A Review on Beneficial Aspects of *Terminalia Chebula*

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Abstract- *The plant Terminalia chebula, sometimes referred to as "Haritaki/Myrobalan," has long been used in traditional medicine.A species of Terminalia is known as black or chebulic myrobalan (Fam. Combretaceae) Terminalia chebula Retz. The name "King of Medicine" refers to T. chebula in Tibet.Because of its many medicinal applications, Terminalia chebula is a significant plant in the field of pharmaceutics. Most people refer to it as Hritaki. It has been widely used in many traditional medicine systems, including Unani, Tibb, Ayurveda, and Siddha. Tannins, alkaloids, and other phytochemicals found in this herb are responsible for its widespread use in traditional medical systems. Several electronic databases were used to search for studies on the pharmacological effects of T. chebula and its phytoconstituents that were published between January 1996 and December 2021. The biological characteristics of T. chebula, including as its antioxidative, antiproliferative, antimicrobial, proapoptotic, anti-diabetic, anti-aging, hepatoprotective, anti-inflammatory and antiepileptic effects, were discovered during the previous period by a number of laboratory techniques.*

Keywords- Antimicrobial, Anti-diabetic, Anti-aging, Hepatoprotective, Anti-inflammatory, and antiepileptic.

I. INTRODUCTION

Furthermore, medicinal plants are the source of more than half of today's pharmaceuticals. Terminalia chebula Retz, also referred to as "Haritaki/Myrobalan," has long been used in traditional medicine.T. chebula has biological qualities that include anti-oxidative, anti-proliferative, antimicrobial, proapoptotic, anti-diabetic,anti-aging, hepatoprotective, anti-inflammatory, and antiepileptic effects.Studies on the pharmacological effects of Terminalia chebula and its phytoconstituents that were published between January 1996 and December 2021 were examined[1].Terminalia chebula Retz. (Fam. Combretaceae) is referred to as the "King of Medicine" in Tibet and consistently ranks highest among the "Ayurvedic Materia Medica" due to its remarkable therapeutic properties. Many phytochemicals, including polyphenols, terpenes, anthocyanin, flavonoids, alkaloids, and glycosides, may be responsible for the health benefits that have been reported. Traditional homeopathic and Unani medicines address a variety of illnesses using all sections of the tree. The fruit that is dried is the most often utilized component in medical procedures.

Figure 1: Terminalia chebula

Figure 2: A leafless Terminalia chebula tree

II. DESCRIPTION

Myrobalanus chebula (Retz.)also known botanically as terminalia chebula.this herb belongs to Combretaceae family,The medium-to-large deciduous Terminalia chebula tree can reach a height of 30 meters (98 feet) with a trunk diameter of up to 1 meter (3 feet 3 inches).Its branches stretch out and it has a rounded crown. With some longitudinal fissures, the bark is a dark brown color[1] .Two sizable glands are located at the top of the petiole of the ovate, elliptical leaves. The blooms are terminal spikes or short panicles, monoecious, dull white to yellow, and have a strong, disagreeable odor.

Table 1 : Scientific Classification

Kingdom	Plantae
Subkingdom	Tracheoibiont
Class	Magnoliopsida
Subclass	Rosidae
Division	Maginoliophyte
Super division	Spermatophore
Common name	Harro
Order	Myrtales
Family	Combretac
Genius	Terminalia
Species	Terminalia chebula

Table 2 : Vernacular Names

Tamil	Kadukkai
Telugu	Karakkai
Oriya	Haridra
Punjabi	Har, Harar
Hindi & Sanskrit	Harra
Assam	Kilikha
Bengali	Haritaki
Gujarati	Hardo
Marathi	Hirda

III. MORPHOLOGY OF TERMINALIA CHEBULA

The enormous Chebulic myrobalan tree has an umbrella-shaped crown and densely packed branches. It can reach a height of 25 meters and a bole girth of 2.5 meters.Bark on stems is dark brown. During the cold season, the 8–20 cm long, sub-opposite, elliptical or oblong-ovate leaves are deciduous. The presence of two sizable glands at the apex of the petiole and irregularly shedding dark brown bark are characteristics that distinguish this species[2].

Figure 3: Terminalia Chebula leaves

Figure 4: Terminalia Chebula trees

Figure 5:Terminalia chebula flowers

Figure 6: Terminalia chebula seeds

IV. MICROSCOPY OF TERMINALIA CHEBULA

Having an umbrella-shaped crown and densely packed branches, myrobalan is a huge tree that can reach a height of 25 meters and a bole girth of 2.5 meters.Bark on stems is dark brown. During the cold season, the 8–20 cm long, sub-opposite, elliptical or oblong-ovate leaves are deciduous.The fruit's transverse cut reveals the epicarp, which is made up of an epidermal cell layer, the outer tangential wall, and the upper part of the dense walls radially.Mesocarp is composed of two or three layers of collenchymas, followed by a broad zone of parenchyma with scattered vascular bundles, fibers, and sclereids in groups; parenchyma has simple pitted walls; sclereids are elongated and come in a variety of shapes and sizes; parenchyma contains aggregate crystals of calcium oxalate and tannins; starch grains are simple, rounded or oval in shape, measuring 2–7 μm in diameter[3].

Leaves

Leaves often have straight walls, an irregular form, and a polygonal shape. The walls of the cells were thin. The walls exhibited undulations on both their adaxial and abaxial surface. Large, anomocytic, hypoostomatic stomata with a stomatal index of 25.16 and a stomata number of 23.66 in terminalia chebula characterized the epidermal cells on the adaxial surface.

Seeds

Under microscope, metabolites like starch grains tannins were observed,the sections cleared with chloral hydrate to observe various ergastic cell contents like crystals of calcium oxalate crystals, calcium carbonate and silica. It was observed that tannins starch grains and lignin.[4].

Powder Microscopy

The powder has a dull creamish yellow color and is finely ground (Sieve No. 80). It is smooth to the touch, has a lump-forming texture, and has an astringent taste and smell.The surface view of the powder shows polygonal epidermal cells with straight anticlinal walls; the fibers have peg-like outgrowths and simple pitted thin and thick walls with wide lumen; the sclereides are of different sizes and shapes, irregular, and pitted; the abundance of stone cells has a narrow lumen and branched pits (ramiform) through thick cell wall; the vessels have spiral, pitted, and reticulate thickenings; the starch grains are simply isolated, round to oval in size, 6 to 10 μ; the tannin masses are yellowish brown[4]; the starch grains are simple isolated, round to oval in size, 6 to 10 μ in size; the yellowish brown tannin masses.

V. GEOGRAPHY OF TERMINALIA CHEBULA

Terminalia chebula surrounded over the Sub-Himalayan routes, which stretch from the Ravi eastward to West Bengal and Assam. The species reaches a maximum elevation of 1,500 meters in the Himalayas.

VI. HABITAT OF TERMINALIA CHEBULA

In addition to Asia, the Terminalia chebula tree can be found in countries like Egypt, Turkey, and Iran[3]. In India, the Terminalia chebula, also known as the haritaki tree, grows in deciduous forests in the states of Himachal Pradesh, Tamil Nadu, Kerala, Karnataka, Uttar Pradesh, Andhra Pradesh, and West Bengal. Terminalia chebula trees can grow up to 2000 meters above sea level, and they prefer environments with 100–150 cm of annual rainfall and 0.17 degrees Celsius of temperature[5].

VII. PHYTOCONSTITUENTS OF TERMINALIA CHEBULA

Using established protocols, seed extract was examined for the presence of alkaloids, flavonoids, phenols, carbohydrates, glycosides, terpenoids, saponins, proteins, and tannins.Gallic acid, ellagic acid, tannic acid, ethyl gallate, chebulic acid, chebulagic acid, corilagin, mannitol, ascorbic acid (vitamin C), and other chemicals have been found in T. chebula through phytochemical study, According to one source, T. chebula has 32% tannins. According to several writers (Odebiyi and Sofowora, 1990; Vogel, 1958; Kapoor etal., 1969; Fadeyiet al., 1989), phytochemical analysis is a prominent phytoconstituent of plant extracts. The plant extracts were examined to determine if they contained biologically active substances such as tannin, quinine, alkaloids, flavonoids, phenolic compounds, saponin, and steroids (Harborne, 1973)[5] .Using accepted procedures, chemical tests are carried out on the powdered form and the aqueous extract of each plant sample.Numerous recognized or unidentified phytoconstituents from harad can be effective tools for the discovery of novel medications because there is a link between pharmacological action and secondary metabolites produced by nature. Hydrolyzable tannins, which can range in percentage from 20 to 50%, make up Terminalia chebula's total phytoconstituents and are in charge of its pharmacological properties. Several categories of phytochemicals.

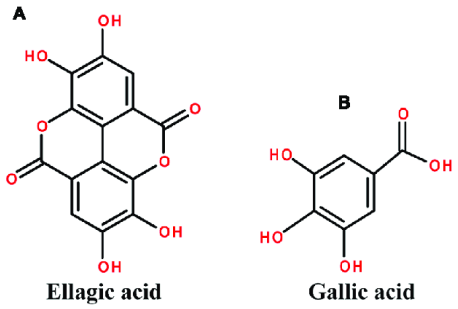

Figure 7: Phytoconstituents of Terminalia chebula

VIII. PHARMACOLOGICAL ACTIVITY OF TERMINALIA CHEBULA

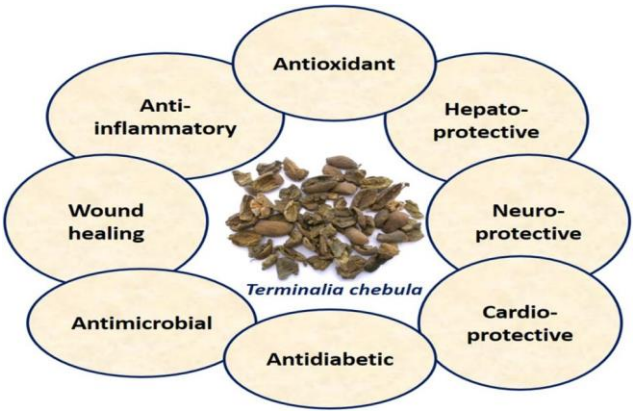

Figure 8: Pharmacological activities of Terminalia chebula

A. ANTI-BACTERIAL ACTIVITY:

Terminalia chebula exhibited antibacterial efficacy against human pathogenic pathogens that were both gram-positive and gram-negative. Leaf extract has bactericidal effects against Salmonella sp., Shigella sp., Escherichia coli, and Vibrio cholerae. Additionally, it inhibits ear infections. From the stem bark of T. chebula, triterpenoids and their derivatives were extracted, and these compounds shown promising antibacterial activity against Salmonella typhi, E. coli, S. aureus, Pseudomonas aeruginosa, and Bacillus subtilis. Gentamicin, trimethoprim, and gallotannin from T. chebula fruit function together as efflux pump inhibitors. Through the efflux pump mechanism, bacteria can develop multidrug resistance.The pathogenicity of P. aeruginosa is decreased by elastacic acid and its structural derivatives from T. chebula through the downregulation of phosphate kinase-1 (PPK-1), which results in a decrease in RpoS expression[6].It works by lowering urease activity to combat Helicobactor pyroli, a common bacteria that causes gastritis, ulcers, and stomach cancer. The methicillin-resistant S. aureus showed reduced growth and activity with exposure to the T. chebula extract, indicating the antibacterial action. Ripe seeds have demonstrated strong antibacterial qualities, especially against S. aureus. The aqueous extract of T. chebula strongly inhibited the growth of salivary bacteria known as Streptococcus mutants.

B. ANTI-OXIDANT ACTIVITY :

The fruit, bark, and leaves of T. chebula all contain phenolics, which have a strong antioxidant effect. T. chebula's aqueous extract scavenged DPPH radicals and reduced the activity of xanthine/xanthine oxidase. The antioxidative properties of acetone extract were attributed to flavonols, hydroxybenzoic acid derivatives, hydroxycinnamic acid derivatives, aglycon, and glycosides. High antioxidant activity was shown by the T. chebula fruit methanol extract in the ORAC, FRAP, and DPPH procedures. More antioxidant activity than any other extract has been found in the acetone extract of T[7]. Chebula bark, which also shows a remarkable capacity to scavenge free radicals. T. cheubla fruit aqueous extract prevents oxidative stress and delays the onset of age-induced damages.

C. ANTI-FUNGAL ACTIVITY:

Antifungal efficacy against many dermatophytes and yeasts was demonstrated by an aqueous extract of T. chebula. It works well against the dermatophytes Epidermophyton, Floccosum, Microsporum gypseum, and Trichophyton rubrum as well as the pathogenic yeast Candida albicans. It has also been shown to have an inhibiting impact on three yeast species (Candida spp.) and three dermatophytes (Trichophyton spp.). Three yeast species (Candida spp.) and three dermatophytes (Trichophyton spp.) were inhibited by an aqueous extract of T. chebula galls. The methanol extract of T. chebula exhibited in vitro anticandidal action against Candida albicans that was resistant to clotrimazole. Trichophyton glabrata was subjected to antifungal activity by seed extract.

D. CYTOPROTECTIVE ACTIVITY:

An effective cytoprotective effect was seen on HEK-N/F cells by the fruit of Terminalia chebula ethanolic extract. Furthermore, its extract showed a significantcytoprotective action against UVB-induced oxidative damage. These results were attributable to Terminalia chebula's inhibitory effect on the age-dependent shortening of the telomere length, as demonstrated by Southern blot analyses of DNA taken from sub-culture passages.The active components of the herbal cure Kashi (myrobalan, the fruit of T. chebula) that inhibited cytotoxic Tlyphocyte-mediated cytotoxicity were identified as gallic acid (GA) and caffeic acid (CA). Furthermore, when administered at the same dosages, GA and CA inhibited granule exocytosis in response to anti-CD3 stimulation.

E. ANTI-DIABETIC ACTIVITY:

Terminalia chebula has been traditionally used in digestive tract applications; for example, an ethanol extract of dried T. chebula, Morus Alba, Poria cocos, and Zea mays was shown to favorably alter glucose-stimulated insulin secretion by retarding α-glucosidase activity. Transport of glucose across the cell monolayer was considerably reduced by the ethanol extract of dried T. chebula Retz, Polygonatum odoratum, and Glycyrrhiza uralensis.The ingestion of a decoction comprising of Terminalia chebula, Glycyrrhiza glabra, Petroselinum crispum, Swertia chirayita, and Boerhavia diffusa enhanced the anti-glycation properties, hence offering significant promise for the management of diabetes problems. T. chebula exhibits efficacy against endothelial cell dysfunction caused by advanced glycation end products (AGEs).

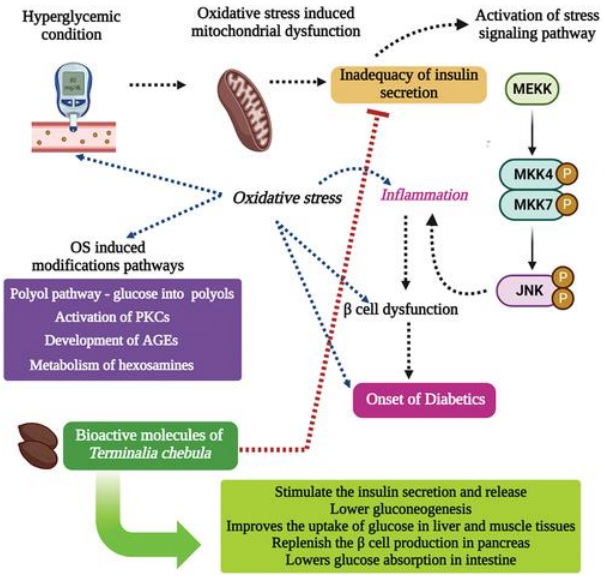

Figure 9: Anti-diabetic property of the *Terminalia chebula*

F. ANTI VIRAL ACTIVITY:

The fruits of the T. chebula plant produced three galloyl glucoses (II–IV), GA (I), and four HIV-1 integrase inhibitors. Their galloyl moiety is mostly responsible for the chemicals' suppression of HIV-1 integrase 3′-processing.Retroviral reverse transcriptase inhibitory activity is also possessed by T. chebula. Its ability to shield epithelial cells from the influenza. A virus explains its historical application in promoting the healing of acute respiratory infections. The human immunodeficiency virus-1 reverse transcriptase was significantly inhibited by the methanol and aqueous extracts of T. chebula, with an IC50 of less than 5 µg/mL. Additionally, it showed both in vitro and in vitvo therapeutic effectiveness against the herpes simplex virus. These results led a group of Japanese scientists to look into T. chebulas's impact on the human cytomagalovirus (CMV)[8]. They discovered that.

G. ANTI ARTHRITIC ACTIVITY:

One potential disease-modifying medication for rheumatoid arthritis is Terminalia chebula.Research indicates that the acetone extract from Terminalia fruit, Chebulas have been found to have a more significant impact on the management of CFA-induced arthritis, particularly in terms of lowering the inflammatory components. The start and progression of collagen-induced arthritis in mice were dramatically inhibited by chelagic acid, which was extracted from the ethanolic extract of Terminalia chebula fruit. Both formaldehyde- and CFA-induced arthritis showed a considerable reduction in joint swelling when the Terminalia chebula HCl extract was applied in comparison to the control[13].

H. ANTI-HEPATOPROTECTIVE ACTIVITY:

Terminalia chebula fruit extract was found to have hepatoprotective properties in a variety of animals whose liver damage was caused by injections of dextran, 2-acetylaminofluorene, ethanol administration, and anti-tuberculosis medications (rifampicin, isoniazid, and pyrazinamide), all of which were found to be preventive in their respective cases. T. chebula is said to promote hepatic recovery by upregulating anti-oxidant gene expression and protein levels in liver tissue, as well as pro-inflammatory cytokines including TNF-α and IL-1β, according to Choi et al.

I. ANTI CONVULSANT ACTIVITY:

Terminalia chebula ethanolic extract considerably shortened the duration of seizures brought on by maximal electroshock.Since they shorten the duration of seizures brought on by maximum electroshock and delay the latency of seizures brought on by pentylenetetrazole and picrotoxin, ethanolic extracts are known to have anticonvulsant properties.

J. ANTI-MICROBIAL ACTIVITY:

The field of microbiology experienced a startling expansion in understanding. Although microorganisms and their resistance to antibiotics have grown more prevalent, the hunt for natural antimicrobial agents to protect humans from harmful infectious diseases has accelerated during the past 20 years.Traditional medicinal plants and their bioactive components are a popular topic among the various strategies that have been created[12].

K. ANTI CARCINOGENIC ACTIVITY:

The strongest growth-inhibitory phenolics of T. chebula were determined to be chebulinic acid, tannic acid, and ellagic acid, according to a group of researchers who reported the fruit's phenolics' inhibitory effect on cancer cell growth [9]. In various malignant cell lines, such as human (MCF-7) and mouse (S115) breast cancer cell lines, human osteosarcoma cell line (HOS-1), human prostate cancer cell (PC-3), and a non-tumorigenic immortalized human prostate cell line (PNT1A), ethanol extract of T. chebula fruit inhibited cell proliferation and induced cell death in a dose-dependent manner. Additionally, T. chebula fruit powder and bark acetone extract include ingredients with potential anti-carcinogenic properties[10].

L. ANTI PROTOZOAL ACTIVITY:

Terminalia chebula exhibited antiamoebic activity against Entamoeba histolytica in a combination with four other botanicals (Boerhavia diffusa, Berberis aristata, Tinospora cordifolia, and Zingiber officinale). The combination cured an experimental amoebic liver abscess in hamsters at a maximum rate of 73%, and an experimental caecal amoebiasis in rats when used topically. Plasmodium falciparum was inhibited by the acetone extract of T. chebula seeds.

M. ADAPTOGENIC AND ANTI ANAPHYLACTIC ACTIVITY:

As part of an experiment to evaluate the adaptogenic properties of six Ayurvedic herbs, T. chebula fruit was one of them. Through various mechanisms, all six of the traditional rasayana herbs were able to help the animals combat a wide range of stressors.Furthermore, research on animals demonstrates that T. chebula extract has a potent antianaphylactic effect as seen by the reduction in blood histamine levels when the extract is given after induction of anaphylactic shock.

N. WOUND HEALING ACTIVITY:

When an alcoholic extract of T. chebula leaves was applied topically to rat dermal wounds, the wounds healed more quickly as evidenced by increased contraction rates and shorter epithelialization times.In a dose-dependent manner, T. chebula Fructus water extract showed considerable healing effectiveness against vascular smooth muscle cells (VSMC) wounds. T. chebula extract can stop lipid peroxidation and speed up the healing process because of its strong antioxidant qualities.

O. ANTI AGING ACTIVITY:

Ageing is accelerated by stress, which also leads to immune cell dysregulation. Stress from the swimming endurance test raises noradrenaline and adrenaline levels in the plasma. The outcomes of the swim endurance test show that the T. chebula extract possesses the ability to maintain the typical plasma level of MAO and catecholamines while also enhancing physical endurance. It increases muscle glycogen stores, lowers rat muscle lactic acid and ammonia concentrations—two harmful byproducts of exerted muscle—and has strong antioxidant properties. Therefore, it offers significant stress-induced anti-aging exercises.

P. ANTI-MUTAGENIC, CHEMOPREVENTIVE AND RADIOACTIVE ACTIVITY:

In Salmonella typhimurium, the antimutagenic properties of Terminalia chebula 's aqueous extract and hydrolyzable tannins have been shown. Terminalia chebula aqueous extract prevented the development of strand breaks in plasmid PBR322 DNA caused by gamma radiation. Before mice were exposed to radiation throughout their bodies, an aqueous extract of Terminalia chebula was given to them. This prevented both radiation-induced DNA damage and the peroxidation of membrane lipids in the mice's liver. Additionally, it shielded human cells from the in vitro DNA exposure caused by gamma radiation.T. chebula demonstrated chemopreventive effects on oxidative stress, toxicity, and cell proliferation.

Table 3 : Structure and activities of some active compounds and their derivatives from Terminalia chebula

Class of compounds	Compounds	Plant parts	Activities
Phenolic acid	Ellagic acid	Fruit	Antibacterial activity against intestinal bacteria *Clostridium perfringes*, *Escherichia coli*; antiproliferative activity
Phenolic acid	Chebulic acid	Fruit	Hepatoprotecttive, antioxidant and free radical scavenging activity, cytoprotective

Phenolic acid	Neochebulic acid	Fruit	Hepatoprotecttive, antioxidant and free radical scavenging activity
Phenolic acid	Gallic acid	Fruit	Antioxidant, antibacterial, antiviral, cytoprotective activity
Phenolics	2, 4-chebulyl-beta-D-glucopyranose	Fruit	Antiproliferative activity
Phenolic acid	Chebulinic acid	Fruit	Antiproliferative activity
Benzoic acid	Hydroxybenzoic acid derivatives	Fruit	Antioxidant activity
Cinnamic acid	Hydroxycinnamic acid derivatives	Fruit	Antioxidant activity

IX. USES OF TERMINALIA CHEBULA

This is a good gastrointestinal prokinetic drug, stomachic, liver stimulant, appetite enhancer, and moderate laxative. For persistent diarrhea, Terminalia chebula fruit powder has been utilized. It is applied to nervous irritation and weakness**.**Harad's Rasayana (rejuvenating) quality aids in hair growth and makes it a rich source of vitamin C, iron, manganese, selenium, and copper. Harad is used to treat a variety of skin conditions linked to urticaria, allergies, and skin rashes[11].Cardio protective qualities found in harad fruit help to strengthen the heart's cardiac muscles and enhance heart health in general. Additionally, a healthy Harad diet promotes the development of beta cells, which lowers insulin resistance.There are compounds in the fruit of the Terminalia chebula tree that may have analgesic properties. Additionally, it may lower blood sugar.For aged skin, constipation, diabetes, diarrhea, high cholesterol, osteoarthritis, and many other ailments, people utilize Terminalia chebula.

X. ADVERSE EFFECTS OF TERMINALIA CHEBULA

Combining diabetes medicine with Terminalia chebula may result in dangerously low blood sugar levels. Decreased blood sugar, fever, diarrhea, stomatitis, dehydration, starvation, tense jaw muscles, and pitta imbalances. Suppressing blood glucose level,Diarrhea, Acute fever,
Dehydration.

Figure 10: Adverse effects of Terminalia chebula

XI. CONCLUSION

As a plant with a broad range of pharmacological and therapeutic properties, Terminalia chebula is among the most adaptable. The unique source of numerous kinds of chemicals with a wide range of chemical structures is this adaptable medicinal plant. Terminalia chebula is useful against a variety of disorders and can also help address the issue of drug resistance following thorough research into its toxicity, pharmacotherapeutics, mechanism of action, and bioactivity as well as following appropriate standards and clinical trials. Terminalia chebula is a very adaptable plant with a multitude of pharmacological and therapeutic benefits. Its properties, including antibacterial activity and wound healing, make it useful for a wide range of applications.

XII. ACKNOWLEDGEMENT

We would like to offer gratitude to Dr. J. Karthi for his constant inspiration.

CONFLICT OF INTEREST :

There is no conflict of interest to disclose.

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