Chapter 2
Medicinal Ethnobotanicals in Mitigating Pollution-Induced Oxidative Damage With Mechanisms and Therapeutic Potential:
Mechanistic Basis of Plant Antioxidant Defense

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ABSTRACT

Environmental pollution remains a global health issue linked to numerous diseases, primarily through the generation of reactive oxygen species (ROS) that induce lipid peroxidation, protein and DNA damage, and cellular dysfunction. This review examines the therapeutic potential of medicinal ethnobotanicals in mitigating pollution-induced oxidative stress, with a focus on their molecular mechanisms and therapeutic potentials. Ethnobotanicals, rich in bioactive phytochemicals such as flavonoids, phenolic acids, alkaloids, and terpenoids, exhibit potent antioxidant and cytoprotective properties. Their protective effects are largely mediated through the enhancement of endogenous antioxidant systems and modulation of redox-sensitive signalling pathways. Evidence from both in vivo and in vitro studies highlights the efficacy of selected ethnobotanicals in reducing oxidative biomarkers and restoring tissue homeostasis, particularly in mammalian systems. This review highlights the potential of ethnobotanicals as promising agents in mitigating the health effects of environmental pollutants.

1.0 INTRODUCTION

Environmental pollution has emerged as a critical global health and ecological challenge in the 21st century, with significant impacts on human well-being and ecosystems. Various types of pollution, including air, water, soil, and noise, are linked to numerous health issues such as respiratory diseases, cardiovascular problems, cancer, and neurological disorders (Adigun & Odeleye, 2025). The primary causes of pollution include rapid industrialisation, urbanisation, unsustainable agricultural practices, and poor waste management. Despite global attention, the long-term consequences of environmental degradation persist, particularly in developing countries where awareness and regulations are lacking (Ukaogo et al., 2020).

Air pollution, primarily composed of particulate matter (PM), ozone (O_3), nitrogen oxides (NOx), sulfur dioxide (SO_2), and carbon monoxide (CO), poses significant health risks (Moronkeji and Akinbo 2024). These pollutants, mainly emitted from energy production, industry, traffic, and agriculture, affect multiple organ systems, leading to cardiovascular, respiratory, and neurological diseases (Sigsgaard & Hoffmann, 2024). Exposure to air pollution is a major contributor to morbidity and premature mortality globally. Specific health impacts include chronic obstructive pulmonary disease (COPD), asthma, lung cancer, and central nervous system dysfunctions. The growing concern over air pollution's health effects necessitates a multidisciplinary approach involving public awareness, scientific expertise, and sustainable solutions (Manisalidis et al., 2020). Soil pollution, resulting from