



# Healing with Herbs

Herbal Therapies for Disease Prevention and Treatment

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*Published, marketed, and distributed by:*

Deep Science Publishing, 2025  
USA | UK | India | Turkey  
Reg. No. MH-33-0523625  
www.deepscienceresearch.com  
editor@deepscienceresearch.com  
WhatsApp: +91 7977171947

ISBN: 978-93-7185-504-4

E-ISBN: 978-93-7185-486-3

<https://doi.org/10.70593/978-93-7185-486-3>

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**Citation:** Vaidya, G., Yadav, L., Nyola, N. K., & Kant, R. (Eds.). (2025). *Healing with Herbs: Herbal Therapies for Disease Prevention and Treatment*. Deep Science Publishing. <https://doi.org/10.70593/978-93-7185-486-3>

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## Chapter 3: Cardiometabolic Risk Attenuation via Bioactive Constituents of *Zingiber officinale* and *Allium sativum*: An Integrative Approach to Endothelial Function and Lipid Regulation

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### Abstract

Cardiometabolic disorders, characterized by dyslipidemia, endothelial dysfunction, hypertension, and insulin resistance, remain leading contributors to global morbidity and mortality. Bioactive phytoconstituents of *Zingiber officinale* (ginger) and *Allium sativum* (garlic) have demonstrated promising cardioprotective potential through multifaceted mechanisms. Ginger-derived compounds such as gingerols, shogaols, and paradols exhibit antioxidant, anti-inflammatory, and lipid-lowering effects, while garlic-derived allicin, ajoene, and S-allyl cysteine contribute to cholesterol regulation, vascular protection, and nitric oxide bioavailability. Integrative use of these botanicals has been shown to modulate lipid metabolism, enhance endothelial function, attenuate oxidative stress, and regulate inflammatory cascades, thereby reducing cardiometabolic risk. This review consolidates preclinical and clinical evidence, highlighting molecular pathways such as AMPK activation, NF- $\kappa$ B inhibition, and eNOS upregulation as central mediators of their synergistic actions. The findings underscore the therapeutic potential of *Zingiber officinale* and *Allium sativum* as adjuncts in the prevention and management of cardiometabolic diseases, warranting further translational and clinical investigations.

**Keywords:** *Zingiber officinale*, *Allium sativum*, cardiometabolic risk, endothelial function, lipid metabolism, bioactive phytoconstituents, oxidative stress, inflammation.

### 1. Introduction

Cardiometabolic diseases such as atherosclerosis, hypertension, dyslipidemia, diabetes mellitus and metabolic syndrome are widespread public health problems. These conditions are highly interdependent and they all raise the global burden of CVD, which is an ever increasing major cause of morbidity and mortality (World Health Organization [WHO], 2023). Prevalence of metabolic syndrome has skyrocketed and has affected close to one-third of adults in the developed and developing world alike leading to increased risk for both type 2 diabetes and cardiovascular-event related morbidity (Saklayen, 2018).

One of the central pathophysiological pathways underlying the cascade leading to cardiometabolic diseases is endothelial dysfunction, which can broadly be described by poor NO bioavailability and impaired vasodilation along with enhanced oxidative stress (Daiber et al., 2019). In addition, lipid