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Topic of Research: Plant-derived andrographolide as an adjuvant therapy for the treatment of solid tumors.

Key Findings

Cancer remains a major cause of mortality worldwide, with solid tumors being among the most common forms. However, conventional chemotherapy is limited by systemic toxicity, low aqueous solubility, poor oral bioavailability, and non-specific targeting, all of which reduce treatment effectiveness and increase side effects. Andrographolide (AG), a diterpene lactone derived from *Andrographis paniculata*, possesses notable anticancer, anti-inflammatory, antioxidant, and antiviral properties. Its therapeutic application, however, is constrained by poor solubility and limited bioavailability. Similarly, 5-Fluorouracil (5-FU), a widely used chemotherapeutic agent, faces challenges related to low solubility, rapid clearance and a lack of tumor specificity, often requiring high doses that contribute to significant toxicity.

This study was focused on developing a novel therapeutic strategy by formulating AG and 5-FU into solid lipid nanoparticles (SLNs) to enhance their bioavailability, therapeutic efficacy and safety profile. AG was extracted and authenticated through high-performance thin-layer chromatography (HPTLC) and mass spectrometry (MS). A validated HPTLC method, aligned with international guidelines, was developed for simultaneous quantification of AG and 5-FU in biological samples. Stability studies were conducted under various conditions to assess formulation shelf life.

The SLNs of AG and 5-FU were prepared using solvent injection and characterized by particle size, polydispersity index, surface charge, and structural integrity using advanced analytical techniques. *In vitro* cytotoxicity studies on lung cancer cells demonstrated enhanced anticancer activity of the combined nanoformulation compared to individual agents. *In vivo* studies in murine models revealed a pronounced reduction in tumor size, prolonged survival, and improved overall health outcomes with fewer side effects, including reduced anemia and myelosuppression, compared to standard treatments.

Complementary *in silico* docking and network pharmacology analyses further supported the synergistic interaction between AG and 5-FU, highlighting their ability to modulate multiple cancer-related pathways. The results indicate that the co-delivery of AG and 5-FU via nanoformulations offers a promising approach for improving the therapeutic index of existing chemotherapeutic regimens while minimizing adverse effects.

In summary, this study demonstrates the potential of AG as an effective adjuvant to 5-FU in cancer therapy, providing a novel and more effective strategy for the treatment of solid tumors.