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Editorial

Enhancing Pharmaceutical Development and Toxicological Evaluation in Ghana's Artisanal Mining Sector: The Potential of Zebrafish (*Danio rerio*)

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Artisanal and small-scale mining (ASM) plays a crucial economic role in Ghana. However, the resulting environmental and public health consequences are not fully understood. The employment of mercury, arsenic, and other harmful substances in gold extraction poses considerable threats to ecosystems and human populations [1-4]. While a greater understanding is needed, Ghana's capacity for toxicological investigation, specifically through the use of advanced biological models with translational significance, remains largely undeveloped [5-10].

Danio rerio, often referred to as the zebrafish, is increasingly recognized as a valuable model organism in both toxicological and pharmaceutical studies [11-13]. Widely used internationally for drug discovery and personalized medicine programs, zebrafish offer several advantages, including rapid development, significant genetic similarity to humans, and optical clarity during embryonic development. This transparency allows for direct observation of organ development, behavioral changes, and toxicity at the cellular level [14].

In the realm of pharmaceuticals, zebrafish are important for:

- Assessing the safety and efficacy of potential therapeutic compounds before clinical studies.
- Creating models of human disease processes to promote therapeutic innovation.
- Examining metabolic and genetic reactions to chemical agents.

In Ghana, the complete utilization of zebrafish technology is currently restricted, especially regarding toxicological assessments of mining-related chemicals [15,16]. Many countries worldwide utilize zebrafish to assess environmental toxicity from heavy metals, endocrine-disrupting chemicals, and nanoscale pollutants [15,16]. Locally relevant, biologically significant data is critically needed in Ghana to guide sustainable mining practices and protect at-risk populations [17].

We propose the establishment of zebrafish research facilities within Ghanaian universities and public health institutions to enable:

- Efficient examination of pollutants in water, sediment, and food webs.
- Monitoring of developmental and reproductive effects linked to ASM chemicals.
- Production of data suitable for informing policy decisions on environmental management and public health measures.
- Collaborative partnerships with global zebrafish research organizations.

The incorporation of zebrafish models into Ghana's scientific infrastructure represents a strategic investment in pharmaceutical advancement, environmental protection, and safeguarding public health. The application of this model system offers a valuable means to generate relevant data and guide evidence-based decision-making.

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