WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Anticancer Activity, Antioxidant Activity, and Phytochemical Analysis of Leucaena Leucocephala's Root Extract- A Review

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ABSTRACT:

Originally from southern Mexico and Central America, Leucaena leucocephala (Lam.) de Wit has gained citizenship in more than 130 nations. L. leucocephala's spread is likely a result of its versatile use in things like feed, lumber, paper pulp, and shade trees. Several plant species, including weeds and woody plants, had their germination and growth reduced by L. leucocephala's extracts, leachates, root exudates, litter, and soil from the rhizosphere. The identification of the phytochemicals can be used to forecast the pharmacological activity of a plant. Phytochemicals that are referred to as " Plants are capable of producing secondary metabolites". phytochemicals play a significant part in the longevity of plants, including protective and structural functions. The perennial legume tree Leucaena leucocephala has a long lifespan. It is a tiny, erect, non-climbing shrub or tree that only grows in dry and semi-arid climates. It is a tree with many uses, and the young leaves and seeds are edible. It is applied to increase the fertility of the soil. There have been claims that L. leucocephala's various sections had therapeutic qualities. It has been shown that plant extracts have potent antibacterial and antifungal properties. This plant's phytochemical makeup has been described as being rich in alkaloids, flavonoids, saponins, tannins, and triterpenoids. This plant's pharmacological effects include antibacterial, antidiabetic, anti-inflammatory, anti-cancer, anthelmintic, antioxidant, and larviciding properties. This plant is used traditionally for worm medication, to promote smooth bowel movements, and to cure fractures, sleeplessness, edema, renal inflammation, diabetes, and menstrual irregularities. The main cause of death in both industrialized and developing nations is cancer. A successful strategy for the creation of novel medications for the treatment of cancer patients is the potential anti-cancer agent from herbs. Leucaena leucocephala's leaves and seeds are rich in lipids, crude protein, tannin, carbs, and mimosine. The molecular structure of mimosine, a non-protein amino acid, is identical to that of tyrosine. Although mimosine is poisonous to animals, it can be eliminated by soaking the leaves in water for 24 hours. However, mimosine inhibits the advancement of the cell cycle in human lung cancer cells, which has anticancer properties. The most effective way to combat the oxidative stress-causing free radicals is with antioxidants. endogenous, exogenous, synthetic, or natural antioxidants. The most effective way to combat the oxidative stress-causing free radicals is with antioxidants. endogenous, exogenous, synthetic, or natural antioxidants. Reviewing and summarising the root extract of Leucaena leucocephala's anticancer, antioxidant, and phytochemical analyses.

KEYWORDS: Leucaena Leucocephala, phytochemicals, antioxidant activity, anticancer activity.

INTRODUCTION:

Plants are vital to human existence because they offer food advantages and a variety of therapeutic benefits. Because of their bioactive and medicinal qualities, many plant components like shrubs, herbs, and roots have been used in our daily lives for many ages [1].More than 50,000 plant species are thought to be used for therapeutic reasons globally, and recent medical developments have focused on using plants to purify essential components to design medications with precise biochemical intermediates [2].Due to their beneficial characteristics, various Indian medicinal plants have been utilized to treat a variety of diseases since ancient times [3]. Plants have been utilized in medicine since ancient times and are still employed today, accounting for 10% of all vascular plants and numbering between 350,000 and over half a million species [4]. Due to their anticancer, anti-diabetic, anti-inflammatory, antibacterial, antimicrobial, antifungal, antioxidant, and wound-healing properties, volatile oils, secondary metabolites, polypeptides, polysaccharides, and other natural plant products are utilized [5].

Plant extracts have been found to have antibacterial action against a variety of Gram-positive and Gram-negative bacteria, according to numerous studies. Many of these extracts have antibacterial activity comparable to or superior to that of common antibiotics[6].In plants, secondary metabolites such as tannins, terpenes, polyphenols, glycosides, flavonoids, alkaloids, and a few more pigments help maintain health status by protecting against diseases and stressful situations [7].Any part of the flora can produce plant metabolites, which include alkaloids, phenolic compounds, saponins, and other chemical compounds with known biological activities. In many laboratories, screening plant species is done regularly to discover new bioactive compounds [8]. These plant compounds are active contributors to the health of human and animal immunological, respiratory, excretory, neurological, and circulatory systems [9].In the villages of Tamil Nadu, India, Leucaena leucocephala (Lam.) de Wit is a well-known fodder plant. But this plant contains therapeutic qualities that are concealed within it. Plant metabolites are what provide the substance its medicinal qualities. A medium-sized, quickly-growing tropical tree native to Southern Mexico and Northern Central America is called Leucaena leucocephala (Fabaceae) [10].

Now, it has spread rapidly throughout many tropical and subtropical areas [11]. This plant is also known by the names White Lead Tree, Wild Tamarind, Jumbay, and White Popinac. The common names in India are Kubabul or Subabul [12]. It was advertised as a "miracle tree" due to its exceptional range of applications. The tree has a variety of purposes, including reducing soil erosion and providing fuel for wood, timber, feed, and green manure [13].The species, which may be found between 30 degrees north and south of the equator, is mostly a tropical species with a low tolerance for cold temperatures. It thrives in climates with 650–3000 mm of annual precipitation, 4-6 months of dry weather, and an average annual temperature of 25–30 °C [14].The plant has bipinnate, alternating leaves that have 4–9 pairs of pinnae and 13–21 pairs of leaflets per pinnae. In the twilight, the leaves exhibit nyctinasty [15].

Under stress conditions like cold temperatures and extreme dryness, it is an evergreen plant that can also turn facultatively deciduous [16].Fast-growing species L. leucocephala can achieve reproductive maturity in 12 months, or 4 months in optimum conditions [17].Each flower head produces 100–180 blooms and actively produces young shoots that are 12–21 diameters in diameter. A flower head produces 5–20 pods. Pods measure 11–19 cm long by 15–21 mm broad and hold 8–18 seeds each. The species produces a large number of seeds, largely through self-fertilization, and blooms all year round [18].L. leucocephala may be found all across India, and many locals from the eastern and northeastern regions utilize it as a medicine, demonstrating the relevance of this plant in terms of ethnopharmacology. L. leucocephala has traditionally been used as livestock feed. According to studies, L. leucocephala may be antiemetic and anti-diabetic [19]. In addition to quality food for various animals, the use of plant parts has expanded from methane production [20].

Leucaena leucocephala seeds have a high protein content (24.5%-46%), as well as several critical amino acids and beta-carotene. Consequently, this is a top-notch source of quality protein for animal feed [21]. Species are now more widely distributed throughout the tropics and subtropics [22]. It is likely because of its advantageous characteristics that L. leucocephala has spread. In the tropics and subtropics, the species is known for producing nutritious and high-quality fodder trees.It serves as a feed ingredient for both ruminants (cattle, water buffalo, and goats) and non-ruminants (rabbits, fowl, and fish) animals [23]. Species' leaves are rich in protein (22-28% of dry weight), important amino acids like phenylalanine, leucine, isoleucine, and histidine, as well as various minerals like calcium and phosphorus [24]. Its wood is sturdy and medium-density, appropriate for carpentry materials, and contains up to 20% dry weight of carbohydrates. Its caloric value as fuelwood is around 4600 calories per kg, and its biochar enhances the soil quality of agricultural fields [25].

Leucaena leucocephala is used as a shade tree in several plantations, including those cocoa, coffee, and tea. In addition, it serves as a shelterbelt for various crops [26]. The plant is a potential contender for restoring vegetation to degraded lands, watersheds, and slopes to stop erosion and encourage the growth of vegetation [27]. Additionally, locals in Central America and South Asia eat its leaves and young pods as vegetables. In Mexico, its pods, leaves, and bark are used to make brown, red, and black colors. The species' roots and bark are also employed as a folk cure, and the species' roots are believed to induce abortions [28]. The whole seed of L. leucocephala has been used as a coffee substitute, while the seed gums are used to treat illnesses of the digestive tract and function as laxatives [29]. L. leucocephala seed gum's polysaccharides brought about the cancer-preventive and anti-proliferative properties of the plant [30].

It has been shown that plant extracts have potent antibacterial and antifungal properties [31]. Additionally, the tree has a variety of biological attributes, including antiviral, antidiabetic, anti-inflammatory, anticancer, antithrombotic, anticoagulant, and immunostimulant traits [32]. During regular metabolism, our body produces extremely reactive free radicals like the hydroxy radical, superoxide anion, and singlet oxygen. Endogenous antioxidants typically neutralize these free radicals. Antioxidants are depleted when the production of free radicals increases [33]. These free radicals subsequently harm lipids, proteins, and DNA, which causes a variety of illnesses like cancer, diabetes, asthma, and neurological diseases as well as myocardial infarction [34]. To either neutralize or scavenge these free radicals, antioxidants are therefore necessary. Medical plants have been utilized to cure and prevent illness since the dawn of humanity. Several investigations have confirmed their function as natural antioxidants [35].

People still favor using plant-based remedies even in the current medical system since they are more readily available, more affordable, and safer than manufactured drugs. The secondary metabolites phenol, flavonoids, alkaloids, glycosides, tannins, and others are abundant in plants. According to studies, the phenol and flavonoids found in various plant parts have a protective effect against illnesses brought on by oxidative stress [36].The substances created by plants' regular metabolic processes are known as phytochemicals. Phytochemicals are typically complex in nature and vary depending on the stage of development and the type of plant. These secondary metabolic products are linked to a variety of plant functions, some of which include therapeutic effects [37]. In the 20th century, the idea of creating synthetic and semi-synthetic analogs of plant substances for therapeutic application was introduced. Because these counterparts have the strongest therapeutic benefits, phytochemicals have drawn more attention from researchers in the medical and food industries [38].The screening of phytochemicals in dietary plants is crucial in determining the sources of substances that are significant for both industrial and therapeutic purposes. It is essential to execute a few critical actions to identify secondary metabolites in plants [39]. Different kinds of phytochemicals are present in diverse plant species. Each of these has a special quality and serves a certain purpose. Nutritional advantages, physiological processes, phytotoxicity, antinutritional qualities, pro-oxidants, anti-oxidants, anti-carcinogenic effects, analgesic effects, anti-inflammatory effects, and other therapeutic effects are among these functions [40].

Cancer is one of the leading causes of death worldwide and is a serious issue for public health. Although the prevalence of this disease is increasing, Central and South America, Africa, and Asia account for nearly 70% of all cancer fatalities worldwide [41]. The creation of agents for cancer therapy has been the subject of numerous investigations [42].One kind of treatment for this illness is chemotherapy, and patient care has improved as a result of advancements in anticancer medication. Unfavorable side effects on healthy cells and tissue are unfortunately also brought on by traditional chemical medications. These include baldness, nausea, vomiting, and a reduction in bone marrow function [43]. However, due to their anti-proliferative and pro-apoptotic qualities, numerous phytochemicals and natural antioxidants have lately been proposed as anti-cancer adjuvant therapy [44]. Since natural

herbal remedies have many benefits, the ongoing quest for anticancer drugs or molecules from plants played a crucial role in determining alternative ways to have safe and to reduce the negative effects caused by chemotherapy [45].

Over several decades, some 200 novel chemical compounds have been approved to treat cancer, 50% of which are derived from naturally occurring molecules that have undergone structural alterations to make them safe and beneficial [46]. Organic compounds, such as terpenes, flavonoids, alkaloids, lignans, saponins, vitamins, glycosides, oils, and other secondary metabolites, are crucial in the selective suppression of proliferation and activation of malignant cell death due to their diverse structural makeup [47].Leucaena leucocephala's leaves and seeds are rich in lipids, crude protein, tannin, carbs,and mimosine. The molecular structure of mimosine, a non-protein amino acid, is identical to that of tyrosine.Although mimosine is poisonous to animals, it can be eliminated by soaking the leaves in water for 24 hours [48]. However, mimosine inhibits cell cycle progression in human lung cancer cells to have an anti-cancer effect [49].Due to its antimicrobial, anthelmintic, antibacterial, anti-proliferative and antidiabetic, anticancer, cancer prevention, diuretic, anti-inflammatory, antioxidant, antitumor, antihistaminic, nematicide, pesticide, anti-androgenic, hypocholesterolemic, and hepatoprotective properties, Leucaena leucocephala has been used[50].

TAXONOMICAL CLASSIFICATION:

Kingdom: Plantae

Order: Fabales

Family: Fabaceae

Subfamily: Caesalpinioideae

Genus: Leucaena

Species: leucocephala

ROLE OF MEDICINAL PLANTS:

Since ancient times, pharmacological value has been attributed to medicinal plants and the molecules that are generated from them (phytochemicals). Before civilization began, 60,000 years ago, people began using plants as medicine. Today, plants are the source of more than 30% of all pharmaceuticals (together with their analogs and derivatives), and natural goods will continue to have a significant influence on human medicine. Structure-wise, the majority of synthetic bioactive medications resemble the phytochemicals of the plants that they were initially extracted from. Plant-based remedies are widely used in primary healthcare and the treatment of disease in many underdeveloped nations. The use of plant-derived medicinal items is also becoming more popular due to the risks associated with using chemical medications.since some of these natural chemicals are more effective and less dangerous than synthetic medications. Among the most significant medications with herbal roots are immunomodulators, antibiotics, anti-inflammatory treatments, and cancer-fighting medications.

HISTORICAL USE OF LEUCAENA LEUCOCEPHALA:

Indonesians frequently employ Leucaena leucocephala in traditional medicine, particularly the leaves, and seeds. Active flavonoids found in the leaves of Leucaena leucocephala can lessen pain. Leucaena seeds are used in traditional medicine for their anthelmintic, edema, diabetes, sleeplessness, and kidney inflammatory qualities.People frequently utilize the plant Leucaena leucocephala as a wound remedy. Because it doesn't cause skin irritation, its use has historically been preferred.This plant has been used traditionally to treat worms, promote smooth bowel motions, treat fractures, sleeplessness, edema, renal inflammation, and diabetes, and promote regular menstruation.

ANTICANCER ACTIVITY:

The main cause of death in both industrialized and developing nations is cancer. A successful strategy for the creation of novel medications for the treatment of cancer patients is the potential anti-cancer agent from herbs. Leucaena leucocephala, a mimosoid tree sometimes known as a white lead tree, is a member of the Mimosaceae family and is indigenous to southern Mexico and northern Central America. Leucaena leucocephala's leaves and seeds are rich in lipids, crude protein, tannin, carbs, and mimosine. The molecular structure of mimosine, a non-protein amino acid, is identical to that of tyrosine. Although mimosine is poisonous to animals, it can be eliminated by soaking the leaves in water for 24 hours. However, mimosine inhibits the advancement of the cell cycle in human lung cancer cells, which has anticancer properties.

ANTIMICROBIAL ACTIVITY:

In essence, antimicrobial drugs play a critical role in lowering the burden of infectious diseases worldwide. However, because there are fewer or, in some cases, no effective antimicrobial medicines available to treat infections brought on by pathogenic bacteria, the rise and spread of multidrug-resistant (MDR) strains in pathogenic bacteria have significantly increased the threat to public health.Numerous medicinal plants have been identified as important

sources of naturally occurring antimicrobial chemicals as potential therapeutic options for these troublesome bacterial illnesses. The World Health Organisation (WHO) claims that the greatest place to get a range of medications is from medicinal plants. Due to their antibacterial properties, which are brought on by phytochemicals produced during the plant's secondary metabolism, many plants have been employed. Numerous secondary metabolites found in plants, including tannins, alkaloids, phenolic compounds, and flavonoids, have been discovered in vitro to exhibit antibacterial effects. Leucaenoa leucocephala plant extracts have been shown to have potent antibacterial and antifungal properties.

PHYTOCHEMICALS:

The chemical substances naturally found in plants, known as phytochemicals (Greek: phyton, or "plant"), can have either beneficial or harmful impacts on human health. The richest bio-reservoirs of different phytochemicals are medicinal plants, which are used to treat various diseases and ails. The phytochemical components of plants control their therapeutic qualities. Alkaloids, flavonoids, phenolics, tannins, saponins, steroids, glycosides, terpenes, and other significant phytochemicals are present in diverse plant components and are among the most significant phytochemicals. With phenolics (45%), terpenoids and steroids (27%), and alkaloids (18%) as the three main classes of phytochemicals, nature provides a singular source of structures with significant phytochemical variety. These substances appear to be non-essential to the plant that produces them, but they are crucial to the plant's survival by mediating interactions with rival species, shielding it from pests, stress, and UV rays, and enhancing the color, flavor, and aroma of the plant. Drugs that people can employ to cure a variety of diseases have been created from the metabolites that plants make to protect themselves from biotic and abiotic stresses.

S.NO	Phytochemical	Name of the test
1	**Alkaloids**	**Draggendorff's test** **Wagners test** **Mayers test**
2	**Flavonoids**	**Alkaline reagent test**
3	**Tannins**	**Ferric chloride** **Lead acetate test**
4	**Phenols**	**Ferric chloride** **Lead acetate test** **Liebermann's test**
5	**Saponins**	**Foam test**
6	**Carbohydrates**	**Fehling's test** **Benedict's test** **Molisch's test**
7	**Proteins and Amino acids**	**Fehling's test** **Benedict's test** **Molisch's test**

The following tests are used to analyze the presence of phytochemicals in the root sample of Leucaena leucocephala.

ANTIOXIDANT ACTIVITY:

Several chronic and degenerative diseases, such as atherosclerosis, ischemic heart disease, aging, diabetes mellitus, cancer, immunosuppression, neurodegenerative diseases, and others have been linked to oxidative stress as one of the primary initiating causes. Antioxidants are the most efficient means of eradicating the free radicals that cause oxidative stress.Exogenous or endogenous antioxidants, synthetic or natural, can scavenge free radicals or promote their breakdown and reduce these illnesses, preventing the production of new ones. There is already a growing interest in herbal resources that include natural antioxidants.The hypothesis that plant elements with antioxidant activity are capable of exerting protective effects against oxidative stress in biological systems was substantially supported by epidemiological and in vitro investigations on medicinal plants and vegetables.

ROLE OF ANTIOXIDANT:

The most significant position in the body's metabolism is occupied by the role of free radicals harming cells and tissues. Free radical reactions happen as a result of stable molecules being oxidized into reactive and unstable chemicals. These reactive species have the potential to interact with other substances in the body and damage tissue, which can result in conditions like cancer, Alzheimer's disease, cardiac reperfusion, and other ailments. Free radicals that

can oxidize nucleic acids, proteins, lipids, and DNA include peroxides, hydroperoxides, and peroxyl lipids. They can also start degenerative diseases. Heavy metals, heat, radiation, colors, and preservatives are a few physical and chemical elements that contribute significantly to the overabundance of oxidation reactions.

Chemical substances known as antioxidants can counteract free radicals. By donating electrons to achieve a stable state, these substances block the oxidative processes that lead to degenerative illness. Both natural and artificial components can be antioxidant compounds. Synthetic antioxidants are carcinogenic and have several negative side effects. Because of this, numerous studies have created antioxidant compounds using natural components. The majority of antioxidant chemicals, including vitamin C, vitamin E, carotenoids, and phenolic acids, are derived from these plants. groupings of compounds with varied physical and chemical properties characteristics, such as gallic acid's potent antioxidant activity, were discovered.

CONCLUSION:

Several phytochemical substances with potential bioactivity as antimicrobial and antioxidant agents can be found in the L. leucocephala tree. Plants are utilized for a variety of things, such as food, medicine, fodder, shelter, and so forth. L. leucocephala leaves contain beneficial compounds.Compared to the pod cover extract, L. leucocephala leaf extract shows better anti-oxidant and anti-bacterial activity. Total flavonoid and phenolic component presence, as well as other factors, can be used to explain these qualities. extract from the leaf's phytochemicals.Plants' phytochemical constituents offer defense against pathogens and UV radiation.The species' roots and bark are often employed as a folk cure, and the roots are also believed to induce abortions. As a result, Leucaena leucocephala is well known as a kind of versatile plant.

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