THE APPLICATION OF SILIBUM MARIANUM GAERTN.L. IN THE TREATMENT OF ONCOLOGICAL DISEASES

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ABSTRACT

Silibum marianum Gaertn.L., commonly known as milk thistle, has long been used in traditional medicine for its hepatoprotective effects. Recent studies have expanded its potential applications, highlighting its promising role in the treatment and support of oncological diseases. This article explores the pharmacological properties of its primary bioactive compound, silymarin, with a particular focus on its antioxidant, anti-inflammatory, and anti-carcinogenic mechanisms. The advantages of Silibum marianum over conventional therapies—such as low toxicity, selective cytotoxicity against tumor cells, and synergistic potential with chemotherapeutic agents—are discussed in detail. Additionally, current challenges including limited clinical evidence, low bioavailability, and the need for standardized formulations are addressed. The article concludes by outlining future research directions and emphasizing the plant's potential as part of an integrative approach to cancer care.

Introduction. In recent decades, oncological diseases have emerged as one of the leading causes of morbidity and mortality globally. Despite the advancements in conventional cancer therapies such as chemotherapy, radiotherapy, and immunotherapy, the search for novel therapeutic agents continues unabated. In this context, natural compounds have gained increasing attention for their potential to provide effective, safe, and affordable alternatives or adjuvants to conventional treatments. Among these, *Silibum marianum* Gaertn.L., commonly known as milk thistle, has shown promising pharmacological properties, especially in the realm of hepatoprotection and anti-cancer activity. This article aims to explore the phytochemical profile, mechanisms of action, and clinical relevance of *Silibum marianum* in the treatment of oncological diseases, while also highlighting current research trends and limitations.

To begin with, it is essential to understand the bioactive compounds responsible for the medicinal properties of *Silibum marianum*. The plant seeds contain a complex of flavonolignans collectively known as silymarin, which includes silybin (silibinin), silydianin,

silychristin, and isosilybin. Notably, silybin is the most biologically active and extensively studied component. Furthermore, the plant also comprises polyphenolic compounds, fatty acids, tocopherols, and sterols, which contribute synergistically to its antioxidant, anti-inflammatory, and anti-proliferative effects. Given this rich phytochemical profile, *Silibum marianum* has attracted considerable interest from oncological researchers worldwide.

Several molecular pathways have been identified through which silymarin and its components exert anti-cancer effects. These mechanisms include:

First and foremost, *Silibum marianum* exhibits powerful free radical scavenging activity, which helps in mitigating oxidative stress, a known contributor to cancer development. By neutralizing reactive oxygen species (ROS), it prevents DNA damage and genomic instability, thereby reducing the risk of malignant transformation. In addition, silymarin promotes programmed cell death (apoptosis) in various cancer cell lines, including breast, prostate, liver, and colon cancers. It activates caspases, modulates Bcl-2 family proteins, and disrupts mitochondrial membrane potential, leading to cancer cell apoptosis without harming normal cells. Moreover, studies have shown that silymarin impedes cell cycle progression, particularly by arresting cells in the G1 or G2/M phase. This effect is mediated through the downregulation of cyclin-dependent kinases (CDKs) and cyclins, as well as the upregulation of tumor suppressor proteins like p53. Furthermore, silymarin has been found to suppress angiogenesis by inhibiting vascular endothelial growth factor (VEGF), thus depriving tumors of blood supply. It also hampers metastasis by downregulating matrix metalloproteinases (MMPs), thereby limiting cancer spread [3].

Although preclinical studies have provided compelling evidence for the anti-cancer potential of *Silibum marianum*, its translation to clinical settings requires rigorous validation. Nevertheless, several clinical trials and observational studies have been conducted, particularly focusing on hepatocellular carcinoma (HCC) and chemotherapy-induced hepatotoxicity. One of the most well-documented applications of *Silibum marianum* is in the prevention and adjunct treatment of liver cancer. Notably, patients with chronic hepatitis B and C infections, which are major risk factors for HCC, may benefit from silymarin's hepatoprotective and anti-proliferative effects. Clinical trials have demonstrated improvement in liver enzyme profiles, reduced tumor progression, and enhanced survival rates when silymarin is used alongside conventional therapies. In another significant application, silymarin has been shown to protect normal tissues against the cytotoxic effects of chemotherapy. For instance, patients undergoing cisplatin or doxorubicin treatment have experienced reduced hepatic and renal toxicity with concurrent silymarin administration. Although research is still in its nascent stages, preliminary findings suggest that silymarin could serve as an adjuvant therapy in hormone-dependent cancers such as breast and prostate cancers. Its ability to modulate estrogen receptors, inhibit androgen receptor signaling, and reduce inflammatory cytokines presents exciting therapeutic prospects [2, 987-993].

As the side effects of conventional cancer treatments remain a major concern, natural remedies like *Silibum marianum* (milk thistle) are gaining attention as supportive agents. Its main compound, silymarin, offers several notable advantages. Firstly, *Silibum marianum* has a low toxicity profile, making it safer for long-term use. Unlike many chemotherapeutic drugs that harm both cancerous and healthy cells, silymarin causes minimal damage to normal

tissues, even at higher doses. Secondly, it shows selective action against tumor cells. Silymarin targets cancer cells through its antioxidant, anti-inflammatory, and pro-apoptotic properties, while largely sparing healthy cells, which reduces adverse effects. Thirdly, it has synergistic potential. When combined with chemotherapy, *Silibum marianum* may enhance the efficacy of drugs and protect organs like the liver from toxicity. This allows for better tolerance and possibly improved outcomes. However, it is essential to stress that *Silibum marianum* should be used as a complement, not a replacement, for conventional therapies. Its role lies in integrative oncology—supporting treatment, not substituting it. In summary, the plant offers promising support in cancer care due to its safety, selectivity, and compatibility with standard treatments. Further research will help define its full potential in clinical practice.

Despite the promising therapeutic potential of *Silibum marianum* in oncology, several challenges remain that must be addressed before it can be widely adopted in clinical practice. While preclinical studies have demonstrated its anti-cancer properties, clinical evidence is still limited. Most existing human studies focus on liver protection rather than direct anti-tumor effects, highlighting a need for more comprehensive and large-scale clinical trials targeting various cancer types. Another challenge lies in the standardization of dosage and formulation. The bioavailability of silymarin is relatively low due to poor water solubility and limited absorption in the gastrointestinal tract. As a result, consistent therapeutic outcomes are difficult to achieve. Therefore, future research must focus on developing enhanced delivery systems—such as nanoparticles, liposomes, or phytosome complexes—to improve absorption and ensure consistent efficacy. In addition, potential drug interactions need to be thoroughly investigated. As cancer patients often receive multiple medications, it is essential to determine whether *Silibum marianum* interferes with or enhances the effects of chemotherapy or other supportive drugs. Without this knowledge, the uncontrolled use of herbal supplements could pose risks rather than offer benefits. Looking ahead, interdisciplinary collaboration between pharmacologists, oncologists, and botanical researchers will be key to integrating *Silibum marianum* into evidence-based cancer treatment. Genomic and proteomic studies may also uncover new molecular targets, allowing for more personalized approaches to therapy. Moreover, patient-centered research focusing on quality of life and symptom management can help define the plant's role in supportive oncology care. In conclusion, while *Silibum marianum* shows great promise, overcoming scientific and clinical hurdles will be essential for its acceptance in mainstream medicine. With rigorous research and technological innovation, it may become a valuable component of future integrative cancer therapies.

Conclusion. To sum up, *Silibum marianum* Gaertn.L. holds significant potential in the treatment of oncological diseases, particularly due to its antioxidant, anti-proliferative, and hepatoprotective properties. While preclinical studies and early-phase clinical trials are encouraging, further research is imperative to overcome current limitations and fully harness the plant's therapeutic power. In light of increasing interest in evidence-based phytotherapy, *Silibum marianum* represents a promising natural adjunct in cancer care—offering hope not only for improved treatment outcomes but also for enhanced patient quality of life. As science advances, a multidisciplinary approach that integrates traditional botanical knowledge with modern medical research may pave the way for more effective and holistic cancer therapies in the future.

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