Synthetic strategies and therapeutic applications of sulfur-containing molecules

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Abstract Sulfur-containing molecules play a crucial role in medicinal chemistry, with over 300 FDA-approved sulfur-based drugs exhibiting diverse biological activities and therapeutic potentials. Notably, recent trends show a steady rise in their prevalence, with sulfur incorporated into approximately 10-20 % of newly FDA-approved drugs from 2020 to 2024, rising from 11 % in 2020 to 20 % in 2024. The unique chemical properties of sulfur, including its ability to exist in multiple oxidation states, engage in varied bonding interactions, and enhance molecular stability and solubility, contribute to improved pharmacokinetic and pharmacodynamic profiles. This review highlights synthetic approaches for incorporating sulfur, including sulfonamides, sulfones, and thioethers, and explores their therapeutic applications across antibacterial, antidiabetic, anticancer, and anti-inflammatory drugs. In conclusion, sulfur-based compounds remain essential for drug development, driving innovation and offering broad-spectrum therapeutic solutions.

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