-Methylchrysene |
| | | Y | Benzo[<i>a</i>]pyrene plus the sum of the 4 marker PAHs (Benzo[<i>a</i>]pyrene, Benzo[<i>a</i>]anthracene, Benzo[<i>b</i>]fluoranthene, and Chrysene) |
| Commission Regulation (EC) No 333/2007 Amended by Commission Regulation (EU) No 836/2011 | Food | N | Benzo[<i>a</i>]pyrene Plus Benzo[<i>a</i>]anthracene, Benzo[<i>b</i>]fluoranthene, and Chrysene |
| Commission Recommendation (2005/108/EC) of 4 February 2005 on the further investigation into the levels of polycyclic aromatic hydrocarbons in certain foods | Food | N | 15 SCF PAHs: Benzo[<i>a</i>]pyrene, Benzo[<i>a</i>]anthracene, Benzo[<i>b</i>]fluoranthene, Benzo[<i>j</i>]fluoranthene, Benzo[<i>k</i>]fluoranthene, Benzo[<i>c</i>]fluorene, Benzo[<i>ghi</i>]perylene, Chrysene, Cyclopenta[<i>cd</i>]pyrene, Dibenzo[<i>a,h</i>]anthracene, Dibenzo[<i>a,e</i>]pyrene, Dibenzo[<i>a,h</i>]pyrene, Dibenzo[<i>a,i</i>]pyrene, Dibenzo[<i>a,l</i>]pyrene, Indeno[1,2,3- <i>cd</i>]pyrene, 5-Methylchrysene |

| Legislative Reference | Matrix | ML⁽¹⁾ (Y/N) | Compound |
|--|------------------------------------|-----------------------------------|--|
| Commission Regulation (EC) No 627/2006 | Primary smoke products | N | 15 SCF PAHs, Benzo[a]pyrene, Benzo[a]anthracene |
| Regulation (EC) No 2065/2003 of the European Parliament and of the Council | Primary smoke products | Y | Benzo[a]pyrene, Benzo[a]anthracene |
| Directive 2000/76/EC of the European Parliament and of the Council | Emissions from incineration plants | N | PAHs (Mentioned as carcinogenic compounds that might be subject to limitations in Member States' regulations) |
| Decision No 2455/2001/EC of the European Parliament and the Council | Water | N | PAHs (Annex: Identified as priority hazardous substance), Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[ghi]perylene, Benzo[k]fluoranthene, Indeno[1,2,3-cd]pyrene |
| Directive 2004/107/EC of the European Parliament and the Council | Ambient air | Y | Benzo[a]pyrene |

(1) Maximum level (Y=yes; N=no)

(2) benzo[a]pyrene is considered a marker for PAHs

Toxicity of PAHs included in EPA and EU lists

1. [IARC \(International Agency for Research on Cancer\) classification](#)
2. [IARC alphabetical list of carcinogenic agents](#)
3. For most of the PAHs of interest the information can be found in the following IARC volumes (if it is not the case a different link is reported for the single PAH):
 - a. [IARC Monographs Volume 92](#)
 - b. [IARC Monograph Volume 32](#)
 - c. [IARC Monographs: Supplement 7 - Update of Volumes 1-42](#)
4. [OECD \(Organisation for Economic Co-operation and Development\) guidelines for the testing of chemicals](#)

Table 4: IARC classification for carcinogenicity

| Group | Definition |
|--------------|---|
| 1 | The agent (mixture) is carcinogenic to humans. The exposure circumstance entails exposures that are carcinogenic to humans |
| 2A | The agent (mixture) is probably carcinogenic to humans. The exposure circumstance entails exposures that are probably carcinogenic to humans. |
| 2B | The agent (mixture) is possibly carcinogenic to humans. The exposure circumstance entails exposures that are possibly carcinogenic to humans. |
| 3 | The agent (mixture or exposure circumstance) is not classifiable as to its carcinogenicity to humans. |
| 4 | The agent (mixture) is probably not carcinogenic to humans. |

Table 5: Toxicology and epidemiology related links

| Compound | Matrix | References |
|---|--|---|
| PAHs | Food | Polycyclic Aromatic Hydrocarbons in Food Scientific Opinion of the Panel on Contaminants in the Food Chain Adopted on 9 June 2008: The EFSA Journal (2008) 724, 1-114 |
| | Food | Opinion of the Scientific Committee on Food on the risks to human health of Polycyclic Aromatic Hydrocarbons in food (expressed on 4 December 2002) SCF opinion (SCF/CS/CNTM/PAH/29_Final) |
| | Food | Guidance on submission of a dossier on a Smoke Flavouring Primary Product for evaluation by EFSA (adopted in 2004): EFSA guidance |
| | Feed | RIKILT report 2007.020 |
| | Feed | RIKILT report 2006.001 |
| | NS ⁽¹⁾ | Toxicological profile of Polycyclic aromatic hydrocarbons compiled by The Agency for Toxic Substances and Disease Registry (ATSDR) – US: ASTDR toxicological profile |
| | NS ⁽¹⁾ | Health/Environmental Hazard reported for PAHs by Australian Government: Substance profile |
| | Environment | Environmental Protection Agency (EPA-US) toxicological profile: EPA NCEA |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| NS ⁽¹⁾ | World Health Organisation (WHO) Environmental Health Criteria: EHC Monograph n. 202 | |
| Benzo[a]pyrene (IARC classification: 1) | NS ⁽¹⁾ | EPA-IRIS (Integrated Risk Information System) oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA - Cancer potency information |
| | Food ⁽¹⁾ | World Health Organisation (WHO) – JECFA Monographs: WHO Food Additives Series 28 |
| | NS ⁽¹⁾ | The Risk assessment information system toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0104 |
| Acenaphthene | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |

| Compound | Matrix | References |
|---|-------------------|--|
| (IARC classification: 3) | NS ⁽¹⁾ | General factsheet: EPA - Hazardous wastes |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 1674 |
| Acenaphthylene (no IARC classification) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous wastes |
| Anthracene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| | NS ⁽¹⁾ | Minimal Risk Levels (MRLs) as defined by ATSDR – US: ASTDR MRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0825 |
| Benz[a]anthracene (IARC classification 2B) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0385 |
| Benzo[b]fluoranthene (IARC classification 2B) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0720 |
| | Air | Occupational Safety & Health Administration (OSHA) guidelines: OSHA health guideline |

| Compound | Matrix | References |
|--|-------------------|--|
| Benzo[<i>j</i>]fluoranthene (IARC classification 2B) | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| Benzo[<i>k</i>]fluoranthene (IARC classification 2B) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0721 |
| Benzo[<i>c</i>]fluorene (IARC classification 3) | NS ⁽¹⁾ | IARC references reported at the beginning of the chapter |
| Benzo[<i>ghi</i>]perylene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0739 |
| Chrysene (IARC classification 2B) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 1672I |
| Cyclopenta[<i>cd</i>]pyrene (IARC classification 2A) | NS ⁽¹⁾ | IARC references reported at the beginning of the chapter |
| Dibenzo[<i>a,h</i>]anthracene (IARC classification 2A) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |

| Compound | Matrix | References |
|---|-------------------|--|
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0431 |
| Dibenzo[a,e]pyrene (IARC classification 3) | NS ⁽¹⁾ | IARC references reported at the beginning of the chapter |
| Dibenzo[a,h]pyrene (IARC classification 2B) | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| Dibenzo[a,i]pyrene (IARC classification 2B) | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| Dibenzo[a,l]pyrene (IARC classification 2A) | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| Fluoranthene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| Fluorene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| Indeno[1,2,3-cd]pyrene (IARC classification 2B) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0730 |
| 5-Methylchrysene (IARC classification 2B) | NS ⁽¹⁾ | Not Significant Risk Level (NSRL) as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| Naphthalene (IARC classification 2B) | NS ⁽¹⁾ | Carcinogenicity: IARC Monograph Volume 82 |
| | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |

| Compound | Matrix | References |
|--|-------------------|--|
| | NS ⁽¹⁾ | Chronic Reference Exposure Levels as defined by Office of Environmental Health Hazard Assessment of California (US): OEHHA NSRL |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 0667 |
| Phenanthrene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| Pyrene (IARC classification 3) | NS ⁽¹⁾ | Oral RfD and Carcinogenicity: IRIS toxicological report |
| | NS ⁽¹⁾ | General factsheet: EPA - Hazardous waste |
| | NS ⁽¹⁾ | The Risk assessment information system Toxicity profile: RAIS |
| | NS ⁽¹⁾ | International Labour Organisation (ILO) Safety factsheet: ICSC - 1474 |

(1) Not specified

Occurrence

On the web site of the Directorate-General for Health and Consumers (DG Health and Consumers), under the Rapid Alert System for Food and Feed, a list of alert notifications, information notifications and border rejections for various contaminations and/or non-compliances for food and feed can be found: [RASFF](#), [RASFF portal](#), [RASFF 2009 report](#), [International Portal on Food Safety, Animal & Plant Health](#)

Table 6: Some links concerning PAHs occurrence in various matrices

| Matrix | Link |
|---|--|
| Food | JECFA meeting 2005 (Evaluation of certain food contaminants — Report of the Joint FAO/WHO Expert Committee on Food Additives), 64th meeting, Rome, 8 to 17 February 2005, p. 1 and p. 61. WHO Technical Report Series, No. 930, 2006 JECFA Report on contaminants JECFA Report - PAHs session |
| | Findings of the EFSA Data Collection on Polycyclic Aromatic Hydrocarbons in Food - EFSA report: EFSA/DATEX/002 (rev. 1) |
| | SCOOP report: Collection of occurrence data on Polycyclic Aromatic Hydrocarbons in food Task 3.2.12 (October 2004) Annex 1-5 Annex 6 Annex 7 Annex 8-9 |
| | Contamination from direct smoking CODEX Alimentarius document |
| | Occurrence in Food and Feed ASEAN food safety document |
| | Occurrence in cow milk EPA document |
| Environment – Contamination from Mobile sources | Polycyclic Aromatic Hydrocarbons: Evaluation of Sources and Effects. Commission of Life Sciences on-line book: pages 1-52 |
| Environment – Contamination from Stationary sources | Polycyclic Aromatic Hydrocarbons: Evaluation of Sources and Effects. Commission of Life Sciences on-line book: pages 53-96 |
| Ground and drinking water | EPA-Drinking Water and Health pages Technical factsheet |
| Air | Ambient air pollution by Polycyclic Aromatic Hydrocarbons (PAH). European Commission Position Paper (2001) |

Useful links

European Commission

DG Health and Consumers – Food and feed safety – Contaminants: [Polycyclic Aromatic Hydrocarbons \(PAH\)](#) (Directorate General Health and Consumers of the European Commission)

[EFSA](#) (European Food Safety Authority)

International organisations of general interest for analytical chemistry and food safety

[ACS-AGFD](#) & [ACS-AC](#) (American Chemical Society – Agricultural and Food Chemistry Division & Analytical Chemistry Division)

[AOAC](#) (AOAC International – The Association of Official Analytical Chemists)

[CEN](#) (European Committee for Standardization)

[CIAA](#) (Confederation of the Food and Drink Industries in the EU). The webpage includes general information about food production and agricultural subjects.

[CITAC](#) (Cooperation on International Traceability in Analytical Chemistry)

[Codex Alimentarius](#) (Joint FAO/WHO Food Standards)

[EA](#) (European co-operation for Accreditation: association for accreditation bodies)

[Eurachem](#) (A network of organisations working for the improvement of traceability of chemical measurements)

[Euramet](#) (European Association of National Metrology Institutes)

[Eurolab](#) (the European Federation of National Associations of Measurement, Testing and Analytical Laboratories)

[FDA](#) (US Food and Drug Administration - Food Safety)

[FAO](#) (Food and Agriculture Organization of the United Nations)

[IAF](#) (International Accreditation Forum)

[IAFP](#) (International Association for Food Protection portal)

[ILAC](#) (International Laboratory Accreditation Cooperation)

[ILSI Europe](#) (International Life Sciences Institute)

[IPFSAPH](#) (International Portal on Food Safety, Animal and Plant Health - IPFSAPH)

[ISO](#) (International Organization for Standardization)

[IUPAC](#) (International Union of Pure and Applied Chemistry)

[NIST](#) (National Institute of Standards and Technology - US)

[NMI](#) (National Measurement Institute – Australia)

[NMKL](#) (Nordic committee on food analysis – Methods, Guidelines - e.g. Validation Protocol, Measurement Uncertainty - Training, list of Expert Laboratories are only a few examples of the very useful information that are available in the web-page, some information only accessible upon subscription)

[OECD](#) (Organisation for economic co-operation and development)

[VAM](#) (National Measurement System - Chemical and Biological Metrology Website: Guides and other useful publications)

[WTO](#) (World Trade Organisation)

Organisations of specific interest and some e-publications

[Food magazine.eu](#)

[ISPAC](#) (International Society for Polycyclic Aromatic Compounds web page and its Newsletter)

[EU-RLs-Pesticides](#) (common portal for all European Union Reference Laboratories for Residues of Pesticides)

[EU-RL for dioxins and PCBs in feed and food](#)

[Fera](#) (The food and Environment Research Agency web site)

[Molnar Institute](#) (Software for chromatography, collection of literature on HPLC methods development and application, training)

[RIKILT](#) (RIKILT – Institute of Food Safety is an independent research institute in the area of safe and healthy food)

Publications

Some of the most popular search engines that can be used to find scientific literature sources (books, journals and others) and to search for specific items are listed below:

[SCIRUS](#) (over 450 million scientific items indexed)

[Food navigator](#) (Foodnavigator.com Europe)
[Agris](#) (FAO Search application for Agricultural Sciences and Technologies)
[SCOPUS](#)
[ScienceDirect](#)
[SwetsWise](#)
[PubMed](#)
[EBSCO](#)
[Springerlink](#)
[Elsevier](#)

Books

The following books could be considered as a helpful support in the field of PAHs.

Large (C_n = 24) Polycyclic Aromatic Hydrocarbons: Chemistry and Analysis, J.C. Fetzer, Editor. **2000**: Wiley.

[Wiley link for book description](#)

The carcinogenic effects of Polycyclic Aromatic Hydrocarbons, A. Luch, Editor. **2005**: Massachusetts Institute of Technology.

[World Scientific link for book description](#)

Food Contaminants and residue analysis, 51, Y. Picó, Editor. **2008**: Elsevier.

[Elsevier link for book description](#)

Guidelines

Description of Standardisation bodies activities

CEN (European Committee for Standardization) TC 275 is the Technical Committee for Food Analysis – Horizontal methods. Via the following link the current activities of the committee including released standards and on-going activities for the preparation of new standards can be consulted. Working group (WG) 13 (Neo formed contaminants) and WG 0 (General considerations) are the two WGs dealing with items of interest for laboratories performing PAHs determinations in food matrices. [CEN/TC 275](#)

ISO (International Organization for Standardization) is composed of many different Technical Committees. TC 34 (Food products), TC 69 (Applications of statistical methods), TC 176 (Quality management and quality assurance) and TC 243 (Project Committee: Consumer product safety) are the relevant ones for Food Control Laboratories. In the ISOTC Portal all information about current activities of the TCs can be found, within the Public information folder:

[ISO TC 34 \(Food Products\) Newsletter](#)

[ISO TC 69 webpage](#)

[ISO TC 176 webpage](#)

[ISO TC 243 webpage](#)

List of useful links to documents

[DG Health and Consumers Report on compliancy to legislative limits](#)

DG SANCO Report on the relationship between analytical results, measurement uncertainty, recovery factors and the provisions of EU Food and Feed legislation, with particular reference to Community legislation concerning contaminants in food and undesirable substances in feed

[AOAC Document on method validation](#)

Validation: An invisible Component of Measurement. An explicative paper concerning the meaning of validation, written by Horwitz.

[AOAC Book on accreditation](#)

AOAC Book "Guidelines for Laboratories Performing Microbiological and Chemical Analyses of Food and Pharmaceuticals"

[AOAC ALACC Guide 2007](#)

AOAC Guide "How to Meet ISO 17025 - Requirements for Method Verification"

[CEN Guidance document](#)

Guidance - Uncertainty of measurement concept in European Standards

[List of EA publications](#)

[EA 04/16](#)

European Co-operation for Accreditation "EA guidelines on the expression of uncertainty in quantitative testing"

[EA 04/14](#)

EA Guideline "The Selection and Use of Reference Materials"

[EA 04/18](#)

EA Guideline "Guidance on the level and frequency of proficiency testing participation"

[Eurachem guide on uncertainty](#)

Measurement uncertainty arising from sampling: A guide to methods and approaches
Produced jointly by Eurachem, EUROLAB, CITAC, Nordtest and the RSC Analytical Methods Committee

[Eurachem guide on compliance of results](#)

Eurachem/CITAC guide: "Use of uncertainty information in compliance assessment"

[Eurachem guide on fitness for purpose](#)

Eurachem Guide "The Fitness for Purpose of Analytical Methods. A Laboratory Guide to Method Validation and Related Topics"

[Eurachem/CITAC CG2](#)

Eurachem/CITAC Guide "Quality Assurance for Research and Development and Non-routine Analysis"

[IUPAC/ISO/AOAC International/Eurachem report on recovery](#)

"Harmonised guidelines for the use of recovery information in analytical measurement"

[Eurachem/CITAC CG4](#)

EURACHEM / CITAC Guide "Quantifying Uncertainty in Analytical Measurement" Second Edition

[Eurachem guide on proficiency testing](#)

Eurachem Guide "Selection, use and interpretation of proficiency testing (PT) schemes by laboratories – 2000 Edition 1.0"

[Eurachem guide on VIM 3](#)

Eurachem Guide "Terminology in Analytical Measurement: Introduction to VIM 3"

[Eurachem/CITAC guide on accreditation](#)

Eurachem/CITAC "Guide to Quality in Analytical Chemistry - An Aid to Accreditation"

[Eurachem guide EEE-RM-062rev3](#)

Eurachem Guide "The selection and use of Reference Materials – A basic guide for laboratories and accreditation bodies"

[Eurachem/CITAC guide on traceability](#)

EURACHEM / CITAC Guide "Traceability in Chemical Measurement - A guide to achieving comparable results in chemical measurement"

[EU-RL PAHs document on calibration](#)

Frequently asked questions on calibration

[Eurolab Report on MU](#)

Eurolab Technical Report n. 1/2007 "Measurement uncertainty revisited: Alternative approaches to uncertainty evaluation"

[Eurolab Report on Flexible Scope Accreditation](#)

Eurolab Technical Report n. 2/2008 "EUROLAB Inquiry: Use of the Accreditation Symbol and Accreditation with Flexible Scope – Results"

[ILAC Guidelines](#) (a list of the issued documents related to Quality Assurance and Control in Laboratories)

[ILAC Document on MU](#)

ILAC Guide G17:2002 "Introducing the Concept of Uncertainty of Measurement in Testing in Association with the Application of the Standard ISO/IEC 17025"

[ILAC Document on RM](#)

ILAC Guide G9:2005 "Guidelines for the Selection and Use of Reference Materials"

[ILAC Document on Calibration](#)

ILAC Guide G24:2007 "Guidelines for the determination of calibration intervals of measuring instruments"

[ILAC document on reporting of results](#)

ILAC Guide G8:2009 "Guidelines on the Reporting of Compliance with Specification"

[ILAC Document for scope of accreditation](#)

ILAC Guide G18:2010 "Guideline for the Formulation of Scopes of Accreditation for Laboratories"

[ISO Standard](#)

ISO Guide 33:2000 "Uses of certified reference materials"

[ISO Technical Specification](#)

ISO/TS 21748:2004 "Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation"

[ISO Standard](#)

ISO 13528:2005 "Statistical methods for use in proficiency testing by interlaboratory comparisons"

[ISO Standard](#)

ISO 17043:2010 "Conformity assessment -- General requirements for proficiency testing"

[ISO Standard](#)

ISO Guide 32:1997 "Calibration in analytical chemistry and use of certified reference materials"

[ISO Standard](#)

ISO 11843-1:1997 "Capability of detection -- Part 1: Terms and definitions"

[ISO Standard](#)

ISO 11843-2:2000 "Capability of detection -- Part 2: Methodology in the linear calibration case"

[ISO Standard](#)

ISO 11843-3:2003 "Capability of detection -- Part 3: Methodology for determination of the critical value for the response variable when no calibration data are used"

[ISO Standard](#)

ISO 11843-4:2003 "Capability of detection -- Part 4: Methodology for comparing the minimum detectable value with a given value"

[ISO Standard](#)

ISO 11843-5:2008 "Capability of detection -- Part 5: Methodology in the linear and non-linear calibration cases"

[ISO Standard](#)

ISO 11095:1996 "Linear calibration using reference materials"

[ISO Standard](#)

ISO 28037:2010 "Determination and use of straight-line calibration functions"

[ISO Standard](#)

ISO 21748:2010 "Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty estimation"

[ISO Standard](#)

ISO 7966:1993 "Acceptance control charts"

[ISO Standard](#)

ISO 7870-1:2007 "Control charts -- Part 1: General guidelines"

[ISO Standard](#)

ISO 8258:1991 "Shewhart control charts"

[ISO Standard](#)

ISO/TR 7871:1997 "Cumulative sum charts -- Guidance on quality control and data analysis using CUSUM techniques"

[ISO Standard](#)

ISO 7873:1993 "Control charts for arithmetic average with warning limits"

[ISO Standard](#)

ISO 3534-1:2006 "Statistics -- Vocabulary and symbols -- Part 1: General statistical terms and terms used in probability"

[ISO Standard](#)

ISO 3534-2:2006 "Statistics -- Vocabulary and symbols -- Part 2: Applied statistics"

[ISO Standard](#)

ISO 3534-3:1999 "Statistics -- Vocabulary and symbols -- Part 3: Design of experiments"

[IUPAC Document on PTs](#)

IUPAC Technical report – "The International Harmonized Protocol for the proficiency testing of analytical chemistry laboratories" M. Thompson et al.

[IUPAC Document on IQC](#)

IUPAC Technical report - "Harmonized guidelines for internal quality control in analytical chemistry laboratories" M. Thompson and R. Wood

[IUPAC Document on MV](#)

IUPAC Technical report – " Harmonized guidelines for single-laboratory validation of methods of analysis" M. Thompson et al.

[IUPAC Document on recovery](#)

IUPAC Recommendations "Use of the terms "recovery" and "apparent recovery" in analytical procedures" D.T. Burns et al.

[LGC Best practice guide for calibration design](#)

LGC Document "Preparation of calibration curves – a guide to best practice. (2003)

[NIST Document on MU](#)

NIST Technical Note 1297 - 1994 Edition "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results"

[NMS list of Guides](#)

National Measurement System: Chemical and Biological Metrology Website

[NORDTEST Document on MU](#)

NORDTEST Technical report 537 (2003) – "Handbook for Calculation of Measurement Uncertainty in Environmental Laboratories"

[The Royal Society of Chemistry - AMC](#)

Analytical Methods Committee Technical Briefs: a series of short publications of very high utility for analytical chemists

[VIM 2008](#)

International vocabulary of metrology — Basic and general concepts and associated terms

Training

Institute for Reference Materials and Measurements

[IRMM training page](#)

SARAF (School for Advanced Residue Analysis in Food)

Courses about analytical, QC and QA, reporting aspects for residues in food.

[SARAF](#)

Basic Toxicology Courses. Covered topics range from basic principles of toxicology to epidemiology, from legislation to risk assessment.

[EUROTOX](#)

European Union Reference Laboratory for Single Residue Methods training programme 2008

[EU-RL pesticides training page](#)

Molnar Institute intensive courses for HPLC users

[MI courses](#)

The United Kingdom Accreditation Service calendar of courses

[UKAS training](#)

Proficiency testing providers

Database of Proficiency Tests available in Europe: [EPTIS](#)

[European Union Reference Laboratory for Dioxins and PCBs in feed and food](#)

[FAPAS](#)

[FEPAS](#)

[LGC](#)

[European Union Reference Laboratories for Residues Portal](#)

[National Measurement Institute](#) of Australia

[UNICHIM](#) (in Italian)

Suppliers of calibration standards (pure substances, solutions, isotopically labelled standards)

Single standards (solid and solutions) and mixtures, from different suppliers

[ISPAC webpage](#)

Single standards, solid

[MP Bio list of standards](#)

Single standards (solid and solutions) and mixtures, from different suppliers

[ChemIndustry: example of search for benz\[a\]pyrene](#)

Single standards, solid

[ALFA Aesar](#)

Single standards (solid and solutions, native and labelled) or kits for EPA methods

[SIGMA Aldrich](#)

Single standards (solid and solutions, native and labelled) or kits for EPA methods

[VWR](#)

Single standards (solid and solutions) and mixtures, from different suppliers

[chemexper.com](#)

Single standards (solid and solutions, native and labelled) or kits for EPA methods

[LGC standards](#)

Single standards (solid and solutions, native and labelled) or kits for EPA methods

[Dr. Ehrenstorfer](#)

Single standards (solid and solutions, native and labelled) or kits for EPA and other methods

[CHIRON](#)

Certified reference materials and reference materials

Certified matrix and pure substance reference materials

[JRC-IRMM catalogue PDF format](#) or [JRC-IRMM catalogue search engine](#)

BCR® - 458 (coconut oil PAHs doped)

[JRC - IRMM link to the product](#)

BCR® - 459 (coconut oil PAHs blank)

[JRC - IRMM link to the product](#)

BCR® - 524 (Industrial soil containing PAHs and pentachlorophenol)

[JRC - IRMM link to the product](#)

BCR® - 535 (Freshwater harbour sediment containing PAHs)

[JRC - IRMM link to the product](#)

BCR® - 683 (Beech wood containing PAHs and pentachlorophenol)

[JRC - IRMM link to the product](#)

SRM® - 1647e (16 EPA PAHs in acetonitrile)

[NIST link to the product](#)

SRM® - 1597a (complex mixture of Polycyclic Aromatic Hydrocarbons (from coal tar) in toluene)

[NIST link to the product](#)

SRM® - 1974b (Organics in Mussel Tissue - Mytilus edulis)

[NIST link to the product](#)

SRM® - 2977 (Mussel Tissue - Organic Contaminants and Trace Elements)

[NIST link to the product](#)

SRM® - 1946 (Lake Superior Fish Tissue)

[NIST link to the product](#)

ERM® - CC013a (PAHs in soil)

[BAM webpage](#)

Reference material IAEA-432 (Mytilus edulis –mussel - freeze dried homogenate containing chlorinated compounds and petroleum hydrocarbons)

[IAEA link to the product](#)

Reference material IAEA-406 (Fish freeze dried homogenate containing chlorinated compounds and petroleum hydrocarbons)

[IAEA link to the product](#)

Reference material IAEA-140/oc (Seaweed - Fucus sp. - dried homogenate containing chlorinated compounds and petroleum hydrocarbons)

[IAEA link to the product](#)

Materials characterised by proficiency testing providers

FAPAS

Analytical methods

Table 7: Standardised methods for PAHs determination in various matrices

| Matrix | Method | Comments/links |
|------------------------|--|--|
| Food | ISO/CD TR 24054 | Animal and vegetable fats and oils -- Determination of polycyclic aromatic hydrocarbons (PAH) -- Method using gas chromatography/mass spectrometry (GC/MS) ISO purchase page |
| Food | EN ISO 15753:2006 | Animal and vegetable fats and oils - Determination of polycyclic aromatic hydrocarbons CEN standards TC 275 |
| Food | EN ISO 15302:2007 | Animal and vegetable fats and oils -- Determination of benzo[a]pyrene -- Reverse-phase high performance liquid chromatography method ISO purchase page |
| Primary smoke products | Collaborative study validation. JRC-IRMM | Validation of two Methods for the Quantification of Polycyclic Aromatic Hydrocarbons in Primary Smoke Condensates: Report on the Collaborative Trial Bookshop.europa |
| Water | EN ISO 17993:2002 | Water quality -- Determination of 15 polycyclic aromatic hydrocarbons (PAH) in water by HPLC with fluorescence detection after liquid-liquid extraction ISO purchase page |
| Drinking water | EPA Method 525 | Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry NEMI webpage |
| Wastewater | EPA Method 610 | PAHs: LL extraction + HPLC-FLD or GC-FID NEMI webpage |
| Wastewater | EPA Method 625 | PAHs and other chemical residues: LL extraction + GC/MS NEMI webpage |
| Water | ISO 7981-2:2005 ISO 7981-1:2005 | Water quality -- Determination of polycyclic aromatic hydrocarbons (PAH) -- Part 2: Determination of six PAH by high-performance liquid chromatography with fluorescence detection after liquid-liquid extraction ISO purchase page Water quality -- Determination of polycyclic aromatic hydrocarbons (PAH) -- Part 1: Determination of six PAH by high-performance thin-layer chromatography with fluorescence detection after liquid-liquid extraction ISO purchase page |
| Sediment water | EPA method 8272 | Parent and alkyl polycyclic aromatics in sediment pore water by solid-phase microextraction and gas chromatography/mass spectrometry in selected ion monitoring mode. EPA download PDF file of the method |

| Matrix | Method | Comments/links |
|------------------|-----------------|--|
| Water and wastes | EPA Method 8100 | PAHs: GC-FID NEMI webpage |
| | EPA Method 8310 | PAHs: HPLC-UVD NEMI webpage |
| Soil | ISO 18287:2006 | Soil quality -- Determination of polycyclic aromatic hydrocarbons (PAH) -- Gas chromatographic method with mass spectrometric detection (GC-MS) ISO purchase page |
| Air | EN 15549:2008 | Air quality - Standard method for the measurement of the concentration of benzo[a]pyrene in ambient air CEN standard |
| Waste | CEN 15527:2008 | Characterization of waste - Determination of polycyclic aromatic hydrocarbons (PAH) in waste using gas chromatography mass spectrometry (GC/MS) CEN standard |
| Food | AOAC 973.30 | Polycyclic Aromatic Hydrocarbons and Benzo[a]pyrene in food (1974) |

European Commission

JRC 66955 – Joint Research Centre – Institute for Reference Materials and Measurements

Title: Polycyclic Aromatic Hydrocarbons (PAHs) factsheet – 4th Edition

Author: Donata Lerda

2011 – 27 pp. – 21 x 29,7 cm

Abstract

This Technical Report of the European Union Reference Laboratory (EU-RL) for Polycyclic Aromatic Hydrocarbons (PAHs) aims to deliver useful scientific information to all laboratories dealing with PAHs determination in food, but also in other matrices.

Chemical data of the PAHs of concern (included in 16 EPA and/or 15+1 EU priority lists), European legislation related to PAHs in food and web-links to toxicological information on these compounds are reported. Also the occurrence and analytical methods are included. A long list of links to international organisations of general interest for analytical chemistry and food safety and of organisations of specific interest as well as some e-publications is included. Also links for books, international guidelines, proficiency test providers, standards suppliers can be found. From the previous edition, links were checked and, when necessary, corrected; some information was added.

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The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

