POLYCYCLIC AROMATIC HYDROCARBONS - II

Uses

PAHs are not synthesized chemically for industrial purposes. Rather than industrial sources, the major source of PAHs is the incomplete combustion of organic material such as coal, oil and wood. However, there are a few commercial uses for many PAHs. They are mostly used as intermediaries in pharmaceuticals, agricultural products, photographic products, thermosetting plastics, lubricating materials, and other chemical industries. General uses are:

- Acenaphthene: manufacture of dyes, plastics, pigments, pharmaceuticals and pesticides
- Anthracene: manufacture of dyes and pigments;diluent for wood preservatives;
- Fluoranthene: manufacture of dyes, pharmaceuticals and agrochemicals.
- Fluorene: manufacture of dyes, pigments, pesticides, thermoset plastic and pharmaceuticals;
- Phenanthrene: manufacture of pesticides and resins
- Pyrene: manufacture of pigments

Other PAHs may be contained in asphalt used for the construction of roads, as well as roofing tar.

Precise PAHs, specific refined products, are used also in the field of electronics, functional plastics, and liquid crystals.

Routes of Exposure

The major route of exposure to PAHs in the general population is from breathing ambient and indoor air, eating food containing PAHs, smoking cigarettes, or breathing smoke from open fireplaces. Tobacco smoke contains a variety of PAHs, such as benzo(a)pyrene, and more than 40 known or suspected human carcinogens. For non-smokers the main route of exposure is through food. PAH concentrations in foodstuffs vary. Charring meat or barbecuing food over a charcoal, wood, or other type of fire greatly increases the concentration of PAHs. Some crops, such as wheat, rye, and lentils, may synthesize PAHs or absorb them via water, air, or soil. Water can also contain substantional amounts of PAHs since those chemicals can leach from soil into water or thex can enter water from industrial effluents and accidental spills during oil shipment at sea. Soil also contains PAHs, primarily from airborne fallout.

Therefore, PAH exposure occurs on a regular basis for most people. Occupational exposure may also occur in workers breathing exhaust fumes, such as mechanics, street vendors, motor

vehicle drivers, as well as those involved in mining, metal working, or oil refining. Routes of exposure include ingestion, inhalation, and dermal contact in both occupational and non-occupational settings. Some exposures may involve more than one route simultaneously, affecting the total absorbed dose (such as dermal and inhalation exposures from contaminated air).

Metabolism

Since exposure to PAHs is never to single PAHs, understanding what differences may occur in mixtures of PAHs gives an accurate assessment of the dangers of PAHs. Understanding the dynamics of complex metabolism vis-a-vis single metabolism of PAHs and possible effects on the toxicity expression of PAHs is a necessary advancement to accurately impact and guide remediation strategies.

Studies were carried out comparing the metabolism of the PAHs Phenanthrene (PHE), Flouranthene (FLA) and Benzo(a)pyrene (BAP) in single, binary, and ternary mixtures by monitoring the disappearance of the parent compound. It was observed that PAH metabolism in the single PAH experiment differed from metabolism in both binary and ternary mixtures. Enzyme competition was evident in the metabolism of mixtures, changing significantly the metabolism patterns of individual PAHs. PAH structure was also seen to affect metabolism in mixtures and the possible creation of toxicity effects during mixture metabolism. PAH concentration changed over time with faster change during single PAH metabolism followed by ternary mixture metabolism and finally binary metabolism. These results affirm that substrate interactions must be considered in the risk assessment approaches to the dangers posed by exposure to PAHs.

Due to the high lipophilicity of this class of compounds, their bioavailability after ingestion and inhalation is significant. Scientific investigations have shown that detectable levels of PAH occur in almost all internal organs, particularly in organs that are rich in adipose tissue. These organs can serve as storage depots from which the hydrocarbons can be gradually released. Once they enter the organism polycyclic aromatic hydrocarbons require a multistep metabolic activation by specific enzymes. The enzyme system primarily responsible for PAH metabolism is the mixed-function oxidase system. The first reaction is an epoxidation. PAH epoxides can then be conjugated with glutathione and this is regarded as a true detoxification reaction. The epoxides that are not conjugated with glutathione are converted into phenols and diols. These PAH metabolites, however, are sometimes not sufficiently polar to be excreted and are therefore have to be conjugated with glucuronic or sulfuric acids to enable excretion. Most metabolites of PAH are excreted in feces and urine.

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