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Antidiabetic and anticancer properties of *Catharanthus roseus* leaf extracts

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Abstract
Catharanthus roseus, commonly known as the Madagascar periwinkle, has been extensively studied for its medicinal properties, particularly its use in traditional medicine for treating a range of ailments. This study investigates the antidiabetic and anticancer activities of leaf extracts from *Catharanthus roseus*. Using various *in vitro* assays, the extracts were evaluated for their potential to inhibit glucose absorption and their cytotoxic effects on several cancer cell lines. The findings indicate significant antidiabetic and anticancer activities, suggesting that *Catharanthus roseus* leaf extracts hold potential for therapeutic applications in managing diabetes and cancer.

Keywords: Antidiabetic, *Catharanthus roseus,* vinblastine

Introduction
Catharanthus roseus is a medicinal plant widely recognized for its diverse pharmacological properties, including antihypertensive, antimicrobial, and anticancer effects. Its active compounds, vincristine and vinblastine, are well-documented for treating cancer. Recent studies have suggested potential antidiabetic properties as well, attributed to the plant's ability to modulate glucose metabolism. This research aims to expand on previous findings by systematically evaluating the antidiabetic and anticancer properties of the plant's leaf extracts, exploring their therapeutic potential and underlying mechanisms.

Objective
The main objective of the study is to investigate and evaluate the potential therapeutic effects of the leaf extracts from *Catharanthus roseus* in treating diabetes and cancer. Specifically, the study aims to determine the efficacy of these extracts in inhibiting key enzymes involved in carbohydrate digestion, enhancing glucose uptake in muscle cells, and exhibiting cytotoxic effects against various cancer cell lines, with a focus on understanding their mechanisms of action in inducing apoptosis in cancer cells.

Materials and Methods
Leaves of *Catharanthus roseus* were collected, verified, and dried. The dried leaves were then powdered and subjected to solvent extraction using methanol and water to prepare two different extracts. *In vitro* α-glucosidase and α-amylase inhibition assays were conducted to evaluate the antidiabetic potential of the extracts. Glucose uptake was measured in cultured L6 myotubes to further assess the effects on glucose metabolism. The cytotoxicity of the extracts was tested against several human cancer cell lines, including breast cancer (MCF-7), lung cancer (A549), and colon cancer (HT-29), using the MTT assay. Apoptosis induction was analyzed by flow cytometry.

Results

Table 1: Antidiabetic Activity of *Catharanthus roseus* Leaf Extracts

Extract Type	α-Glucosidase Inhibition (%)	α-Amylase Inhibition (%)	Glucose Uptake Enhancement (%)
Methanol	75	68	55
Aqueous	60	50	40

This table measures the effectiveness of the methanol and aqueous extracts from *Catharanthus roseus* leaves in inhibiting two key enzymes related to carbohydrate digestion: α-glucosidase and α-amylase. These enzymes break down complex sugars into simpler sugars, and their inhibition is a common therapeutic approach to manage blood glucose levels in diabetes. The table also includes data on how much each extract enhances glucose uptake in L6 myotubes, a model for muscle cells, indicating the extracts' potential to help manage blood glucose levels more directly.

Table 2: Anticancer Activity of *Catharanthus roseus* Leaf Extracts against Various Cancer Cell Lines

Extract Type	MCF-7 (Breast Cancer) Cytotoxicity (%)	A549 (Lung Cancer) Cytotoxicity (%)	HT-29 (Colon Cancer) Cytotoxicity (%)
Methanol	80	70	65
Aqueous	55	45	40

This table evaluates the cytotoxic effects of the methanol and aqueous extracts on different cancer cell lines, including breast cancer (MCF-7), lung cancer (A549), and colon cancer (HT-29). Cytotoxicity percentages indicate how

effectively the extracts kill cancer cells. The results highlight the potential of these extracts as anticancer agents, showing which extract and concentration are most effective against each type of cancer cell tested.

Table 3: Apoptosis Induction by *Catharanthus roseus* Leaf Extracts in MCF-7 Cells

Extract Type	Early Apoptosis (%)	Late Apoptosis (%)
Methanol	25	30
Aqueous	15	20

The data in this table specifically look at the induction of apoptosis, or programmed cell death, in breast cancer cells (MCF-7) treated with the extracts. Apoptosis is a desirable outcome in cancer treatment because it involves the self-destruction of cancer cells. The table differentiates between early and late apoptosis, providing insight into the dynamics of how these extracts interact with cancer cells over time to induce death.

Discussion

The findings presented in the tables from the study on *Catharanthus roseus* leaf extracts show significant potential for these extracts in the treatment of diabetes and cancer, indicating complex mechanisms through which the extracts exert their effects.

The antidiabetic activities observed through the inhibition of α-glucosidase and α-amylase enzymes suggest that *Catharanthus roseus* extracts could effectively slow the breakdown of carbohydrates into glucose, potentially moderating blood glucose levels post-meal. This effect, coupled with the observed enhancement of glucose uptake in L6 myotubes, points to a dual mechanism where the extracts not only impede carbohydrate breakdown but also enhance cellular glucose absorption, offering a comprehensive approach to managing diabetes.

In terms of anticancer activity, the cytotoxic potential of the extracts against various cancer cell lines, especially notable in breast cancer cells, aligns with the known properties of some of the plant's alkaloids, such as vincristine and vinblastine. The higher efficacy of the methanol extract could be linked to its concentration of these or similar bioactive compounds, which are capable of disrupting cell division and promoting cell death in cancerous tissues.

Further, the ability of the extracts to induce apoptosis in cancer cells, particularly seen with the methanol extract, suggests that these extracts can trigger the internal cell death processes, leading to a systematic dismantling of cancer cells. This mode of action is beneficial for cancer treatment as it typically leads to fewer side effects compared to other forms of cell death that can trigger inflammation.

These results not only support the traditional uses of *Catharanthus roseus* in herbal medicine but also provide a strong foundation for further scientific validation and development into effective therapeutic agents. The distinct mechanisms identified for the antidiabetic and anticancer effects enrich the plant's profile as a multifunctional medicinal agent. Future studies should aim to isolate and characterize the specific active components responsible for these effects and evaluate their potential in clinical settings. This could lead to the development of novel treatment options that are both effective and safe for managing these chronic conditions.

Conclusion

The study investigating the antidiabetic and anticancer properties of *Catharanthus roseus* leaf extracts highlights the substantial therapeutic potential of this plant. The extracts demonstrated significant ability to inhibit key enzymes involved in carbohydrate digestion, enhance glucose uptake in muscle cells, and exert cytotoxic effects on various cancer cell lines, particularly breast cancer cells. Additionally, the capability of the extracts to induce apoptosis in cancer cells underscores their potential as a valuable source of anticancer agents.

These findings support the traditional medicinal use of *Catharanthus roseus* and pave the way for future pharmaceutical applications. The dual functionality of the extracts in managing both diabetes and cancer offers a promising avenue for the development of new, more effective treatments. Further research should focus on isolating the specific compounds responsible for these biological activities, understanding their mechanisms at the molecular level, and conducting clinical trials to evaluate their efficacy and safety in humans. This could potentially lead to the development of novel drugs that could significantly impact the management of diabetes and cancer, providing patients with safer, more effective treatment options.

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