

Impact, Sources, and Mitigation Strategies of PAHs in Food

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PAHs, known as Polycyclic Aromatic Hydrocarbons, are a group of organic compounds that consist of multiple fused benzene rings and contain only carbon and hydrogen atoms. These compounds are commonly found in the environment and are often present in high levels. As a result, concerns regarding their impact on human health have arisen, particularly after ingestion. PAHs originate from both natural and anthropogenic sources. PAHs can be naturally produced in coal, crude oil, volcanic eruptions, forest fires, gasoline and geological processes, while anthropogenic sources involve human activities such as industrial processes, burning of fossil fuels, and smoking processes in food. Although they can be found in various environmental sources such as air and water, one significant pathway of human exposure is through the consumption of contaminated food. The presence of PAHs in food poses a potential risk to human health. Therefore, it is crucial to understand the abundance of PAHs in food, identify their sources, develop measurement techniques to determine their levels, and investigate the associated health problems caused by them. Figure 1 shows some important PAHs present in food.

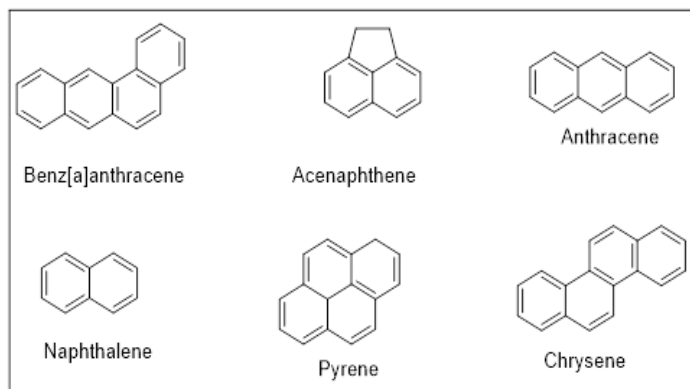


Fig 1: Structure of some important PAHs present in food

Sources of PAHs in Food

Food consumption plays a crucial role in human exposure to environmental contaminants like PAHs. The presence of PAHs in food can be attributed to various factors, including food preparation and processing methods, as well as the contamination of soil where crops or plants are grown, or water bodies

where marine life or fish reside. Thus, it is crucial to have a comprehensive understanding of the diverse sources of PAHs in order to effectively evaluate and reduce their levels in the food web.

- ❖ **Cooking Methods:** PAHs can be produced during cooking, especially while grilling, smoking and barbecuing of food. This may result to the deposition of PAHs on food surface when they are prepared by direct contact with open flames or hot surfaces. Grilling or barbecuing can cause the formation of PAHs on meat's surface because they are able to direct exposures directly, including through flames and high temperatures. Recent studies have also revealed that consuming burnt or well-done meat is linked to high levels of PAHs.
- ❖ **Food Processing:** PAHs may be introduced to some food types via different processing techniques such as smoking, drying or roasting. Smoking and curing processes may result in enhanced concentrations of PAHs detected among smoked fish, bacon and ham. The PAH content may also increase through the process of roasting and drying coffee beans, cocoa beans, and tea leaves. Presence of PAHs are also reported in fats and oils, including sunflower, olive, soybean, and palm oils. Vegetable fats and oils tend to have higher levels of PAHs within their food group. Typically, the concentrations of PAHs are higher on the surface of plants.
- ❖ **Contaminated Water and Soil:** PAHs can also be absorbed by plants and animals from contaminated water or soil. This may take place in industrial zones, sites of waste dumping or other places where PAHs have found their way into the environment.
- ❖ **Vegetables and Grains:** PAHs are more often linked to animal products, but they can also be seen in vegetables and cereals grains especially when grown on polluted land. It is suggested that washing and peeling may help to keep PAH levels low in these foods.

Health risk associated with PAHs in food

Exposure and high levels of pollutants containing PAHs results in the short-term health effects. For example, Anthracene, benzo(a)pyrene causes eye and skin irritation, naphthalene results in the inflammation of the skin, nausea and vomiting. Furthermore, exposure of PAHs also causes long-term health effects, including skin, lung, bladder and gastrointestinal cancers; DNA, kidney and liver damage; Gene mutation and cardiopulmonary mortality.

- ❖ **Cancer Risk:** Some PAHs, like Pyrene and benzo[a]pyrene are defined as cancer-causing agents, and ongoing exposure to higher concentrations may lead in an elevated risk for developing a tumor. IARC classifies some PAHs as group 1 carcinogens.
- ❖ **Mutagenic and Genotoxic Effects:** Human activities and exposure to PAHs can lead them in manifesting mutagenic genotoxic potential that may result to create DNA damages. These impacts are alarming as they could lead to the development of different types of disease.
- ❖ **Developmental and Reproductive Effects:** Animal exposure to PAH has been reported to cause developmental and reproductive end points. Despite the limited understanding of the specific effects on humans, it is advisable to practice caution for individuals considered vulnerable.

Regulatory Limits

Most countries have regulations for PAH limits in food. These controls are focused on keeping the levels of PAHs in food products below acceptable thresholds. It is, however warranted that constant monitoring and the application of these limitations are essential. Moreover, the introduction of adequate good manufacturing practices in the food processing

industry like controlling cooking temperatures and avoiding direct contact with flames, are some recommendations that will serve to minimize or reduce PAHs forming as a result. Another way of protecting against the high-level exposure to PAHs from specific sources comprises consuming an enriched diet which includes different foods. This line of thinking, basally, guarantees the optimized amount in nutrients ingested.

Conclusion

Food containing polycyclic aromatic hydrocarbons is a complicated problem that presents health risks. Although, some regulations are attempted to reduce the release of PAHs in products, through consumer means of healthier cooking practices and a balanced diet. It is critical for further research and continued efforts to monitor PAH concentrations in foods not only continue but also be vigilant. This will help safeguard the integrity of a nation's food supply while at the same time ensuring that public health standards are upheld.

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