

Bioactive Constituents and Therapeutic Potential of Moringa oleifera

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ABSTRACT

Moringa oleifera, commonly known as the drumstick tree, has gained considerable scientific attention due to its rich phytochemical composition and diverse pharmacological properties. The plant contains multiple bioactive compounds, including polyphenols, flavonoids, isothiocyanates, glucosinolates, and alkaloids, which collectively contribute to its antioxidant, anti-inflammatory, anticancer, and antimicrobial activities. This review summarizes the major bioactive constituents of *M. oleifera* and highlights their mechanisms of action in relation to chronic disease prevention and health promotion.

INTRODUCTION

Medicinal plants remain a major source of therapeutic agents, and *Moringa oleifera* is among the most extensively studied species due to its

nutritional and medicinal value. Various parts of the plant, particularly the leaves, are rich in secondary metabolites that exert significant biological effects. The growing prevalence of

chronic disorders such as cardiovascular diseases, diabetes, cancer, and neurodegenerative conditions has intensified research into plant-derived antioxidants and anti-inflammatory agents. In this context, *M. oleifera* represents a promising functional food and phyto therapeutic candidate (Arshad *et al.*, 2025).

1. Major Bioactive Compounds in *Moringa oleifera* and their Therapeutic Potential

1.1 Polyphenols

Polyphenols are a large group of naturally occurring phytochemicals known for their potent antioxidant properties. The leaves of *M. oleifera* contain high concentrations of phenolic compounds that play a critical role in scavenging free radicals and reducing oxidative stress. Oxidative stress is a key contributor to the pathogenesis of chronic diseases, including cardiovascular disorders and cancer. By neutralizing reactive oxygen species (ROS), polyphenols help protect cellular structures, including lipids, proteins, and DNA, from damage. Additionally, these compounds modulate inflammatory pathways, further supporting their protective role in chronic disease prevention (Owon *et al.*, 2021).

1.2 Flavonoids

Flavonoids constitute an important subclass of polyphenols present in *M. oleifera*. These compounds exhibit strong antioxidant and anti-inflammatory activities. Flavonoids help stabilize free radicals, reduce lipid peroxidation, and regulate signaling pathways involved in inflammation. Their protective effects extend to metabolic disorders, as evidence suggests their potential role in improving glycemic control and enhancing insulin sensitivity. Furthermore, the antimicrobial properties of flavonoids may contribute to immune defense and infection control (Olusanya *et al.*, 2020).

1.3 Glucosinolates

Glucosinolates serve as precursors to biologically active metabolites such as isothiocyanates. These compounds influence enzymes involved in detoxification and cell cycle regulation, thereby contributing to anticancer mechanisms. Beyond their chemoprotective potential, glucosinolates have been associated with immune modulation and suppression of pro-inflammatory mediators (Chhikara *et al.*, 2021).

1.4 Isothiocyanates

Isothiocyanates are sulphur-containing compounds derived from glucosinolates. In *M. oleifera*, these bioactive molecules are associated with chemopreventive and detoxifying properties. They enhance the activity of phase II detoxification enzymes, thereby facilitating the elimination of carcinogens and toxic metabolites. Through modulation of apoptosis and inhibition of abnormal cell proliferation, isothiocyanates may play a significant role in cancer prevention. Additionally, their hepatoprotective effects support liver function and systemic detoxification processes (Kashyap *et al.*, 2022).

1.5 Alkaloids

Alkaloids are nitrogen-containing secondary metabolites with diverse pharmacological activities. In *M. oleifera*, alkaloids are reported to exhibit analgesic, antibacterial, and anti-inflammatory properties. These compounds may contribute to the plant's traditional use in managing pain, promoting relaxation, and supporting overall physiological balance. Their bioactivity enhances the therapeutic synergy of moringa's phytochemical composition. Their multifunctional properties strengthen the overall therapeutic profile of *M. oleifera* (Roni *et al.*, 2021).

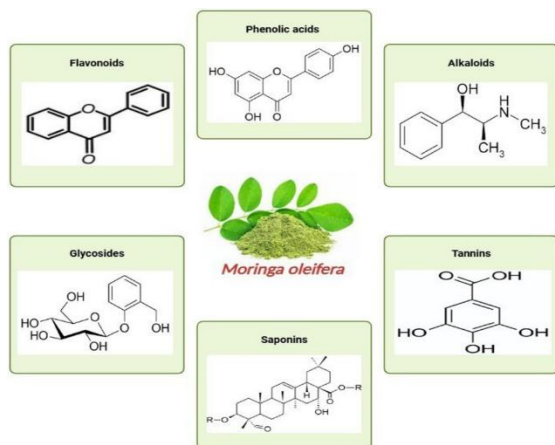


Figure 1. Bioactive Compounds in *Moringa oleifera*

CONCLUSION

Moringa oleifera represents a valuable source of bioactive compounds with significant therapeutic potential. Its rich composition of polyphenols, flavonoids, isothiocyanates, glucosinolates, and alkaloids contributes to antioxidant, anti-inflammatory, anticancer, and antimicrobial activities. The synergistic interaction among these phytochemicals enhances the plant's role in preventing and managing chronic diseases. Further clinical investigations are warranted to fully elucidate its mechanisms of action and optimize its application in functional foods and phytomedicine (Guzmán-Maldonado *et al.*, 2020; Hu *et al.*, 2023).

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