STUDENTS' CORNER
LETTER TO THE EDITOR

Harnessing synthetic organisms for the detoxification of polycyclic aromatic hydrocarbons in Pakistan

Syed Ibrahim[1], Abdullah Bin Faisal[2]

Dear Editor, Rapid industrialisation and urbanisation have placed Pakistan as the seventh-largest emitter of polycyclic aromatic hydrocarbons (PAHs) in the world.[1] These hazardous organic compounds, consisting of fused aromatic rings, are released due to anthropogenic activities such as vehicular emissions, industrial processes, and agricultural practices.[2] Traffic pollution contributes to 60% of urban PAH emissions in Pakistan.[1] Humans are primarily exposed to PAHs through dermal contact, ingestion, inhalation and breast milk.[3]

Short-term exposure to high PAH levels can impair lung function in asthma patients and exacerbate thrombotic effects in individuals with coronary heart disease.[4] Long-lasting exposure leads to malignancies of the skin, lungs and gastrointestinal tract.[1] In 2009, 100 agents were classified as human carcinogens by International Agency for Research on Cancer (IARC); including PAHs.[3]

Developing countries usually have high levels of PAHs due to increasing industrialization and population coupled with lack of strategies to deal with the pollutant. Various studies have been conducted in Pakistan, and PAHs have been found in urban soils, vegetables, water, air and even mangrove leaves.[3]

Despite this, limited research exists on PAH remediation methods and their effectiveness. Traditionally, physical and chemical methods are used for remediation, which include but are not limited to, filtration, incineration, oxidation and photocatalysis. However, these only displace PAHs, without structurally breaking them down.[2] Bioremediation, which relies on microbial degradation, is a promising solution but remains hindered by slow degradation rates and limited microbial efficiency.

Synthetic biology presents a viable alternative by engineering microorganisms to enhance PAH degradation pathways. There have been developments in genome editing and synthetic genomics, which enable the growth of microbes that produce specific enzymes to help in biodegradation.[5]

The current situation in Pakistan raises a dire need for steps to be taken for remediation of PAHs. There is a lack of research on the methods being used and their effectiveness. Given the worsening pollution crisis, Pakistan urgently requires effective PAH remediation strategies. While synthetic biology offers a promising solution, its practical application in Pakistan remains unexplored. Studies are urgently needed to explore the mechanisms of genetic engineering, the associated legal frameworks in Pakistan, and the acceptability of such procedures among the general population, particularly with the worsening pollution crisis.

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[1]Second year MBBS Student, Aga Khan University, Karachi, Pakistan;
[2]Fourth Year MBBS Student, Aga Khan University, Karachi, Pakistan.
Correspondence: Syed Ibrahim. e-mail: syed.ibrahim2@scholar.aku.edu
ORCID ID: 0009-0007-3268-9809

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