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A Review on Herbal Drugs Used in Cancer Treatment

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ABSTRACT:-

Cancer remains one of the most prevalent and deadly diseases world wide, accounting for nearly 10 million deaths annually. Although siibgnificant advancements have been made in conventional cancer treatments—such as surgery, radiotherapy, chemotherapy, and targeted therapies—these approaches often come with substantial side effects, high costs, and the development of drug resistance. In response, there has been a growing global interest in complementary and alternative medicines, particularly herbal remedies, which are often perceived as safer and more holistic options.Herbal medicines have been used for centuries across traditional systems of medicine, including Ayurveda, Traditional Chinese Medicine (TCM), and Siddha. Modern pharmacological research has validated the anticancer potential of many medicinal plants and their bioactive compounds. Herbs such as *Curcuma longa* (turmeric), *Catharanthus roseus* (periwinkle), *Taxus brevifolia* (Pacific yew), *Camellia sinensis* (green tea), *Withania somnifera* (ashwagandha), and *Panax ginseng* have demonstrated significant anticancer activities. These include inducing apoptosis, arresting the cell cycle, inhibiting angiogenesis, reducing inflammation, and modulating immune responses.This review provides a comprehensive overview of key herbal drugs used in cancer treatment, focusing on their active constituents, molecular mechanisms of action, types of cancers targeted, and findings from preclinical and clinical studies. The paper also discusses the challenges associated with herbal medicine, such as variability in plant extracts, lack of standardization, and potential interactions with conventional drugs. Furthermore, it highlights the need for more rigorous scientific validation, standardized formulations, and integrative strategies to effectively combine herbal and modern cancer therapies.Ultimately, herbal drugs represent a valuable but underutilized resource in oncology. With continued research and clinical validation, these natural compounds could play a significant role in the future of cancer prevention and treatment.

KEYWORDS:-Herbal medicine, Anticancer agents,Phytochemicals,Curcumin, Ginsenosides, Integrative oncology

INTRODUCTION :-

Cancer, characterized by the uncontrolled growth and spread of abnormal cells, remains a significant global health challenge, demanding continuous advancements in therapeutic strategies. [1] While conventional treatments such as surgery, radiotherapy, and chemotherapy have made substantial progress in improving patient outcomes, the quest for more effective and less toxic therapies persists.[2]Throughout history, plants have served as a rich source of medicinal compounds, and this legacy continues to influence modern drug discovery, particularly in the field of oncology. [3] Indeed, several established chemotherapeutic agents are derived directly or indirectly from plant sources, underscoring the potent bioactivity present within the plant kingdom.[4] The term "herbal drugs" in the context of cancer treatment can encompass a spectrum of substances, ranging from purified, single chemical entities isolated from plants to complex mixtures of phytochemicals found in crude herbal extracts and traditional preparations.[5] This review focuses on the role of plant-derived substances that have demonstrated or are under investigation for their therapeutic potential against cancer. This includes both well-established chemotherapeutic drugs of plant origin and promising herbal extracts or isolated phytochemicals currently undergoing preclinical and clinical evaluation.[6]

This paper aims to provide a comprehensive overview of the use of herbal drugs in cancer treatment. We will explore the journey from identifying bioactive plant compounds to their development as anticancer agents, examine the preclinical and clinical evidence for various herbal drugs, discuss the challenges associated with their development and regulation, and finally, consider future directions for harnessing the therapeutic potential of plants in the fight against cancer. By synthesizing the current knowledge, this review seeks to offer insights into the evolving role of herbal drugs in the multifaceted landscape of cancer therapy. The term "herbal drugs" within the scope of cancer treatment encompasses a broad spectrum of plant-derived substances. This includes not only highly purified, single chemical entities isolated from plants that have been developed into pharmaceutical drugs [7] but also complex mixtures of phytochemicals present in crude herbal extracts and traditional medicinal preparations. [8] Understanding this distinction is crucial, as both categories hold relevance in the ongoing exploration of plant-based anticancer strategies. Established plant-derived chemotherapies often target fundamental cellular processes critical for cancer cell survival and proliferation, [9] providing a strong precedent for the potential of plant-based molecules.

Beyond these established drugs, a wealth of scientific inquiry is dedicated to investigating the anticancer potential of various herbal extracts and individual phytochemicals. Preclinical studies, utilizing in vitro (cell-based) and in vivo (animal model) systems, have revealed promising activities for numerous plant-derived compounds, including their ability to inhibit cancer cell growth, induce programmed cell death (apoptosis), interfere with tumor angiogenesis (blood vessel formation), and modulate immune responses. These findings suggest that the plant kingdom harbors a vast, largely untapped

resource of potential anticancer agents. [10]This review aims to provide a comprehensive and critical analysis of the current landscape of herbal drugs used in cancer treatment. We will trace the historical impact of plants on cancer chemotherapy, [11] delve into the mechanisms of action and clinical applications of established plant-derived anticancer drugs, and explore the preclinical evidence supporting the potential of other herbal extracts and phytochemicals. Furthermore, we will address the inherent challenges in translating herbal research into clinical practice, including issues related to standardization, identification of active constituents, and the design of rigorous clinical trials.[12,14] Finally, we will discuss the regulatory considerations and highlight promising avenues for future research aimed at unlocking the full therapeutic potential of herbal drugs in the ongoing fight against cancer. By synthesizing the existing body of knowledge, this review intends to offer a nuanced perspective on the current and future role of herbal drugs in cancer therapy.[15]

Types Of Cancers:-

1) Cancers of Blood and Lymphatic Systems:

a) Hodgkin's disease

b) Leukemia's

c) Lymphomas

d) Multiple myeloma

e) Waldenstrom's disease

2) Skin Cancers:

a) Malignant Melanoma

3) Cancers of Digestive Systems:

a) Esophageal cancer

b) Stomach cancer

c) Cancer of pancreas

d) Liver cancer

e) Colon and Rectal cancer

f) Anal cancer

4) Cancers of Urinary system:

a) Kidney cancer

b) Bladder cancer

c) Testis cancer

d) Prostate cancer

5) Cancers in Women:

a) Breast cancer

b) Ovarian cancer

c) Gynecological cancer

d) Choriocarcinoma

6) Miscellaneous Cancers:

a) Brain cancer

b) Bone cancer

c) Characinoid cancer

d) Nasopharyngeal cancer

e) Retroperitoneal sarcomas

f) Soft tissue cancer

g) Thyroid cancer

Cause Of Cancers:-

According to modern medicine, the majority of cancer cases are caused by DNA alterations that lessen or completely eradicate the normal controls over

development, maturation, and programmed cell death.[16]People with specific genetic backgrounds are more likely to experience these changes (as demonstrated by the identification of genes linked to certain cancer cases and the familial prevalence of certain cancers) as well as those infected with chronic viruses (e.g., HIV may cause lymphoma, viral hepatitis may cause liver cancer). Regardless of a person's genetic makeup or any viruses that could affect their risk of developing cancer, the primary cause is frequently

exposure to radiation (including natural cosmic and earthly radiation) and/or carcinogenic chemicals (including those found in nature), combined with the immune system's inability to eradicate the cancer cells early in their growth. Years after being exposed to chemicals or radiation, immunological weakness may develop. [17] Additional factors include exposure to asbestos, alcohol, tobacco, excessive caffeine and other drug use, sunlight, and infections with oncogenic viruses like cervical papilloma viruses and adenoviruses Karposis sarcoma (HSV). These are undoubtedly linked to the development of cancers in mammals. Nonetheless, these agents are frequently present in large populations. As a result, cancer cells divide even when

Normally, normal cells will hold off until they receive a unique chemical transduction signal. Such stop signals from nearby tissues would be disregarded by the tumour cells. In contrast to normal cells, which undergo programmed cell death (apoptosis) after 50–70 generations, cancer cells also possess the quality of immortality, even in vitro. As cancer cells proliferate, they invade neighbouring tissues and spread to other parts of the body. The most deadly component of carcinogenesis is metastasis.

According to scientists, environmental factors include things like radiation and chemicals in our homes and workplaces, smoking, diet, and infectious diseases. as well as traces of contaminants in the air, food, and drinking water. Tobacco use, poor diet, and insufficient exercise are other factors that are more likely to have an impact; however, the level of risk from pollutants varies depending on exposure, intensity, and concentration. When workers are exposed to ionising radiation, chemicals that cause cancer, certain metals, and other specific substances—even at low exposure levels—the risk of developing cancer increases significantly. Many people who do not smoke but are exposed to smokers' exhaled smoke are at increased risk due to passive tobacco smoke.

The Mechanism of Herbal Drugs in Cancer Therapy:- [18]

1. Inhibiting cancer cell proliferation directly by stimulating macrophage phagocytosis, enhancing natural killer cell activity.

2. boosting blood serum levels of interferon, interleukin 2 immunoglobulin, and complement to encourage the death of cancer cells.

3. Enforcing the necrosis of tumour and inhibiting its translocation and spread by blocking the blood source of tumour tissue.

4. Enhancing the number of leukocytes and platelets by stimulating the hemopoietic function. 5. Promoting the reverse transformation from tumour cells into normal cells.

6. encouraging metabolism and halting the development of cancer in healthy cells.

7. Increasing appetite, enhancing sleep, and reducing pain, all of which benefit patients

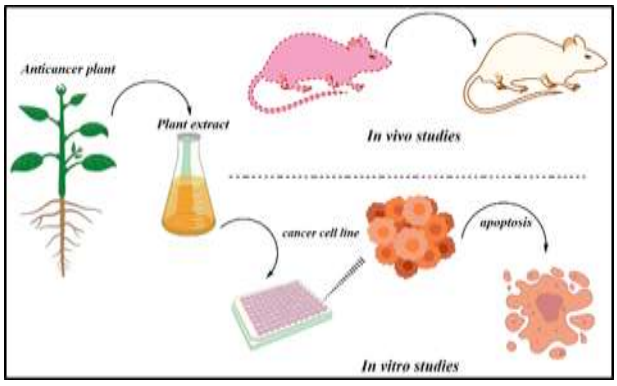

Fig No 1

HERBAL MEDICINE IN CANCER TREATMENT:-

Actinidia chinensis:-

Chinese doctors use the root of this plant to treat cancer. ACPSR is a polysaccharide found in Actinidia chinensis that has anticancer and immune-boosting properties.[19]

Astragalus:

Astragalus is obtained from the dried root of Perennial herb of Astragalus membranaceus, Angelica gigas, and Trichosanthes kirilowii which belongs to the family o Fabaceae.23-24 The chemical constituent of Astragalus is Polysaccharides, saponins, flavonoids, isoflavonoids, sterols, and astragalosides are the major chemical components of A membranaceus roots. Extraction of SH003, a novel herbal medicine containing Astragalusmembranaceus, Angelica gigas, and Trichosanthes Kirilowii demonstrated the ability to function as an anticancer agent. agent. SH003 inhibits the binding of vascular endothelial growth factor (VEGF) to its VEGF receptor 2 (VEGFR2;KDR) receptor, thereby inhibiting VEGF/VEGFR2 signaling and tumor endothelial cell migration, invasion and formation of the tube. This inhibits tumor

Angiogenesis.[20]

Agave americana:-

A.americana leaf ethanolic extract exhibits antitumor and cytotoxic properties. Steroid saponins, alkaloids, coumarins, isoflavonoids, hecogenin, and vitamins A, B, and C are all found in leaves. As a result, this plant may be used to create new anticancer medication leads. [21]

Allium sativum:-

In India, Allium sativum, commonly known as garlic or lasun, is used to treat a wide range of illnesses. Allicin, a key component of raw garlic, undergoes a rearrangement that produces ajoene. A tumorgenic lymphoid cell line derived from a Burkitt lymphoma, human primary fibroblasts, and a permanent, nontumorgenic cell line derived from baby hamster kidney cells have all been used to test its cytotoxic effect. The range of the cytotoxic action was 2–50 μg/ml. Certain organo-sulfur compounds in garlic, like S-allylcysteine, have been demonstrated in several animal models to slow the growth of chemically induced and transplantable tumours. Garlic (250 mg/kg, p.o., three times a week) significantly suppressed male wistar rats. 4-nitro quinoline-1-oxide-induced carcinogenesis of the tongue as demonstrated by the absence of the carcinomas during the initiation phase and their decreased frequency during the post-initiation phase.[22]

Ginger:-

The dried rhizomes of the Zingiber plant are used to make ginger.

officinale Roscoe, a member of the Zingiberaceae family.Terpenes, lipids (3–8%), carbohydrates (50–70%), and phenolic compounds32 are the primary nutrients found in ginger rhizomes. Ginger contains phenolic compounds like gingerol, paradols, and shogaol, as well as terpene components like zingiberene, β-bisabolene, α-farnesene, β-sesquiphellandrene, and α-curcumene.There are more of these gingerols (23–25%) and shogaols (18–25%) available than others. In addition, there are minerals known as gingerols and shogaols, proteins, amino acids, raw fibre, ash, phytosterols, and vitamins (such as nicotinic acid and vitamin A).

Additional substances linked to gingerol- or shogaol (1–10%) that have been identified in the ginger rhizome include diarylheptanoids, 6-paradol, 1-dehydrogingerdione, 6-gingerdione and 10-gingerdione, 4-gingerdiol, 6-gingerol, 8-gingerdiol, and 10-gingerdiol. The taste and scent of ginger are caused by a concoction of different oils, including gingerol and shogaol.Free radical scavenging, antioxidant pathways, gene expression changes, and apoptosis induction are some of the mechanisms underlying ginger's chemopreventive effects, which reduce tumour initiation, promotion, and progression. [23,25]

Aloe Vera:-

The dried juice of the leaves of Aloe barbadensis Miller, also referred to as Curacao aloes, and Aloe perryi Baker, also known as Socotrine aloes, is used to make aloes. Miller's Aloe ferox

and this species' hybrids with the Liliaceae family's cape aloes, Aloe africana Miller and Aloe spicata Baker.Active ingredients and their characteristics:

Vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids are among the 75 potentially active ingredients found in aloe vera. Vitamins: It contains the antioxidant vitamins A (beta-carotene), C, and E. Choline, folic acid, and vitamin B12 are also present. Glycoproteins (lectins) and polysaccharides are the two aloe fractions that are said to have anticancer properties. Aloe vera gel showed antitumor activity in several studies, as evidenced by decreased tumour burden, extended survival rates, tumour necrosis, and tumour shrinkage. Aloe gel may be used in cancer chemoprevention due to reports of glutathione S-transferase induction and inhibition of phorbol myristic acetate's tumor-promoting effect. Immune response stimulation has an indirect effect on antitumor activity. [26,28]

Turmeric:-

The dried rhizome of Curcuma longa Linn. (syn. C. domestica Valeton), a member of the Zingiberaceae family, is used to make turmeric. Three to six percent of turmeric is made up of polyphenolic compounds called curcuminoids, which are a combination of curcumin, demethoxycurcumin, and bisdemethoxycurcumin.

Turmeric's primary ingredient is curcuminoids. Compared to demethoxycurcumin or bisdemethoxycurcumin, pure curcumin exhibits stronger superoxide anion scavenging activity. death of cancer cells without endangering healthy cells. It accomplishes this by inhibiting the kappa B activation pathway,

which is connected to a number of inflammatory diseases, including cancer. Curcumin may have anti-cancer effects, according to some recent research. Turmeric was successful in preventing stomach, lung, colon, breast, and skin cancers in laboratory mice when administered orally**.** [29,30]

Tea:-

It includes the prepared leaves and leaf buds of Thea sinensis (Linne) Kuntz, a member of the Theaceae family. Caffeine (1–5%) is abundant in the leaves. In trace amounts, it also contains theobromine and theophylline. Tannin (10–20% gallotannic acid) is what gives the tea leaves their colour. Yellow oil is the source of the scent. Protein, wax, resin, and ashes are also found in tea leaves. Tea contains more than 700 different compounds, many of which were already known to have anti-disease properties, according to a 2006 USDA study. These substances, which include polysaccharides, flavonoids, specific vitamins, and amino acids, are known to combat disease.Every type of tea, including oolong, black, white, and green, was discovered tohave significant concentrations of antioxidants, which are potent anti-aging and anti-tumor agents. Vitamin C, which is abundant in tea, is known to combat free radicals that cause cancer. Tea has powerful cleansing qualities and a low glycemic index.

Tea drinking on a regular basis has long been linked to a lower risk of heart disease and diabetes. [31]

Onion:-

Allium cepa is the species from which onions, also referred to as bulb onions or common onions, are derived. It is a member of the Amaryllidaceae family.Onions are rich in chemicals.substances like diallyl disulphide, diallyl trisulfide, and other sulphurous compounds like allicin, quercetin, and fisetin. In addition to having a high level of antioxidant activity, onions are linked to several pharmacological properties, such as anti-inflammatory, anti-bacterial, and anti-carcinogenic properties. One study showed that adult mice fed onions had high antioxidant activity. Onion consumption is directly associated with an increased risk of developing common cancer. To lower the levels of cancer and onion consumption, researchers from the Italian Mario Negri Institute for Pharmacological Research combined data from multivariate models and controlled studies conducted in Switzerland and Italy. Although the risk rates differ, Onions reduced the risk of breast, ovarian, prostate, oesophageal, renal cell, colorectal, and mouth cancers. Polyphenols, which are abundant in onions, help prevent cancer and other illnesses. Antioxidants, which are also known to fight cancer, are abundant in onions. Quercetin, a substance found in these well-known vegetables, has also been demonstrated to reduce cancer tumour cells.[32]

***Morinda Citrifolia*:-**

The compounds damnacanthol, NB10, and NB11 that were separated from Morinda citrifolia have potent anticancer properties against a variety of cancers, especially sarcomas and lung cancer. Morinda citrifolia has potent hepatoprotective, immune-boosting, and antioxidant qualities**.**[33]

Ocimum Sanctum:-

Eugenol, eugenol derivatives, linolenic acid, rosmarinic acid, and flavonoids like orientin, vicenin, cirsilineol, cirsimaritin, isothymusin, isothymonin, and apigenein are all found in Ocimum sanctum. By preventing the cancer cells from receiving oxygen and nutrients and starving them, eugenol, orientin, and vicenin prevent the growth and spread of a number of cancers, including breast, liver, and fibrosarcoma. Ocimum sanctum is the source of ursolic acid, which has tissue-protective and immune-boosting qualities. Ocimum sanctum polysaccharides have radioprotective and antioxidant qualities. Ocimum sanctum prevents many types of cancer, especially breast cancer, and lessens the negative effects of radiation and chemotherapy. [34]

Burdock Root:-

It comes from the Arctium lappa species, the It is derived from the Arctium lappa species A. minus and A. tomentosum.The plant known as burdock is a member of the Asteraceae family. the bitter guaianolide-type components, sulphurous acetylene compounds, polyacetylenes, and mucilage are found in burdock roots. Butyrolactone lignans, arctigenin, and arctiin are found in seeds. Arctiin, which is found in burdock seeds, may offer some cancer prevention benefits.

According to preliminary research, intestinal bacteria convert arctiin into estrogenic and antiestrogenic compounds. Burdock leaves could have It has been demonstrated that lappaol F causes cell death and G (1) and G (2) cell-cycle arrest. In other research, arctigenin suppressed inducible nitric oxide synthase (iNOS)/nitric oxide, which prevented ovarian cancer cells from proliferating and caused caspase-3-dependent apoptosis. (NO)/survivin signalling pathway/signal transducer and activator of transcription-3 (STAT3). According to recent studies, burdock root is highly effective in eliminating the carcinogens that build up in our digestive tracts when specific foods are not adequately broken down15. Burdock root is a base for a number of herbal anti-cancer remedies, such as "Essiac" and "Flor-Essence." In actuality, burdock root was used in the 1919 anti-cancer product known as "Hoxsey." treating breast cancer in particular According to some herbalists, burdock root can prevent the spread of cancer cells. In Russia and India, it is frequently used to treat cancer. Due to its relatively high potassium content, burdock is safe to use, with the exception of people taking potassium-lowering diuretics.[35,37]

***Terminalia Chebula*:-**

Hydrolyzable tannins from Terminalia chebula have been shown to have antimutagenic effects on Salmonella typhimurium.The fruits of Terminalia chebula contain phenols that inhibit the growth of cancer, such as tannic acid, ellagic acid, and chebulinic acid.There have been reports of encouraging antimutagenic and anticarcinogenic properties in Terminalia chebula fruit powder and bark acetone extract.[38]

ADVANTAGES AND LIMITATIONS OF HERBAL DRUGS IN ONCOLOGY:-

Advantages :-

A) **Multi-targeted Mechanism of Action**

Unlike conventional chemotherapeutic drugs that often target a single molecular pathway, many herbal compounds act on multiple signaling pathways simultaneously. This includes modulation of apoptosis, inhibition of angiogenesis, suppression of inflammation, and interference with metastasis. For instance, curcumin from Curcuma longa affects NF-κB, STAT3, and COX-2 signaling pathways.

b**) Lower Toxicity and Side Effects**

Compared to synthetic chemotherapy drugs, herbal medications typically have fewer side effects.Their natural origin and historical use in traditional medicine suggest better tolerability. For example, Withania somnifera (Ashwagandha) is known to reduce stress and fatigue, making it useful as an adjunct to conventional therapies.

c) **Cost-effectiveness**

Most herbal remedies are derived from locally available plants and are relatively inexpensive compared to standard chemotherapeutic agents. This is especially important in low- and middle-income countries where access to conventional cancer treatment may be limited.

d) **Synergistic Potential with Conventional Therapies**

Some herbal drugs have shown synergistic effects when used with chemotherapy or radiotherapy, potentially enhancing efficacy and reducing required doses of conventional drugs. For example, green tea polyphenols (EGCG) have been found to sensitize cancer cells to chemotherapeutic agents.

e) **Immune-modulating Properties**

Several herbal compounds modulate immune responses, which is crucial in cancer prevention and control. Astragalus membranaceus, for instance, is used in Traditional Chinese Medicine to boost immunity and support cancer patients during chemotherapy.

Limitations :-

a) Lack of Standardization

The absence of standardisation in dosage, preparation, and quality control is one of the biggest disadvantages of herbal medications. Variability in growing conditions, harvesting time, and extraction methods can lead to inconsistent concentrations of active ingredients.

b) Poor Bioavailability

Many potent phytochemicals exhibit low water solubility, poor absorption, rapid metabolism, and systemic elimination, which limits their therapeutic potential. For instance, curcumin has low oral bioavailability, necessitating formulation improvements such as liposomes or nanoparticles.

c) Limited Clinical Evidence

While many herbal compounds show promising in vitro and in vivo results, there is a paucity of well-designed, large-scale randomized clinical trials to support their efficacy and safety in humans. Regulatory approval is difficult without such data.

d) Herb-Drug Interactions

Herbal medicines can interact with conventional cancer drugs, either enhancing toxicity or reducing efficacy. For example, St. John's Wort induces cytochrome P450 enzymes and may reduce the effectiveness of chemotherapeutic agents like irinotecan and paclitaxel.

e) Slow Onset of Action

Compared to targeted drugs or chemotherapy, herbal treatments often take longer to show effects. This may not be suitable for aggressive or late-stage cancers where rapid intervention is necessary.

f) Regulatory Challenges

Herbal drugs are often categorized as dietary supplements rather than pharmaceuticals, which subjects them to less stringent regulatory oversight. This can result in the availability of substandard or adulterated products in the market.

CONCLUSION :-

Cancer remains one of the most complex and deadly diseases worldwide, with significant limitations associated with current treatment modalities, such as severe side effects, resistance development, and high financial costs. Herbal medicines, derived from centuries-old traditional medical systems like Ayurveda, Traditional Chinese Medicine, and Siddha, offer promising alternative or complementary strategies in cancer management. Numerous plant-

derived compounds such as curcumin (from *Curcuma longa*), ginsenosides (*Panax ginseng*), withanolides (*Withania somnifera*), and epigallocatechin gallate (*Camellia sinensis*) have demonstrated potent anticancer properties in preclinical and, to some extent, clinical studies.

Herbal drugs exert their effects through multiple mechanisms, including inhibition of cancer cell proliferation, induction of apoptosis, suppression of angiogenesis, and modulation of the immune system. They also exhibit synergistic potential when combined with conventional treatments, enhancing therapeutic outcomes while potentially minimizing toxic side effects.

Despite these promising attributes, the clinical adoption of herbal medicines in oncology is still hindered by several limitations. These include the lack of standardization and quality control, poor bioavailability of certain phytochemicals, limited high-quality clinical trials, and possible herb-drug interactions. Moreover, regulatory frameworks for herbal medicines vary globally, posing further challenges for their integration into mainstream cancer care.To harness the full potential of herbal drugs in oncology, future research should focus on improving bioavailability through advanced drug delivery systems (e.g., nanotechnology), conducting large-scale randomized controlled trials, and developing standardized herbal formulations. Interdisciplinary collaborations between ethnobotanists, pharmacologists, oncologists, and regulatory authorities are essential for ensuring safe and effective integration of herbal medicines into modern cancer therapy.In conclusion, herbal drugs represent a valuable yet underutilized resource in the ongoing battle against cancer. With rigorous scientific validation and strategic integration into existing treatment regimens, they could play a transformative role in making cancer therapy more holistic, personalized, and accessible.

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