

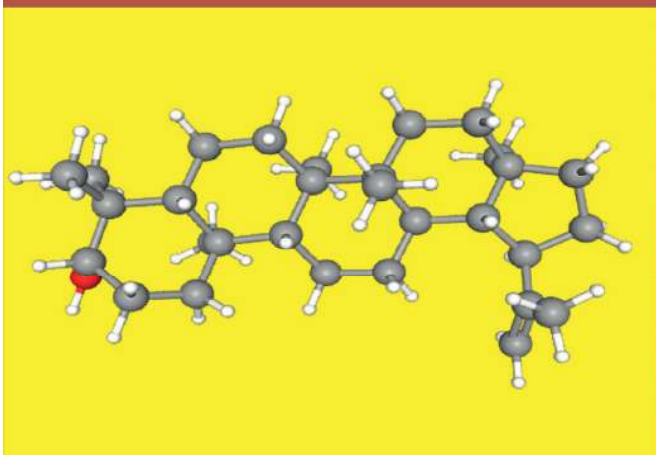


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LUPEOL

THERAPEUTIC APPLICATIONS
IN HUMAN HEALTH AND DISEASE



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10 Cell Growth Regulation and Molecular Targets of Lupeol

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10.1 INTRODUCTION

Cancer remains a leading cause of mortality worldwide, driven by uncontrolled cell growth, resistance to apoptosis, and the dysregulation of key signaling pathways (Wahab & Siddique, 2025). Understanding the mechanisms of cell growth regulation is crucial for developing effective therapeutic interventions (Wu et al., 2013). In recent years, natural compounds have gained significant attention in cancer research due to their potential to target multiple oncogenic pathways while exhibiting minimal toxicity to normal cells (Fatma & Siddique, 2023). Among these bioactive compounds, lupeol, a pentacyclic triterpene found in various fruits, vegetables, and medicinal plants, has emerged as a promising anticancer agent (Chaudhry et al., 2022). Lupeol exhibits a broad spectrum of pharmacological properties, including antioxidant, anti-inflammatory, anti-arthritic, and antimicrobial activities. More notably, extensive research highlights its potent anticancer effects across various malignancies, including breast and lung cancers (Siddique & Saleem, 2011; Tsai et al., 2016; Sen et al., 2024).

Lupeol has been reported to induce apoptosis in breast cancer cells by downregulating anti-apoptotic proteins, including Bcl-2 and Bcl-xL while inhibiting metastasis in lung cancer through modulation of the ERK signaling pathway and reducing EMT-associated gene expression (Maurya et al., 2020; Sohag et al., 2022). Moreover, its ability to modulate critical oncogenic signaling cascades, including PI3K/AKT/mTOR, and its selectivity in targeting cancer cells over normal cells position lupeol as a highly valuable candidate for cancer therapy. Given the increasing resistance to conventional chemotherapeutics, environmental risk factors such as air pollution, and the rising consumption of tobacco-related products, the need for novel and effective anticancer agents has never been more urgent. The ability of lupeol to regulate proliferative markers, suppress tumor progression, and enhance the efficacy of existing chemotherapeutic agents underscores its potential in cancer prevention and treatment (Banu, 2024; Fatma et al., 2024). This chapter aims to provide a comprehensive analysis of the anticancer mechanisms of lupeol, its pharmacokinetic properties, and its therapeutic promise. By exploring the latest findings, we seek to highlight the significance of lupeol as a natural compound with translational potential in oncological research.

10.2 CHEMICAL PROPERTIES AND SOURCES OF LUPEOL

Lupeol is a pentacyclic triterpene belonging to the lupane-type triterpenoids, characterized by its unique chemical structure, Lup-20(29)-en-3 β -ol. Structurally, it consists of five interconnected six-membered rings with a hydroxyl (-OH) group at the C-3 position, which plays a crucial role in its bioactivity (Figure 10.1) (Bednarczyk-Cwynar et al., 2016). The nonpolar nature of lupeol influences its pharmacokinetic behavior, particularly its absorption, distribution, metabolism, and excretion.