



Phyllanthus Emblica Linn: A Phytoconstituent and Pharmacologically Important Plant Review.

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ABSTRACT

In addition to being a superb source of natural medicine, plants have contributed significantly to human progress from ancient times. The gift of nature to humanity is medicinal herbs, which promote a long, healthy life free from illness. *Emblica officinalis* (Euphorbiaceae family), commonly referred to as amla or Indian gooseberry, is a significant and extensively utilized herbal plant. The fruits in particular offer a variety of pharmacological advantages, even if the entire plant is used for medicinal purposes. They are used as a tonic and pharmaceutical to restore lost energy and stamina. Amla is rich in nutrients and a wonderful source of minerals, amino acids, vitamin C, and other micronutrients. In traditional medicine, the fruits are used to treat inflammation, jaundice, and diarrhea. Ascorbic acids, tannins, flavonoids, saponins, terpenoids, and several other bioactive substances have been demonstrated to possess pharmacological properties such as antibacterial, antioxidant, anti-inflammatory, hepatoprotective, and anticancer effects. The majority of this article discusses the pharmacological qualities, traditional applications, geographic distribution, commercialization, and therapeutic qualities of this highly prized medicinal plant.

Keyword: Amla, Chemical constituent, Medicinal plant, Health benefits, Pharmacological properties

Introduction

The deciduous Euphorbiaceae family tree known as the Indian gooseberry, *Phyllanthus emblica* Linn. (syn. *Emblica officinalis*), is also referred to as Amla or Amla in Hindi and amalika in Sanskrit. The sour, bitter, astringent, and very fibrous Indian gooseberry, also known as Amla, is an edible fruit. Because of their abundance of different nutrients, nutritionists and Ayurvedic practitioners greatly regard it. It's an ancient Indian natural medicine technique that dates back 5,000 years. Indian gooseberries, or amla, are frequently consumed pickled in India. It is most likely the most significant natural source of vitamin C, which the digestive system can readily absorb. Southeast Asia's tropical regions are home to the Indian gooseberry, often known as amla. It is a small to medium-sized deciduous tree with thin, light grey bark that is 8 to 18 meter height. The plant has simple, feather-like leaves that are closely spaced throughout the branchlets. Flowers: greenish yellow, in axillary fascicles; fruits: globose, meaty, pale yellow, with six faint vertical furrows enclosing six trigonous seeds in 2-seeded 3-crustaceous cocci; fruits are unisexual, males numerous on short, slender pedicels, females few, sub sessile, ovary 3-celled. The fruits are often picked by hand after climbing to the branches that bear them. They mature in the fall, from October to December. The Indian cuisine frequently includes the fruits.

They can be consumed fresh or in a variety of forms, including juice, chutneys, pickles, murabbas, and powder, which can be used in other recipes. (1,2,3

Taxonomical Classification

Kingdom	Plantae
Division	Angiospermae
Class	Dicotyledonae
Order	Geraniales
Family	Euphorbiaceae
Genus	Emblica

Species	Officinalis Geartn
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Vernacular names of E. Officinalis (4,6,7,8,9,10)

Language	Vernacular Name
Indonesia	Balakka
English	Indian Gooseberry
French	Phyllanthe emblica
German	Amla
Chinese	Anmole
Lao	Mak kham bom
Italian	Mirabolano emblico
Odiya	Anla
Kashmiri	Anola
Portuguese	Mirabolano
Konkani	Aavalo
Arabic	Ambliy, Amlaj
Persian	Amelah, Amuleh
Bengali	Ambolati, Amla, Aonla, Amlaim
Hindi	Amla, Daula, Anola, Anvurah
Marathi	Anvala, Bhuiawali, Aonli, Avola
Panjabi	Ambal, Ambli, Amla, Aonla
Sanskrit	Adiphala, Amalaki, Triphala, Amrita
Telugu	Amalakamu, Nelli, Triphalamu, Usirki
Urdu	Anwala, Aamla

History

One of the most beneficial traditional herbal remedies and the greatest gift to humanity, amla has been used for centuries to treat and control illnesses. Minerals, vitamins, and other biochemical materials are stored there. In the first century AD, a Sanskrit process for preparing emblica was documented. Arabic, Tibetan, and Egyptian writings, as well as the Sidha (Indian), Ayurvedic, and Unani medical systems, have all documented the use of emblemica for therapeutic purposes. Both fresh and dried forms of every plant part fruit, seed, leaves, roots, bark, and flowers are utilised. According to the Ayurvedic system, amla fruit is known for being dry and light and for having a cooling effect on energy levels. The fruit is frequently consumed as a pickle in India. (1,2)

Morphology

Macroscopic characteristics

The leaves are distichous, light green, glabrous, narrowly linear, subsessile, and closely spaced along the branchlets. They measure 10–13 mm by 2.5–3 mm and resemble pinnate leaves [4,5].

The fruit has a diameter of 1.3 to 1.6 cm, is green, meaty, globose, and has six hidden vertical furrows. When it reaches maturity, it tends to turn light yellow or brick-red [5,6].

The flower has fimbriate bracts at the base and is greenish-yellow, refrigerant, and aperient. It is found in axillary fascicles on the leaf-bearing branchlets, frequently on the bare part beneath the leaves. While female flowers are scarce and subsessile, male flowers are numerous and have short, slender pedicels. Three cells make up the disk, and the styles connect at the base. The seed is sweet and bitter.(5)

Microscopic characteristics

The leaf exhibits a bifacial structure in its transverse section. Single-layered, tangentially elongated cells with thin cuticles cover the top epidermis. Mesophyll can be classified as either spongy or palisade. Palisade cells are roughly 44–50 u long, single-layered, and vertically elongated. Five to six layers of parenchymatous cells with numerous intracellular gaps make up spongy parenchyma. Rosette-shaped calcium oxalate crystals with a diameter of 18–22 u are found in certain cells. The presence of paracytic stomata is a characteristic of the lower epidermis. Every cell tests positive for tannin. Neither surface has any trichomes or hairs. Collateral bundles are seen in the middle of the transverse slice across the midrib area, with xylem pointing ventral and phloem dorsal. Below the vascular bundle are arms of lignified fibers in the shape of a crescent. (4)

Chemical constituents

One of the plants that has been examined the most is amla. It contains biologically significant substances such as tannins, alkaloids, phenolic compounds, and flavonoids, according to earlier research. (11,12) Some of the stated advantages of Amla, such as the treatment of intestinal and respiratory conditions, especially intestinal ulcers, may be readily explained by the fruit's tannin content. Additionally, amla is a great source of vitamins, citric acid, pectin, carbs, and other necessary amino acids. (13) Amla's nutritional benefits are widely recognized. It is thought to be one of the best sources of vitamin C and is abundant in minerals and polyphenols. Together, the aforementioned chemical and nutritional components make it a well-liked superfood. (14)



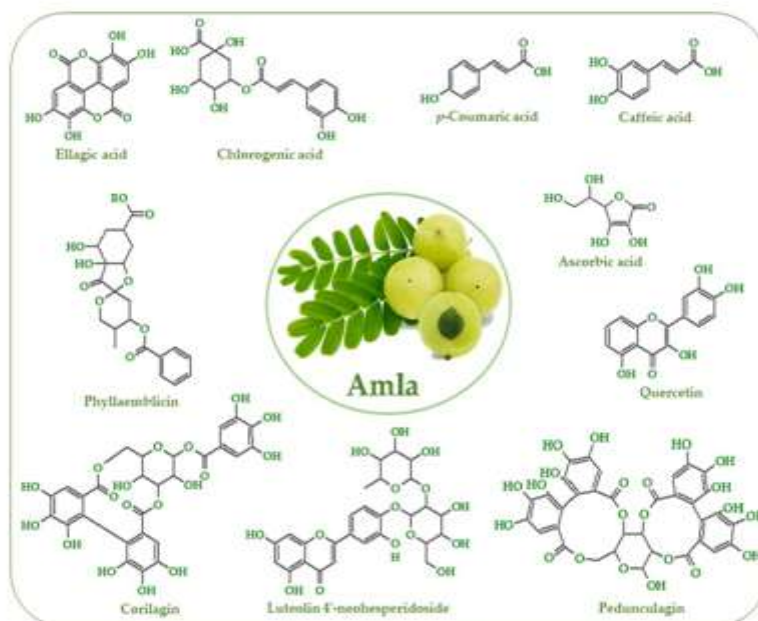
Figure chemical constituents of Phyllanthus emblica.

Health Benefits and Pharmacological Characteristics of Emblica officinalis

Although all parts of *E. officinalis* are used medicinally, the fruits are more widely used to treat a variety of infectious and non-infectious diseases, either by themselves or in conjunction with other traditional herbs. *E. officinalis* may be a restorative and dietary tonic that contains essential vitamins and amino acids, and it may be an especially awesome source of vitamin C and minerals when compared to other citrus natural products. [15] One of the

foremost examined plants is *E. officinalis*, and investigate appears that it contains alkaloids, phenolic compounds, and tannins. [16] It has been demonstrated that the fruits of *E. officinalis* are characterized by higher levels of vitamin C, as well as a significant presence of minerals, protein, and amino acids such as lysine, glutamic acid, proline, aspartic acid, alanine, and cystine. The fresh pericarp of *E. officinalis* has higher concentrations of the hydrolyzable tannins pedunculagin, punigluconin, and emblicanin A and B. [15,16,17]

Pharmacological research on amla has demonstrated its various beneficial properties, including antitussive, analgesic, anti-atherogenic, adaptogenic, gastrointestinal, cardiac, nephroprotective, anticancer, and neuroprotective effects. Additionally, amla is recognized for its antioxidant, chemopreventive, anti-inflammatory, anti-mutagenic, immunomodulatory, and free radical scavenging capabilities. These qualities are beneficial in the treatment and prevention of multiple diseases as atherosclerosis, cancer, peptic ulcer, diabetic anemia, heart diseases, liver disorders and various others. [18]



Chemical structures of various constituents of Amla

Antioxidant properties of Emblica

Emblica's antioxidant characteristics. Any metabolic process starts with free radicals, which are constantly produced by the body's regular use of oxygen. Actually, there's a energetic harmony between the body's generation of free radicals and the amount of cancer prevention agents that are accessible to rummage, extinguish, and secure the living being from damaging effects. [19] Strong antioxidant activity was demonstrated by *Emblica officinalis*, which was used as a health tonic in a traditional Indian medicine. Antioxidants found in *Emblica officinalis* are water soluble and heat durable, although they are only partially extractable with ether. [20] Oxidative activities can damage the body's basic cells even though they are essential for existence. By reducing the production of free radicals and raising antioxidant levels, amla supports cell viability. [21] Nature has produced many enzymes, including glutathione (GSH), catalase (CAT), peroxidase, superoxide dismutase (SOD), and other complex antioxidant defense mechanisms, including vitamins A, C, and E, to counteract oxidative damage. [15] Reactive oxygen species (ROS) and lipid hydroperoxide were shown to significantly decrease in a study that incubated *E. officinalis* for 24 hours. Additionally, *E. officinalis* increased antioxidant enzyme activity, glutathione peroxidase (GSH) levels, and antioxidant capacity. Also, when managed once day by day for seven days, the dynamic tannoids of *E. officinalis* diminished lipid peroxidation within the frontal and striatal cortex and expanded the movement of GSH peroxidase (GPX), catalase (CAT), and superoxide dismutase (Grass) in these brain locales [16] In spite of the fact that the mash and seed of *E. officinalis* each have unmistakable phytopharmacological parts, the complete natural product is known for its antioxidant qualities. [15] With IC₅₀ values (the lowest drug concentration required to produce 50% inhibition in vitro) of 6 g/ml and 13 g/ml for DPPH radical scavenging activity, respectively, the pulp of *E. officinalis* possesses a greater antioxidant capacity than the seeds. [15] Embellicanin A and B, which are found in amla fruit, are said to have strong antioxidant properties. By reducing the generation of free radicals and increasing antioxidant levels, amla improves cell viability. [22] The results also imply that the tannoids, which are not vitamin C but have properties similar to it, may be the source of *E. officinalis*' antioxidant action. [23] According to another study, the phytochemicals in amla have the ability to function as a superior metal ion chelator, halting oxidative cascades. [24] Emmicinanin A and B (37% & 33%, respectively), punigluconin (12%), and pedunculagin (14%), the tannoid active components of Amla, were tested for antioxidant activity in a rat model.

Anti-inflammatory properties of Emblica

Limited anti-inflammatory benefits are seen in animal models of acute and chronic inflammation; greater dosages result in less granulomatous tissue and edema.[25,26] There are no clinical research results available for Emblica's use as an anti-inflammatory drug. However, research conducted in vitro utilizing bronchial epithelial cells taken from a cystic fibrosis patient showed that the expression of pro-inflammatory cytokines was inhibited. [27] It was also shown in vitro that dried emblica fruit extract, utilizing donated cartilage from individuals with osteoarthritis, inhibited collagenase and hyaluronidase.[28] Through potential transcription factor regulation, crude extracts have also caused mature osteoclasts to undergo apoptosis without influencing osteoclastogenesis.[29,30] Various substances originating from plants have been shown to possess notable anti-inflammatory properties. They therefore represent promising substances for the development of new drugs, particularly for the management and/or treatment of long-term inflammatory diseases including rheumatism, asthma, atherosclerosis, inflammatory bowel disorders, and so forth. [16]

Anticancer properties of Emblica

Although there are no published clinical trials or epidemiological data, there is a lot of curiosity in the possible application of Emblica in the treatment of cancer. Rats administered Emblica extracts demonstrated improved cell survival, decreased chromosomal abnormalities, number of injured cells, frequency of micronuclei in bone marrow cells, and formation of free radicals in response to heavy metal carcinogens. [31,32,33,34] In response to malignant cells (lymphoma and mammary carcinoma), rats given embryo extracts demonstrated increased natural killer cell activity, antibody-dependent cellular cytotoxicity, and survival. [35,36,37] One of these tests revealed a decrease in tumor volume but no effect on tumor development.[31] It has been shown that organic acid gallates and hydrolyzable tannins are cytotoxic to tumor cells. [38] According to one published study, emblica did not lower the characteristics of lung cancer in mice.[39] Emblica extracts improved the 30-day survival rate, reduced overall mortality, and shielded irradiated mice from radiation illness. [40,41,42] There is no clinical study data available on the usage of Emblica in malignant diseases, according to research. Nonetheless, in vitro research has been carried out using human cancer cell lines, such as those from the lung, liver, cervical, ovarian, and breast. [43,44,45,46] According to a different study, Emblica's antimetastatic effectiveness is crucial in reducing cancer migration, cell invasion, proliferation, and adhesion in a manner that is dependent on time and dosage. In this instance, MMP2 and MMP9 expression both dropped, suggesting a biological mechanism for anti-metastasis.[20] Furthermore, numerous research have demonstrated that *E. officinalis* may guard against the negative effects of radiation and chemotherapy.[15]

GI properties of Emblica

Animal studies using alcoholic and aqueous extracts of Emblica have demonstrated preventive and restorative effects in stomach ulcers that have been created. [47,48,49] However, one experiment demonstrated a biphasic response, with larger dosages of ethanolic fruit extracts showing ulceration on histology and healing at lower concentrations. [50] Studies conducted in vitro on live mice and rodents' jejunum and ileum demonstrate antidiarrheal and spasmolytic effects on castor oil-induced diarrhea, which may be brought on by muscarinic action and calcium channel blocking. [51] There is no clinical evidence to support the use of Emblica for diarrhea or stomach ulcers. When compared to a placebo group, the daily intake of 500 mg of amla extract (two tablets per day) decreased the frequency and intensity of heartburn and regurgitation. The aforementioned studies support the idea that consuming amla phytochemicals, particularly polyphenols, can protect the organs involved in digestion. Furthermore, it would appear logical to suggest that ancient medical practices with amla are partially supported by modern medicine.

Antifungal properties of Emblica

The *P. emblica* extract demonstrated an inhibitory effect on the mycelial growth of *Fusarium solani*, a fungus responsible for dry potato tuber rot, when tested at a concentration of 100%. [52] notable antifungal effect was observed in the aqueous extract of essential oil against eight species of *Aspergillus* fungi, specifically *Aspergillus candidus*, *A. columnaris*, *A. flavipes*, *A. flavus*, *A. fumigatus*, *A. niger*, *A. ochraceus*, and *A. tamari*. [53] In this investigation, petroleum ether, chloroform, methanol, benzoene, and ethanol were among the several solvents used in the extraction procedure. When compared to the other solvents, the methanol extract of EO demonstrated the strongest antifungal efficacy. [53] When compared to ethyl acetate and aqueous extract, the methanolic extract of amla shown a considerable inhibitory activity against *S. aureus*, *E. coli*, and *Candida* species. [54] When the efficacy of EO extracts in hexane and methanol against *Fusarium oxysporum* and *Rhizoctonia solan* was evaluated, it was shown that the fractions obtained from the methanol extract were more efficient against both test pathogens. [55] Extricates of EO natural products, *Aloe vera*, and *Vitex negundo* clears out were tried for their antifungal adequacy against *A. niger*, *A. flavus*, *A. oryzae*, *P. chrysogenum*, and *T. viride*. *P. chrysogenum* continued to be the most resistant strain, but all of the plants showed the greatest potential against *T. viride*. [56]

Antiviral properties of Emblica

P.emblica has a variety of secondary metabolite classes. [57] Plant roots containing phyllaemblicin B demonstrated the ability to suppress the Cocksackie virus.[58,59] Pentagalloylglucose inhibits influenza A virus replication by prevention of adsorption of the virus and suppressing release of virus [60] By inhibiting viral enzymes, a number of plant extracts have the potential to combat HIV. [61] Plant extracts from *P.emblica* may have anti-HIV properties by blocking the virus's reverse transcriptase enzyme.[62] Four solvents (n-hexane, carbon tetrachloride, chloroform, and aqueous fractions) were used in this investigation for extraction; at a concentration of 1 mg/ml, the aqueous and n-hexane fractions showed the greatest inhibition of the recombinant HIV reverse transcriptase enzyme. [62]

Antimicrobial properties of Emblica

Emblica extracts, both alcoholic and aqueous, demonstrated efficacy against common human diseases such as bacteria, viruses, and fungi. There seems to be more activity against gram-positive bacteria and less effectiveness against fungi. [63,64,65,66] The phenolic content has been linked to activity against Herpes Simplex Viruses 1 and 2 [67] while phyllaemblicin B, which was isolated from the plant's roots, shown action against the Cocksackie virus.

[58,59] Mice with induced *Klebsiella pneumoniae* reacted to food supplementation with powdered fruit during a 30-day period. In the short term, however, colonization was not stopped (15 days). [68]

Antidiabetic properties of *Emblica*

P. emblica L. has naturally occurring chemicals that have been linked to preventive effects against diabetes. According to an in vitro study, the primary phytochemicals in amla, such as ellagic acid and ascorbic acid, decreased the activity of important enzymes involved in the digestion of glucose, namely glucosidase and amylase. [69] In order to cure diabetes and its aftereffects, diet is essential. The anti-hyperglycemic and hypoglycemic effects of several traditional medicines have been reported in varying degrees. These effects seem to be brought about by insulin sensitization, preventing the absorption of glucose from food, or increasing insulin production by pancreatic cell stimulation. [15] Oral administration of the extracts (100 mg/kg body weight) significantly reduced blood sugar levels in 4 hours in both normal and alloxan (120 mg/kg) diabetic rats. *E. officinalis* and a concentrated form of its tannoids effectively postpone the development of diabetic cataract in rats. Aldose reductase (AR) contributes to the development of secondary complications from diabetes, including cataracts. It has been demonstrated that *E. officinalis* is a potent AR inhibitor. [70] More than half of all diabetic individuals develop diabetic neuropathy, one of the most common microvascular effects of the disease. A study examined the effects of a high flavonoid extract of *E. officinalis* on male Spague-Dawley rats suffering from type 2 diabetes-related diabetic neuropathy. When administered to diabetic rats, *E. officinalis* extract (EOE) raised the rats' pain threshold level in a hot plate test and tail flick delay in a hot immersion test relative to the control group. [16] One of the most prevalent microvascular consequences of diabetes is diabetic neuropathy, which affects more than half of all diabetics. A study looked at how a high flavonoid extract of *E. officinalis* affected male Spague-Dawley rats with diabetic neuropathy caused by type 2 diabetes. When given to diabetic rats, *E. officinalis* extract (EOE) increased the rats' tail flick latency in a hot immersion test and their pain threshold level in a hot plate test compared to the control group. [20] Oral administration of a 1:1 combination of Amla extract (AE) and epigallocatechin gallate (EGCG) for three months improved antioxidant defense and diabetic and atherogenic indices in uremic diabetic patients. [16,20]

Analgesic/Antipyretic properties of *Emblica*

Mice were used to investigate the analgesic and antipyretic effects of alcohol and aqueous extracts of *Emblica* fruit. With the exception of the response to the heat pain model, when *emblica* showed no activity, the results were comparable to those of aspirin. [71]

Skin protection properties of *Emblica*

In vitro research employing human skin fibroblasts and animal trials have shown enhanced collagen synthesis and cell proliferation at wound and ultraviolet B light (UBV) photoaged locations.[72,73,74] In place of hydroquinone, *Emblica* extracts have been the subject of a small number of clinical investigations when combined with other ingredients in skin-lightening creams. [75]

Conclusion

Nowadays, there is a renewed interest in studying Indian traditional medicinal plants.

Despite their effectiveness, the other medical systems have a multitude of side effects that frequently result in major problems. Herbal medication solves all of these issues because it is natural. Amla, or *Emblica officinalis*, plays a significant role in Ayurveda, an ancient medical system in India. Amla has the highest concentration of vitamin C and other vital elements, making it a powerful antioxidant with biological qualities that help prevent a wide range of health issues. We attempted to provide an overview of the traditional and scientifically supported use of amla in this paper. Despite amla's long history of medical benefits, it is imperative to demonstrate and investigate these benefits at the molecular level using the most up-to-date methods and biotechnological instruments. Given that it is regarded as a safe herbal remedy with no negative side effects, it can be said that India gooseberry is a fruit whose effectiveness and use have been demonstrated both traditionally and clinically. In these cases, raising people's understanding of ethnobotany and encouraging them to use these vast resources sensibly are essential for leading healthy lives. With the use of improved screening techniques, it is also urgently need to create and describe novel natural medications derived from plants and other natural sources.

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