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## Unlocking the Power of Medicinal Plants: A Mini Review of Some of the Plants Used in Combination Therapies for Cancer Treatment

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### Abstract

*The rising of cancer burden globally, with new incidences and deaths annually, demands the consideration of advanced treatment strategies away from conventional therapies. This mini-review highlights the possible of medicinal plants serving as an adjunct in combination therapies for the enhancement and effectiveness of cancer treatments while reducing drug resistance and side effects. The review combines existing literature on numerous medicinal plants that establish anticancer properties, elucidating their active compounds, mechanisms of actions, and clinical uses. The challenges associated with integrating these natural remedies into mainstream oncology are also addressed, including standardization, safety, and regulatory concerns. The discussion underlines the impact of understanding the multifaceted mechanisms of action of phytochemicals in targeting various cancer pathways, thus providing a promising path for developing more whole cancer treatment strategies. Ultimately, this review aims to exploring the knowledge gap concerning the therapeutic roles of medicinal plants in combination therapies, promoting for further research for confirmations.*

**Keywords: Cancer, Medicinal plants, Combination therapies, Phytochemicals**

### Introduction

Cancer is one of the biggest driving factors of deaths around the world, where it is estimated that 18.1 million new cancer cases and 9.6 million cancer-related deaths occurred in 2018, making it a critical disease. Hence, the search for an effective treatment remains a current research issue (Adekilekun et al., 2024a). Recently, there has been great interest in the role of medicinal herbs as a potential therapeutic tool in the treatment of cancer (Pandy and Wang, 2022; Choudhari et al., 2020; Adekilekun et al., 2024b). Therefore, the integration of traditional and modern medicine appears to be a promising one to suppress the drawbacks of modern cancer therapies (Pandy et al., 2022). Although modern therapies have reached great heights in the treatment of cancer, the mortality rate and drug resistance are still a challenge. The threat posed by cancer to global healthcare systems has grown increasingly severe.

Currently, chemotherapy, radiotherapy, immunotherapy, and targeted therapies are used widely for cancer management, though often effective, but also associated with wicked responses and poor quality of life. This has made the use of natural products, including plants, as possible sources for new anticancer agents and area of bias (Fontana et al., 2023). Herbal medicine has been employed by various cultures in cancer treatment for centuries because it is considered safe and inexpensive (Qadir et al., 2021). More so, herbal medicine has enticed attention as an adjunctive approach and an alternate strategy to the current oncological drugs. As such, there is great shift of curiosity in using medicinal plants as combination therapies for cancer treatment. But, the therapeutic restrictions such as insufficient or documented efficacy, undesirable side effects and drug resistance are

oftentimes caused by the long period use of single chemotherapeutic drug (monotherapy). Various combination of anticancer strategies like nucleic acids with chemotherapeutic agents; or chemotherapy with tumor immunotherapy combinations, have been incorporated to serve as way to counter these therapeutic limitations with less potential risks (Quan et al., 2022).

There is an increasing trend toward using complementary and/or alternative medicines in combination with conventional medicine or other cancer treatment. Several reports have demonstrated the effectiveness of using medicinal plants alone or combined with standard chemotherapeutics. Combination therapy, meaning the use of more than a drug or treatment, has emerged as a bright approach to subdue drug resistance and improve the efficacy in treatment of diseases (Ng et al., 2022; Quan et al., 2022). The misinformation from the advertisement of herbal therapies generated greater concern among healthcare professionals in complementary and alternative medicine. It is necessary to fill a gap of understanding based on peer-reviewed and published literature on various studies of medicinal plants and cancer, therefore this review intends to provide an overview on the use of medicinal plants as part of combination therapies in cancer treatment. We conducted a broad literature hunt using several electronic databases, including Google Scholar, PubMed, Elsevier, Scopus, Web of Science, ResearchGate, and Springer. We engaged keywords such as “anticancer drugs”, “Medicinal plants”, “Combination therapies”, “Anticancer drugs with plants origin”, “clinical trials on cancer”, “cancer prevalence” or any similar term identified to be relevant to studies published within years 2020 and 2025. Addressing this, the present research needs the investigation and compilation of various medicinal plants that have been studied for cancer combination therapies, along with their active components, methods of preparation, molecular pathways, and animal or human models used for study are researched.

## Understanding the Pathophysiology of Cancer and Current Treatment Approaches

Cancer is a multidimensional and complex ailment defined by hysterical cell invasion, evolution, and metastasis. The cancer pathophysiology involves genetic and epigenetic alterations series that disrupt normal cellular activities, leading to malignancy development and progression (Johariya et al., 2024). Carcinogenesis is the procedure by which normal cells metamorphose into cancer cells and it in these phases: (1) initiation where epigenetic changes or genetic mutations occur because of environmental or inherited factors, for example, radiation, viruses, or carcinogenic materials; (2) promotion where cells with initiated mutations are stimulated to proliferate, often by hormonal or growth factors; and (3) progression where the accumulation of additional genetic mutations leads to loss of cell cycle control, apoptosis, and tissue invasion (Chen et al., 2020). Cancer cells also exhibit various genetic alterations in different ways including: oncogene activation that is mutations in proto-oncogenes, such

as Ras or Myc, lead to constitutive activation and uncontrolled cell growth; tumor suppressor gene inactivation meaning that mutations in genes like *p53* or *BRCA1/2* impair DNA repair and cell cycle regulation; and these is microsatellite instability where DNA defects mismatch repair genes, such as *MLH1* or *MSH2*, resulting to genetic instability. Another characteristics displayed by cancer cells is altered cellular processes, which could be uncontrolled cell proliferation through disrupted cell cycle regulation and increased growth factor signaling, apoptosis evasion by inhibition of programmed cell death through mechanisms like Bcl-2 overexpression, and angiogenesis by fabrication of new blood vessels to assist tumor growth, invasion and metastasis by disrupting cell-cell adhesion, increased motility, and invasion through basement membranes (Arneth, 2020). The tumor microenvironment displays a crucial function in cancer progression, through stromal cells like fibroblasts, immune cells, and endothelial cells that support tumor growth; extracellular matrix that altered matrix composition and structure facilitate tumor cell migration; and hypoxia induced angiogenesis and metabolic reprogramming (Arneth, 2020). Explicating these mechanisms is important for developing efficient cancer therapies and improving patient responses. Understanding the pathophysiology towards the treatment goals of cancer informs early detection, targeted therapies and personalized medicine by tailoring treatment strategies to individual tumor characteristics, patients' underline diseases and drug reactions (Johariya et al., 2024).

Medicinal plants have traditionally been known to have the potential to be used to treat various diseases, including malignancy. There have also been reports on the anticancer effects exhibited by various compounds obtainable from plants, such as taxol and camptothecin, obtainable from *Taxus brevifolia* and *Camptotheca acuminata*, respectively. These compounds show strong cytotoxic effects against metastatic cancer cells and are known to act by influencing cellular signaling pathways (Salac et al., 2022). The use of medicinal plants as anticancer drugs can also be linked to the reality that about 60% of all the anticancer drugs presently employed are natural in origin. One among the hallmarks or characteristics of cancer is the capacity to offer prolonged proliferative signaling (Dehelean et al., 2021; Garcia-Oliveira et al., 2021). This is often achieved through the deregulation of growth factor signaling pathways, which enable cancer cells to become "masters of their own destinies" and bypass normal cellular homeostatic mechanisms. The acquisition of these hallmarks can occur through a variety of genetic and epigenetic changes, including mutations, chromosomal alterations, and dysregulation of histone modifications (Zhang et al., 2021). Therefore, using different pathways of mechanisms of action by exploring combinations of plants might bring an efficient and safe treatment strategy.

## Roles of Medicinal Plants in Cancer Treatment

Medicinal plants have long been recognized as potential agents in the management and treatment of different diseases, and their role in cancer treatment has also gained significant

attraction in recent years. Promising new anti-cancer agents are being developed from the plants, with some now in clinical development. Plants have been long relied on in the treatment of cancer, for which over 3000 species have reportedly been used (Gielecińska et al., 2023; Kudamba et al., 2024). Although uses may be related to treating conditions that resemble skin growth or tumors, the use of many medicinal plants in cancer treatment has well-documented potential. Cancer is a potentially devastating disease that has plagued humanity for centuries and, therefore, has been the theme of much research and exploration of treatment. The interest in the potential of medicinal plants as sources of compounds exhibiting anti-cancer activity has been stimulated by the quest for effective and safe therapies.

Phytochemicals, or plant-derived compounds, have been the target of a tremendous amount of research work in the realm of cancer medication. Phytochemicals include a diverse set of compounds, particularly anticancer agents, and have been the target of research work in clinical trials. Taxol, extracted from the Pacific yew tree, and camptothecin, obtained from the Chinese happy tree, are two examples of a tremendous amount of successful anticancer compounds extracted from plants (Krishnaprabu, 2020). Other compounds, like curcumin extracted from turmeric, and ingenol mebutate extracted from the Euphorbia plant, have demonstrated efficacy in clinical trials for their anticancer action. While medicinal plants have shown promise in cancer treatment, they should not substitute conventional cancer therapies without the regulation of a healthcare expert (Gielecińska et al., 2023; Chandra et al., 2023; Kudamba et al., 2024).

The revealing and development of these plant-based anticancer effects often involve a multifaceted approach (Figure 1), including the identification of the natural source which remains the most essential steps in the discovery, their therapeutic targets, and the structural alterations that can intervene or treat in the following mechanisms (Figure 1).

**Chemoprevention:** Medicinal plants may prevent or delay cancer development by inhibiting carcinogenic pathways. Medicinal plants may prevent cancer progression through antioxidant, anti-inflammatory, and immunomodulatory effects (Malviya & Malviya, 2023).

**Complementary and/or Alternative therapy:** Plant extracts and compounds can be used alone as alternative to conventional cancer treatments or alongside conventional cancer treatments to improve their efficacy and exhibit less side effects (Déciga-Campos et al., 2022).

**Anti-tumor effects:** Certain plant compounds have direct anti-tumor properties, inhibiting growth of cancer cells and inducing apoptosis (Huang et al., 2023)

**Immunomodulation:** Medicinal plants can stimulate the immune coordination to identify and thus fight cancer cells (Parbat et al., 2021).

**Anti-angiogenic effects:** Plant compounds can inhibit tumor angiogenesis (blood vessel formation), starving cancer cells of nutrients and oxygen (Kola et al., 2022).

**Supportive/Alleviate care:** Medicinal plants can improve quality of life for patients by decreasing treatment-related side effects and manage cancer-related symptoms, such as pain, nausea, and fatigue (Bonow et al., 2021; Motoo & Cameron, 2022).

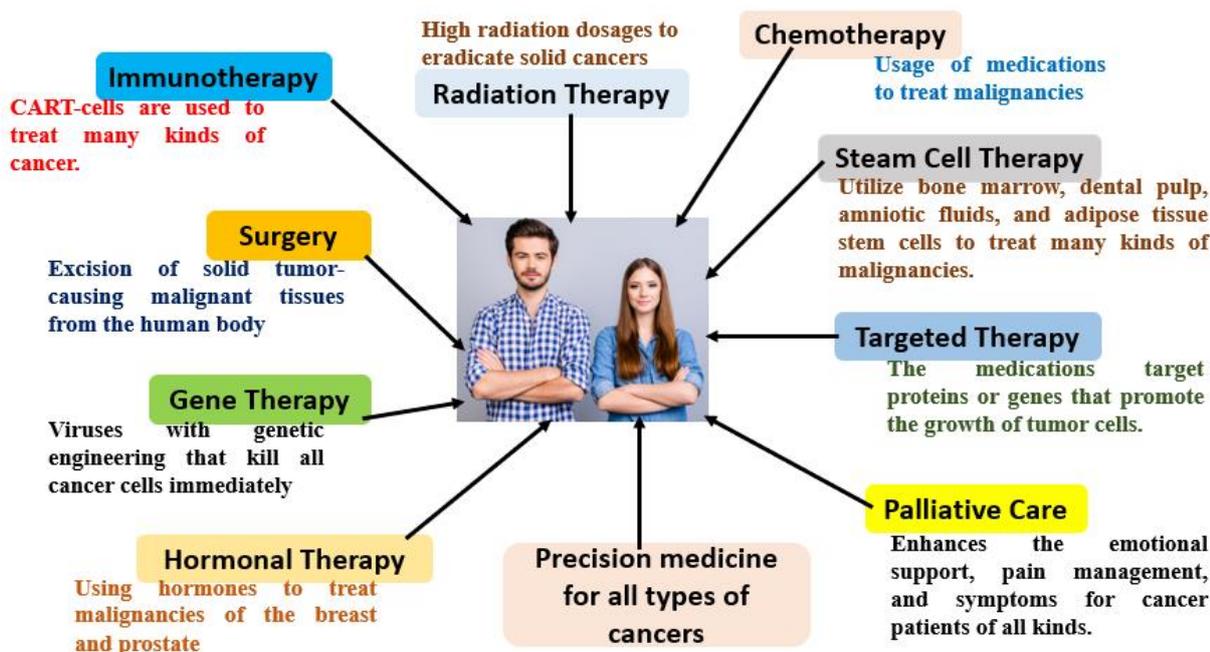


Figure 1: Different intervention strategies for cancer treatment

**Plants’ Mechanisms of Action in the Treating Cancer**

Chemical action varies depending on the specific plant with their phytochemicals and cancer type therefore, recent survey

have disclosed the significant potency of several plant-derived compounds in combating cancer (Dehelean et al., 2021; Shrihastini et al., 2021). The conventional treatment of cancer with few challenges including those associated with mortality rate and the adverse or deadly side effects make the discovery of newborn anticancer agents originated from plants under intense research because reports from various *in-silico*, *in-vivo*, *in-vitro* experimental procedures had demonstrated their

potential as promising candidates for the cancer treatment (Dehelean et al., 2021; Shrihastini et al., 2021; Adekilekun et al., 2024b). Numerous studies have also emphasized the anticancer prospective of various plant-based compounds, including terpenoids, xanthones, flavonoids, coumarins, phenolic compounds, anthocyanins, alkaloids, and carotenoids (Table 1).

**Table 1: The Anticancer Potential of Various Plant-Based Compounds**

Activities	Description	Phytochemicals Identified
Antioxidant	Plants neutralize free radicals, reducing oxidative stress and cancer cell growth.	Flavonoids, Polyphenols, saponins, alkaloids, phenols, carotenoid
Anti-inflammatory	Plants reduce inflammation, which can contribute to cancer development and progression.	Flavonoids, Polyphenols, phenolics, alkaloids, terpenoids
Anti-angiogenic	Plants inhibit tumor angiogenesis, starving cancer cells of nutrients and oxygen.	Glycosides, Polyphenols, Flavonoids, terpenoids, alkaloids
Apoptosis Induction	Plants induce programmed cell death in cancer	Alkaloids, Terpenes, Flavonoids
Cell Cycle Arrest	Plants halt cell proliferation by arresting cell cycle progression.	Terpenes, Flavonoid, Polyphenols
Immunomodulation	Plants induce the immune system to identify and attack cancer cells.	Glycosides, Terpenes, Polyphenols
Inhibition of Metastasis	Plants prevent cancer cell migration and invasion.	Flavonoid, Alkaloid, Polyphenols, Carotenoid, Triterpenoids, Isothiocyanates
Inhibition of Cancer Stem Cells	Plants target and eliminate cancer stem cells.	Polyphenol, Isoflavone
Modulation of Gene Expression	Plants regulate genes involved in cancer process and progression.	Polyphenol, organosulfur
Inhibition of Oncogenic Pathways	Plants block signaling pathways that promote cancer growth.	Flavonoids, Triterpenoids

**Footnote:**

**Challenges and Opportunities in Using Medicinal Plants as Combinations Therapies**

Medicinal plants have been seen as valuable root of natural remedies, with a rich history of use in traditional practices globally. As modern medicine continues to grapple with complex health challenges, the potential of medicinal plant combinations to provide innovative and effective therapies has gained increasing attention. Medicinal plants contain many types of active phytochemicals that have potential to be used to develop new drugs (Swami et al., 2022; Adekilekun et al., 2024). The diversity of plants and their potential chemical makeup provide a source of sustainable alternatives for drug development. The use of plant combinations has been recorded in Traditional Medicine, which has been shown to have synergistic effects when combined with different compounds or components of a plant(s). Consequently, the drug resistance problem in modern medicine, combined with the introduction of new diseases, leads to the investigation into the potential

combination(s) of medicinal plants in order to develop new approaches (Mamun & Khan, 2020; Sadiku et al., 2022; Che et al., 2024). Investigating the options that exist in creating multidisciplinary and synergistic approaches involving the traditional knowledge of Medicinal Plants combined with modern science is one option to create Herbal Medicines (Jin et al., 2023; Bagul et al., 2025). However, the utilization of medicinal plants as combination therapies cannot be without its challenges because the complex chemical composition of medicinal plants, with varying concentrations of bioactive compounds, can make it difficult to standardize and reproduce the desired therapeutic effects, exploring this area could also make a perfect progress in Herbal therapy (Jin *et al.*, 2023; Dar et al., 2023; Chaachouay & Zidane, 2024). Understanding the challenges and opportunities as shown in Figure 2 could harness the potential of medicinal plant combination therapies to improve cancer treatment outcomes therefore making the goal of this research.

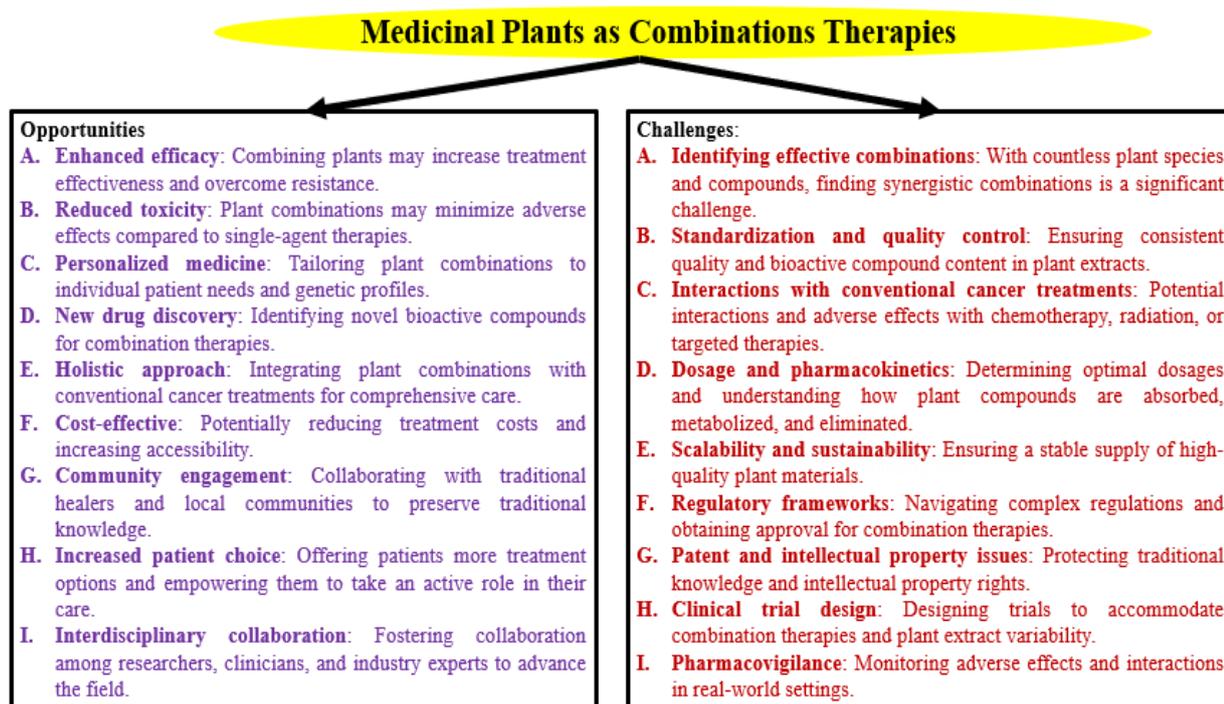


Figure 2: Medicinal Plants as Combinations Therapies

### Efficacy, Safety and Regulatory Concerns

Natural remedies are standardized herbal preparations consisting of the complex mixtures of a plant or more, containing the active components plant parts in the crude or refined state. Insufficient data about most plants pointed out to assure their quality, effectiveness and safety therefore the assumption that herbal remedies are side effects free is false (Basaran et al., 2022; Dar et al., 2023; Chaachouay & Zidane, 2024). However, for this same non availability of data, the adverse occurrence from phyto-therapeutic agents are less identified and compared frequently with synthetic drugs, but well-contained clinical trials have nowadays confirmed that such effects truly exist. Various regulatory models for herbal medicines are presently obtainable including dietary supplements and traditional medicines thus improvement in the processes and procedures of regulation is definitely needed (Ouoba et al., 2022; Berle-Keys et al., 2023).

WHO guidelines for appraising the efficacy, quality, and safety of herbal medicines were aimed at aiding manufacturers, national regulatory authorities, and scientific organizations. Furthermore, pharmacopeic treatise on herbal medicines and the ground of guidelines for the appraisal of herbal drugs was published by WHO. The bioactive compound extraction should be revealed and standardized on the ground of active rule or main compounds along with the chromatographic characteristics (GC, HPLC, HPTLC, and TLC) (Umamaheswari et al., 2021; Jain et al., 2024).

WHO Guidelines: Quality Standardization of Herbal Formulations (Umamaheswari et al., 2021; Jain et al., 2024)

(1) . *Quality control of plants' preparations, crude material, and finished products.*

(2) . *Shelf-life and Stability valuation*

(3) . *Safety studies: safety profile documentation based on practice and/or toxicological studies.*

(4) . *Assessing the efficacy using ethno-medical data and also biological activity estimations.*

Herbal remedies perform agonistic or antagonistic role that enhance the drug therapies thus, understanding the conventional drugs is a necessary obligation for effective herbal treatments (Chaachouay, 2025). Cases of unethical media practices of herbal medicines in Nigeria become increasing with unabated advertisement with misleading, deceptive and defrauding claims. Therefore, regulatory bodies respond to these activities in other to curb the menace and debilitating effect on health (Richard, 2023; Suleman et al., 2025). The usage of herbal medicines in both rural and urban regions is on the increase, therefore the Nigerian Government has recognized the need and also approved and adopted guidelines for the activity of traditional medicine. The National Agency for Food and Drug Administration and Control (NAFDAC) presented a rule titled 'Guidelines for the Registration and Control of Herbal Medicinal Products and Related Substances in Nigeria' making regulation of herbal drugs a reality (Obi et al., 2022).

**Plants Combinations Effects** (Sauter et al., 2020; Zhou et al., 2023; Bota et al., 2024):

A. **Synergistic Potentials:** Combination of plants with different bioactive compounds can increase their individual anti-cancer properties.

B. **Multiple Target:** Plant combinations can target numerous signaling pathways and mechanisms, reducing the risk of resistance.

C. Improved Bioavailability: Combining plants may improve the absorption and bioavailability of individual compounds.

**Safety Concerns** (Wyk et al., 2020; Rani, 2020; Kapoor et al., 2025; Gonfa et al., 2025):

- A. Interactions with conventional drugs can lead to reduced efficacy or adverse effects.
- B. Toxic effects especially with certain plants with known toxic or have adverse effects.
- C. Optimizing dosage of plant combinations can be difficult, with excessive consumption leading to adverse effects.
- D. Some plant combinations may not be suitable for pregnant or breastfeeding women.
- E. Allergic reactions occurrence or exacerbate existing allergies.
- F. Regulatory status is limited therefore the quality of products can vary widely.

### 3. Case Studies and Clinical Trials

The usage of plant-derived compounds in cancer management has gathered momentous attention recently. Some of the vital aspects of current cancer chemotherapy, such as the role of genetics, genomics, and the concept of aneuploidy as the primary driver of cancer, have also been explored in this context (Ben-David and Amon, 2020; Heng and Heng, 2022). Encompassing research has been done on the anticancer activities of various natural compounds of plant origin that are used in treating different cancers with emphasis on their pathways and research developmental stages (Table 2). These studies highlighted the possibility of the natural products in addressing the increasing mortality related to cancer and the adverse effects of conventional cancer treatments. Compounds such as paclitaxel, homoharringtonine, curcumin, and ingenol mebutate have demonstrated successful clinical trial outcomes and are already in use or under development for anticancer therapy (Warrier et al., 2020; Joshi et al., 2024; Chunarkar-Patil et al., 2024).

### 4. Anticancer Drug Resistance

Over the past twenty-year, interpretation of the genetic flaw that underline cancer has pushed for excess of novel referenced cancer drugs. Though, initially these agents can be extremely effective, but the resistance to monotherapies remains a serious task (Jin et al., 2023). Combining drugs possibly assist in avoiding the resistance, but difficult to be tried clinically due to high number drugs combined. Rational behind drug combinations is due to a sound consideration of the inherent molecular mechanisms related to possible therapy resistance which are possibly strong in treatment of cancer (Jin et al., 2023). The resistance to chemotherapy and/or molecularly directed therapies remains a leading

problem confronting contemporary cancer investigation. Therefore, improved preclinical studies and use of strong high-throughput screening methods for interpretation and management of drug resistance through data from clinical assessment of drug combinations and even use of prognostic biomarkers to accommodate stratification of patients are drastically helping in lessen the resistance (Hernández & Rueda, 2023). The problem of cancer therapy resistance is multidimensional with some key factors including tumor growth kinetics; physical barriers; tumor heterogeneity; immune system with microenvironment; and undruggable cancer mechanism. The conception of a framework that analyses and divides resistance into its biological causal factor is required in addressing resistance. This concerted information would allow development of means that are could reveal real-time clinical options, and which will be improved via a feedback operation that is echoed by discovered phenotypic results (Khan et al., 2024; Garg et al., 2024; Sah et al., 2024).

### Conclusion and Future Directions

The uncovering of new anticancer agents originated from plants has become an area of active exploration. Conceptualizations to metabolite purification, speedy dereplication, and biological assessment, including analytical hyphenated methods, molecular networking, and modern cellular and animal models, have been employed to streamline the drug discovery process. Combination of drugs helps prevent resistance, but the number of likely drugs combined immensely exceeds what could be tried clinically, due to limited finances and even patient availability (Zhong et al., 2021; Liu et al., 2021; Jin et al., 2023). The rationality for drug combinations is because of deep disposition of the underlying molecular processes associated with resistance making potentially prevailing input in the management of cancer. There is need for general resolution to this menace known as “cancer drug resistance” through many interventions including earlier detection of tumors allowing cancer seizure; reconciling observations during therapy; introduction of unique drugs with enriched pharmacological values that result in better responses; recognition of cancer cell colony by high-throughput synthetic lethality surfaces, and consolidation of clinico-genomic data with computational modelling (Zhong et al., 2021; Jin et al., 2023), therefore exploration of combination of herbal medicines could be a way to holistically address the cancer drug resistance.

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**Supervision/Proof-readings:** Racheal M. Omodamiro, Ngozi Kalu Achi,

**Writing– review & editing:** Habeebat A. Oyewusi, Habeebulahi Ajibola Adekilekun, Olorunshola D. Omodamiro,

**Data Availability Statement**

Data sharing and availability were not applicable to this study (No new data was created or analyzed in this study).

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**Table 2: Different Natural Compounds of Plant Origin Used in Treating Various Cancers with their Pathways and Developmental Stage.**

Natural Compound/Plant Source	Mechanism of Action	Target Genes	Cancer Type and other Pharmacological Benefits
Curcumin (Turmeric) (Curcuma longa)	Inhibits cell proliferation (TNF, IL-), induces apoptosis (p53, BCL1, MCL1, Caspase-2).	TNF, AR, VEGF, IL-, FGF, EGF, HER-2, EGFR, NF-κB, STAT, AP-1	Breast, head and neck, skin, lung, gastrointestinal, prostate, colorectal, hypoglycemic, antimicrobial, neuroprotective, and immunomodulatory
Resveratrol (berries, grapes, peanuts)	Affects cell cycle regulation (CDK, P53), Antioxidant	NF-κB, APE1/Ref-1, MCP-1, LSD1	head and neck, ovarian, cervical, Breast, blood, kidney, liver, eye, cervical, uterine, bladder, prostate, brain, lung, thyroid, esophageal, skin, gastric, colon, and bone, Neurodegenerative diseases, antiobesity, antiviral, cardioprotective, antidiabetic
Paclitaxel (Taxol) (Taxus brevifolia, Pacific yew tree)	Disruption of microtubule function (p53; Breast cancer 1 gene (BRCA1))	IL-1β, JNK1, TNF-α, AP-1, ERK1, p38, IL-1α,	Breast, lung, ovarian
Epigallocatechin gallate (EGCG) (Green tea)	Induction of apoptosis, proliferation inhibition, Antioxidant,	CDH1 (e-cadherinegene), Retinoic acid receptor DNMT1, β(RARβ), DAPK1, HDAC1, DNMT3B	Colorectal, breast, bladder, prostate, head and neck, lung, Antibacteria, Alzheimer's disease, metabolic syndrome
Sulforaphane (Cruciferous vegetables)	Induction of enzymes detoxification, pro-apoptotic.	AURKA, TIMP1, CRYAB, CEP55, CRC, PLCE1, and MMP28	Colorectal, Neurodegenerative disease, diabetes, cardiovascular diseases, obesity
Genistein (Soybeans)	Angiogenesis Inhibition, Modulation of hormone activity, Antioxidant	p16-INK4a, p21-WAF1, p16-INK4a and p21-WAF1	Breast, lung, colorectal, pancreatic, anti-inflammatory, antibacterial, Cardiovascular diseases and antiviral activities
Quercetin (Onions, apples, redwine, tea)	Inhibition of cell proliferation, anti-inflammatory, antioxidant	Cytochrome crelease, bcl-2-associated Xprotein (BAX), Cysteine-aspartic proteases (caspase)-3, Anti-apoptoticBcl-2, Caspase-9, Transforming growth factorβ (TGF-β),	prostate, breast, lung, colorectal, cardiovascular diseases, obesity, diabetes
Capsaicin (Chili peppers)	Apoptosis induction, inhibition of cell growth.	c-myc, p53, c-Ha-ras	Breast, lung, bladder, colon and pancreatic, colorectal, antimicrobial effects, metabolic disorders
Silymarin/Silibinin (Milk thistle)	Cell regeneration, Antioxidant, Anti-inflammatory	TGF-β, interferon-gamma, IL-2, TNF-α, IL-4, COX-2 and NF-κB	Skin, breast, colorectal, lung, pancreatic, gastrointestinal, prostate, Preventive effects in nephrotoxicity, hepatotoxicity, viral hepatitis, and neurotoxicity. Depression, lung diseases, prostate diseases
Berberine (Berberis plants)	Promotes apoptosis, Inhibition of cell progression	IL-1, IL-6, TNF, cyclooxygenase2 and prostaglandinE2	Colon, metabolic diseases (e.g., diabetes and obesity), antimicrobial, antiprotozoal, antidiarrheal and antitrichoma activity
Ellagic acid (Nuts, Pomegranates, berries)	Anti-proliferative, Antioxidant	p65, p53-dependentgenes, NF-kBp50, PPAR family	Colorectal, bladder, prostate, breast, lung, ovarian, anti-inflammatory, neuroprotective, diabetes, hypertension, and hyperlipidemia
Lycopene (Watermelon, Tomatoes, pink grapefruit)	Anti-proliferative, Antioxidant	IGFBP-3, uPAR, c-fos	Lung, breast, colorectal, ovarian, pancreatic, cervical, Epilepsy, Parkinson's disease, Alzheimer's disease, Cardioprotective and anti-microbial properties
Indole-3-carbinol (Cruciferous vegetables)	Apoptosis, Modulation of estrogen metabolism,	CYP1A1, AhR, CYP1B1	Head and neck, lung, breast, bladder, Cardioprotective, antioxidant, and anti-inflammatory effects
Beta-glucans	Stimulation of immune	CR3, TLR-2/6	Prostate, breast, ovarian, colorectal,

(Oats, barley, mushrooms)	response.			cardiovascular system, lipid metabolism, ameliorating glucose, and blood pressure
Allicin (Garlic)	Pro-apoptotic, anti-proliferative, Antioxidant	anti-	<i>E2F3, E2F2, E2F1</i>	Bladder, colorectal, lung, Breast, prostate, neuroprotection, anti-inflammatory, anti-alzheimer, antioxidant, antidiabetic, cardio protective,
Catechins (Fruits, tea, cocoa)	Anti-proliferative, anti-inflammatory, Antioxidant	anti-	MAPkinase, JAKs, JNK, BCL-2, Nrf2	Pancreatic, colorectal, breast., lung, anti-inflammatory, anti-diabetic, anti-neuroprotective, memory enhancer, bactericidal, anti-arthritis, hepato-protective
Ursolic Acid (Apples, cranberries, basil, <i>Newbouldia laevis</i> )	Inhibition of metastasis, induction of apoptosis.		<i>MMP-9, Bcl-2, BAX, Bcl-xL, CT45A2</i>	Hepatocellular carcinoma, Breast, anti-inflammatory, anti-oxidant
Limonene (Citrus peels)	Anti-proliferative, Induction of detoxification enzymes		<i>Bcl-2-associated Xprotein (BAX), Cysteine-aspartic proteases (caspase)-3, Cytochrome-C release, Caspase-9, Transforming growth factorβ (TGF-β), Anti-apoptotic Bcl-2</i>	Not directly associated with the cause of specific cancers, rather involved in cellular pathways related to apoptosis and regulation of cell survival, analgesic, antibacterial, immune regulation, treatment of metabolic diseases, neuroprotection, anti-inflammatory properties, antioxidant
Vinblastine (Periwinkle plant, <i>Catharanthus roseus</i> )	Inhibition of microtubule assembly		<i>CCNB1, AURKA</i>	Colorectal, Breast, lung, prostate, ovarian, Hodking's disease, lymphosarcoma, reticulum cell sarcoma, acute leukemia, carcinoma of the breast, choriocarcinoma
Vincristine (Periwinkle plant, <i>Catharanthus roseus</i> )	Inhibition microtubule formation, Binds to tubulin		<i>CYP3A5, CYP3A4</i>	Lymphoma, Liver, leukemia, Wilms tumor, neuroblastoma, Hodking's disease, reticulum cell sarcoma, lymphosarcoma, breast carcinoma, acute leukemia, choriocarcinoma
Topotecan (Happy tree, <i>Camptotheca acuminata</i> )	Inhibition of DNA topoisomerase I.		<i>ABCG2, ABCB1, IFIH1, ALDH1A1, SAMD4, EPHA3</i>	Ovarian, breast, colon.
Irinotecan (Happy tree, <i>Camptotheca acuminata</i> )	Inhibits DNA topoisomerase I.		<i>UGT1A1</i>	colorectal, pancreatic, ovarian, and lung cancers
Etoposide (May apple plant, <i>Podophyllum peltatum</i> )	Inhibition of DNA topoisomerase II.		<i>SEMA5A, SLC7A6, PRMT7</i>	Lung cancer (SCLC) and testicular cancer.
Beta-carotene (Carrots, sweet potatoes, spinach)	Modulates immune response, Antioxidant,		<i>SEMA5A, SLC7A6, PRMT7</i>	Involved in difference biological processes, including cell signalling and immune response, cataract, osteoclastogenesis, reduce the risk of age-related macular degeneration (AMD), coronary heart diseases

Source: Clinical trials from 2011 to 2022 and data from FDA 1996-2022.