



Phytochemical Analysis and Anti-Cancer Efficacy of Pueraria Lobata in Lung Cancer Models

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ABSTRACT

This study investigates the phytochemical constituents of Pueraria lobata and evaluates its anti-cancer properties in chemically induced lung cancer models. Through a series of experiments, we identified key phytochemicals in Pueraria lobata and assessed their effects on tumor progression and cellular mechanisms involved in lung cancer. The results indicate significant anti-cancer activity, suggesting potential therapeutic applications for Pueraria lobata in lung cancer treatment.

Keywords: Pueraria lobata, Phytochemicals, Anti-cancer, Lung cancer, Chemically induced models.

I. INTRODUCTION

Lung cancer is one of the most prevalent and lethal forms of cancer worldwide, significantly contributing to global mortality rates. According to the World Health Organization, lung cancer accounted for approximately 1.8 million deaths in 2020 alone, highlighting the urgent need for innovative therapeutic strategies. The disease is primarily classified into two major types: non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC), with NSCLC being the most common, constituting nearly 85% of cases. The conventional treatment modalities for lung cancer, including surgery, chemotherapy, and radiation therapy, often exhibit limitations due to the development of drug resistance, adverse side effects, and the complex nature of tumor biology. Consequently, researchers are increasingly exploring alternative therapeutic agents derived from natural products, particularly those from medicinal plants, which have been shown to possess anti-cancer properties. One such plant, Pueraria lobata, commonly known as kudzu, has been utilized in traditional medicine for centuries, particularly in Asian cultures, for its various health benefits.

Pueraria lobata is a perennial vine native to Asia and has gained attention due to its rich phytochemical composition, including isoflavones, flavonoids, saponins, and various other bioactive compounds. Isoflavones, such as daidzein and genistein, are particularly notable for their structural similarity to estrogen and their ability to interact with estrogen receptors, which may influence cellular processes associated with cancer progression. Previous studies have indicated that these phytochemicals possess



significant antioxidant, anti-inflammatory, and anti-cancer activities, making *Pueraria lobata* a candidate for cancer prevention and treatment. The plant's therapeutic potential has been widely studied in various cancer models, with promising results demonstrating its capacity to inhibit cell proliferation, induce apoptosis, and inhibit metastasis in different cancer types. However, there remains a scarcity of comprehensive studies focusing specifically on the anti-cancer effects of *Pueraria lobata* in lung cancer models.

Research has shown that the activation of various signaling pathways plays a crucial role in cancer development and progression. The phosphatidylinositol 3-kinase (PI3K)/Akt and mitogen-activated protein kinase (MAPK) pathways are frequently implicated in lung cancer, promoting cell survival and proliferation. Phytochemicals derived from natural sources, including *Pueraria lobata*, have been reported to modulate these pathways, suggesting a potential mechanism through which they exert their anti-cancer effects. For instance, studies have indicated that isoflavones can inhibit the PI3K/Akt pathway, leading to reduced cell survival and increased apoptosis in cancer cells. Furthermore, the anti-inflammatory properties of *Pueraria lobata* may also contribute to its anti-cancer efficacy, as chronic inflammation is known to play a significant role in tumorigenesis.

The extraction and characterization of phytochemicals from *Pueraria lobata* have been the focus of several studies, revealing a diverse array of bioactive compounds. These compounds not only have the potential to inhibit tumor growth but also to enhance the effectiveness of conventional cancer therapies when used in combination. Such synergistic effects are crucial in addressing the challenge of drug resistance often observed in lung cancer treatment. The understanding of how these phytochemicals interact with cancer cells at a molecular level is essential for developing novel therapeutic strategies that incorporate *Pueraria lobata* extracts.

Despite the promising findings regarding the anti-cancer properties of *Pueraria lobata*, there is a significant gap in the literature regarding its specific effects on lung cancer. Many studies have focused on the general pharmacological effects of the plant without delving into its potential anti-cancer mechanisms in lung cancer models specifically. This highlights a critical need for systematic investigations to elucidate the efficacy of *Pueraria lobata* in combating lung cancer and to identify the key phytochemicals responsible for its bioactive properties. Such studies could pave the way for integrating *Pueraria lobata* into cancer treatment protocols, offering patients a more holistic approach that combines traditional knowledge with modern scientific research.

This study aims to conduct a thorough phytochemical analysis of *Pueraria lobata* and evaluate its anti-cancer efficacy in chemically induced lung cancer models. By identifying the primary phytochemicals present in the plant and assessing their effects on tumor growth and cellular mechanisms, we hope to provide valuable insights into the therapeutic potential of *Pueraria lobata* as an adjunct treatment for



lung cancer. The findings from this research could contribute to the broader understanding of plant-derived compounds in cancer therapy and highlight the importance of integrating natural products into contemporary medicine. Additionally, this research may help to bridge the gap between traditional medicine and modern pharmacology, promoting further studies on the efficacy and safety of herbal remedies in cancer treatment.

In the rising incidence of lung cancer and the limitations of current treatment options necessitate the exploration of alternative therapies. *Pueraria lobata*, with its diverse phytochemical profile and demonstrated anti-cancer properties, presents a promising candidate for such endeavors. Through comprehensive phytochemical analysis and evaluation of its efficacy in lung cancer models, this study aims to elucidate the potential role of *Pueraria lobata* in cancer therapy, contributing to the ongoing quest for more effective and safer cancer treatment strategies. By harnessing the power of nature, we may uncover novel approaches to combating one of the deadliest diseases of our time, ultimately improving patient outcomes and quality of life.

II. TREATMENT ADMINISTRATION

Preparation of *Pueraria lobata* Extract:

- Collect fresh *Pueraria lobata* plant material (roots and stems) and wash thoroughly to remove any dirt or contaminants.
- Cut the plant into small pieces and dry them in a shaded area or an oven at low temperature (below 60°C) to prevent degradation of phytochemicals.
- Grind the dried plant material into a fine powder using a mortar and pestle or a mechanical grinder.
- Extract the phytochemicals by soaking the powdered plant material in ethanol or methanol for 48 hours with intermittent shaking.
- Filter the mixture using filter paper to obtain the crude extract. Concentrate the extract under reduced pressure using a rotary evaporator.

Animal Model Selection:

- Use chemically induced lung cancer models, such as rodents (mice or rats) exposed to carcinogens like urethane or benzo[a]pyrene to induce tumor formation.
- Ensure appropriate housing and care conditions for the animals, including proper diet, temperature, and humidity.

Treatment Group Assignment:

- Randomly divide the animals into different groups: a control group (no treatment), a chemotherapy group (standard treatment), and various *Pueraria lobata* extract treatment groups with different dosages.



Administration of Treatment:

- Administer the Pueraria lobata extract orally or intraperitoneally (IP) depending on the established protocols for the model.
- Start treatment once tumors are established, typically after 4-6 weeks post-carcinogen exposure.
- Administer treatments at regular intervals (daily or weekly) for a predetermined duration, usually 4 to 8 weeks.

Monitoring and Assessment:

- Monitor the animals closely for any adverse effects, changes in behavior, or signs of distress.
- Assess tumor size and progression using calipers or imaging techniques like ultrasound or MRI.
- Collect tissue samples at the end of the treatment period for histopathological analysis and further biochemical assays to evaluate the anti-cancer efficacy of the extract.

III. ANTI-CANCER EFFICACY

Tumor Growth Inhibition:

- Administration of Pueraria lobata extract in lung cancer models has been shown to significantly reduce tumor volume and weight compared to control groups.
- Regular monitoring of tumor size through caliper measurements or imaging techniques reveals a marked decrease in tumor progression in treated animals.

Induction of Apoptosis:

- The extract promotes apoptosis (programmed cell death) in cancer cells, as evidenced by increased expression of pro-apoptotic markers such as caspase-3 and Bax, and decreased levels of anti-apoptotic proteins like Bcl-2.
- Histological analysis of tumor tissues demonstrates signs of apoptosis, including chromatin condensation and fragmentation.

Inhibition of Cell Proliferation:

- **Pueraria lobata** extract effectively inhibits cell proliferation by downregulating cell cycle regulators, such as cyclins and cyclin-dependent kinases (CDKs).
- This is reflected in decreased levels of Ki-67, a marker associated with active cell division, in tumor tissues from treated animals.

Modulation of Signaling Pathways:

- The extract exhibits a modulatory effect on key signaling pathways involved in cancer progression, particularly the PI3K/Akt and MAPK pathways.
- In vitro studies show that Pueraria lobata can suppress the activation of these pathways, leading to reduced cell survival and growth.



Anti-Inflammatory Effects:

- The anti-cancer efficacy of *Pueraria lobata* is complemented by its anti-inflammatory properties, which help mitigate the tumor-promoting effects of chronic inflammation.
- The extract reduces levels of pro-inflammatory cytokines (e.g., IL-6, TNF- α) and inhibits the activation of nuclear factor kappa B (NF- κ B), a transcription factor that promotes tumor growth and survival.

Enhancement of Chemotherapeutic Effects:

- When combined with standard chemotherapeutic agents, *Pueraria lobata* extract has been shown to enhance their efficacy, potentially overcoming drug resistance mechanisms in lung cancer cells.
- Synergistic effects have been observed, leading to more effective tumor reduction than when either treatment is used alone.

IV. CONCLUSION

In the study of *Pueraria lobata* demonstrates its significant anti-cancer efficacy in lung cancer models, highlighting its potential as a complementary therapeutic agent. The phytochemical analysis revealed a rich composition of bioactive compounds that collectively contribute to tumor growth inhibition, induction of apoptosis, and modulation of key signaling pathways involved in cancer progression. Furthermore, its ability to enhance the effectiveness of conventional therapies and reduce metastasis underscores its relevance in contemporary cancer treatment strategies. Overall, *Pueraria lobata* emerges as a promising candidate for further investigation, paving the way for innovative approaches to lung cancer management.

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