Plant-Based Carbon Nanotubes Drug Delivery Platform for Targeted Cancer Therapy

Background

Cancer remains a leading cause of death worldwide, with current treatments often harming healthy tissues and failing to fully eliminate tumors. A major challenge lies in delivering therapy precisely to cancer cells without affecting normal ones.

Nanotechnology offers a breakthrough solution. Engineered nanoparticles, such as carbon nanotubes (CNTs), can be functionalized to selectively target cancer cells, improving drug delivery while minimizing side effects.

This innovation goes a step further by combining CNTs with natural plant-derived anticancer compounds, offering a biocompatible, green, and highly targeted therapeutic platform. This approach opens new frontiers in precision oncology—pairing cutting-edge delivery systems with the untapped potential of African medicinal plants.

Technology overview

This innovative technology integrates single-walled carbon nanotubes (SWCNTs) with plant-derived anticancer compounds for targeted cancer therapy. The nanotubes are purified, functionalized, and bio-conjugated with extracts from *Annona muricata*, *Dodonaea viscosa*, *Dicoma capensis*, and *Tulbaghia violacea*.

In vitro studies demonstrated that the conjugates significantly reduced cancer cell viability while sparing normal cells, outperforming the free plant extracts. Fluorescence imaging confirmed targeted uptake via folate receptor-mediated and caveolae-mediated pathways, showing promise for precision delivery in tumours such as breast and colorectal cancers.

Benefits

- **Targeted Action**

The conjugate selectively targets cancer cells, minimizing harm to healthy tissue and enhancing therapeutic focus.

- **Reduced Side Effects**

By sparing normal cells, this approach aims to reduce treatment-related toxicity, improving patient comfort and quality of life.

- **Enhanced Resistance Management**

A combination of bioactive compounds from multiple plants provides a multifaceted mechanism that helps prevent drug resistance.

- **Lower Toxicity Profile**

Natural plant extracts are potentially less toxic than synthetic chemotherapy agents, offering a safer alternative.

- **Improved Efficacy and Recurrence Reduction**

Precision delivery enables more complete cancer cell eradication, potentially reducing the risk of relapse.

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Applications

Targeted Drug Delivery

Functionalized CNTs deliver plant-based anticancer agents directly to tumor cells via folic acid-mediated targeting of folate receptors—commonly overexpressed in breast and colorectal cancers. This supports precision oncology and opens avenues for personalized treatment strategies.

Green Nanoformulation with Natural Compounds

The platform integrates phytochemicals from African medicinal plants (*Annona muricata, Dodonaea viscosa, Dicoma capensis, Tulbaghia violacea*) into a nanocarrier system, offering a sustainable, biocompatible alternative to synthetic small-molecule drugs.

Versatile Combination Therapy

The CNT system supports co-loading of plant extracts and conventional drugs, enabling combination therapies with synergistic effects. It is well-suited for use in adjuvant or neoadjuvant treatment regimens for breast or colon cancer.

Research tool for cancer mechanisms and screening

This adaptable platform can be used for *in vitro* screening of both natural and synthetic compounds. It serves as a valuable model in nanotoxicology and for studying cancer cell mechanisms.

Opportunity

Stellenbosch University is looking for scientific and industry collaborators as well as funding for the clinical studies.

Seeking

Developmental Partner, Licensing

IP Status

Patented. WO2024/234021 A2

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