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Poisons and Carcinogens: Herbs to the Rescue—An Update on the Protective Role of Nigerian Medicinal Plants

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Abstract*—Exposure to environmental poisons and carcinogens remains a major global public health concern, particularly in developing countries such as Nigeria, where contamination of food, water, and air is prevalent. Heavy metals, pesticides, and industrial pollutants have been implicated in the development of cancers, neurological disorders, and organ toxicity. This review examines the protective potential of selected Nigerian medicinal herbs against toxic and carcinogenic agents. Emphasis is placed on Moringa oleifera, Hibiscus sabdariffa, Zingiber officinale, Curcuma longa, and Annona muricata, which exhibit antioxidant, anti-inflammatory, chelating, and anticancer properties. Evidence from experimental studies indicates that these plants mitigate heavy metal toxicity, reduce oxidative stress, and modulate molecular pathways involved in carcinogenesis. Mechanisms of action include reactive oxygen species scavenging, apoptosis induction, inhibition of tumour proliferation, and regulation of signalling pathways such as NF-κB and Nrf2. Despite their therapeutic promise, concerns regarding safety, standardization, and dosage remain. The update highlights the need for integrating traditional herbal knowledge with modern pharmacological research to develop cost-effective interventions for toxin-related diseases.*

***Keywords*—** *Carcinogens, Heavy metals, Nigerian herbs, Antioxidants, Moringa oleifera, Toxicity.*

I. Introduction

A poison is any substance of natural or synthetic origin capable of causing harm to biological systems when administered in sufficient quantities. Toxins represent a subset of poisons produced by living organisms, such as aflatoxins from *Aspergillus flavus* and cholera toxin from *Vibrio cholerae*. Carcinogens are agents capable of inducing cancer through chemical, physical, or biological mechanisms.

Environmental exposure to poisons and carcinogens is increasing globally, with significant implications for human health. In Nigeria, exposure occurs through contaminated food, water, air, and occupational hazards. Heavy metals such as lead (Pb), cadmium (Cd), arsenic (As), and mercury (Hg), along with environmental pollutants, contribute to disease burden (Maftouh *et al*., 2024).

The principle by Paracelsus—"the dose makes the poison"—highlights that toxicity is dose-dependent. However, chronic low-dose exposure to environmental contaminants poses long-term health risks. This study explores the protective roles of Nigerian medicinal plants in mitigating toxic and carcinogenic effects.

II. Sources and Health Risks of Poisons and Carcinogens

A. Sources of Exposure

Heavy metals and environmental toxins originate from multiple sources, including industrial emissions, contaminated food and beverages, agricultural chemicals, and air pollution. Studies have reported the presence of arsenic in beverages and food products, highlighting widespread exposure risks (Maduabuchi *et al*., 2007).

B. Health Implications

Exposure to toxicants is associated with cancer development, neurological disorders, and organ toxicity. Lead exposure, for example, has been linked to kidney damage and cognitive impairment. Cancer is characterised by uncontrolled cell proliferation, invasion of surrounding tissues, and metastasis (Brown *et al*., 2023).

III. Medicinal Plants with Protective Properties

A. Moringa oleifera

Moringa oleifera (Fig. 1) is widely used in traditional medicine due to its antioxidant, anti-inflammatory, anticancer, and antimicrobial properties. Its bioactive compounds, including flavonoids and phenolic acids, contribute to heavy metal chelation and reduction of oxidative stress (Arshad *et al*., 2025). Furthermore, hypolipidemic effects have been seen in experimental models using M. oleifera seed oil (Olatosin et al., 2018).

B. Hibiscus sabdariffa

Hibiscus sabdariffa (Fig. 2) contains polyphenols, anthocyanins, and vitamin C, which contribute to its antioxidant and anti-inflammatory properties. These compounds help neutralise reactive oxygen species and reduce lipid peroxidation (Montalvo-González *et al*., 2022).

C. Zingiber officinale

Zingiber officinale (ginger) (Fig. 3) contains gingerols and shogaols, which exhibit strong antioxidant and anti-inflammatory activities. These compounds act through free radical scavenging and modulation of inflammatory pathways such as NF-κB (Ayustaningwarno *et al*., 2024).

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Fig. 1. Images of *M. oleifera* tree, leaves, seeds, and flowers

Fig. 2. Images of the *H. sabdariffa* plant, leaves, calyces, and flowers.

Fig. 3. Images of the *Z. officinale* rhizome and sprouting root.

D. Curcuma longa

Curcuma longa (turmeric) (Fig. 4) contains curcumin, a bioactive compound with potent anticancer and anti-inflammatory properties. Curcumin regulates gene expression, induces apoptosis, and inhibits tumour growth (Fuloria *et al*., 2022).

E. Annona muricata

Annona muricata (soursop) (Fig. 5) contains annonaceous acetogenins with demonstrated anticancer activities, including apoptosis induction and inhibition of tumour proliferation (Mutakin *et al*., 2022).

IV. Role of Herbs in Mitigating Heavy Metal Toxicity

Herbal interventions have shown promise in reducing heavy metal toxicity. *Hibiscus sabdariffa* has been reported to protect against cadmium-induced biochemical alterations (Ogunbiyi & Obi, 2017). Similarly, *Moringa oleifera* exhibits detoxifying effects and can ameliorate heavy metal-induced toxicity, especially when combined with antioxidants such as ascorbic acid (Usman *et al*., 2023).

Fig. 4. Images of the *C. longa* rhizome roots and plant.

Fig. 5. Images of the *A. muricata fruits,* leaves and seeds.

V. Case Study: Protective Effects of *Moringa oleifera* Against Lead Toxicity

Experimental studies indicate that *Moringa oleifera* significantly reduces lead-induced toxicity. In animal models, administration of *M. oleifera* extract normalised liver enzymes and improved histological outcomes in liver and kidney tissues (Melebary & Elnaggar, 2023).

VI. Mechanisms of Action of Medicinal Herbs

A. Antioxidant Mechanisms

Medicinal herbs exert antioxidant effects by scavenging reactive oxygen species and by enhancing endogenous antioxidant systems via pathways such as the Nrf2 pathway (Arshad *et al*., 2025).

B. Anti-inflammatory Mechanisms

These herbs inhibit inflammatory signalling pathways, including NF-κB, and suppress pro-inflammatory cytokines such as TNF-α and IL-6 (Chiș *et al*., 2023).

C. Anticancer Mechanisms

Anticancer effects include apoptosis induction, cell cycle arrest, and inhibition of oncogenic pathways such as PI3K/Akt and JAK/STAT (Wu *et al*., 2021).

VII. Herbs in Cancer Prevention and Treatment Support

Annona muricata and Curcuma longa are two examples of plants that have shown anticancer properties by preventing the growth of tumours and inducing apoptosis. These effects are

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mediated through the modulation of molecular targets involved in cancer progression (Widyananda *et al*., 2022).

VIII. Safety and Precautions

Despite their benefits, medicinal herbs may interact with conventional drugs, cause toxicity at high doses, and lack standardisation. Therefore, careful regulation and clinical validation are required.

IX. Conclusion and Recommendations

Nigerian medicinal plants have significant potential to mitigate the effects of environmental toxins and carcinogens. Their integration into healthcare systems could provide cost-effective solutions for disease prevention.

X. Future Research Directions

Future research should focus on pharmacological validation, optimisation of herbal combinations, and the application of computational tools, such as QSAR/QSPR modelling, in drug discovery.

Declaration of Interest

The authors declare no competing interests.

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