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NATURE'S WARRIORS: UNVEILING THE POWER OF ANTICANCER MEDICINAL PLANTS

Shubhangi Shelar[1], Snehal Bagadane, Shrutika Gaikwad, Snehal Chakorkar[1]

[1] Department of Pharmacology, Dr. D. Y. Patil Institute of Pharmaceutical Sciences and Research, Pimpri, Pune, Maharashtra, India

[2] Department of Pharmaceutical Chemistry, S.N.D. College of Pharmacy, Babhulgaon, Yeola, Maharashtra, India

[3] Department of Pharmaceutics, Abhinav Education Society's College of Pharmacy, Narhe, Pune, Maharashtra, India

Abstract:

Cancer is characterized by the unbridled multiplication of abnormal cells that can invade surrounding tissues and spread through lymphatic and vascular pathways. Though research has made leaps and bounds in recent years, the battle against cancer continues. Our arsenal against this enemy ranges from traditional methods like surgery, chemotherapy, and radiation therapy to cutting-edge advancements. However, these therapies often come at a cost, harming healthy cells as they target the cancerous ones. This is where medicinal plants emerge as potential allies. Many plants possess potent anticancer properties. They achieve this through various mechanisms, such as blocking harmful enzymes, activating protective ones, aiding DNA repair, and triggering antioxidant reactions. This review delves into the promising potential of naturally occurring compounds found in traditionally and currently used medicinal plants as weapons against cancer. The key lies in their inherent antioxidant capabilities, which form the cornerstone of their anticancer activity. Furthermore, the rich tapestry of pharmacological properties found in medicinal plants, including cytotoxicity and chemoprevention, has drawn significant attention to natural products like flavonoids, terpenoids, and steroids. This article explores the exciting promise of harnessing these naturally occurring chemicals from medicinal plants to combat cancer effectively.

Keywords: Phytopharmaceuticals, Anticancer property, Chemotherapy, Herbal plants, Cancer

INTRODUCTION:

Cancer, a formidable foe in the relentless battle for human health, continues to cast a long shadow (Article, 2005). While conventional therapies have made strides, the search for potent yet gentler

treatments remains unwavering (Ong et al., 2018). In this quest, a beacon of hope shines from the verdant kingdom: herbal medicines beckoning with their ancient wisdom and powerful phytochemicals. This article delves into the exciting realm of anticancer potential hidden within the leaves, roots, and bark of nature's bounty.

We embark on a journey to dissect the mechanisms by which these botanical warriors wage war against cancer cells. From free radical scavenging to apoptosis induction, we unveil the diverse weapons in their arsenal (Sa, 2000). We explore the clinical evidence mounting to support these natural allies, showcasing their success in targeting various cancer types. However, we also navigate the challenges that lie ahead, from standardization and safety concerns to the need for robust clinical trials. This is not a tale of folklore and speculation but a scientific saga unfolding. As we peel back the layers of mystery surrounding these potent plant-derived compounds, we discover a promising avenue for complementary and alternative cancer therapies. Join us as we explore the anticancer potential of herbal medicines, a narrative filled with hope, resilience, and the unwavering pursuit of a healthier future.

On the other hand, some care needs to be taken while using herbal medicines. 1) It's essential to consult a doctor before using any herbal medicines, especially if anyone is undergoing conventional cancer treatment, as some herbs may interact with medications or worsen specific side effects (Allegra et al., 2023). 2)Herbal medicines are not a substitute for conventional cancer treatment and should only be used as a complementary therapy. 3) The effectiveness of herbal medicines for cancer can vary greatly depending on the type of cancer, the individual, and the specific herbal product used.4) More research is needed to fully understand herbal medicines' potential benefits and risks in cancer treatment (Yin et al., 2013).

This introduction sets the stage for your article, establishing the significance of herbal medicines in the fight against cancer. It provides a glimpse into the mechanisms, evidence, and challenges involved, piquing the reader's interest and inviting them to delve deeper into the fascinating world of natural anticancer agents (Kingston and Newman, 1900) .

Mechanism of Herbal Medicine as Anticancer Agent:

Herbal medicines show their anticancer action by various mechanisms like;

1. Inhibiting Cancer Cell Growth and Proliferation: Certain herbs, like turmeric (containing curcumin) and green tea (rich in epigallocatechin gallate, EGCG), possess antiproliferative properties. They may hinder the rapid division and multiplication of cancer cells (Manuscript et al., 2014).

2. Inducing Apoptosis (Programmed Cell Death) in Cancer Cells: Herbs like mistletoe and graviola have been shown to trigger apoptosis in cancer cells, causing them to self-destruct. This can help shrink tumors and slow cancer progression (Safarzadeh et al., 2014).

3. Reducing Inflammation: Chronic inflammation is a hallmark of cancer and can promote tumor growth. Herbs like ginger and boswellia possess anti-inflammatory properties that may help dampen this process.

4. Boosting the Immune System: A robust immune system is crucial for fighting cancer. Herbs like echinacea and astragalus may help stimulate the immune system and enhance its ability to target and destroy cancer cells(Block and Mead, 2003).

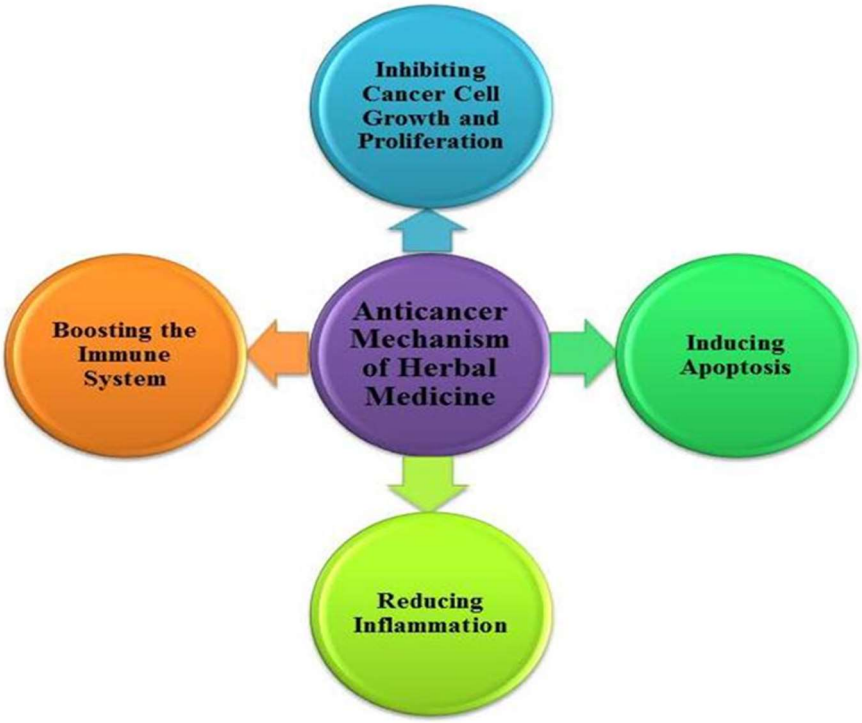

Figure 1: Mechanism of Herbal Medicine as Anticancer Agent

Current market Scenario in the case of herbal medicine:

Looking forward to the market scenario of anticancer herbal medication, it was observed that the herbal market is undergoing a dynamic transformation shaped by a complex interplay of growing interest, regulatory hurdles, scientific advancements, and ethical considerations. Let's dive into the current scenario:

1. Rising Demand: Public interest in complementary and alternative therapies (CAMs), including herbal medicines, is steadily increasing. This is driven by a desire for more holistic approaches, concerns about the side effects of conventional treatments, and growing awareness of the potential benefits of natural products. The global market for herbal cancer remedies is estimated to reach USD 182.4 billion by 2027, reflecting this surge in demand (Block and Mead, 2003).

2. Regulatory Tightrope: Despite the surge in popularity, the regulatory landscape for herbal medicines needs to be more cohesive and complex. Regulatory authorities are grappling with ensuring safety, efficacy, and standardization while acknowledging the inherent variability of natural products. Some countries have stricter regulations, like the European Union's Traditional Use Registration system, while others adopt a more lenient approach. This inconsistency creates ambiguity for both consumers and manufacturers (Ekor, 2014).

3. Scientific Scrutiny: While anecdotal evidence for the efficacy of herbal medicines abounds, robust scientific research is necessary to validate their claims and establish clear clinical benefits. More rigorous clinical trials are needed to evaluate the effectiveness of specific herbal compounds for different cancer types. This will pave the way for their integration into mainstream cancer treatment protocols (Tuomilehto, n.d.).

4. Ethical Concerns: The booming market for herbal cancer remedies raises ethical concerns about exploitation and misinformation. Unscrupulous actors may capitalize on vulnerable patients' desperation, making exaggerated claims and selling unproven products. Sustainability and responsible sourcing of medicinal plants are also crucial considerations. Overharvesting can pose ecological threats and deplete valuable resources (Ekor, 2014).

5. Collaborative Future: The future of herbal medicines in cancer treatment lies in collaboration and open communication. Regulatory bodies, researchers, herbal medicine practitioners, and conventional healthcare professionals must work together to establish best practices and ethical guidelines. Integrating traditional knowledge with scientific rigor can pave the way for developing safe and effective herbal therapies based on solid evidence (Nien et al., 2023).

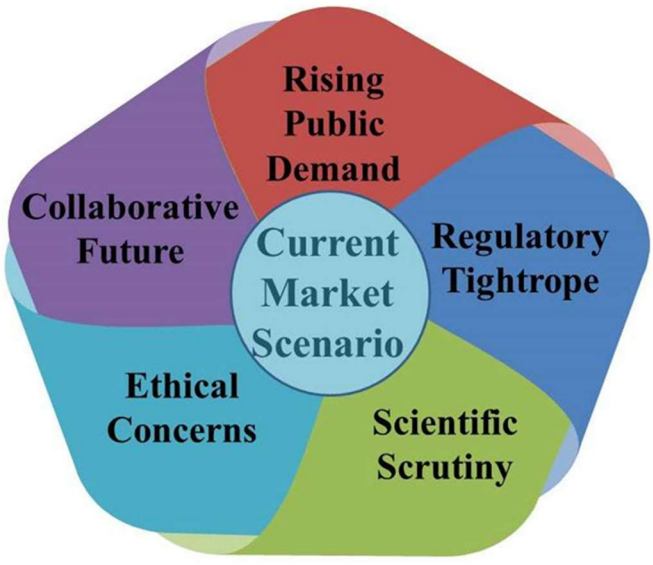

Figure 2: Current market Scenario in case herbal medicine

The current market scenario for herbal medicines has exciting possibilities and stark challenges. By addressing the regulatory gaps, conducting rigorous research, and prioritizing ethical considerations, we can unlock the true potential of these natural allies in the fight against cancer. Responsible and informed use remains critical to navigating this promising yet complex landscape.

Plant Compound with anticancer property

Polyphenols: Polyphenolic compounds include flavonoids, tannins, curcumin, resveratrol, and gallacatechins, and are all anticancer compounds. Polyphenols act by one of the following mechanisms: Antioxidant activity: Polyphenols combat free radicals and oxidative stress, which are known to contribute to cancer development (Combinations, 2016). Induction of apoptosis: They trigger programmed cell death in cancer cells, preventing their uncontrolled growth. Inhibition of angiogenesis: Polyphenols can hinder the formation of new blood vessels, thereby limiting tumor growth and spread. Anti-inflammatory effects: Chronic inflammation is linked to cancer risk, and polyphenols can help dampen inflammatory processes. Modulation of signaling pathways: They can interfere with various signaling pathways involved in cell proliferation, differentiation, and survival of cancer cells.

DNA protection: Polyphenols can interact with DNA and protect it from damage caused by carcinogens (Cháirez-ramírez and Cruz-lópez, 2021).

A specific example of a polyphenol compound is Epigallocatechin gallate (EGCG). Found in green tea, it exhibits promising anticancer activity against various cancers. Curcumin: The active component of turmeric, shows potential in colon, breast, and other cancers. Resveratrol: Found in grapes and red wine, it has been linked to reduced cancer risk and tumor growth. Quercetin: Widely present in fruits and vegetables, exhibits antiproliferative and pro-apoptotic effects on cancer cells.

Flavonoids: Various plants, such as fern species and plants used in traditional Chinese medicines like the litchi leaf, have been investigated for their flavonoid content and how these compounds affect cancer cells (Ullah et al., n.d.).

Brassinosteroids: Brassinosteroids (BRs) are naturally occurring plant hormones. They play crucial roles in various plant processes, including i) Cell growth and differentiation: BRs regulate hormone signaling pathways that control how plant cells divide, specialize, and mature. ii) Elongation of stems and roots: BRs stimulate the growth of cells in stems and roots, leading to longer and stronger plant structures. iii) Stress resistance and tolerance: BRs can help plants resist and cope with environmental stresses like drought, salinity, and disease. iv) Regulation of senescence: BRs delay the aging process in plants, extending their productive lifespan (Manghwar et al., 2022).

Beyond their importance for plant growth and development, BRs have also shown promising therapeutic potential in the fight against cancer. Research suggests they may be able to induce

apoptosis (programmed cell death) in cancer cells, slow tumor growth, and Inhibit the growth and spread of cancerous cells.

Sr.No	Name of Plant	Biological Source	Active chemical Constituents	Other information
1.	Turmeric	Turmeric is a rhizome of Curcuma longa, a rhizomatous herbaceous perennial plant belonging to the ginger family Zingiberaceae,	Curcumin	The anticancer potential of curcumin is mainly due to its ability to inhibit and activate various intracellular transcription factors, thus regulating the expression of multiple proteins that participate in tumor growth and development (Ortega et al., 2019).
2.	Ginger	Ginger is a rhizome of Zingiber officinale, an herbaceous perennial plant of the family Zingiberaceae,	Curcumin, gingerenone A, gingerols, zingerone	Methanolic extract of Zingiber officinale rhizome (ZOME) for anticancer activity against human cervical cancer HeLa cells and breast cancer MDA-MB-231 cells and antioxidant activity using 1,1-diphenyl-2-picryl hydroxyl (DPPH) scavenging assay, 2,2'-azinobis-3-ethylbenzothiozoline-6-sulfonic acid (ABTS) cation decolorization test. Antiproliferative activity was substantiated by 3-

				[4,5-dimethylthiazol-2-yl]-2,5-diphenyl tetrazolium bromide (MTT) and colony formation assay for cell viability and cell proliferation, Hoechst staining was performed to examine apoptosis (Compounds, n.d.)
3.	Ashwagandha Winter cherry, Indian ginseng	Ashwagandha, a perennial shrub Withania somnifera, also known as Indian ginseng, belongs to the nightshade family Solanaceae.	Withaferin A, D	Withania Somnifera leaves have also been shown to inhibit the growth of human cancer cell lines comparable to that of adriamycin. The leaf extract produced antiproliferative activity on NCI-H460 (lung), HCT-116 (colon), SF-268 (central nervous system), and MCF-7 (breast) human tumor cell lines (Rai et al., 2015).
4.	Garlic	Garlic is the ripe bulb of Allium sativum Linn., belonging to the family Liliaceae.	Allicin, alliin, allixin	According to human population research, garlic reduces the risk of esophagus, stomach, and colon cancer. Several bioactive compounds in garlic, including DATS, allicin, DADS, diallyl sulfide, and allyl mercaptan, have

				anticancer properties (Verma et al., 2023).
5.	Vinca Madagascar periwinkle.	Vinca is the dried entire plant of Catharanthus roseus Linn., belonging to the family Apocynaceae.	Vinblastine, vincristine	Vinca alkaloid class of cell cycle–specific cytotoxic drugs that work by inhibiting the ability of cancer cells to divide: Acting upon tubulin, they prevent it from forming into microtubules, a necessary component for cellular division (Moudi et al., 2013).
6.	Liquorice	Liquorice consists of subterranean peeled and unpeeled stolons, roots, and underground stems of Glycyrrhiza glabra Linn and other species of Glycyrrhiza belonging to the family Leguminosae.	Glycyrrhizin	The anticancer activities of licorice components appear to include cycle arrest, apoptosis induction, and general antioxidant effects. Commonly reported indirect protein targets important in tumorigenesis include many cell cycle-related proteins, apoptosis-associated proteins, MMP proteins, COX-2, GSK-β, Akt, NF-κB, and MAP kinases. Notably, several licorice components were reported to directly bind to and inhibit the activities of PI3-K, MKK4, MKK7, JNK1, mTOR, and Cdk2, resulting in

				decreased carcinogenesis in several cell and mouse models with no apparent toxicity (Giri and Narasu, 2000).
7.	Podophyllum, Mayapple	Podophyllum consists of the dried rhizomes and roots of Podophyllum peltatum Linn., belonging to the family Berberidaceae.	Podophyllotoxin, asiragalin, podophyllin.	Podophyllum peltatum has cell cycle-specific activity in the late S phase and G2 phase. Etoposide inhibits topoisomerase II by stabilizing the enzyme–DNA complex and preventing the unwinding of DNA (Koltai, 2022).
8.	Silybum marianum (Milk thistle)	Silymarin (SM) is a C25-containing flavonoid mixture extracted from the Silybum marianum (milk thistle) plant belonging to the family daisy.	Silymarin, Silybin	silymarin could act as a preventive (anti-promoter) of cancer in mouse mammary glands treated with DMBA (dimethylbenzanthracene) and TPA (tetradecanoylphorbol acetate). The treatment protocol they employed made it possible to differentiate whether the chemoprevention worked at the initiation stage of carcinogenesis (DMBA phase) or during promotion

				(TPA phase)(Koltai, 2022)
9.	Green Tea	Green Tea is a dried leaves Camellia sinensis belonging to the family Theaceae.	Epicatechin, epigallocatechin,epigallocatechin gallate, epigallocatechin-3-gallate	Green tea contains substances called polyphenols. A sub group of these polyphenols is called catechins. Scientists think catechins give green tea its antioxidant properties (Oh et al., 2023).
10.	Hemp	Hemp is the pericyclic fiber obtained from Cannabis sativa Linn., belonging to the family Cannabinaceae.	Cannabinoids, cannabinol,	Dronabinol (Marinol®/Syndros®) is a medicine containing delta-9-tetrahydrocannabinol (THC). It is approved by the US Food and Drug Administration (FDA) to treat nausea and vomiting caused by cancer chemotherapy, as well as weight loss and poor appetite in patients with AIDS (Seltzer et al., 2020).
11.	Aloe barbadensis (Aloe vera)	The biological source of aloe is the dried latex of its leaves. It is also known as curacao, cape, and socotrine aloe. It belongs	Aloe-emodin, Aloin	Aloe vera can be a potential therapeutic agent for various cancers, including breast and lung cancers (Tong et al., 2021).

		to the Liliaceae family.		
12.	Silver birch	species of tree Betula pendula, the family Betulaceae	Betulin, Betulinic acid	betulin can exert important anticancer activities through modulation of diverse cellular pathways (Tuli et al., 2021)
13.	Asiatic Pennywort	Centella Asiatica is a herbaceous, perennial plant in the flowering plant family Apiaceae.	Asiaticoside, Asiatic acid	Asiaticoside, Asiatic acid kills iron-enriched breast cancer cells but doesn't harm many healthy ones (Saxena et al., 2014).
14.	Digitalis purpurea (Foxglove)	Digitalis, a drug obtained from the dried leaves of the common foxglove (Digitalis purpurea), belongs to the Scrophulariaceae plant family.	Gitoxigenin, gitoxin	The ability of digitalis to block cell proliferation has been well established for some time. Digitalis in non-toxic concentrations has recently been shown to induce apoptosis in different malignant cell lines. In light of the pivotal role of apoptosis in cancer development and progression and this new experimental finding concerning digitalis, it seems probable that the apoptosis-inducing capability is explained by mechanisms other

				than Na+/K+ ATPase inhibition (Haux, 1999).
15.	Clove	Cloves are the aromatic flower buds of a tree S. aromaticum in the family Myrtaceae,	Eugenol, carvacrol, thymol, anthocyanins	in vitro and in vivo antitumor effects and biological mechanisms of ethyl acetate extract of cloves (EAEC) and the potential bioactive components responsible for its antitumor activity. The impact of EAEC on cell growth, cell cycle distribution, and apoptosis was investigated using human cancer cell lines (Lok et al., 2023).
16.	Guava	Psidium guajava is a fruit of the plant Psidium guajava L, belonging to the family Myrtaceae.	Quercetin 3-glucuronide, d-glucuronic acid, xanthyletin	A novel terpenoid saponin glycoside isolated from a fraction of a methanolic guava leaf extract was assessed for its anticancer activity through the MTT assay (Lok et al., 2023) .
17.	Thuja occidentalis, Arborvitae, white cedar	Thuja occidentalis, also known as northern white-cedar, eastern white-cedar, or arborvitae, is an evergreen	Thujone	The protective effect of T. occidentalis against radiation-induced toxicity in mice has also been reported. Studies have found that thuja has promising cytotoxic effects on Dalton's lymphoma

		coniferous tree in the cypress family Cupressaceae,		ascites (DLA), Ehrlich ascites carcinoma (EAC), and lung carcinoma L929 cells (Saha et al., 2014).
18.	Dandelion	Dandelion (Taraxacum officinale L. syn. Taraxacum vulgare L.), belonging to the Asteraceae family	Vitamins (A, C, K), calcium, lipotropic choline	An aqueous dandelion root extract (DRE) in several cancer cell models, with no toxicity to non-cancer cells. This study examined the cancer cell-killing effectiveness of an aqueous DRE in colon cancer cell models. Aqueous DRE induced programmed cell death (PCD) selectively in > 95% of colon cancer cells, irrespective of their p53 status, by 48 hours of treatment (Ovadje et al., 2016).
19.	Olive	Olive oil is a fixed oil that expresses the ripe fruits of Olea Europaea Linn. or Indian olive (O. ferruginea), belonging to the family Oleaceae.	Oleic acid, oleuropein, pinoresinol, oleanolic acid, maslinic acid	As a result of this analysis, oleuropein was the most abundant phenolic substance in OLE and was determined to be 0.23 µg mL–1 with 2.3% (w v–1) of OLE (Su, 2023).

20.	Ammi visnaga, Toothpick plant	Ammi visnaga is an herbaceous annual or sometimes biennial plant belonging to the Family Apiaceae	Visnadine, Quercetin, β-sitosterol, kaempferol, cimifugin, and khellol	anticancer activity of visnagin, a natural furanochromone derivative, isolated from Ammi visnaga L., against malignant melanoma (HT 144) cell lines. The singlet oxygen production capacity of visnagin was determined by the RNO bleaching method, while the MTT assay determined cytotoxic activity (Öztürk et al., 2019).
21.	Asafoetida-Devil's Dung	It is oleo gum resin obtained from the rhizome and root of Ferula asafoetida belonging to umbelliferae.	Sesquicoumarin, oleic acid, β-sitosterol	Ferulic acid is one of these compounds that has antioxidant neu, protective, and anticancer properties (Amin et al., 2023).
22.	Tinospora cordifolia (Heart-leaved moonseed)	Giloy (Tinospora cordifolia) is a climbing shrub that grows on other trees from the botanical family Menispermacea.	Tinosporine, Berberine	Tinospora cordifolia (Thunb.) Miers (Giloy) inhibits oral cancer cells in a dose-dependent manner by inducing apoptosis and attenuating epithelial-mesenchymal transition (Patil et al., 2021).
23.	Neem	Neem is a plant named Azadirachta	Azadirachtin, nimbolide	There is overwhelming evidence to indicate that neem limonoids

		indica, belonging to the family Meliaceae.		exert anticancer effects by preventing the acquisition of hallmark traits of cancer, such as cell proliferation, apoptosis evasion, inflammation, invasion, angiogenesis, and drug resistance (Agrawal et al., 2020).
24.	Thymus vulgaris (Thyme)	Thyme is a flowering plant of plant Thymus vulgaris, the Lamiaceae family	Thymol, carvacrol	Thyme EO reduced cancer cell viability in a dose-dependent manner after 24 h treatment, with an IC50 value equal to 75.1 ± 15.2 µg/ml; simultaneously, the inhibition of cancer cell migration and colony formation capacity was evidenced (Kubatka et al., 2019).
25.	Lepidium sativum (Cress)	Lepidium sativum (garden cress) is an essential herb from the Brassicaceae family.	Vitamins (A, B, C, and E), α-linolenic acid, isothiocyanate, glucosinolates	Polyphenolic compounds are known to mediate their anticancer properties by induction of apoptosis. The present results also demonstrate that L. sativum inhibits the growth of CAL-27 cells by inducing apoptosis, as revealed by characteristic changes in nuclear

				morphology (Tuomilehto, n.d.).

Co administration of herbal compound with allopathic medicine

Co-administering herbal compounds with allopathic medications can be a complex issue with both potential benefits and risks. It's essential to proceed cautiously and under the guidance of a qualified healthcare professional like an Ayurveda doctor or a doctor familiar with herbal-drug interactions (Borse et al., n.d.).

Potential benefits:

Synergistic effects: Some herbal compounds might enhance the effectiveness of certain allopathic medicines, leading to improved therapeutic outcomes. For example, St. John's wort may boost the antidepressant effects of certain medications.

Reduced side effects: Certain herbs help mitigate the side effects of allopathic drugs. For instance, ginger may help reduce nausea caused by chemotherapy (Borse et al., n.d.).

Potential risks:

Adverse interactions: Herbal compounds can interact with allopathic medicines, leading to unpredictable and potentially harmful effects. These interactions can affect how the body absorbs, metabolizes, or eliminates the herbal compound or the medication.

Increased toxicity: Some herbs can amplify the toxicity of certain allopathic drugs, leading to organ damage or other serious health problems(Tuli et al., 2021).

Important precautions:

Always disclose: Inform your doctor and other healthcare professionals about all your medications and herbal supplements, including dosages and brand names.

Seek professional guidance: Don't self-medicate with herbal compounds while taking allopathic drugs. Consult a qualified healthcare professional who can assess co-administration's potential risks and benefits in your specific case.

Start with low doses: If co-administration is deemed safe, start with low doses of the herbal compound and the medication and monitor for any adverse effects.

Additionally:

The quality and standardization of herbal products can vary significantly. Choose reputable brands and products with clear information about their contents and potential interactions. Be aware that

herbal interactions are only sometimes well-documented or fully understood. Research on this topic is ongoing, and new information may emerge.

Remember, safety should be your top priority. Always prioritize the guidance of qualified healthcare professionals when considering co-administering herbal compounds with allopathic medications.

Conclusion:

In conclusion, the landscape of cancer treatment is undergoing a significant shift, with the potential of nature's warriors - anticancer medicinal plants - coming to the forefront. Armed with diverse mechanisms of action, from targeting specific cancer pathways to boosting the immune system, these herbal allies offer a promising avenue for complementary or alternative therapies. Most anticancer action depends upon plant compounds like alkaloids, flavonoids, and terpenes that can disrupt cancer cell growth, induce apoptosis, and modulate the immune response.

While explaining the current Market Scenario of herbal medicine as an anticancer activity, we conclude that the market is booming, and navigating its complexities requires addressing standardization, quality control, and regulatory hurdles to ensure patient safety and efficacy. A treasure trove of natural weapons lies within plants, with highlights like curcumin from turmeric, resveratrol from grapes, and vinblastine from periwinkle showcasing their potent anticancer effects. Exploring the synergy between herbal and conventional therapies holds immense promise, but careful considerations regarding potential interactions and dosage optimization are crucial. Harnessing the power of medicinal plants offers many advantages, including reduced side effects, improved quality of life, and potentially lower treatment costs. Recognizing the limitations and potential risks associated with herbal medicines, such as herb-drug interactions and herb-induced toxicities, is essential for responsible use.

Looking ahead, further research and clinical trials are necessary to unlock the potential of these natural warriors fully. However, the current evidence paints a compelling picture of a future where medicinal plants stand side-by-side with conventional therapies, empowering patients with a broader and more personalized arsenal in the fight against cancer. By embracing the wisdom of nature, we can unlock a new era of hope and healing.

References:

Agrawal, S., Bablani, D., Sircar, K., Chowdhry, A., 2020. Journal of Oral Biology and Craniofacial Research A review of the anticancer activity of Azadirachta indica (Neem) in oral cancer. J. Oral Biol. Craniofacial Res. 10, 206–209. https://doi.org/10.1016/j.jobcr.2020.04.007

Allegra, S., Francia, S. De, Turco, F., Bertaggia, I., Chiara, F., Armando, T., Storto, S., Mussa, M.V., 2023. Phytotherapy and Drugs : Can Their Interactions Increase Side Effects in Cancer Patients ? 75–89.

Amin, M., Sirizi, G., Ghalenoei, J.A., Allahtavakoli, M., Forouzanfar, H., Bagheri, S.M., 2023. Wj b c 14, 28–40. https://doi.org/10.4331/wjbc.v14.i2.28

Article, O., 2005. Fighting Cancer is Half the Battle ... 1.

Block, K.I., Mead, M.N., 2003. Integrative Cancer Therapies Immune System Effects of Echinacea , Ginseng , and Astragalus : A Review. https://doi.org/10.1177/1534735403256419

Borse, S.P., Singh, D.P., Nivsarkar, M., n.d. Understanding the relevance of herb – drug interaction studies with special focus on interplays : a prerequisite for integrative medicine.

Cháirez-ramírez, M.H., Cruz-lópez, K.G. De, 2021. Polyphenols as Antitumor Agents Targeting Key Players in Cancer-Driving Signaling Pathways 12, 1–25. https://doi.org/10.3389/fphar.2021.710304

Combinations, T., 2016. Their Combinations. https://doi.org/10.3390/nu8090552

Compounds, B., n.d. Bioactive Compounds and Bioactivities of Ginger (Zingiber o ffi cinale Roscoe) 1–21.

Ekor, M., 2014. The growing use of herbal medicines : issues relating to adverse reactions and challenges in monitoring safety 4, 1–10. https://doi.org/10.3389/fphar.2013.00177

Giri, A., Narasu, M.L., 2000. Production of podophyllotoxin from Podophyllum hexandrum : a potential natural product for clinically useful anticancer drugs 17–26.

Haux, J., 1999. Digitoxin is a potential anticancer agent for several types of cancer 53, 543–548.

Kingston, D.G.I., Newman, D.J., 1900. Natural products as anticancer agents.

Koltai, T., 2022. Role of Silymarin in Cancer Treatment : Facts , Hypotheses , and Questions 1–38. https://doi.org/10.1177/2515690X211068826

Kubatka, P., Uramova, S., Kello, M., Kajo, K., Samec, M., Jasek, K., Vybohova, D., Liskova, A., Mojzis, J., Adamkov, M., Zubor, P., Smejkal, K., Svajdlenka, E., Solar, P., Samuel, S.M., 2019. Anticancer Activities of Thymus vulgaris L . in Experimental Breast Carcinoma In Vivo and In Vitro.

Lok, B., Babu, D., Tabana, Y., Dahham, S.S., Adam, M., Adam, A., Barakat, K., Sandai, D., 2023. The Anticancer Potential of Psidium guajava (Guava) Extracts.

Manghwar, H., Hussain, A., Ali, Q., 2022. Brassinosteroids (BRs) Role in Plant Development and Coping with Different Stresses.

Manuscript, A., Cancers, T., Druggability, T., 2014. NIH Public Access 12, 1281–1305.

Moudi, M., Go, R., Yong, C., Yien, S., Nazre, M., 2013. Vinca Alkaloids 4, 1231–1235.

Nien, Y., Susan, H., Jyothirmai, C., Gary, G., Jun, D., 2023. Integrating herbal medicine into oncology care delivery : development , implementation , and evaluation of a novel program. Support. Care Cancer. https://doi.org/10.1007/s00520-023-07577-x

Oh, J., Muthu, M., Shiv, S., Pushparaj, C., Gopal, J., 2023. Anticancer Therapeutic Effects of Green Tea Catechins (GTCs) When Integrated with Antioxidant Natural Components.

Ong, M., Mutai, P., Weru, I., 2018. Study of the use of complementary and alternative medicine by cancer patients at Kenyatta National Hospital ,. https://doi.org/10.1177/1078155218805543

Ortega, A.M.M., Rubi, M., Campos, S., 2019. Metabolites in Cancer Prevention and Treatment, Bioactive Compounds. Elsevier Inc. https://doi.org/10.1016/B978-0-12-814774-0.00005-0

Ovadje, P., Ammar, S., Guerrero, J., Arnason, J.T., Pandey, S., 2016. Dandelion root extract affects colorectal cancer proliferation and survival through the activation of multiple death signalling pathways 7.

Öztürk, F.A., Jahan, H., Beyazit, N., Günaydın, K., 2019. The anticancer activity of visnagin , isolated from Ammi visnaga L ., against the human malignant melanoma cell lines , HT 144. Mol. Biol. Rep. 0, 0. https://doi.org/10.1007/s11033-019-04620-1

Patil, S., Ashi, H., Hosmani, J., Yahya, A., Ali, Y., Mushtaq, S., Parveen, S., Ali, H., Varadarajan, S., Raj, A.T., Patil, V.R., Vyas, N., 2021. Saudi Journal of Biological Sciences Tinospora cordifolia (Thunb .) Miers (Giloy) inhibits oral cancer cells in a dose-dependent manner by inducing apoptosis and attenuating epithelial-mesenchymal transition. Saudi J. Biol. Sci. 28, 4553–4559. https://doi.org/10.1016/j.sjbs.2021.04.056

Rai, M., Jogee, P.S., Agarkar, G., Alves, C., 2015. Anticancer activities of Withania somnifera : Current research , formula- tions , and future perspectives. Pharm. Biol. 00, 1–9. https://doi.org/10.3109/13880209.2015.1027778

Sa, F.M., 2000. Role of reactive oxygen species in apoptosis : implications for cancer therapy 32.

Safarzadeh, E., Shotorbani, S.S., Baradaran, B., 2014. Herbal Medicine as Inducers of Apoptosis in Cancer Treatment 4, 421–427. https://doi.org/10.5681/apb.2014.062

Saha, S., Bhattacharjee, P., Mukherjee, S., Manchanda, R., Chakrabarty, R., Das, T., Sa, G., 2014. Contribution of the ROS-p53 feedback loop in thuja-induced apoptosis of mammary epithelial carcinoma cells 1589–1598. https://doi.org/10.3892/or.2014.2993

Saxena, K., Bedi, Y.S., Taneja, S.C., Bhat, H.K., 2014. NIH Public Access 9, 581–591.

Seltzer, E.S., Watters, A.K., Jr, D.M., Granat, L.M., 2020. Cannabidiol (CBD) as a Promising Anti-Cancer Drug.

Su, Y., 2023. Antiproliferative and Apoptotic Effects of Olive Leaf Extract Microcapsules on MCF - 7 and A549 Cancer Cells. https://doi.org/10.1021/acsomega.3c01493

Tong, X., Li, M., Li, D., Lao, C., Chen, J., Xu, W., Du, J., Zhang, M., Yang, X., Li, J., 2021. Aloe vera gel extract : Safety evaluation for acute and chronic oral administration in Sprague-Dawley rats and anticancer activity in breast and lung cancer cells 280. https://doi.org/10.1016/j.jep.2021.114434

Tuli, H.S., Sak, K., Gupta, D.S., Kaur, G., Aggarwal, D., Parashar, N.C., Choudhary, R., Yerer, M.B., Kaur, J., Kumar, M., Garg, V.K., Sethi, G., 2021. Anti-Inflammatory and Anticancer Properties of Birch Bark-Derived Betulin : Recent Developments.

Tuomilehto, J., n.d. Herbal medicines: where is the evidence? 321, 395–396.

Ullah, A., Munir, S., Badshah, S.L., Khan, N., Ghani, L., Poulson, B.G., Emwas, A., Jaremko, M., n.d. Therapeutic Agent 1–39.

Verma, T., Aggarwal, A., Dey, P., 2023. Medicinal and therapeutic properties of garlic , garlic essential oil , and garlic-based snack food : An updated review 2026, 1–16. https://doi.org/10.3389/fnut.2023.1120377

Yin, S., Wei, W., Jian, F., Yang, N., 2013. Therapeutic Applications of Herbal Medicines for Cancer Patients 2013.