IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

The Role of Medicinal Plants in Cancer Treatment

Dr. Devarinti Srihari Reddy, Associate Professor

Government Degree College, Maheshwaram, Telangana.

DOI: https://doi.org/10.56975/ijrar.v13i1.329786

Abstract

Cancer remains a major life threatening disease worldwide. Though conventional allopathic therapy is well advanced with respect to diagnostics and therapeutics, treatments like chemotherapy, radiation, and surgery have some adverse effects and expensive. Hence, there is a growing interest in the role of medicinal plants in cancer treatment. Medicinal plants based treatment can offer complementary approaches to cancer treatment, potentially improving patient outcomes and quality of life (Pandey et al. 2021). This article reviews the importance of medicinal plants in cancer therapy, their mechanisms of action and future prospects of phototherapy.

Key words: Medicinal plants, cancer treatment, phytochemicals, apoptosis, cell signalling;

1. Introduction

The global burden of cancer is shocking, with an estimated 19.3 million new cases and almost 10 million cancer-related deaths reported in 2020 for 36 cancers in 185 countries (Sung et al., 2021). Patients suffering from cancers are increasingly exploring the benefits of alternative medicine, mainly due to severe side effects in usage of modern anticancer drugs and high economic burden (Wargovich et al., 2001; Steenkamp, 2003; MacLaughlin et al., 2006). The World Health Organization (WHO) identified the potential of alternative medicine, including herbal remedies, in cancer treatment (WHO, 2013). In traditional medicine, herbs have been used since a long time either directly or as dietary supplements, as they offer no side effects (Arora, Rajesh & Malhotra, Poonam & Chawla, Raman & Gupta, Damodar & Sharma, Rakesh & Baliga, Manjeshwar Shrinath, 2010). Indian Herbal Medicine for Cancer Therapy and Prevention. 10.1201/b10330-39). Phytochemicals of herbal medicines like flavonoids, carotenoids, vitamin C, vitamin E, selenium, dithiolthiones, isothiocyanates, indoles, phenols, plant sterols, limonene etc. contain antioxidant properties,

and inhibit cancer promotion and progression. This article aims to discuss the significance of evidence-based medicinal plants in cancer therapy, focusing on their therapeutic potential, mechanisms of action, and the importance of scientific validation.

2. Medicinal Plants with Anticancer Properties

2.1. *Curcuma longa* (Turmeric)

Curcuma longa (Turmeric) belongs to the family Zingiberaceae. Turmeric produced from the rhizomes, is a main ingredient of traditional food preparations as a spice. Several secondary metabolites including phenolic acids, flavonoids, and alkaloids with pharmacological activities are produced in the plant. Curcumin, the active phytochemical compound found in turmeric, is extensively studied for its anticancer properties. As per the reports, curcumin can induce apoptosis (programmed cell death) in cancer cells, inhibit tumor growth, and reduce metastasis (Anand et al., 2008, Heger M et al, 2013 and Xie L et al, 2022). Anti-oxidant and free radical scavenging activity of Curcumin is reported (Ak, T., & Gülçin, I., 2008). Curcumin I (diferuloyl methane), curcumin II (feruloyl-p-hydroxy cinnamoyl methane) and curcumin III (his-(p-hydroxy cinnamoyl) methane) are found to be potent inhibitors of mutagenesis (Anto, R. J et al. 1996). It is observed that curcumin supplementation is useful in patients with colorectal cancer, lung cancer, breast cancer, brain cancer, prostate cancer and gastric cancer etc. (Coker-Gurkan A.et al, 2019; C Kumar et al., 2019; Liu W.H., 2019; Coker-Gurkan et al. 2018;Berrak et al, 2016; *Wu G.Q., et al, 2016*; *Díaz-Osterman C.J et al, 2016;* Watson P.A. et al. 2015; Thapa, D., & Ghosh, R. 2015). It is reported that, curcumin induces apoptosis by down regulation of Bcl2 and MMP-2/9 expression, and activation of p53 (Kuttikrishnan et al. 2019; Zhang et al. 2019; Lee et al. 2015)

2.2. *Annona muricata* (Soursop)

Annona muricata belongs to the family Annonaceae. It is commonly known as soursop and became popular for its potential anticancer properties. It is proved that extracts from *Annona muricata* can induce apoptosis in cancer cells and inhibit tumor growth. Compounds such as acetogenins possess cytotoxic effects against various cancer cell lines, including breast, prostate, and colon cancers (Suganya Ilango et al., 2022). Its extracts reported to have anti-inflammatory and antioxidant properties, which may further contribute to their anticancer effects (Moghadamtousi, S. Z., et al., 2015).

2.3. *Catharanthus roseus* (Vinca rosea)

Catharanthus roseus belongs to the family Apocyanaceae. It is a well-known source of two alkaloids vincristine and vinblastine. Vincristine is used to treat leukemia, lymphoma, and pediatric cancers. Vinblastine is effective to treat Hodgkin's lymphoma, breast cancer, and testicular cancer. These compounds work by inhibiting microtubule formation during cell division, effectively stopping cancer cell proliferation (Kumar et al., 2026). The evidence supporting the efficacy of *Catharanthus roseus* in cancer treatment supports the importance of traditional knowledge in guiding scientific research (Bisht et al., 2011; Pooja, 2017; Harshini et al., 2020).

2.4. *Centella asiatica* (brahmi)

Centella asiatica belongs to Apiaceae family is a traditional medicinal plant of India, used for memory power and as a nervous tonic (Bisht et al., 2011; Avni et al., 2008). The chloroform extracts of C. asiatica leaves possesses alkaloids that were assessed for their cytotoxicity effect in human lung epithelial carcinoma cell line (Sinduja S SS et al., 2025).

2.5. *Piper longum* (Long pepper)

Piper longum belongs to the family Piperaceae. Piperine (1-Piperoylpiperidine) is an alkaloid extracted from this plant. It is shown in the clinical trials that piperine has anticancer actives in many cancer cells. It induced apoptosis in human ovarian cancer cells (Si et al., 2018). Piperine induced apoptosis and it decreased androgen receptor and prostate specific antigen (PSA) levels in prostate cancer cells (Samykutty et al., 2013). Piperine can regulate p53 expression and inhibit cell cycle proteins (CDK2, Cyclin A) to result in apoptosis in breast cancer cells (Grinevicius et al., 2019). Piperine combined with chemotherapy agent docetaxel had synergic cytotoxicity effects by inhibition of CYP3A4 activity in castration-resistant prostate cancer [98].

Si L, Yang R, Lin R, et al. Piperine functions as a tumor suppressor for human ovarian tumor growth via activation of JNK/p38 MAPK-mediated intrinsic apoptotic pathway. Biosci Rep. 2018; 38: BSR20180503.

Samykutty A, Shetty AV, Dakshinamoorthy G, et al. Piperine, a bioactive component of pepper spice exerts therapeutic effects on androgen dependent and androgen independent prostate cancer cells PLoS One. 2013; 8: e65889.

2.6. Taxus baccata (Yew tree)

Taxus baccata, belongs to the family Taxaceae. Needles, leaves and seeds of the plant are used for extraction of phytochemicals like Taxol (Paclitaxel), taxodione, gibberellin A-12, carnosol, sugiol, ferruginol, phenylbutyl, isolaricresinol, taxiresinol, lariciresinol and baccatin III. Taxol is the most important compound found to treat cancers (Bisht et al., 2011; Ankit et al., 2019; Milena et al., 2015).

2.7. *Zingiber officinale* (Ginger)

Zingiber officinale belongs to Zingiberaceae family. Its active component gingerol, has been recognized for its anticancer properties. Gingerol, shogaol and paradol are active compounds isolated from its rhizomes. Gingerol and shogaols reported to have anticancer, antioxidant, and antiinflammatory effects. Research indicates that gingerol can inhibit the proliferation of various cancer cells, including those of the breast, colon, and prostate (Lin et al., 2012; Liu et al., 2017). It is shown that ginger can enhance the effectiveness of chemotherapy drugs by synergetic effect and reduce the side effects associated with cancer treatment (Li C et al., 2021).

2.8. *Withania somnifera* (Ashwagandha)

Withania somnifera belongs to the family Solanaceae. Popularly it is called as Ashwagandha and used in traditional and Ayurvedic medicine for its anti stress properties. It is reported that withanolides, the active compounds in Ashwagandha, can inhibit cancer cell proliferation and induce apoptosis in various cancer types, including breast and lung cancers (Parvaiz A. Dar et al., 2017; Singh, N., 2021). Ashwagandha may enhance the efficacy of chemotherapy while reducing its side effects (Bisht et al., 2011; Avni et al., 2008; Saranya et al., 2019).

Table 1: Description of anti-cancer compounds from various medicinal plants

S.No.	Botanical name	Common name	Anti-cancer compounds	Reference
1	*Annona muricata*	Soursop	Chlorogenic acid, ledol, ferulic acid, vanillic acid, myricetin, cleistopholine, anonaine, myrcene, α-β-pinene, asimilobine, lanuginosine, catechin, epicatechin, stepharine, bullatacin, acetogenin.	Avni et al., 2008; Saranya et al., 2019; S.M. Bassam et al., 2020; Amudha & Vanitha, 2017; S.M. Bassam et al., 2020; Joseph et al., 2019

2	*Catharanthus roseus*	Vinca rosea	Vinorelbine, vinblastine, vincristine and vindesine.	Bisht et al., 2011; Pooja, 2017; Harshini et al., 2020; Kumar et al., 2026
3	*Centella asiatica*	bramhi	Madecassoside, vallarine, asiatic acid, hydrocotylin, brahmoside, madecassic acid, asiaticosides, centelloside, β-sitosterol and brahminoside.	Bisht et al., 2011; Iwan et al., 2016
4	*Curcuma longa*	Turmeric	Curcumin, glucuronide, demethoxycurcumin and bisdemethoxycurcumin	Bisht et al., 2011; Ankit et al., 2019; Avni et al., 2008; Antonio & Giuseppina, 2019
5	*Piper longum*	Long pepper	Piperine, β-sitosterol, piperlongumine, sylvatine, guineensine and piperlongumine.	Bisht et al., 2011; Saranya et al., 2019; Amit et al., 2014
6	*Taxus baccata*	Taxus	Paclitaxel, taxodione, carnosol, sugiol, ferruginol, phenylbutyl, isolaricresinol, taxiresinol, lariciresinol and baccatin III.	Bisht et al., 2011; Ankit et al., 2019; Milena et al,2015.
7	*Withania somnifera*	Ashwagandha	Withanolides, anahygrine, anaferine, withanine, β-sitosterol, chlorogenic acid, somniferine, cysteine and scopoletin.	Bisht et al., 2011; Avni et al., 2008; Saranya et al., 2019.
8	*Zingiber officinale*	Ginger	Gingerol, shogaol and paradol	Rastogi N et al., 2015; Nigam N et al., 2010; Park YJ, et al., 2006; Rastogi N 2014; Lin CB et al., 2012;

3. Discussion

The active ingredients or phytochemicals of medicinal plants exhibit various mechanisms of action that contribute to their anticancer effects. Many of them act through induction of apoptosis in cancer cells and prevent their growth. Many medicinal plants are rich in antioxidants that scavenge free radicals and protect cells from oxidative damage. Chronic inflammation is a known risk factor for cancer development. Several medicinal plants have anti-inflammatory properties that can help mitigate this risk. Angiogenesis, the formation of new blood vessels, is essential for tumor growth and metastasis. Several medicinal plants have the ability to inhibit angiogenesis, thereby preventing tumor growth. Phytochemicals of these plants usually modulate cell signalling pathway by down regulation of Bcl2 and MMP-2/9 expression, and activation of p53. They also reported to have immune modulatory activity to prevent cancer growth.

Nevertheless, it is important to validate the efficacy of these medicinal plants through well designed clinical trials in more effective way. Standardization of protocols for herbal products is vital to ensure consistent quality and potency. Evidence-based medicinal plants can serve as complementary therapies alongside conventional cancer treatments. Increasing awareness and understanding of the role of medicinal plants in cancer treatment among healthcare professionals and patients is crucial. While the potential of medicinal plants in cancer treatment is promising, several challenges must be addressed to facilitate their integration into clinical practice.

4. Conclusion

Medicinal plants have a lot of therapeutic potential in cancer treatment. Medicinal plants play a vital role in improving cancer care. Phytochemicals from the medicinal plants are shown to work independently or synergistically to prevent the cancer growth by inducing apoptosis, preventing microtubule formation, modulation of immune response/ cell signalling pathway and anti proliferation activity in cancer cells. It is reported that active ingredients of medicinal plants reduced the side effects of chemotherapy, when integrated with conventional therapy. However, rigorous scientific validation through clinical trials and standardization is essential to ensure their safety and efficacy. By bridging traditional knowledge with modern research, we can unlock the full potential of medicinal plants in the fight against cancer, ultimately benefiting patients and healthcare systems worldwide.

References

1. Ak, T., & Gülçin, I. (2008). Antioxidant and radical scavenging properties of curcumin. *Chemico-biological interactions*, 174(1), 27-37.
2. Anand P, Sundaram C, Jhurani S, Kunnumakkara AB, and Aggarwal BB (2008) Curcumin and cancer: an "old-age" disease with an "age-old" solution. Cancer Lett 267:133–164
3. Ankit, S., Robbie, H., & Sudeep, C. (2019). Traditional herbal knowledge among the inhabitants: A case study in Urgam Valley of Chamoli Garhwal, Uttarakhand, India. Evidence-Based Complementary and Alternative Medicine, 1–21. 10.1155/2019/5656925
4. Anto, R. J., George, J., Babu, K. D., Rajasekharan, K. N., & Kuttan, R. (1996). Antimutagenic and anticarcinogenic activity of natural and synthetic curcuminoids. *Mutation Research/Genetic Toxicology*, 370(2), 127-131
5. Arora, Rajesh & Malhotra, Poonam & Chawla, Raman & Gupta, Damodar & Sharma, Rakesh & Baliga, Manjeshwar Shrinath. (2010). Indian Herbal Medicine for Cancer Therapy and Prevention. 10.1201/b10330-39. In book: Bioactive Foods and Extracts (pp.519-543)
6. Attia Y.M et al., (2020) Inhibition of aldehyde dehydrogenase-1 and p-glycoprotein-mediated multidrug resistance by curcumin and vitamin D3 increases sensitivity to paclitaxel in breast cancer. Chem. Biol. Interact.;315:108865. doi: 10.1016/j.cbi.2019.108865.
7. Avni, G., Desai, G. N., Qazi, & Bhat, H. K. (2008). Medicinal plants and cancer chemoprevention. Current Drug Metabolism, 9(7), 581–591.
8. Berrak O., Akkoc Y., Arisan E.D., Coker-Gurkan A., Obakan-Yerlikaya P., Palavan-Unsal N. (2016).The inhibition of PI3K and NF-κB promoted curcumin-induced cell cycle arrest at G2/M via altering polyamine metabolism in Bcl-2 overex