


Chapter 1


Nrf2 Modulators and the Prospects of Indigenous Medicinal Plants

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ABSTRACT

*Nrf2 is a key transcription factor regulating genes for antioxidant defense, inflammation control, and detoxification, protecting cells from oxidative stress. Natural Nrf2 activators like sulforaphane, curcumin, and quercetin enhance cellular resilience and show promise in treating neurodegenerative, cardiovascular, and metabolic diseases. Conversely, Nrf2 inhibitors such as halofuginone and bardoxolone methyl are used in oncology to suppress tumour-promoting overactivation. Indigenous medicinal plants—especially turmeric (*Curcuma longa*) and moringa (*Moringa oleifera*)—are rich in phytochemicals that modulate Nrf2, offering a natural strategy for chronic disease prevention. However, African plants remain underexplored, and clinical trials on natural modulators are limited, with gaps in dosage, efficacy, and safety data. Despite these limitations, the chapter highlights the therapeutic potential of indigenous plants in modulating Nrf2 pathways and recommends intensified research and clinical validation.*

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1.0 INTRODUCTION

Non-communicable diseases, encompassing cardiovascular diseases, cancers, diabetes, chronic respiratory illnesses, and neurodegenerative disorders, now account for approximately 74% of all deaths globally, translating to over 41 million lives lost annually (Shitaw et al., 2025; VanderJagt et al., 2022). Persistent inflammation and oxidative stress are now widely accepted as driving forces in the pathogenesis and progression of these diseases (VanderJagt et al., 2022).

Despite their often slow and insidious progression, NCDs have collectively surpassed communicable diseases as the principal cause of death, disability, and economic burden in the 21st century (Oso et al., 2023). Recent projections estimate that this global burden will intensify by an additional 17% over the next decade, disproportionately impacting low and middle-income countries (LMICs) (Wang et al., 2020). These regions, particularly Africa, are projected to experience a 27% rise in NCD-related mortality, driven by urbanization, lifestyle changes, and persistent challenges to health system capacity (Wang et al., 2020). In 2020, up to 80% of NCD deaths in LMICs occurred before age 70, illustrating the premature and devastating nature of the epidemic (Oso et al., 2023; VanderJagt et al., 2022).

Nigeria, home to over 219 million people in 2022, now faces a dual disease burden, with NCDs representing about 27–30% of all deaths (over 600,000 annually) (WHO Regional Office for Africa, 2023; Oso et al., 2023). As shown in Table 1, additional statistical data on the occurrence of major NCDs in Nigeria are provided.

Across the spectrum of NCDs in Nigeria, major risk factors include hypertension (prevalence above 31%), obesity, tobacco use, physical inactivity, unhealthy diets, and excessive alcohol consumption. See more details in Table 1.

The concentration of NCDs among economically disadvantaged and rural populations is accentuated by out-of-pocket health costs, late presentations, and inaccessible preventive care, driving further impoverishment and social inequities (Oso et al., 2023).

Table 1. Major NCDs and occurrence in Nigeria (2020–2025)

Disease	Occurrence	Key Findings	References
Cardiovascular Disease	10–27%	Leading NCD cause; high DALYs	Ojo et al., 2024; Ogah et al., 2023
Diabetes (all forms)	4.1 – 5.8%	South-south zone highest (8.5%)	Olamoyegun et al., 2024; Esan et al., 2024.
Cancer (incidence)	100,000/year	High case-fatality (delayed diagnoses)	Olayeriju et al., 2021

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