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Peer Review

Review of: "Polycyclic Aromatic Hydrocarbons in Brazilian Food: A Critical Review of Levels, Human Health Risk Assessment, and Potential Gaps in the Recent Literature"

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Broad scientific and regulatory basis

The text presents references to international regulatory bodies (IARC) and uses recognized toxicology concepts such as Hazard Quotient (HQ), Hazard Index (HI), and Cancer Risk (CR). This strengthens the credibility and scientific consistency of the analysis.

Discussion on different classes of PAHs

There is a good differentiation between high molecular weight (HMW-PAHs) and low molecular weight (LMW-PAHs), highlighting not only the most studied compounds (BaP) but also the least investigated (such as naphthalene), highlighting important gaps in knowledge.

Use of national data (IBGE)

The work connects global findings with the Brazilian reality, contextualizing the exposure to PAHs in food consumed in the country. This increases the practical relevance of the review.

Recognition of methodological limitations

The text recognizes potential problems of overestimation of risks when using total concentrations instead of bioavailable concentrations. This methodological self-criticism shows scientific maturity and avoids alarmist conclusions without a solid basis.

Identification of research gaps and priorities

The work clearly points out areas that need research: bioaccessibility, cumulative effects, synergy

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between compounds, impact of food processing, and exposure in vulnerable groups (pregnant women, children, infants). This paves the way for future research agendas and public policies.

Integration of different exposure pathways

Although the focus is on the feeding route, the text also recognizes that exposure to PAHs occurs through multiple pathways (inhalation, water intake, dermal contact), broadening the view of the problem.

Classification of the IARC as internationally recognized risk evidence

The text mentions that benzo[a]pyrene (BaP) is classified as Group 1 - carcinogenic to humans. This is not just an opinion of the authors: it is a categorization validated by one of the most respected institutions in world public health. Thus, by associating its findings with this classification, the article is anchored in consolidated and universally accepted evidence.

Example: "BaP is carcinogenic in humans (Group 1, IARC)" shows that the assessed risks are not hypothetical but proven.

Differentiation between groups of toxicological risk

The text also highlights compounds such as Dibenz[a,h]anthracene (Group 2A - probably carcinogenic) and others like BbF, BkF, Ind, Chr (Group 2B - possibly carcinogenic). This hierarchical classification strengthens the argument that not all PAHs have the same toxicological weight, avoiding generalizations and giving nuance to risk assessment.

Integration of classical toxicological concepts

The use of Hazard Quotient (HQ), Hazard Index (HI), and Cancer Risk (CR) gives the study a common language of risk toxicology. These parameters are internationally accepted to measure hazard, dose, and cumulative risk. By using them, the authors make their conclusions comparable with other studies and regulatory benchmarks.

Example: highlighting that values of HI > 1 or CR > 10 exceed acceptability limits reinforces that the identified risks are not arbitrary but aligned with regulatory parameters.

Using Identified Research Gaps to Inform Future Studies or Policies

The article highlights several important research gaps—such as the limited data on low-molecular-weight PAHs (LMW-PAHs), the scarcity of food-specific contamination profiles (particularly naphthalene), and the lack of studies on cumulative and synergistic effects. These gaps can directly shape the agenda for both future research and public policy:

Food safety monitoring programs: The lack of systematic data on PAH levels in staple foods (e.g., rice, vegetable oils, dairy products) could motivate national agencies like ANVISA to establish targeted monitoring frameworks for high-risk food groups.

Toxicological research priorities: Since the article underscores the underestimated role of LMW-PAHs and their potential co-carcinogenic effects, future studies could focus on mechanistic toxicology, especially regarding synergy between LMW and HMW compounds.

Regulatory thresholds and dietary guidelines: Evidence of bioaccessibility and cumulative exposure could inform policies that move beyond current "total concentration" limits and instead set standards based on bioavailable fractions.

Public health initiatives: Highlighting the vulnerability of groups such as children, pregnant women, and infants can support the development of dietary advisories or educational campaigns tailored to these populations.

Example: If systematic profiling of naphthalene in rice and cachaça confirms elevated cancer risks, regulators could set maximum residue limits (MRLs) for these commodities and design safer processing methods.

Addressing Regional Disparities in PAH Research within Brazil

The article notes the scarcity and fragmentation of Brazilian data, which often focuses on specific regions or food matrices. To strengthen the national picture, the authors could propose or undertake:

Comparative regional monitoring: Implement multi-center studies across diverse Brazilian states (North, Northeast, South, etc.) to capture dietary and environmental differences in PAH exposure, especially considering distinct agricultural practices, food processing techniques, and cooking habits.

Integration of local dietary surveys: Use IBGE consumption data stratified by region to prioritize foods that are more culturally and regionally relevant (e.g., cassava in the North, cachaça in the Southeast, fish in coastal areas).

Collaborative research networks: Advocate for the creation of inter-university or government-academic partnerships that share data and analytical protocols, reducing regional inequalities in research capacity.

Policy adaptation to local realities: Recommend that regulatory standards and intervention strategies not rely solely on national averages but reflect the regional heterogeneity of exposure risks.

Capacity building: Encourage investments in laboratories and technical training in underrepresented regions, enabling local institutions to generate their own monitoring data rather than depending on a few centralized research centers.

Example: If Northeast Brazil shows higher levels of PAHs in smoked seafood due to traditional processing, tailored policies could involve developing cleaner smoking technologies or providing incentives for safer methods, while national policies alone might overlook this regional risk.

Enhancing Regional Research Collaboration and Data Sharing in Brazil

Given the strong regional disparities in available data, the authors could recommend specific mechanisms to build a more cohesive national research landscape:

Establish a national PAH monitoring network: Supported by government agencies (e.g., ANVISA, CNPq), this network could standardize analytical protocols across institutions and ensure comparability of results.

Create open-access national databases: A centralized digital repository where universities, laboratories, and health agencies can deposit PAH monitoring data would enhance transparency and avoid duplication of efforts.

Foster inter-regional partnerships: Encourage joint projects between institutions in well-resourced regions (e.g., Southeast Brazil) and those in underrepresented areas (North and Northeast). This could include capacity-building initiatives such as shared equipment, technical training, and fellowships.

Engage with local dietary and cultural practices: Collaborative projects should account for region-specific diets (cassava in the North, seafood in the Northeast, cachaça in the Southeast) to ensure that research outcomes are relevant for public health interventions at the local level.

International collaboration as leverage: Partnering with global agencies or research consortia could bring technical and financial support while also ensuring Brazilian data are represented in global risk assessments.

Declarations

Potential competing interests: No potential competing interests to declare.