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Plant-Derived Bioactive Compounds: Emerging Frontiers in Drug Discovery

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Abstract: *Plant-derived bioactive compounds have been pivotal in pharmacotherapy, yielding treatments for diseases like cancer and infections, exemplified by paclitaxel from Taxusbrevifolia and artemisinin from Artemisia annua. Despite their potential, natural product-based drug discovery faced challenges in the 1990s, including limitations in high-throughput screening, isolation difficulties, and complex chemical optimization, leading to reduced pharmaceutical interest. Recent technological advancements have revitalized the field, positioning these compounds as key solutions for global health issues like antimicrobial resistance. Innovations in analytical tools, such as high-performance liquid chromatography-mass spectrometry and nuclear magnetic resonance spectroscopy, enhance the isolation and identification of bioactive molecules. Genome mining and synthetic biology enable discovery and scalable production of novel compounds, while advanced microbial cultivation boosts yields. Artificial intelligence accelerates lead identification and optimization. These breakthroughs overcome past barriers, streamlining drug development. Plant-derived compounds, with complex chemical profiles, offer promise against antimicrobial resistance, where conventional antibiotics falter. Challenges like sustainable sourcing, regulatory harmonization, and ethical concerns, including biopiracy, persist. This review synthesizes these advancements, their applications, and opportunities to harness plant-derived compounds for unmet medical needs, driving sustainable, innovative therapeutics in modern medicine.*

Keywords: Natural products, plants, bioactive compounds, drug discovery, pharmacology

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