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Ethnomedicinal Plants in Cancer Therapy

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ABSTRACT: Cancer is a dangerous illness that advances dramatically. Cancer has emerged as the leading cause of death worldwide, second only to heart disease. Cancer is caused by a number of variables, including genetics, habitual behavior, and the environment. Because of the high fatality rate associated with cancer and the negative side effects of radiation and chemotherapy, many cancer patients look for alternative and/or complementary therapies. The search for herbal remedies to treat a variety of illnesses, including cancer, is the beginning of traditional medicine's lengthy history. several plants that are utilized in traditional medicine have several bioactive substances that have the power to cure illnesses, which also aids in disease prevention.The anti-inflammatory and antioxidant qualities of these substances are also investigated, highlighting their potential for the treatment of oxidative stress and inflammatory illnesses. Additionally, the paper investigates the anti-cancer potential of bioactive compounds from medicinal plants, shedding light on their mechanisms of action and potential as cutting-edge therapeutic medicines. Additionally, these compounds' neuroprotective and neuro-pharmacological actions are examined, highlighting their significance in neurological illnesses. Insights into the possible uses of bioactive chemicals derived from medicinal plants in immunotherapy and the treatment of cardiovascular disease are provided by an examination of their immunomodulatory qualities and cardiovascular health advantages.

KEYWORDS: Cancer, Bioactive Compounds, Medicinal Plants, Anti-inflammatory, Neuroprotective

I. INTRODUCTION

Cancer is distinct from infectious and environmental diseases brought on by antigens that are not native to our bodily systems, as well as diseases linked to microbes and parasites. There are several reasons why human malignancies form when normal cells are mutated by genetic or epigenetic causes.[1]. The science of epigenetics examines how variations in heritable gene expression cause aberrant cells to proliferate.[2] Abnormal gene function and altered gene expression patterns, loss of normal cell growth, development, and regulation, faulty apoptosis, angiogenesis, and metastasis to other healthy tissue or organs are the causes of cancer.[3] Metastasis is the process by which cancer spreads from its original cells or tissue to another healthy area of tissues or organs.[4] Globally, there will be 28.4 million new cases of cancer in 2040, which is 47 percent more than the average number in 2020, according to GLOBOCAN estimates. Due to demographic changes, the rate of transitioning is expected to rise significantly from 65 to 95 percent compared to 32 to 56 percent, and it may rise even more as a result of globalization and rapid economic growth.[5] The extensive body of knowledge generated by researching cancer cells aids in slowing the disease's progression. In addition to the discomfort and side effects of chemotherapeutic treatment, cancer was long thought to be a terminal disease that could not be cured, which made patients feel afraid and despondent. Therefore, scientific research in the field of cancer is crucial to improving and sustaining the health care system and treatment, meeting the medical demands of cancer patients, and extending their life expectancy.[6,7] The cancer treatment regimen that has been used for the past 15 years, which is based on histomorphology features and organ origin-based treatment, is altered by the development of molecular and tumor biology.[8]In fact, natural products have somewhat lost their advantages in recent years due to the introduction of molecular biology and combinatorial chemistry, and they now play a supporting role in medication development and discovery. However, there has been a resurgence of interest in natural chemicals and their potential as a potent foundation for therapeutic development in more recent times. The co-evolution of plants and animals is probably the reason for the search for pharmaceutically active plant extracts. It is not surprising that plants have evolved defense mechanisms to protect themselves from predators and that they also produce substances that can negatively affect an animal's physiology.[9] frequently exhibiting a synergistic function that amplifies their impact [[10] In this context, understanding the cytological processes behind their behaviors appears to be crucial for a future accurate assessment and advancement. This study was inspired by earlier observations made in this lab while looking

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for plant extracts' antibacterial qualities.In this context, understanding the cytological processes behind their behaviors appears to be crucial for a future accurate assessment and advancement. This study was inspired by earlier observations made in this lab while looking for plant extracts' antibacterial qualities.[11] It is anticipated that there would be 11.5 million cancer deaths worldwide by 2030, up from 7.1 million in 2002.[12] Chemotherapy is frequently used to treat cancer. Cancer cells divide when healthy cells do not because they lose many of the regulatory processes that healthy cells have. Because of this characteristic, cancer cells are vulnerable to chemotherapy medications. A vast collection of effective chemotherapeutic medicines has been established as a result of almost 50 years of systematic drug research and development. Nevertheless, there are inherent issues with chemotherapy therapies as well. Chemotherapeutic treatments can result in a variety of toxicities. One frequent chemotherapeutic drug that is known to produce myelotoxicity is 5-fluorouracil.[13]

II. CANCER AND MEDICINAL PLANTS

For millennia, people have known that plants contain anticancer powers. Drugs to treat small cell lung cancer and testicular cancer were eventually developed as a result of the isolation of podophyllotoxin and many other substances (referred to as lignans) from the common mayapple (Podophyllumpeltatum).[18] Numerous research have examined the chemoprotective qualities of plants, such as Abrusprecatorius'santicarcinogenic effects on ascites tumor cells, fibrosarcoma in mice, and Yoshida sarcoma in rats [19]. Boswelliaserrata in human epidermal carcinoma of the nasopharynx, Asparagus racemosa in human epidermoid carcinoma, and Anacardiumoccidentale in hepatoma are further plants that have demonstrated anticarcinogenic qualities. Gynandropispentaphylla in hepatoma, Euphorbia hirta in Freund virus leukemia, and Erthyrinasuberosa in sarcoma Withaniasomnifera in a variety of malignancies, Picrorrhizakurroa in hepatic cancers, Nigella sativa in Lewis lung carcinoma, and Peaderiafoetida in human epidermoid carcinoma of the nasopharynx [20].

2.1 Tinosporacordifolia (wild) Miers

Tinosporacordifolia is a large, smooth, climbing deciduous shrub without bristles that is also referred to as guduchi in Sanskrit, giloya in Hindi, and heartleaf moonseed plant in English (Fig. 1). Although the stem of the shrub is the part that is most frequently used, significant alkaloids are also known to be present in the roots. Common locations for this plant include China, India, Myanmar, and Sri Lanka.T. cordifolia is also known as "amrita" in old Ayurvedic lexicons. This plant is called "amrita" because of its capacity to promote youth, energy, and longevity. The stem of T. cordifolia is used to treat jaundice, fever, urinary tract infections, dyspepsia, and general weakness.[21]

The adaptogenic, immunomodulatory, and antioxidant properties of T. cordifolia are widely recognized in contemporary medicine.[22]

2.2 Curcuma longa Linn

Curcuma longa is commonly referred to as haldi in Hindi, haridra in Sanskrit, and turmeric in English. The plant's rhizome has long been utilized in cooking (Fig. 3). Curcumin (diferuloylmethane, chemical structure shown below), a polyphenol obtained from the plant's rhizome, is the active component of this plant[27]. Turmeric is used for both cancer prevention and treatment [28].

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Curcumin's capacity to suppress the expression of several genes, such as NF-kappa B, Activator Protein 1 (AP-1), Epidermal Growth Receptor 1 (EGR-1), cycloxygenase 2 (COX2), lysyl oxidase (LOX), nitric oxide synthase (NOS), matrix metallopeptidase 9 (MMP-9), and tumor necrosis factor (TNF), may be linked to its anti-proliferative qualities.[29]

2.2 Allium sativum (garlic)

Garlic is a common name for Allium sativum. The sulfur-containing compound's original creator, allicin, is in charge of its medicinal qualities. Ajoene, another chemical that contains sulfur, slows the growth of cancer. Selenium has antioxidant properties. Garlic extract that has been ripened can prevent the spread of cancer.[34]

Ajoene inhibited human breast cancer cells' ability to proliferate.[35] When encapsulated in silver nanoparticles, A. sativum demonstrates anticancer efficacy against MCF-7 breast cancer cells, with an IC50 value of 89.86 µg/mL.[36]

2.3 Echinacea

Echinacea is a member of the Asteraceae family. The most widely utilized species are E. purpurea, E. angustifolia, and E. pallida. The most prevalent usage of E. purpurea is in the treatment of cancer. It is frequently referred to as coneflower. Natural Killer Cells (NKCs) are increased, and the flavonoids stimulate the immune system.[37] E. purpurea root and leaf crude extracts have IC50 values of 350 µg/mL and 280 µg/mL against BT-549 cell lines, respectively.[38]

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Ethyl acetate (Ea-AcOEt) was used to create the DC extract of E. angustifolia. The echinacoside and caffeic acid content of this extract were measured using HPLC, and its cytotoxicity against MDA-MB-231 and MCF-7 cells was determined to be 28.18 ± 1.14 µg/mL and 19.97 ± 2.31 µg/mL, respectively. Furthermore, paclitaxel and Ea-AcOEt had a synergistic effect.[39]

2.4 Andrographispaniculata (Burm. F.) Nees

Andrographispaniculata is a plant that grows in India and Sri Lanka. It is also referred to as bhunimba and kalmegha in Sanskrit, kiryat in Hindi, and the king of bitters and chiretta in English. The roots and leaves are the sections of the plant that are typically utilized medicinally. The extract of A. paniculata contains stigmasterols, flavonoids, and diterpenes.[40]

A paniculata is a strong immune system stimulant that activates both antigen-specific and non-specific immunological responses, according to studies done on mice.the paniculata is a strong chemoprotective agent that works well against a range of infectious and carcinogenic agents since it can trigger both kinds of immune responses. [41]

2.5 MappiafoetidaMiers. / NothapodytesfoetidaMiers

Tropical nations are typically home to Mappiafoetida, also known as Nothapodytesfoetida. Recently, M. foetida's therapeutic qualities have drawn interest from all over the world. Camptothecin, a powerful chemotherapeutic medication used to treat leukemia, is the active ingredient in M. foetida tree wood (chemical structure shown below).[43] According to recent research, the camptothecine is also produced by an endophytic fungus that develops on this plant[44].

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To evaluate the anticancer potential of camptothecines and their analogues, a number of Phase II clinical trials have been carried out. A wide spectrum of actions against solid epithelial cancers, leukemia, and lymphoma have been demonstrated by the Phase II trials[47]. It has been demonstrated that topotecan, another artificial alteration of 10-hydroxycamptothecine, inhibits the growth of rhabdomyosarcoma cells, osteogenic sarcoma xenografts, and human colon cancer cells[48].

2.6 Rhuscoriaria

Sumac, or Rhuscoriaria, is a plant that includes tannins, flavonoids, and phenolic acids [49]. By blocking the STAT3, NKκB, and NO pathways, it prevents breast cancer from spreading. By causing cell cycle arrest at the G1 phase and senescence, R. coriariaethanolic extract (RCE) suppresses cell proliferation [50].

By activating p38 and ERK1/2, R. coriaria caused senescence and autophagy cell death, demonstrating its potential as a therapeutic treatment against breast cancer [51]. In T47D, MCF-7, and MDA-MB-231 cell lines, RCE also increases p21 and decreases the expression of cyclin D1, c-myc, PCNA, p27, phosphor-RB, and senescence-associated β-galactosidase. The IC50 value of MDA-MB-231 cell lines was 215 µg/mL, while that of MCF-7 cell lines was 155 µg/mL [52].

2.7 Withaniasomniferan (Linn)Dunal

(Linn) Withaniasomnifera A little subtropical plant, dunal (Solanaceae) is also called winter cherry in English and ashwagandha in Sanskrit and Hindi. W. somnifera is marketed globally due to its therapeutic qualities, and its roots and leaves have been utilized in the Indian traditional medical system known as Ayurveda. Additionally, it belongs to the GRAS (generally recognized as safe) group of plants, which have a number of medicinal applications[53]. Because of its anti-stress and energy-boosting properties, W. somnifera has long been used in Indian traditional medicine [54].

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However, the ability to synthesize these withanolides or isolate them from plants in therapeutic quantities has presented significant obstacles to their practical application in clinical settings. An elite variety of W. somnifera's root and leaf extracts are combined in a specific ratio by scientists at the Indian Institute of Integrative Medicine in Jammu, India, to create a unique formulation that is rich in withanolide A and withaferin A [Indian Patent: 0202NF2006; Del 01321 dated 19-06-2007]. According to their recent research, this W. somnifera mixture seems to provide a multi-modal activity against cancer disease [55].

III. BIOACTIVE SUBSTANCES AND THEIR PROSPECTS FOR THE FUTURE

Numerous bioactive substances found in medicinal plants have the potential to treat a range of illnesses, including cancer [58]. Among the many traditional medical approaches used worldwide, Ayurveda is the one that is most widely used in India. Nichinda (Vitextrifolia), Indian Ipecac (Tyloporaindica), Arjuna Bark (Terminaliaarjuna), and other plants already discussed in this review are some of the traditional cancer-fighting plants utilized in India. Due to their biomedical qualities, these ethnobotanical resources can be utilized as natural substitutes [59]. In addition to boosting the effectiveness of chemotherapy medications, plant-based bioactive chemicals can occasionally have negative side effects when used as chemotherapeutic medicines [60]. Additionally, these bioactive substances modify the immune system and cellular processes, which suppresses breast cancer [61]. By restoring miRNA expression, bioactive substances such as tanshinones, berberine, matrine, and astragaloside IV shown an inhibitory effect on breast cancer cells. These herbs aid in enhancing general health in addition to preventing or inhibiting cancer [62].

IV. CONCLUSION

Controlling the development and spread of cancer is crucial, and every workable treatment is crucial. An alternative to traditional allopathic therapy for the treatment of the condition is the use of medicinal plant products to control or stop the carcinogenic process. Numerous herbs have undergone clinical evaluations, and research is ongoing to determine their potential tumoricidal effects on a range of malignancies [63]. To give a thorough overview of their molecular targets and specificity, these natural compounds have been used to target particular biological pathways in order to produce antitumor efficacies. The primary cause of natural product restrictions is the extracts' variability. Numerous active metabolites, including alkaloids, flavonoids, terpenes, saponins, steroids, and glycosides, are found in plant extracts. The mechanisms of the therapeutic response are the combined effect that results from the antagonistic, neutralizing, and synergistic effects of the individual effects in order to determine the minimum effective dose of a given sample and its maximum tolerable dose. Medicinal plants are utilized as a better alternative for treating adverse effects from radiation, chemotherapy, and surgery. Therefore, there is proof that plant-based products can have antitumor benefits while having comparatively minimal adverse effects. Strong anticancer drugs could be discovered as a result of more research on plants and compounds produced from them.

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