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A COMPREHENSIVE REVIEW ON PHARMACOLOGICAL AND AYURVEDIC ASPECT OF PHYLLANTHUS EMBLICA (AMALKI)

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ABSTRACT
Common names for Phyllanthus emblica, also called Emblica officinalis, include Indian gooseberry, Amla, and Amalaki. The fruit of this plant is its primary product. In the Indian traditional medical system, it is regarded as a necessary ayurvedic plant. This plant's many parts are used to cure a variety of illnesses and conditions, including diabetes, dyspepsia, diarrhoea, fever, stomachaches, coughs, and colds. It significantly reduces acidity and peptic ulcers. It functions as a liver tonic, diuretic, laxative, and refrigerant. Vitamin C, amino acids, phenolic compounds, tannins, steroids, flavonoids, alkaloids, and other chemical elements are abundant in the plant. Numerous pharmacological characteristics, including antioxidant, antibacterial, anti-inflammatory, radioactive, hepatoprotective, immunomodulatory, neuroprotective, antidiabetic, and antitussive qualities, are linked to these chemical compounds of the P. Emblica plant. The fruit of this plant is regarded as a potent Rasayana in Ayurveda, and it is used to treat inflammation, jaundice, and diarrhoea, among other conditions. The traditional and contemporary applications of the P. emblica plant are compiled in the current review article.

KEYWORDS: Amlaki, Ayurveda, Folk uses, Rasapanchak, Pharmaceutical properties.

INTRODUCTION

Commonly referred to as Amalaki, Amla, or Indian gooseberry, Phyllanthus emblica (syn. Emblica officinalis) is a member of the Euphorbiaceae family (Khan, 2009). It is the universe's first tree, according to Indian mythology. The plant is well-known for its incredibly nutrient-dense fruit, which also contains phenolic compounds, amino acids, and vitamin C (Srivasuki, 2012). The tropical and subtropical regions of Indonesia, India, China, Thailand, and Malaysia are home to the euphorbiaceous plant P. emblica (Figure 1) (Khurshid et al., 2020). Amla is utilized in a number of Ayurvedic formulations, including Chyawanprash, which is typically used as a tonic (Jagetia, 2002), Triphala churna, which is linked to anti-aging and relieves mental illnesses (Sripanidkulchai and Fangkrathok, 2014). One of the best-selling fruits on the market, P. emblica fruit has a wide range of uses in the food, medical, and cosmetic industries. It also has outstanding therapeutic potential. As an expectorant, purgative diuretic, laxative, and liver tonic, it is also utilized in a variety of preparations, including pickles, preserves, and jellies (Manjunatha et al., 2001). According to Priya and Islam (2019), the plant's leaves are used as an aphrodisiac and are regarded as a revitalizing herb that may be used to cure skin conditions and coughs. In Ayurveda, the plant's fruit is employed as a potent Rasayana to treat a variety of illnesses, including dysentery, inflammation, jaundice, and diarrhoea (Shanmugasundaram, 1983). This plant's fruit is mostly eaten in India as pickles and has diuretic properties (Unander et al., 1990).

Table 1: Vernacular names.

Marathi	Amla
Gujrati	Ambala
Malayalam	Nelli kayi
English	Emblic myrobalan, Indian gooseberry
Kashmiri	Aomla
French	Phyyanthe emblica
Chinese	Anmole
German	Amla
Italian	Mirobolena emblico
Malaysian	Popok, Melaka
Punjabi	Anula, Amla
Orissa	Anala, Ainla
Hindi	Amla
Sanskrit	Amalaki
Bengali	Amlaki
Nepali	Amala
Kannada	Nellikaai

Table 2: Taxonomical Classification.

Taxonomical rank	Taxon
Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Angiospermae
Class	Dicotyledonae
Subclass	Rosidae
Order	Geraniales
Family	*Euphorbiaceae*
Genus	*Phyllanthus*
Species	*emblica*
Common name	Amla

BOTANICAL DESCRIPTION

The Euphorbiaceae family includes the small to medium-sized deciduous tree Phyllanthus emblica. This plant can grow up to 8–18 meters tall, with crooked trunks and spreading branches. The branchlets are typically deciduous, glabrous, slightly pubescent, and 10–20 cm long. The stem has a 70 cm diameter on average (Kulkarni and Ghurghure, 2018). The thick, light grey bark reveals the new surface beneath the older bark by exfoliating thin, uneven flakes. The leaves have a feathery look and are pinnate, narrowly linear, obtuse, simple, alternating, sub sessile, and measure 10–13 mm in length and 3 mm in width. Near the base, the main trunk may occasionally be further separated into two to seven scaffolds (Yahia, 2019). According to Kulkarni and Ghurghure (2018), the flowers are 4 to 5 mm long, unisexual, pale greenish, and borne in the leaf axils in clusters of roughly 6 to 10. Fruits are fleshy, depressed, and globose in shape. They weigh 5.3–5.7 g, with a diameter of 2.1–2.4 cm, and a volume of 4.5–5.0 mL. The six-ribbed fruit stone splits into three sections, each of which has two seeds. The seeds weigh between 572 and 590 mg and measure 2-3 mm in width and 4-5 mm in length (Scartezzini and Speroni, 2000).

GEOGRAPHICAL DISTRIBUTION

Native to India, P. emblica is primarily found in the tropical and subtropical areas of the nation. According to Thilaga et al. (2013), the plant is mostly found in Malaysia, Bangladesh, Bhutan, Sri Lanka, Myanmar, Pakistan, China, Uzbekistan, and Mascarene Island. It grows mostly in the mountainous and plain regions of the Kashmir valley and is mostly found in tropical and subtropical coastal districts in India (Rai et al., 2012).

PHYTOCHEMICAL CONSTITUENTS

Alkaloids, tannins, phenolic acid, flavonoids like quercetin and kaempferol, carbohydrates (pectin), amino acids, vitamin C, citric acid, ebellicanin-A and B, pectin, ascorbic acid, and triallyl glucose are among the several chemical components found in P. emblica. Twenty-eight percent of tannins are found in the plant's fruits. Emblicanin A and B, two hydrolysable tannins, make up this substance. Furthermore, P. emblica contains a variety of phytochemical elements in its fruit, seeds, leaves, roots, and stems (Bhattacharya et al., 2002).

Fruits:-- Proteins (0.5%), fats (0.1%), fibers (3.4%), gum (13.75%), albumin (13.08%), crude cellulose (17.08%), mineral matter (4.12%), nicotionic acid (0.2 mg/100g), phyllembelin (Talreja et al., 2019), gallic acid, methyl gallate, citric acid, ellagic acid, quercetin, carbohydrate (14.1%), vitamin C (6 mg/g), ellagitannin (chebulinic acid), (14.1%), corilagin, geraniin (dehydroellagitannin), 3,6-di-O-galloyl-D-glucose, corilagin, 1,6-di-O-galloyl beta-D-glucose, isostrictinin, and 3-ethylgallic acid (EI-Desouky et al., 2008; Dasaroju and Gottumukkala, 2014).

Seeds: -- Fatty acids, phosphatides, essential oil, and fixed oil (16%) are all present. Linoleic acid (44.0%), linolenic acid (8.8%), stearic acid (2.15%), myristic acid, and palmitic acid (4.0%) are among the fatty acids. (Khan 2009).

Leaves: -- Tannins are abundant in the leaves. Phyllantine, phyllembein, malic acid (gallotannin), ellagic acid, gallic acid, chebulagic acids, chebulic, chebulinic acids, and alkaloids phyllantidine are also present.

Bark: -- Leukodelphinidin and proanthocyanidin are present.

Roots: -- Roots include lupeol and ellagic acid.

TRADITIONAL AND MODERN VIEW

Ayurvedic View: - The herb P. emblica is utilized to balance the body's vitiated tridoshas, which are Pitta, Kapha, and Vata. The herb P. Emblica is utilized as a rejuvenator (Rasayana) in the Ayurvedic medical system. According to Mirunalini and Krishnaveni (2010), the herb has purgative, hepatoprotective, expectorant, spasmolytic, hypolipidemic, and hypoglycaemic qualities. Aphrodisiac, diuretic, laxative, rejuvenating, cooling, and carminative qualities are linked to this plant's bitter, sour, astringent, anodyne, and sweet fruit. Cephalalgia, bronchitis, dyspepsia, colic, flatulence, peptic ulcer, leprosy, anaemia, hepatopathy, diarrhoea, dysentery, menorrhagia, cardiac disorders, ophthalmopathy, intermittent fevers, inflammations, leucorrhea, skin disorders, diabetes, and premature graying of hairs are among the conditions that amalaki is used to treat (Sanskaran et al., 2013). Additionally, the plant has anti-inflammatory, antipyretic, hepatoprotective, nephroprotective, cardioprotective, analgesic, and therapeutic qualities (Mirunalini and Krishnaveni, 2010). The rasapanchak (properties) of the plant is-----

Sanskrit/English	Sanskrit/English
Veerya/ Potency	Sheet / Cold
Vipak/ Metabolic property	Madhur / Sweet
Guna / Physical property	Guru / Heavy, Ruksha / dry, Sheet / Cold
Rasa / Taste	Panchrasa (sour, bitter, sweet, pungent, astringent), Amlapradhan / Sour

Actions and Properties
Doshakaram: It harmonizes the body's vitiated tridoshas, which are Pitta, Kapha, and Vata.

Sansthanik-Karam: Amalaki in paste form soothes discomfort, lessens burning, and aids in obstructing the urine. This plant's decoction is good for the hairs and eyes.

It is utilized as a brain tonic or nervine, according to Abhyanga-naadisansthan.

Paachansansthan: It stimulates liver functions, relieves constipation, diarrhoea, and dysentery, and serves as an appetizer.

Raktavahsansthan: It aids in the promotion of haemoglobin and is used to treat cardiac conditions.

Shwasansansthan: It aids in clearing the body of extra phlegm.

Prajanansansthan: It promotes and sustains conception. It also has aphrodisiac properties and is used to treat spermaturia, leucorrhea, menorrhea, and to strengthen the uterus.

Mutravahsansthan: It has diuretic and anti-diabetic properties and is used to treat dysuria and urine blockage.
Twacha: It treats skin conditions.

Taapkram: It has antipyretic properties and lessens excessive thirst and the body's general burning sensation.

Satmikaran: It helps alleviate generalized weakness and is utilized as a rejuvenator.

Folk Uses: - According to ethnobotanical traditions, it is the universe's first tree. This plant's fruit is used as a vermifuge when combined with honey. It is also used to make green fruit preserves and pickles. The plant's fruit paste is used to treat bladder irritation and urine retention, either by itself or in conjunction with Nelumbium speciosum. The plant's seed infusion is used to treat diabetes and as a febrifuge (Grover et al., 2015). The plant's fruit extract is used to treat hiccups and difficult breathing when combined with honey. When combined with T. chebula and T. belericais, the fruit decoction is used to treat biliousness, bleeding, diarrhoea, and chronic dysentery. Fenugreek seeds and leaf infusion are used as a bitter tonic and to cure chronic diarrhoea in youngsters. This plant's dried fruit is used to treat dyspepsia, anaemia, and jaundice. According to Kumar et al. (2012), the plant's fruits are used to cure wounds, diarrhoea, ingestion, nausea, inflammation, and skin sores. The leaves of the plant have antipyretic and aphrodisiac properties and are used to treat bronchitis, asthma, and vomiting. Additionally, this plant is utilized to cure cardiac conditions, scurvy, and cancer (Dhale and Mogle, 2011). When combined with coconut oil, the dry fruit helps keep hair from going gray (Mirunalini and Krisgnaveni, 2010).

Modern View:-- Around the world, more people are using herbal remedies. According to published research, the sales of herbal goods climbed by 3% to 12% annually between 2000 and 2008 (Organization, 2003). The increased demand for herbal products also increases the risk of using herbal medicines because of contaminated raw materials that contain harmful metals, microbes, and other residues, as well as adulteration (addition of counterfeit or subpar plant material, conventional drugs, or foreign material), which lowers the quality of both the raw material and the final product. The quality of herbal medicines is also impacted by internal problems such as non-uniformity (caused by environmental factors, geographic distribution, usage of pesticides, fertilizers), and complexity in the ingredients. The low quality of medications is partly caused by a lack of standardized methods. It takes advantage of the original drug's use in the traditional medical system by failing to identify it (Yee et al., 2005). Rapid and contemporary methods are needed to verify the authenticity of herbal medications in order to meet the demands of traditional international markets (Kumar et al., 2020).

REPORTED THERAPEUTIC AND PHARMACOLOGICAL PROPERTIES
The most important herbal plant used to cure a wide range of illnesses is P. emblica. The plant's phytochemical components are in charge of its many pharmacological and medicinal qualities. Below is a discussion of some of the published research on its medicinal qualities.

Antioxidant: -- When tested in a rat model, the Amla aqueous extract exhibits antioxidant activity. Rat liver microsomes and mitochondria are harmed by the extract's inhibition of radiation, which causes lipid peroxidation and superoxide dismutase (Khopde et al., 2001). Another study examined P. emblica's antioxidant capacity to improve the oxidation stability of transesterified Pongamia biodiesel (PBD) and Jatropha biodiesel (JBD). The Folin-Ciocalteae technique was used to measure the antioxidant capability against the DPPH radical and total phenolic content. PBD and plain JBD had oxidation stability of 3.71 and 4.24 hours,

respectively. P. emblica was found to improve the OS of JBD and PBD by up to 15.63 hours and 14.26 hours, respectively, with 1000 ppm mixing after being loaded at several weight proportions (Singh et al., 2019). At a dose of 2.56 mg/ml, the plant's ethanolic extract's free radical scavenging activity was found to be 68±0.33%, whereas rutin's was 58±1.15% (Bashir et al., 2018).

Antimicrobial: --Using the agar well diffusion method, the antibacterial activity of the plant's alcoholic and aqueous extracts was assessed against a variety of gram-positive and gram-negative bacteria, including Staphylococcus aureus, E. coli, and Candida albicans. It was discovered that the extract exhibited dose-dependent growth inhibitory action (Gandhi et al., 2020).

Antidiabetic: -- Rats with diabetes induced by streptozotocin were used to test the antidiabetic potential of the methanolic extract of P. emblica fruit. When taken daily for 28 days, the quercetin component found in the methanolic portion had strong antidiabetic effects. At dosages of 25, 50, and 75 mg/kg body weight, the extract significantly raises plasma insulin and haemoglobin levels while lowering blood glucose and urine sugar levels (Srinivasan et al., 2018). To ascertain the plant extract's antidiabetic properties, another in vivo investigation was carried out using a rat model. When the plant extract is administered to diabetic rats, the glucose level drops dramatically to 166±0.7 mg/dl on day 8 at 8 h, as opposed to 380±0.7 mg/dl at a dosage of 80 mg/kg. Additionally, it causes rats to lose up to 274.11±0.97 g of weight (Bashir et al., 2018). The effects of the plant's aqueous extract on type II diabetes, triglycerides, and liver-specific enzymes were investigated in a different study using rats that had been given alloxan to induce diabetes. When given intraperitoneally to diabetic rats, the extract at a dosage of 200 mg/kg body weight lowers blood glucose levels and causes hypotriglyceridaemia by lowering TG levels at 0, 1, 2, and 4 hours (Qureshi et al., 2009).

Hepatoprotective: -- P. emblica's amlaki extract exhibited hepatocarcinogenic properties. In the rat model, the oral treatment of amla extract decreases the liver tumors caused by N-nitrosodiethylamine. In rats, it effectively prevented hepatocarcinogenesis caused by diethyl nitrosamine and 2-acetylaminofluorene. Rat liver pathological symptoms were recovered by the plant's methanolic fruit extract at dosages of 100 and 200 mg per body weight. The amla plant's quercetin component reduced the fibrogenic effects and liver damage caused by dimethyl nitrosamine (Baliga et al., 2019). Gallic acid, tannins, flavonoids, alkaloids, vitamin C, ellagic acid, and other chemical components are abundant in the P. emblica plant. The hepatoprotective potential of the plant extracts and their components was examined. By preventing the impact on hepatic steatosis and liver fibrosis in vitro, various research on the Amla plant shown hepatoprotective efficacy. In vivo, gallic acid has been shown to ameliorate oxidative stress, hepatosteatosis, and dyslipidaemia brought on by a high-fat diet (HFD). Rats fed a high-fat diet showed that the plant's aqueous extract decreased peritoneal fat, epididymal fat, body weight, and improved steatosis via lowering adiponectin in adipocytes, PPAR-alpha in the liver, and SREBP-1c in the liver (Huang et al., 2017).

Nephroprotective: -- The nephroprotective effect of E. officinalis on renal failure associated with oxidative stress throughout the aging process was investigated by Yokozawa et al. (2007). When given to aged rats, the plant extract was found to lower their elevated levels of urea nitrogen and serum creatinine. Furthermore, Yokozawa et al. (2007) found that elderly rats also showed a substantial decline in tail arterial blood pressure, serum Thio barbituric acid-reactive substance levels, mitochondria, and renal homogenate. In a different study, the ethanol extract from the plant was tested for nephroprotective effects using a rat model. At doses of 50, 100, and 150 mg/kg body weight, the extract was shown to lower creatinine and urea levels in rats given ethylene glycol and ammonium chloride (Girsang et al., 2019).

Anti-inflammatory: -- Lipopolysaccharide-induced RAW264.7 macrophages were used to create an inflammation model in order to assess the plant's anti-inflammatory properties. It was discovered that the several solvent extracts of P. emblica, including petroleum ether and ethyl acetate, inhibited the release of NO and cytokines (TNF-alpha, IL-1beta, and IL-6) in RAW264.7 macrophages (Wei et al., 2018). The anti-inflammatory properties of the ethanolic extract of P. Emblica leaves were investigated in a different investigation using a carrageenan-induced mouse model. The 25 mouse models used for the in vivo investigation were split up into five groups, each with five animals. Piroxicam and amlaki leaf extract were not administered to Group 1. Twenty milligrams of piroxicam suspension were administered to the second group. The mice in groups 3, 4, and 5 received doses of 100, 200, and 300 mg/kg body weight of the ethanolic extract. On the fifth day, measurements were taken by using a syringe to collect exudates. The oedema volume in the positive control group was 0.05±0.03 ml, while in the negative control group it was 0.09±0.02 ml, according to the results. According to Asmilia et al. (2020), groups 3, 4, and 5 had significantly greater oedema volumes, measuring 0.07±0.01 ml, 0.06±0.02 ml, and 0.07±0.01 ml, respectively.

Antitussive: -- By mechanically stimulating the laryngopharyngeal and tracheobronchial mucosal regions of the airways, the antitussive properties of the plant extract P. Emblica were examined in conscious cats. The extract's ability to control coughing at a dosage of 50 mg/kg body weight when taken orally was not clearly apparent. At larger dosages, such as 200 mg/kg body weight, the results were successful and demonstrated a notable reduction in cough (NE/min-1) frequency and

multiple cough attempts (NE). Cough attack severity was more pronounced in expirium (IA-) and inspirium (IA+). Codeine and dropropizine were the conventional medications used in this investigation; the extract was found to be more effective than non-narcotic antitussive agents but less effective than the traditional narcotic antitussive medicine codeine.

Antihyperlipidemic: -- In various experimental animal models, the hyperlipidaemic potential of P. emblica's fruit juice and gallic acid was examined. In the rat model, hyperlipidaemia was brought on by the administration of poloxamer-407, a high-fat diet, and tyloxapol supplements. In the rat model, treatment with gallic acid and P. emblica fruit juice resulted in a drop in plasma cholesterol and a slowed rate of oil filtration in the liver and aorta. Additionally, the plant extract boosted the expression of peroxisome proliferator-activated receptors-alpha (PPARα) and elevated the degree of lipid oxidation through carnitine palmitoyl transferase (CPT) while decreasing the activity of hepatic lipogenic enzymes. Increased cholesterol uptake through elevated LDL-receptor expressions on hepatocytes was also noted, as was a decreased rate of LDL-receptor degradation brought on by a decrease in proprotein convertase subtilisin/Kexin type 9 (PCSK9). Additionally, by upregulating the expression of the Glut4 and PPARϒ proteins in adipose tissue, P. emblica restored glucose homeostasis. Accordingly, it demonstrated notable hyperlipidaemic activity through decreased expression of PCSK9 and lipogenic enzymes and increased expression of PPARs, lipogenic enzymes, and Glut4 (Variya et al., 2018).

Antidiarrheal: -- Castor oil was used to produce diarrhoea in three randomly chosen groups of mice, each with five mice, in order to assess the antidiarrheal activity. Distilled water with 1% Tween-80 (10 ml/kg) was given to the first group. The second group was given LO (leperamide), a common motility medication, orally at a dose of 3 mg/kg. The third group received a dosage of 500 mg/kg body weight of the plant's fruit extract orally. In the rat model, P. emblica methanol extract shown antidiarrheal action by significantly reducing GIT motility at doses of 50, 100, and 150 mg/kg, respectively (Khurshid et al., 2020).

Gastro-protective: -- In patients with gastrointestinal diseases, the ethanolic extract of P. emblica dried fruit was tested for its gastro-protective properties. For the examination, thirty patients were chosen, and they were split up into three groups of ten each. For 14 days each, these three groups received treatment with omeprazole, lactose (placebo), and P. emblica ethanolic extract. The ethanolic extract was administered to the test group at a daily dosage of 500 mg. Patients in the negative control group (placebo) received 500 mg lactose tablets three times a day. Lastly, omeprazole at the suggested dosage of 40 mg per day was administered to the positive control groups. The ethanolic extract decreased discomfort, vomiting, sleep disturbances, and the healing of injured mucosa, according to the results (Iqbal et al., 2017).

Immunomodulatory: -- The immunomodulatory efficacy of P. emblica and Costus speciosus aqueous extracts was evaluated in 42 mature male albino rats weighing 150–200 g, split into 6 groups (n=7). The group that received the aqueous extract had higher blood levels of CD4, CD8, CD19, CD16, IgM, and IgG, indicating greater immunomodulatory action. Consequently, with dosages of 250 and 500 mg/kg, the serum levels of albumin and globulins rose (Bakr and Naga, 2020).

CONCLUSION

This herb has been utilized medicinally from ancient times, according to the literature review. Many traditional healers utilize P. emblica to treat a variety of illnesses. This plant's fruit, which is its most used component, is a great source of vitamin C and other phytochemical ingredients like flavonoids, tannins, and phenolic compounds. The plant parts have long been used to treat cancer, diabetes, liver problems, coughs, and respiratory conditions like bronchitis and asthma. Furthermore, the fruit of this plant is a primary element in a number of ayurvedic formulations, including Raga Shadava (which provides sustenance), Panaka (which calms pitta-related diseases), and Chyavanprash and other preparations. The plant's chemical components have been linked to a number of biological and pharmacological benefits, including anti-inflammatory, hepatoprotective, nephroprotective, and antidiabetic effects. However, more research on the plant is required to assess its undiscovered phytochemical components and determine its more pharmacological characteristics, which could result in the creation of novel medications.

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