MEDICINAL PLANTS IN THE ADJUVANT TREATMENT OF LUNG CANCER: SCIENTIFIC EVIDENCE, PHARMACOLOGICAL EFFECTS, AND IMPLICATIONS FOR CLINICAL PRACTICE

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Abstract

This chapter aims to analyze, in an expanded manner, the use of medicinal plants as an adjuvant strategy in the treatment of lung cancer, highlighting the available scientific evidence, the main pharmacological effects of bioactive compounds and the implications for clinical practice. This is an integrative literature review, conducted based on the selection of studies indexed in national and international databases, such as PubMed, Scopus and SciELO, prioritizing recent and relevant publications in the area of integrative oncology. The results show that several medicinal plants, including *Curcuma longa* (turmeric), *Zingiber officinale* (ginger) and *Camellia sinensis* (green tea), have antioxidant, anti-inflammatory, immunomodulatory and antiproliferative properties, acting on cellular pathways related to carcinogenesis and tumor progression, decreasing the activation of the pathways: Phosphatidylinositol 3-kinase (*Phosphoinositide 3-Kinase*), *Protein Kinase B* and *Mechanistic Target of Rapamycin*. Curcumin, Inhibits pathways such as NF-κB, COX-2, TNF-α, IL-1β and IL-6 and Modulates macrophages, lymphocytes and inflammatory cytokines; 6-gingerol, 8-gingerol, 10-gingerol, 6-shogaol, paradol, zingerone Reduces the activation of Nuclear Factor Kappa B (NF-κB), inhibits the *Protein Kinase B* (Akt) pathway, decreases the production of prostaglandins, reduces the synthesis of Nitric Oxide (NO – Nitric Oxide) and reduces the release of pro-inflammatory cytokines, such as Tumor Necrosis Alpha (TNF-α), Interleukin 1 Beta (IL-1β) and Interleukin 6 (IL-6), Epigallocatechin-3-gallate inhibits NF-κB, inflammatory mediators and pathways associated with chronic inflammation. Such substances can contribute to the reduction of

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adverse effects associated with chemotherapy, such as nausea, fatigue and systemic inflammation, promoting an improvement in patients' quality of life. However, important limitations were identified, such as the methodological heterogeneity of the studies, lack of dose standardization, scarcity of robust clinical trials and risks of drug interactions. It is concluded that the use of medicinal plants in the context of lung cancer has relevant therapeutic potential as a complementary approach, as long as it is based on scientific evidence and carried out under qualified professional supervision, with the development of more rigorous clinical research being essential for its safe incorporation into care practice.

Keywords: Adjuvant therapy, Integrative oncology, Lung cancer, Medicinal plants, Phytotherapy.

INTRODUCTION

Lung cancer remains one of the leading causes of cancer-related mortality worldwide, representing a major challenge for health systems due to its high incidence, late diagnosis, and unfavorable prognosis. According to the World Health Organization, the disease is among the most lethal globally and is strongly associated with risk factors such as smoking, exposure to environmental carcinogens, and genetic predispositions. In this context, the search for complementary therapeutic approaches has increased, with the use of medicinal plants standing out as an adjuvant strategy in oncological care.

The delimitation of the research problem centers on the following question: what scientific evidence supports the use of medicinal plants as adjuvant therapy in lung cancer, and what are their pharmacological effects and implications for clinical practice? Although phytotherapy has been widely used in traditional and complementary medicine, important gaps still remain regarding its efficacy, safety, and standardization in the oncological context (Greenwell; Rahman, 2015).

The general objective of this chapter is to analyze the use of medicinal plants as adjuvant treatment for lung cancer, based on updated scientific evidence. The specific objectives are: (i) to describe the main bioactive compounds present in medicinal plants with antineoplastic potential; (ii) to discuss the

pharmacological effects related to antitumor action; (iii) to evaluate the benefits and risks associated with the use of these therapies; and (iv) to reflect on their implications for clinical practice in oncology.

The justification for the development of this study is based on the growing interest in integrative oncology and on the need to expand therapeutic possibilities that contribute to improving patients' quality of life. According to David Gorski (2014), although many complementary therapies show promising potential, it is essential that they be rigorously evaluated from a scientific perspective to ensure their efficacy and safety. Moreover, the indiscriminate use of medicinal plants may entail risks, such as drug interactions and adverse effects, reinforcing the importance of professional guidance.

From a theoretical perspective, several studies have investigated the effects of natural compounds in combating cancer. Bharat B. Aggarwal et al. (2007) highlight the role of curcumin, derived from *Curcuma longa*, in modulating inflammatory and apoptotic pathways in tumor cells. Similarly, M. S. Butt and Sultan (2009) demonstrate the effects of green tea polyphenols (*Camellia sinensis*) in inhibiting cell proliferation. Greenwell and Rahman (2015), in turn, emphasize the potential of natural compounds in the discovery of new anticancer agents. These findings reinforce the relevance of scientific investigation into medicinal plants as therapeutic adjuvants, especially in the context of lung cancer.

Thus, this chapter seeks to contribute to a critical and evidence-based understanding of the use of medicinal plants in oncology, promoting an approach grounded in evidence and aligned with contemporary demands in clinical practice.

METHODOLOGY

TYPE OF STUDY

This chapter is characterized as an integrative literature review, with a qualitative approach and a descriptive-analytical nature, enabling the synthesis of scientific knowledge regarding the use of medicinal plants as adjuvant therapy in lung cancer. This type of study makes it possible to gather and analyze results from previously published research, contributing to a broader understanding of the

phenomenon under investigation. According to R. Whittemore and K. Knafl (2005), the integrative review is suitable for incorporating evidence into clinical practice, especially in interdisciplinary areas such as integrative oncology.

SEARCH STRATEGY AND DATA SOURCES

The search for studies was conducted in recognized scientific databases, including PubMed, Scopus, Web of Science, and SciELO. Controlled and uncontrolled descriptors were used, combined with Boolean operators (AND, OR), such as: “lung cancer,” “medicinal plants,” “phytotherapy,” “adjuvant therapy,” and “integrative oncology.” The selection prioritized articles published between 2010 and 2025, in Portuguese, English, and Spanish, ensuring currency and scientific relevance.

INCLUSION AND EXCLUSION CRITERIA

Original studies, systematic reviews, and clinical trials addressing the use of medicinal plants or derived compounds in the adjuvant treatment of lung cancer were included, with a focus on pharmacological effects, therapeutic efficacy, and safety. Duplicate studies, studies with unclear methodology, non-peer-reviewed publications, and those with no direct relationship to the proposed topic were excluded.

DATA SELECTION AND ANALYSIS PROCESS

Article selection took place in three stages: reading of titles, analysis of abstracts, and full-text reading of eligible studies. For data organization and analysis, an instrument was developed containing information such as authors, year of publication, type of study, main findings, and conclusions. The analysis was conducted qualitatively, allowing the results to be categorized into thematic axes, such as pharmacological properties, clinical benefits, and risks associated with the use of medicinal plants.

ETHICAL ASPECTS AND SCIENTIFIC RIGOR

Because this is research based on publicly accessible secondary data, submission to a research ethics committee was not required. However, ethical principles related to scientific integrity were respected, with proper citation of the authors and sources used. As emphasized by Denise F. Polit and Cheryl Tatano Beck (2017), methodological rigor is essential to ensure the reliability and validity of results in review studies.

METHODOLOGICAL DISCUSSION

The choice of the integrative review as the method proved appropriate for meeting the objectives of the study, since it allows for a comprehensive analysis of different research designs and the identification of gaps in scientific knowledge. However, limitations inherent to this type of study should be considered, such as the heterogeneity of the included works and the possible presence of publication bias. Even so, as argued by Brian Haynes and colleagues (2006), the use of systematized search and selection strategies contributes significantly to the quality of the evidence produced.

Thus, the methodology adopted enabled a critical and evidence-based analysis of the use of medicinal plants in the adjuvant treatment of lung cancer, providing relevant support for evidence-based clinical practice.

RESULTS AND DISCUSSION

The results of this integrative review show a growing scientific interest in the use of medicinal plants as adjuvant therapy in lung cancer, especially with regard to their pharmacological effects and their potential to improve patients' quality of life. The analysis of the selected studies made it possible to organize the findings into thematic categories, as presented in the following tables.

Table 1 presents the main medicinal plants identified in the studies, their bioactive compounds, and the pharmacological effects described in the literature.

Table 1

Medicinal plants and their pharmacological effects in lung cancer

Medicinal plant	Bioactive compound	Main pharmacological effect	Reference
Curcuma longa (turmeric)	Curcumin	Anti-inflammatory and antiproliferative	Aggarwal et al. (2007)
Camellia sinensis (green tea)	Polyphenols (EGCG)	Antioxidant and tumor inhibition	Butt; Sultan (2009)
Zingiber officinale (ginger)	Gingerol	Induction of apoptosis	Greenwell; Rahman (2015)

Source: Author's own work (2026).

It is observed that the bioactive compounds present in these plants act on different cellular pathways related to carcinogenesis, including the regulation of inflammation, oxidative stress, and programmed cell death. Curcumin has been widely studied for its ability to modulate transcription factors such as NF-κB (Aggarwal et al., 2007), inhibiting Nuclear Factor Kappa B (NF-κB), a transcription factor that regulates the expression of several genes involved in the inflammatory response; reducing the production of pro-inflammatory mediators, including Cyclooxygenase-2 (COX-2), an enzyme responsible for the synthesis of inflammatory prostaglandins; and cytokines such as Tumor Necrosis Factor Alpha (TNF-α), Interleukin-1 Beta (IL-1β), and Interleukin-6 (IL-6). As a result, inflammation, edema, and tissue damage are reduced (Mirzaei et al., 2021; Moller et al., 2023).

Curcumin exhibits significant antioxidant activity through the activation of Nuclear Factor Erythroid 2–Related Factor 2 (Nrf2), considered the main regulator of cellular antioxidant mechanisms. Activation of Nrf2 stimulates the expression of antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and heme oxygenase-1 (HO-1), which act in the neutralization of reactive oxygen species and in the reduction of cellular oxidative stress (He et al., 2022; Zhang et al., 2023). Green tea polyphenols demonstrate potent antioxidant activity (Butt; Sultan, 2009). The main green tea polyphenols are: epigallocatechin-3-gallate (EGCG) – the main and most abundant catechin (50–65% of total catechins); epigallocatechin (EGC); epicatechin-3-gallate (ECG); and

epicatechin (EC). EGCG is considered primarily responsible for the biological effects of green tea. Green tea polyphenols also exhibit significant anti-inflammatory activity. EGCG is capable of inhibiting the activation of Nuclear Factor Kappa B (NF-κB), a transcription factor that regulates the expression of several genes involved in the inflammatory response. Consequently, there is a reduction in the production of pro-inflammatory mediators, including Tumor Necrosis Factor Alpha (TNF-α), Interleukin-1 Beta (IL-1β), Interleukin-6 (IL-6), and Cyclooxygenase-2 (COX-2), contributing to decreased inflammation and tissue injury (Yang; Wang, 2016; Zhang et al., 2023). The main bioactive compounds in ginger (*Zingiber officinale*) associated with anticarcinogenic activity are gingerols, especially 6-gingerol, and shogaols, mainly 6-shogaol. Compounds such as 8-gingerol, 10-gingerol, paradol, and zingerone are also present and exhibit antioxidant, anti-inflammatory, immunomodulatory, and antiproliferative properties (Sharma et al., 2022; Jia et al., 2023). 6-gingerol acts at different stages of carcinogenesis by reducing cell proliferation, interrupting the cell cycle, and inducing apoptosis (programmed cell death). This compound increases the expression of the Bax protein (B-cell lymphoma-associated X protein), which promotes apoptosis; reduces the expression of the Bcl-2 protein (B-cell lymphoma 2), responsible for cell survival; and activates caspases, enzymes that execute the process of programmed cell death. In this way, it promotes the elimination of genetically altered or potentially tumorigenic cells (Wala et al., 2022; Noor et al., 2024). 6-shogaol exhibits potent antiproliferative and pro-apoptotic activity. Its mechanism involves inhibition of the *Protein Kinase B*/Mechanistic Target of Rapamycin (Akt/mTOR) pathway. This pathway regulates cell growth, protein synthesis, metabolism, and cell survival, and is frequently hyperactivated in various types of cancer. 6-shogaol also reduces the activity of Nuclear Factor Kappa B (NF-κB), one of the main regulators of the inflammatory response, and of Signal Transducer and Activator of Transcription 3 (STAT3), a protein involved in cell proliferation, angiogenesis, and resistance to apoptosis (Jia et al., 2023; Figueroa-González et al., 2024).

The bioactive compounds in ginger also play an important role in preventing tumor invasion and metastasis. In a study conducted by Wala et al. (2022) with human breast adenocarcinoma cells, 6-

gingerol demonstrated the ability to reduce the expression of Matrix Metalloproteinases 2 (MMP-2) and 9 (MMP-9), enzymes responsible for degrading the extracellular matrix and basement membrane. The decreased activity of these enzymes resulted in a lower migratory and invasive capacity of tumor cells. Similarly, Chen et al. (2023) observed that 6-shogaol significantly reduced the mobility and invasion of colorectal cancer cells, an effect associated with the suppression of MMP-2 and MMP-9 expression and the modulation of signaling pathways related to metastasis. These results indicate that ginger compounds may hinder tumor dissemination by preserving the integrity of the extracellular matrix and limiting the invasive capacity of cancer cells (Wala et al., 2022; Chen et al., 2023).

Table 2 summarizes the main clinical benefits observed in the analyzed studies, especially in the context of adjuvant treatment.

Table 2

Clinical benefits of using medicinal plants as adjuvant therapy

Type of intervention	Observed benefits	Reference
Phytotherapy associated with chemotherapy	Reduction of nausea and vomiting	Ernst (2008)
Use of natural compounds	Decrease in systemic inflammation	Aggarwal et al. (2007)
Integrative therapies	Improvement in quality of life and well-being	Ernst (2008)

Source: Author's own work (2026).

The findings indicate that the use of these therapies may contribute significantly to symptom control and adherence to conventional treatment. According to Ernst (2008), integrative practices, when used appropriately, may promote relevant benefits in oncological care.

However, despite the promising results, Table 3 presents the main limitations identified in the literature.

Table 3

Limitations and risks associated with the use of medicinal plants

Identified limitation	Clinical implication	Reference
Lack of dose standardization	Difficulty in clinical application	Gorski (2014)
Few robust clinical trials	Low level of scientific evidence	Greenwell; Rahman (2015)
Possible drug interactions	Risk to patient safety	Gorski (2014)

Source: Author's own work (2026).

The critical analysis reveals that the methodological heterogeneity of the studies and the scarcity of controlled clinical trials limit the generalization of the results. In addition, the indiscriminate use of these substances may pose risks, especially due to interactions with chemotherapeutic drugs (Gorski, 2014).

Overall, the results demonstrate that medicinal plants have potential as adjuvant therapy in lung cancer (Table 1), particularly in the modulation of biological processes and symptom relief (Table 2). However, their use should be based on scientific evidence and carried out under professional supervision (Table 3), reinforcing the need for further clinical studies to ensure their safety and efficacy in healthcare practice.

CONCLUSION

This chapter aimed to analyze the use of medicinal plants as adjuvant treatment for lung cancer, based on scientific evidence, highlighting their pharmacological effects and implications for clinical practice. Based on the integrative review conducted, it was possible to achieve the proposed objectives, enabling the identification and discussion of the main bioactive compounds, their mechanisms of action, and their potential benefits in the oncological context.

The results showed that medicinal plants such as *Curcuma longa*, *Camellia sinensis*, and *Zingiber officinale* have antioxidant, anti-inflammatory, immunomodulatory, and antiproliferative properties, acting on important pathways related to carcinogenesis and tumor progression, such as the Nuclear Factor Kappa B (NF-κB) pathway, responsible for regulating inflammation and the expression of pro-inflammatory cytokines; the *Protein Kinase B*/Mechanistic Target of Rapamycin (Akt/mTOR) pathway, involved in cell growth, metabolism, and survival; the Mitogen-Activated Protein Kinase/Extracellular Signal-Regulated Kinase (MAPK/ERK) pathway, which controls cell proliferation and differentiation; the Signal Transducer and Activator of Transcription 3 (STAT3) pathway, associated with tumor proliferation, angiogenesis, and resistance to apoptosis; and the Wnt/β-catenin pathway, an important regulator of differentiation, cellular renewal, and tumor development. In addition, these bioactive compounds modulate the activity of Nuclear Factor Erythroid 2–Related Factor 2 (Nrf2), strengthening cellular antioxidant mechanisms, and reduce the expression of Matrix Metalloproteinases (MMP-2 and MMP-9), enzymes related to tumor invasion and metastasis formation. Together, the modulation of these pathways contributes to the reduction of chronic inflammation, oxidative stress, uncontrolled cell proliferation, angiogenesis, tumor invasion, and cancer progression.

Furthermore, it was found that the use of these substances may contribute to reducing the adverse effects of chemotherapy, such as nausea, vomiting, fatigue, and systemic inflammation, thereby improving patients' quality of life. However, relevant limitations were also identified, including the scarcity of robust clinical trials, lack of dose standardization, and risks of drug interactions.

As a contribution, this study reinforces the importance of integrative oncology and the use of evidence-based complementary approaches, offering theoretical support for health professionals in clinical decision-making. It also broadens the discussion on the need to integrate traditional and scientific knowledge safely and effectively in the care of oncology patients.

In oncology clinical practice, turmeric, ginger, and green tea should be understood as integrative and adjuvant strategies, and not as substitute treatments. Their use may contribute to symptom control,

reduction of inflammatory processes, and improvement in quality of life, but it must be individualized, taking into account the type of cancer, disease stage, chemotherapy regimen, liver function, bleeding risk, use of anticoagulants, and possible drug interactions. Therefore, the safest recommendation is that these therapies be used only with follow-up by the oncology, pharmaceutical, and nutritional team, respecting safe doses and avoiding concentrated supplements without professional evaluation.

Finally, future studies with more rigorous methodological designs are suggested, especially randomized clinical trials evaluating the efficacy, safety, dosage, and possible interactions of medicinal plants in the treatment of lung cancer. Such investigations are essential to consolidate the use of these therapies in clinical practice, ensuring greater reliability and safety for patients.

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