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Anthraquinone – origins and interpretation

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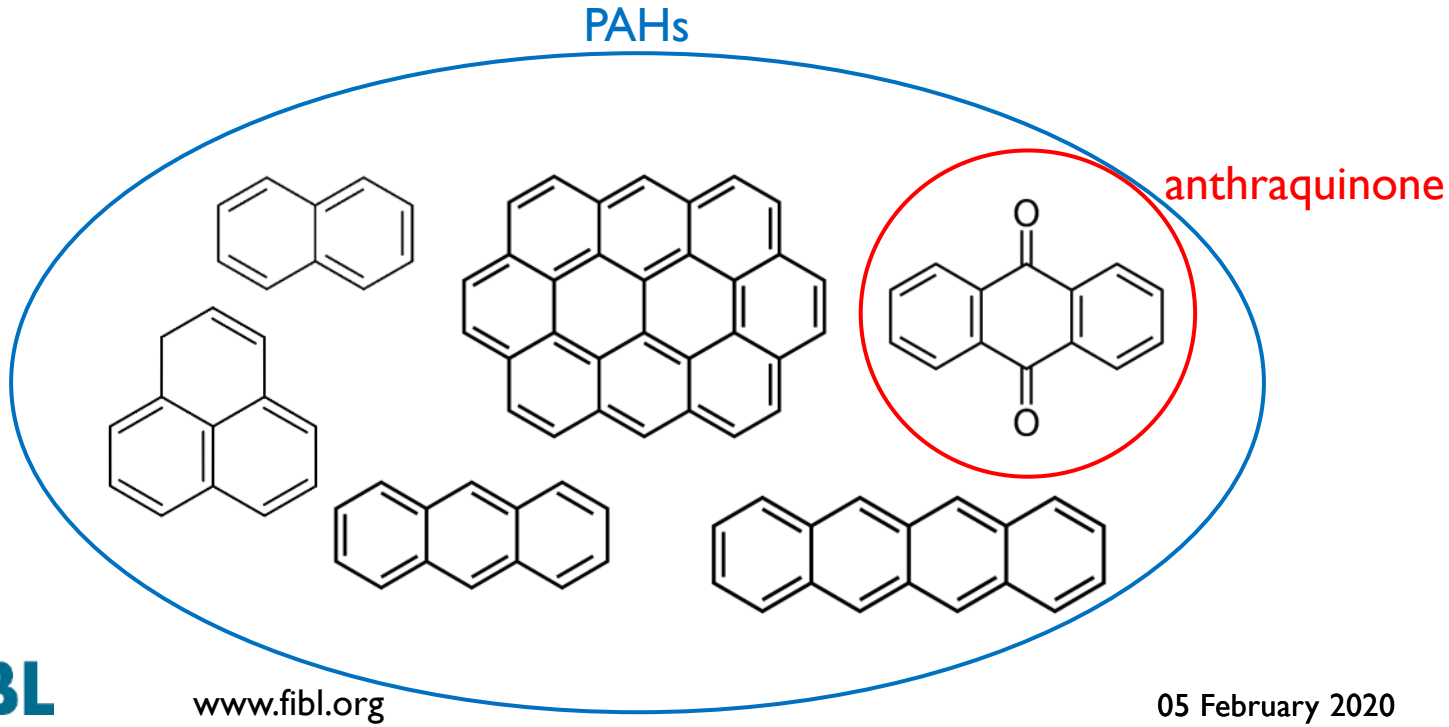
What is anthraquinone?

- Anthraquinone is an aromatic organic compound with the formula $C_{14}H_8O_2$.
- It belongs to the group of 'polycyclic aromatic hydrocarbons' (PAHs), a group of substances which contain multiple aromatic rings.



Origins of PAHs in general

- PAHs are formed during pyrolysis (incomplete combustion) of organic material, such as wood, petrol, coal, tobacco etc.
- Typical sources of PAHs
  - wood fires
  - tobacco smoking
  - heating (coal, petrol, wood etc)
  - traffic
  - indutrial sites
  - waste deposits

Origins of anthraquinone

- Anthraquinone can originate from the same sources as other PAHs (see previous slide).
- In addition, it has several specific applications:
  - precursor of dyestuffs / pigments
  - 'digester' in paper making
  - plant protection (details on following slides)
  - catalist in the production of hydrogen peroxide*
  - medical uses*

*not relevant for residue cases

Use as a pesticide

- The only pesticide use of anthraquinone is as a repellent seed treatment against birds.
- Effectivity has been demonstrated mainly for maize, rice, sunflower, wheat.
- It can also be used in other arable crops such as millet on seedlings of forest trees and near airports.
- In the EU, this use is not authorized any more since January 2009, due to human health concerns.
- In the USA, this use is authorised (trade name: Avipel).

Case study: possible seed treatment origin

- In a warehouse in Ukraine, dust was sampled and analyzed.
- The dust contained multiple pesticides and also anthraquinone.
- The warehouse was old and had previously been used for general storage purposes.
- It is possible (but could not be verified) that the warehouse was contaminated because
  - the warehouse had been used also for storage of seeds treated with anthraquinone as a bird repellent, or that
  - seeds had been treated with anthraquinone inside the warehouse.

Use in packaging materials

- In the past, anthraquinone was used as an additive in cellulose production, and has ended up in paper / cardboard.
- Anthraquinone derivatives are important pigments.
- In the EU, these uses are not authorised any more for food contact materials.

Contamination from drying, heating or smoking

Like all PAHs, anthraquinone is formed in combustion processes.

- open fires
- smoking of meat products
- cigarette smoking

Commodities where anthraquinone is regularly found

In the following commodities, anthraquinone is regularly detected:

- black teas
- dried mushrooms
- dried fruit and vegetables (less frequently)

Case study: black teas

- Study by Stiftung Warentest in 2014:
- 27 brands of black tea analyzed
- 8x Ceylon-Assam; 19x Darjeeling, incl. 6 organic Darjeeling teas
- All samples contained some anthraquinone, but amount varied greatly (0.006 – 0.076 mg/kg)
- 2 samples exceeded the MRL of 0.02 mg/kg

Interpretation:

- Black tea is fermented at 30 °C, then dried at 85 °C.
- Traditionally, this is done with wood fire. This is a contamination risk.

Interpretation of anthraquinone findings

Unauthorized use, fraud issues:

- Is the crop grown from seed which may be picked by birds?
  - If yes: use as a repellent is possible
  - If no: use as a repellent is not possible

The answer is **no** for:
- black teas
- dried mushrooms
- dried fruit and vegetables

Contamination, food safety issues:

- Is the food dried or heated, or does it have other contact with fires/smoke/exhausts?
- Is the food exposed to cigarette smoke, traffic exhausts or industrial smoke?
- Were all packaging materials anthraquinone-free?

Enforcement decisions

Unauthorized use, fraud issues:

- If the investigation demonstrates unauthorized use, the lot has to be de-certified.

Contamination, food safety issues:

- If the MRL is exceeded, the lot cannot be marketed (neither as conventional nor as organic food).
- If anthraquinone levels are relatively high, the operator should check his procedures for contamination risks and possibly amend them.
  - Processing steps involving open fires are in the foreground.

Thank you for your attention!

If you have questions:

- FiBL report on anthraquinone: https://orgprints.org/34122/
- FiBL technical sheet on repelling rooks: https://shop.fibl.org/chde/1550-kraehenabwehr.html
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