



Synthetic strategies and pharmacological insights into Boswellic acid-hybrid based therapeutics

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Abstract Boswellic acids are pentacyclic triterpenoids from *Boswellia* spp., that have a wide range of pharmaceutical promises in anti-inflammatory, anti-cancer, and immunomodulatory therapies. Chemical modifications, including triazole conjugates, acetylated derivatives and synthetic analogues, enhance its enzyme inhibition, tumour suppression and regulation of the inflammatory pathway. These hybrids improve binding to 5-lipoxygenase (5-LOX) and nuclear factor-kappa B (NF- κ B), thereby increasing therapeutic effectiveness in cancer, arthritis, and metabolic disorders. Dimeric and monomeric BA hybrids have both received considerable research attention; however, monomeric BA hybrids are increasingly favored owing to their superior

bioactivity, stronger target-binding affinity, and enhanced cellular permeability compared with dimeric analogues. This review highlights BA hybrids synthesis, pharmacological advantages of improved efficiency, sustainability, and versatility, while noting limitations such as solubility and structural flexibility in reported metrics. In the current review, BA hybrids present new opportunities for targeted therapy to advance precision medicine and drug development. To fully capitalize on these opportunities, future research should prioritize comprehensive structure–activity relationship studies, the refinement of hybrid-design strategies, and the integration of emerging technological platforms to advance the development of BA hybrids.

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