



Amla: An ancient medicinal plant with wide-ranging properties

*Radha Singh, Kusum Singh

Department of Zoology, Institute of Basic Sciences, Bundelkhand University, Jhansi, U.P., India

*Corresponding email: radha060291@gmail.com

ARTICLE INFO	ABSTRACT
<p>Original Review Article Received on October 19, 2024 Revised on October 27, 2024 Accepted on November 17, 2024 Published on November 30, 2024</p> <p>Article Authors Radha Singh, Kusum Singh</p> <p>Corresponding Author Email radha060291@gmail.com</p>	<p>Amla belongs to the family Euphorbiaceae. It is also named <i>Phyllanthus emblica</i>, Amla, or Indian gooseberry. The species is native to India and grows in tropical and subtropical areas. The amla is known for its therapeutic properties and holds a reputed position in the Ayurvedic, Siddha, and Unani systems of medicine. It is known that all parts of amla are useful in curing numerous diseases. Among all, the most essential part is the fruit. Amla fruit is well known for its high levels of vitamin C (ascorbic acid), which is resistant to storage and heat damage due to cooking. It has bioactive compounds like tannins, flavonoids, saponins, ascorbic acid, and many other vital compounds that are verified to have diverse pharmacological activities like antidiabetic, antioxidant, hepatoprotective, anti-inflammatory, immunomodulatory, anticancer, radioprotective, and many other activities. This abstract outline the significant pharmacological properties of amla, including its nutritional value, phytochemical constituents, traditional uses, and use as a home cure, and gives a view of the cure of many diseases and disorders for the benefit of human health.</p>
PUBLICATION INFO	KEYWORDS
<p>International Journal of Agricultural Invention (IJAI) RNI: UPENG/2016/70091 ISSN: 2456-1797 (P) Vol.: 9, Issue: 2, Pages: 126-135 Journal Homepage URL http://agriinventionjournal.com/ DOI: 10.46492/IJAI/2024.9.2.20</p>	<p><i>Phyllanthus emblica</i>, Vitamin C, Pharmacological Actions, Phytochemical Constituents</p>

HOW TO CITE THIS ARTICLE

Singh, R., Singh, K. (2024) Amla: An ancient medicinal plant with wide-ranging properties, *International Journal of Agricultural Invention*, 9(2): 126-135, DOI: 10.46492/IJAI/2024.9.2.20

Numerous therapeutic plants have been utilized for centuries in our Indian traditional medical systems (Ayurveda, Unani, and Siddha); the majority of the medications have a unique herbal base. Amla is a key component of the traditional Ayurvedic remedy "Chyawanprash," which is thought to delay aging and keep one youthful. Ayurveda has utilized plant fruits as a powerful Rasayana (Jain *et al.*, 2015). Although the traditional medical system makes use of practically every part of the plant, including the roots, leaves, and stems, it is primarily recognized for the medicinal properties of fruits. Either the fruit by itself or in conjunction with other plants is utilized. The fruit has a large number of polyphenolic components in addition to phytochemical compounds. Numerous phytochemical constituents, including flavonoids, tannins, alkaloids, and terpenoids, have been demonstrated to have beneficial biological properties.

Tannin is abundant in the tree's leaves and bark (Bhagat, 2014). With 200–900 mg of vitamin C per 100 grams of edible part, amla is the highest natural source of this potent antioxidant. The gelatinous, plum-sized amla fruit has naturally occurring and heat-stable vitamin C, better assimilated than synthetic vitamin C. Amla is used in sauces, candy, dried chips, pickles, jellies, and powder. It makes the hair strong and dandruff-free while preventing premature graying (Kumar *et al.*, 2012). Ayurveda makes extensive use of its fruits, which when taken regularly boost immunity and fight against cancer as well as chronic illnesses like high cholesterol, colds, coughs, influenza, fatigue, and inflammatory problems. Acidity, peptic ulcers, liver disease, cardiac problems, anemia, ophthalmic abnormalities, memory enhancement, boosting immunity against many other diseases are all effectively treated by it (Jain *et al.*, 2015).

Table 1. Vernacular Name (Jain *et al.*, 2015)

Language / Country	Vernacular Names	Language / Country	Vernacular Names
Chinese	Anmole	Hindi	Amla, Aoula, Amlika, Anvurab
French	Phyllanthe Emblic	Kannada	Nelli Kayi
German	Amlabaum	Karnataka	Nellikayi, Bela nelli
Italian	Mirabolano emblica	Kashmir	Aonla
Malaysian	Popok Melaka	Malayalam	Nelli Kayi
Nepalese	Amba	Marathi	Amla
Persian	Aamlah	Oriya	Anala, Ainla
Portuguese	Mirabolano emblica	Punjabi	Aula, Amla
Assam	Amlaku, Amalaki, Amalakhu	Sanskrit	Dhatri-phala, Amraphalam, Sripthalam, Amalaki
Bengali	Dhatri	Tamil	Nelli, Nellikayi, Toppi
English	Emblic myrobalan, Indian gooseberry	Telugu	Usirikaya
Gujarati	Ambla	Urdu	Aavnlaa, Amlaj

Table 2. Phytochemical Components (Variya *et al.*, 2016, Khan, 2009)

Plant Part	Compounds
Whole plant	Ellagic acid, Gallic acid, Quercetin.
Fruit	1-6-di-O-galloyl- β -D-glucose, 3-6-di-O-galloyl-D-glucose, Caffeic acid, Chebulagic acid, Chebulaginic acid, Chebulic acid, Chebulinic acid, Chlorogenic acid, Corilagic acid, Corilagin, Coumaric acid, Emblicanin-A, -B, Glucogallin, L-malic acid 2-O-gallate, Mucic acid 2-O-gallate, Myricetin, Pedunculagin, Phyllantidine, Phyllantine, Phyllemblic acid, Phyllemblicin, Phyllemblicinic acid, Punigluconin, Vitamin C (Ascorbic acid).
Leave	Amlaic acid, Apigenin-7-O-(6'-butyryl- β -glucopyranoside), Kaempferol, Kaempferol-3-O-glucoside, 1-2-3-4-6-penta-O-galloylglucose, 5 α ,6 β ,7 α -acetoxysito-sterol, luteolin-4'-O-neohesperidoside, Trihydroxysitosterol.
Root	Phyllaemblicin-A, B, and C, Phyllaemblic acid, lupeol.
Bark	Leucodelphinidin, B-sitosterol, Lupeol, Proanthocyanidin.
Seed, Seed Oil	Linoleic acid, Stearic acid, Linolenic acid, Oleic acid, Palmitic acid, sitosterol.

Table 3. Botanical Classification of Amla

Kingdom	Plantae
Division	Angiospermae
Class	Dicotyledonae
Order	Malpighiales
Family	Phyllanthaceae
Genus	Phyllanthus
Species	<i>P. emblica</i>

Pharmacological Properties

Effects on Diabetes

Both humans and animals have been examined for the anti-diabetic effects of amla and its extract. In fasting blood glucose experiments in normal rats, the administration of 300 mg/kg body weight of an aqueous extract of Amla seeds resulted in a maximal

reduction in blood glucose levels of 27.3% at the 6-hour time point (Mehta *et al.*, 2009). The enzymes α -amylase and α -glucosidase were both strongly inhibited by amla fruit extract in "Type 2" diabetes (Nampoothiri *et al.*, 2011). Amla's strong vitamin C content makes it useful for controlling diabetes. When taken daily for two months, a combination of bitter gourd and amla juice stimulated the pancreas to release insulin, which lowered blood sugar levels in diabetics. Diet limitations should be strictly observed while taking this medicine. Additionally, it will prevent diabetic eye problems (Patel, 2011). After four hours of oral treatment at a dose of 100 mg/kg body weight, a mixed methanolic extract of "Triphala" dramatically lowered blood sugar levels in both normal rats and rats with type 1 diabetes induced by alloxan.

Amla and its tannins have useful effects on diabetic cataracts, diabetic neuropathy, and diabetic uremia (Kumar *et al.*, 2014). Using the in-silico method, secondary metabolites from Amla, including ellagic acid, estradiol, sesamine, kaempferol, zeatin, quercetin, and leucodelphinidin, may have antidiabetic properties based on their binding to sodium-glucose co-transporter type 2 inhibitors (SGLT2), glucagon-like peptide receptor agonists (GLP-1 agonists), and peroxisome proliferator-activated receptor-gamma (PPAR- γ) proteins (Sharma *et al.*, 2020).

Antioxidant and Radical-Scavenging Properties

Methanol extract of amla exhibited the highest scavenging activity against DPPH, $O^{2\cdot-}$, OH^{\cdot} , and NO radicals and also significantly inhibited the oxidation of low-density lipoprotein (LDL) *in vitro* (Nampoothiri *et al.*, 2011). Amla fruit extract shows beneficial effects on alcohol-induced brain mitochondrial dysfunction in rats. Administration of the amla fruit extract to alcohol-treated rats lowered the levels of NO, protein carbonyls, and lipid peroxide levels and elevated the activities of the antioxidant enzymes succinate dehydrogenase (SDH), nicotinamide adenine dinucleotide (NADH) dehydrogenase, and cytochrome-c-oxidase, as well as the content of cytochromes in the brain (Reddy *et al.*, 2011). Reactive oxygen species [ROS, superoxide anion radicals ($O^{2\cdot-}$), hydroxyl radicals (OH^{\cdot}) and hydrogen peroxide (H_2O_2)] and reactive nitrogen species [RNS, nitric oxide (NO) and peroxynitrite ($ONOO^-$)] respectively, cause oxidative and nitrosative stress. Free radicals produced by the actions of these species are highly reactive and cause damage to membrane lipids, proteins, and DNA. The ethyl acetate fraction of a methanolic extract of amla fruits revealed strong NO-scavenging action *in vitro*. The extracts of amla also showed significant protection to DNA against oxidative damage, as shown by the movement of DNA on an agarose gel (Kumar *et al.*, 2014).

Hepatoprotective Effects

The antioxidant property of amla is responsible for its protective efficacy against arsenic-induced hepatic toxicity. Arsenic exposures (3 mg/kg body weight/day for 30 days) in mice showed enhanced oxidative stress in hepatocytes with an increase in lipid peroxidation and a decrease

in the levels of reduced glutathione, superoxide dismutase, glutathione peroxidase, and catalase, along with significant changes in SGOT, SGPT, and creatinine. Administration of amla fruit extract (500 mg/kg body weight/day for 30 days) with arsenic resulted in a significant reduction of arsenic transference related to significant decreases in hepatic arsenic levels and balanced the antioxidant enzyme and levels of serum hepatic enzymes like SGOT and SGPT (Singh *et al.*, 2014). In rats with neonatal streptozotocin-induced type 2 diabetes, treatment with a methanolic extract of amla (250 or 500 mg/kg for 28 days) caused a decrease in lipid peroxidation and an increase in GSH in the liver (Fatima *et al.*, 2017). The beta-sitosterol derivative sitosterol-N, when used in different concentrations (12.5 mg/kg and 50 mg/kg), helped in treatment and was able to reduce the necrosis of liver cells induced by lipopolysaccharide and d-galactosamine (Yin *et al.*, 2018).

Anti-inflammatory Effects

Free and bound phenolic compounds from amla (dose levels 20 and 40 mg/kg) reduced inflammation in carrageenan and cotton pellet-induced acute and chronic inflammation in animals, and at high doses, the effects of both fractions were comparable to treatment with diclofenac (Muthuraman *et al.*, 2010). Acute pancreatitis is a rapidly increasing inflammation of the pancreas and causes high mortality. Amla has been reported to have useful effects in the treatment of acute pancreatitis. Serum levels of lipase and IL-10 were significantly lowered by amla extract. The nucleic acid content, rate of DNA synthesis, pancreatic proteins, and pancreatic amylase content were significantly improved (Sidhu *et al.*, 2011). The leaves of amla were extracted with different solvents, and the inhibitory activity of the extracts on human polymorphonuclear leukocyte (PMN) and platelet function was studied, which confirmed their anti-inflammatory and antipyretic properties (Kumar *et al.*, 2014). Ethanolic extraction of the amla branch significantly inhibited the mRNA expressions of tyrosinase and related proteins (TRP-1 and TRP-2) in B16 murine melanoma cells, as well as inhibited the expression of LPS-induced pro-inflammatory genes (COX-2, iNOS, TNF- α , IL-16, and IL-6) in RAW 264.7 murine macrophage cells (Sripanidkulchai and Junlatat, 2014).

Immunomodulating Effects

The cytoprotective and immunomodulating properties of a 90% ethanol extract of dry amla fruit on lymphocytes were studied using an *in vitro* method. The amla extract significantly inhibited chromium (Cr)-induced free radical production, enhanced cell survival, and restored the antioxidant status to the control level. The amla extract also inhibited apoptosis and DNA fragmentation induced by chromium, relieved the immunosuppressive effects of Cr on lymphocyte proliferation, returned IL-2, and decreased phagocytosis and γ -interferon (γ -IFN) production to control levels (Sai *et al.*, 2003). Amla could enhance natural killer (NK) cell activity and antibody-dependent cellular cytotoxicity (ADCC) in syngeneic BALB/c mice bearing Dalton's lymphoma ascites (DLA) tumors. Treatment with amla showed ameliorative action against both chromium-induced immunosuppression and oxidative stress, as well as lipopolysaccharide and concanavalin-A-intoxicated lymphocyte proliferation. Amla also significantly inhibited DNA fragmentation and restored the levels of IL-2 and interferon- γ (Variya *et al.*, 2016).

Antimicrobial Activity

Extracts from different parts of amla showed different antibacterial potential against Gram-positive and Gram-negative bacteria. Aqueous infusion and decoction of amla exhibited strong activity against *Escherichia coli*, *Klebsiella pneumoniae*, *Klebsiella ozaenae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Salmonella paratyphi* A and B, and *Serratia marcescens*, but did not show any antibacterial activity against some Gram-negative urinary pathogens. The chloroform extract of the fresh, ripe fruit of amla exhibited the strongest inhibitory effect against *Bacillus subtilis* and moderate inhibitory activity against *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella paratyphi*, *Salmonella typhi*, *Shigella boydii*, *Shigella dysenteriae*, *Staphylococcus aureus*, *Sternbergia lutea*, *Vibrio mimicus*, and *Vibrio parahaemolyticus*. Long-term feeding (30 days) suggested that supplementation with amla reduced bacterial colonization in the lung (Kumar *et al.*, 2014). The aqueous extract from amla leaves exhibited maximal inhibitory action against *Staphylococcus aureus* and *Escherichia coli* with 0.1 μ g and 1.0 μ g minimum inhibitory concentrations (MIC), respectively.

Amla root extract failed to produce inhibitory action on both species, while extracts of fruit and seed showed 1.5 and 3.75 μ g and 1.5 and 5.0 μ g MIC, respectively, against *Staphylococcus aureus* and *Escherichia coli*. Silver nanoparticles synthesized through green synthesis using fruit and leaf extracts of amla presented potential antimicrobial activity against many pathogenic bacteria, like *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and *Bacillus subtilis* (Variya *et al.*, 2016).

Antiviral Activity

A polyphenolic compound, 1,2,4,6-tetra-*O*-galloyl- β -d-glucose (1246TGG), isolated from amla in an *in vitro* study, was found to inhibit herpes simplex virus type 1 (HSV-1) and type 2 (HSV-2) infection by inhibiting HSV-1 E and L gene expressions along with viral DNA replication (Xiang *et al.*, 2011). The sesquiterpenoid glycoside isolated from Amla showed potential anti-hepatitis B virus (HBV) actions on the HBV surface antigen (HBsAg) and HBV excreted antigen (HBeAg) secretion (Lv *et al.*, 2014). Coronavirus Disease-2019 (COVID-19), a viral disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a global pandemic by the WHO in 2020. SARS-CoV-2 was the main protease (COVID-19 Mpro), an enzyme mainly involved in viral replication and transcription that has been identified as a crucial target for drug discovery. In a recent study, it was examined that the bioactive compounds of *Embllica officinalis* (Amla), *Phyllanthus niruri* (Bhumi Amla), and *Tinospora cordifolia* (Giloy) inhibit the enzymatic activity of COVID-19 Mpro. 96 bioactive compounds were selected and docked with COVID-19 Mpro and further validated by a molecular dynamics study, and it was revealed that the bioactives, namely amritoside, apigenin-6-C-glucosyl-17-Oglucoside, pectolinarin, and astragaloside, showed better binding affinities with COVID-19 Mpro (Murugesan *et al.*, 2021). Application of *Nigella sativa* through the feed for 28 days was able to increase the body resistance and reduce the mortality of *Litopenaeus vannamei* infected with the white spot syndrome virus (WSSV), with a relative percent survival (RPS) value of 71%. *Nigella sativa* can be combined with *Phyllanthus niruri* in the right composition (1/2N:1/2P and 2/3N:1/3P), although its effectiveness is not better than the application of *Nigella sativa* alone (Lesmanawati *et al.*, 2022).

Effects on the Nervous System

Amla is traditionally used to treat disorders of the central nervous system (CNS). It produced a dose-dependent growth in memory scores in young and aged mice and also inverted the amnesia induced by scopolamine (0.4 mg/kg b.wt.) and diazepam (1 mg/kg b.wt.). This plant may be a useful medicine for the management of Alzheimer's disease on account of its multiple useful effects, such as its memory-improving, cholesterol-lowering, and anti-cholinesterase activities (Vasudevan and Parle, 2007). A standardized hydroalcoholic extract of amla fruits showed effects against kainic acid-induced seizures, cognitive deficits, and markers of oxidative stress in rats. Pre-treatment with amla fruit extract (500 and 700 mg/kg *i.p.*) significantly increased the latency of seizures. The amla fruit extract significantly inhibited the increase in TBARS levels and enhanced the fall in GSH. The Amla fruit extract dose-dependently decreased the kainic acid-induced increase in TNF- α level in the brain (Golechha *et al.*, 2011).

Effects on Cardiovascular Problems

In a study, it was found that *Phyllanthus emblica* juice administered orally can reduce glucose levels, significantly reduce the cardiac hypertrophy index in rats, the collagen and protein content of the left ventricle, serum activity levels of lactate dehydrogenase (LDH), serum levels of creatinine kinase-MB, and malondialdehyde (MDA) levels, while significantly increasing levels of superoxide dismutase (SOD), glutathione (GSH), and catalase. This process mainly prevents cardiac dysfunction in diabetes by increasing the utilization or transport of glucose in the heart, and gallic acid may play a key role in this process. *Phyllanthus emblica* can also increase levels of antioxidant enzymes in the heart and reverse diabetic cardiomyopathy (DCM) (Patel and Goyal, 2011). The cardiovascular protective and lowering lipid profile properties of *Embllica officinalis* ethanolic extract were examined. The lipid profile was found to be altered in high-fat diet-fed rats but was then found to be reversible when the extract was supplemented. Improvement in cardiac autonomic malfunctions was found after the supplementation of *Embllica officinalis* in a group of high-dietary fat-fed rats and altered HR and sympathovagal balance were revealed by electrophysiological evaluation (Kanthé *et al.*, 2017).

Embllica officinalis extract designates its cardioprotective role in high-fat diet-fed rats. Its ethanolic extract altered the histopathology and vascular chemistry of the cardiovascular system induced by a high-fat diet. It was found in rats fed with a high-fat diet that there was a decrease in NO and a significant increase in MDA, and amla extract supplementation showed an improvement in the oxidative stress induced by the high-fat diet (Patil *et al.*, 2019).

Cytotoxic and Anticancer Activities

Amla fruit and its extracts can be used as antineoplastic agents, radioprotective agents, chemopreventive agents, and chemomodulatory agents. The mechanism of the anticancer effects includes the following aspects: Amla fruit or its extracts are free radical scavengers, decrease ornithine decarboxylase, LPO, and hepatic phase I enzyme levels, increase GST levels (a phase II enzyme), contain antioxidant enzymes, control the protein levels important in cell cycle progression, cause apoptosis and cytotoxicity in neoplastic cells, prevent metastasis, and also have antimutagenic and immunomodulatory effects (Baliga and Dsouza, 2011). In an *in vitro* study, amla fruit extract showed anticancer activity in cervical cancer cells. Amla extract resulted in a dose- and time-dependent inhibition of the DNA binding activity of constitutively active activator protein-1 (AP-1) in both HPV16-positive (SiHa) and HPV18-positive (HeLa) cervical cancer cells. Amla-induced AP-1 inhibition was found to be mediated through down-regulation of constituent AP-1 proteins, c-Jun, JunB, JunD, and c-Fos (Mahata *et al.*, 2013).

Effects on Gastric Ulceration

Ethanolic extract of Amla showed biphasic activity in non-steroidal anti-inflammatory drug (NSAID)-induced ulcers in mice, with the healing effect observed at 60 mg/kg and the side effect at 120 mg/kg (Chatterjee *et al.*, 2011). The ethanolic extract of amla was found highly effective in controlling the growth of *Helicobacter pylori in vitro* with minimum inhibitory control ranging from 0.91 to 1.87 $\mu\text{g}/\mu\text{l}$. Plant ethanolic extract is well retained with total phenolics, reducing power, flavonoids, and antioxidant properties, which make amla suitable for remedial use against *Helicobacter pylori* infection and gastric ulcer (Mehrotra *et al.*, 2011).

The healing activity of gallic acid-enriched ethanolic extract (GAE) of Amla fruits against indomethacin-induced gastric ulceration was related to the ability of GAE to alter the cyclooxygenase-(COX-) dependent healing pathways. Treatment with GAE (5 mg/kg/day) and omeprazole (3 mg/kg/day) for 3 days led to the effective healing of the acute ulceration, while GAE could reverse the indomethacin-induced pro-inflammatory changes by reducing neutrophil infiltration and increasing mucosal PGE2 as well as the e-NOS/i-NOS ratio (Chatterjee *et al.*, 2012).

Antidiarrheal Effects

Amla is used as a possible curative in diarrhea *in vivo* (mice) and *in vitro* (rabbit jejunum and guinea pig ileum). Amla crude extract caused an inhibition in castor oil-induced diarrhea and intestinal fluid accumulation in mice at 500-700 mg/kg b.wt. The *in vitro* studies showed that amla fruit extract has antidiarrheal and spasmolytic activities, possibly mediated through the dual blockade of muscarinic receptors and Ca²⁺ channels (Mehmood *et al.*, 2012). Dried amla fruit has a strong cooling activity on the body and is an admirable drug for diarrheal and dysentery. A drink made from amla mixed with lemon juice and mishri is evaluated as highly useful in controlling acute ancillary dysentery. One tablespoonful of the paste of leaves mixed with honey or buttermilk also makes effective medicare in the treatment of diarrhea and dysentery. A compound powder of the emblica seed, chitrak root, chebulic myrobalan, pipili, and pallone is given in suitable doses, according to age, in warm water twice daily, in the morning and at bedtime (Kumar *et al.*, 2012). A fruit decoction of amla mixed with sour milk was given to dysentery cases. The bark assists with the astringency of the fruit. A root decoction and the evaporation of the solution produce an astringent extract equal to catechu. An infusion of the leaves with fenugreek seed is given for chronic diarrhea (Variya *et al.*, 2016).

Hair Growth

The oil obtained from the berries strengthens and promotes the growth of hair. Amla fruit, cut into pieces, dried in a mild shade, and then boiled in coconut oil, is said to be superb for preventing hair graying.

Dried amla pieces are soaked overnight in water, which is useful for nourishing the hair. Its polyherbal ointment and herbal hair oil have hair growth-promoting activity (Banerjee *et al.*, 2009). Herbal formulations with *Hibiscus rosa-sinensis*, *Phyllanthus emblica*, *Trigonella foenumgraecum*, and *Tridax procumbens* showed synergistic effects by a significant increase in hair growth activity (Sabarwal *et al.*, 2009). Amla is reported to improve iron metabolism; iron is involved in the oxygenation of our body's red blood cells. It is essential for normal hair growth and the maintenance of healthy hair. Iron deficiency leads to hair loss because of oxygen deficiency. Amla extracts stimulate the proliferation of dermal papilla cells in a concentration-dependent manner, suggesting their role in hair growth promotion (Luanpitpong *et al.*, 2011).

Strengthens the Eyes

An increase in Ranjaka Pitta (the sub-dosha of Pitta that manages liver function and the blood plasma) and Alochaka Pitta (the sub-dosha of Pitta that manages the eyes and vision) amla supported the health of the eye. Amla leaf infusion is used for sore eyes. The dried fruit soaked in water for a full night produces a decoction that is used as a collyrium (a remedial lotion used on the eye as eyewash) in ophthalmia. It may be used as cold or warm. A seed infusion was also used as a collyrium and was used to treat new inflammations of the conjunctiva and other eye problems. The exudate collected from incisions made on the fruit was used externally to treat inflammation of the eye. Amla reduced pitta without disturbing the other two doshas and was normally used in cataract medicine (Singh *et al.*, 2011). Amla juice with honey is beneficial for protecting eyesight and also for conjunctivitis and glaucoma. It significantly decreases intraocular tension. Juice mixed with honey can be taken twice daily for this condition (Kumar *et al.*, 2012).

Snake Venom Neutralizer

Phyllanthus emblica (methanolic extract of the root) and *Vitex negundo* were discovered to have antisnake venom activity. Plant extracts significantly antagonized the *Viper russellii* and *Naja kaouthia* venom-induced lethality both in *in vivo* and *in vitro* studies.

Both plants extract significantly neutralized *Viper russellii* venom-induced coagulants, inflammatory properties, and hemorrhage-defibrinogenating properties. No precipitating bands were formed between the snake venom and amla extract, which established that amla has potent snake venom-neutralizing abilities (Alam and Gomes, 2003). Phthalate-like active compounds, isolated from the Amla root, exposed neutralizing potential against viper and cobra-induced lethal, cardiotoxic, hemorrhagic-defibrinogenating, neurotoxic activity, phospholipase A2 (PLA2), and proinflammatory activity in experimental mice due to variation of proinflammatory markers, viz., IL-1, IL-6, and TNF- α , and decrease in myotoxicity markers like creatinine phosphokinase (CPK) and lactate dehydrogenase (LDH) (Sarkhel *et al.*, 2011). The *Naja naja* venom-induced coagulant, phospholipase A2, and fibrinolytic activities were effectively inhibited by the aqueous extract of *Embllica officinalis* fruit, leaves of *Ocimum sanctum*, bark of *Azadirachta indica*, and bulbs of *Allium sativum* (Kuriakose *et al.*, 2012).

Respiratory Diseases

As an antioxidant, it is very effective in preventing lipid peroxidation by scavenging reactive species and free radicals, thus preventing tissue damage. Dietary supplementation with Amla protects against *Klebsiella pneumonia*-mediated respiratory tract infection by keeping a check on the induction of proinflammatory cytokines like TNF- α (Saini *et al.*, 2008). Fresh fruit is used for lung inflammation cures in Turkey. A mixture of amla fruit extract or juice, honey, and pipit stopped hiccups and was also helpful in painful respiration.

The fruit juice, along with other components, is used to cure coughs, hiccups, asthma, and other disorders. Dyspnoea (breathing difficulty), Amla (10 gm leaves), a clove, one garlic, black pepper (9 seeds), *Terminalia chebula* (5 fruits), and 25 ml of ghee (made from cow's milk) are all ground into a paste and taken orally once daily for 7 days to get relief. It is also used for oligopnea (shallow or infrequent breaths) (Srivasuki, 2012). Amla is especially valuable in tuberculosis of the lungs, asthma, and bronchitis. Pulmonary antioxidant defenses are widely distributed in the lungs and include both enzymatic

and non-enzymatic systems. The primary non-enzymatic antioxidants are membrane-bound vitamin C and vitamin E (Murugesan *et al.*, 2021).

Radioprotective Effects

Amla fruit pulp significantly decreased the effects of radiation on Swiss albino mice and may be beneficial in decreasing the side effects produced during radiation therapy. An aqueous extract of amla fruit shows radioprotective activities against sublethal gamma radiation in Swiss albino mice. The fruit pulp extract dose found to be most effective against radiation was 100 mg/kg b.wt. with 87.5% survival after 30 days (Kumar *et al.*, 2014). In a study, mice were exposed to γ -radiation. Triphala is a good radioprotective agent, and when it was administered by intraperitoneal route in mice in doses of 5, 6.25, 10, 12.5, 20, 25, 40, 50, and 80 mg/kg body weight for 5 days, it was observed that there was a delay in the onset of mortality and a decrease in the symptoms of radiation sickness in mice (Deshmukh and Choudhari, 2021).

Conclusion

Amla has been playing an important role since ancient times in Ayurveda, a traditional remedy, and tribal prescription for several diseases. Many extracts and herbal formulations of amla showed actions against many diseases, and their effects were akin to those of standard drugs. There are many classic Ayurvedic preparations, such as Chyawanprash, in which amla is used as a main ingredient. It has helped to improve intelligence and memory power since ancient times. A wide range of phytochemical components and polyphenolic compounds were reviewed, and they have different types of pharmacological or biological actions. It is considered to be a safe herbal drug without any adverse effects. So, it can be concluded that amla is a traditionally and clinically verified fruit for both its use and efficacy.

Acknowledgments

I would like to thank the HOD, Department of Zoology, Bundelkhand University Campus, for providing facilities to support me and for guiding me.

References

- Alam, M. I. and Gomes, A. (2003) Snake venom neutralization by Indian medicinal plants (*Vitex negundo* and *Embllica officinalis*) root extracts, *Journal of Ethnopharmacology*, 86(1): 75-80.
- Baliga, M. S. and Dsouza, J. J. (2011) Amla (*Embllica officinalis* Gaertn): A wonder berry in the treatment and prevention of cancer, *European Journal of Cancer Prevention*, 20(3): 225-239.
- Banerjee, P. S., Sharma, M., and Nema, R. K. (2009) Preparation, evaluation, and hair growth stimulating activity of herbal hair oil, *Journal of Chemical Pharmaceutical Research*, 1(1): 261-267.
- Bhagat, M. (2014) Indian Gooseberry (*Embllica officinalis*): Pharmacognosy Review, *Utilization and Management of Medicinal Plants*, 2: 471-487.
- Chatterjee, A., Chatterjee, S., Biswas, A., Bhattacharya, S., Chattopadhyay, S., and Bandyopadhyay, S. K. (2012) Gallic acid enriched fraction of *Phyllanthus emblica* potentiates indomethacin-induced gastric ulcer healing via e-NOS-dependent pathway, *Evidence-Based Complementary and Alternative Medicine*, doi:10.1155/2012/487380.
- Chatterjee, A., Chattopadhyay, S., and Bandyopadhyay, S. K. (2011) Biphasic effect of *Phyllanthus emblica* L. extracts on NSAID-induced ulcer: an antioxidative trail weaved with immunomodulatory effect, *Evidence-based Complementary and Alternative Medicine*, doi:10.1155/2011/146808.
- Deshmukh, C. D. and Choudhari, S. P. (2021) Phytochemical and Pharmacological Profile of *Embllica officinalis* Linn, *Journal of Medical P'ceutical & Allied Sciences*, 10(2): 2698-2703.
- Fatima, N., Hafizur, R. M., Hameed, A., Ahmed, S., Nisar, M., and Kabir, N. (2017) Ellagic acid in *Embllica officinalis* exerts anti-diabetic activity through the action on β -cells of pancreas, *Eur J Nutr.*, 56(2): 591-601.
- Golechha, M., Bhatia, J., Ojha, S. and Arya, D. S. (2011) Hydroalcoholic extract of *Embllica officinalis* protects against kainic acid-induced status epilepticus in rats: Evidence for an antioxidant, anti-inflammatory and neuroprotective intervention. *Pharmaceutical Biology*, 49(11): 1128-1136.
- Jain, R., Pandey, R., Mahant, R. N., and Rathore, D. S. (2015) A Review on Medicinal Importance of *Embllica officinalis*, *International Journal of Pharmaceutical Sciences and Research*, 6(1): 72-84.
- Kanthe, P. S., Patil, B. S., Bagali, S. C., Reddy, R. C., Aithala, M. R., and Das, K. K. (2017) Protective Effects of Ethanolic Extract of *Embllica officinalis* (Amla) on Cardiovascular Pathophysiology of Rats, Fed with High Fat Diet, *Journal of Clinical and Diagnostic Research*, 11(9): 05-09.
- Khan, K. H. (2009) Roles of *Embllica officinalis* in Medicine-A Review, *Bot. Res. Int.*, 2(4): 218-228.
- Kumar, A., Singh, A., and Singh, B. (2014) Assessment of therapeutic potential of *Phyllanthus emblica* (Amla): A Natural Godsend, *International Journal of Cell Science and Biotechnology*, 3: 4-14.
- Kumar, K. P. S., Bhowmik, D., Dutta, A., Yadav, A. P., Paswan, S., Srivastava, S. (2012) Recent Trends in Potential Traditional Indian Herbs *Embllica officinalis* and its Medicinal importance, *Journal of Pharmacognosy and Phytochemistry*, 1(1): 24-32.
- Kuriakose, B. B., Aleykutty, N. A., and Nitha, B. (2012) Evaluation of venom neutralizing capacity of Indian medicinal plants by in vitro methods, *Asian J. Pharma Health Sci.*, 2(4): 552-554.
- Lesmanawati, W., Manalu, W., Rahminiwati, M., Suprayudi, M. A. and Nuryati, S. (2022) Combination of *Nigella sativa* and *Phyllanthus niruri* as An Immunostimulant for the Prevention of White Spot Disease in *Litopenaeus vannamei*, *Journal of Aquaculture and Fish Health*, 11(3): 306-316.
- Luanpitpong, S., Nimmannit, U., Pongrakhananon, V. and Chanvorachote, P. (2011) *Embllica* (*Phyllanthus emblica* Linn.) fruit extract promotes proliferation in the dermal papilla cell of human hair follicles, *Research Journal of Medicinal Plants*, 5(1): 95-100.

- Lv, J. J., Wang, Y. F., Zhang, J. M., Yu, S., Wang, D., Zhu, H. T. (2014) Anti-Hepatitis B Virus Activities and Absolute Configurations of Sesquiterpenoid Glycosides from *Phyllanthus emblica*, *Organic & Biomolecular Chemistry*, **12**: 8764-8774.
- Mahata, S., Pandey, A., Shukla, S., Tyagi, A., Husain, S. A., Das, B. C. (2013) Anticancer Activity of *Phyllanthus emblica* Linn., (Indian Gooseberry): Inhibition of Transcription Factor AP-1 and HPV Gene Expression in Cervical Cancer Cells, *Nutrition and Cancer*, **65(sup1)**: 88-97.
- Mehmood, M. H., Siddiqi, H. S., and Gilani, A. H. (2011) The antidiarrheal and spasmolytic activities of *Phyllanthus emblica* are mediated through the dual blockade of muscarinic receptors and Ca²⁺ channels, *Journal of Ethnopharmacology*, **133**: 856-865.
- Mehrotra, S., Jamwal, R., Shyam, R., Meena, D. K., Mishra, K., Patra, R. (2011) Anti-Helicobacter pylori and antioxidant properties of *Emblica officinalis* pulp extract: A potential source for therapeutic use against gastric ulcer, *Journal of Medicinal Plants Research*, **5(12)**: 2577-2583.
- Mehta, S., Singh, R. K., Jaiswal, D., Rai, P. K., and Watal, G. (2009) Anti-diabetic activity of *Emblica officinalis* in animal models, *Pharmaceutical Biology*, **47(11)**: 1050-1055.
- Murugesan, S., Kottekad, S., Crasta, I., Sreevathsan, S., Usharani, D., Perumal, M. K. (2021) Targeting COVID-19 (SARS-CoV-2) main protease through active phytochemicals of ayurvedic medicinal plants - *Emblica officinalis* (Amla), *Phyllanthus niruri* Linn. (Bhumi Amla) and *Tinospora cordifolia* (Giloy) - A molecular docking and simulation study, *Computers in Biology and Medicine*, **136**: 1-13.
- Muthuraman, A., Sood, S. and Singla, S. K. (2010) The anti-inflammatory potential of phenolic compounds from *Emblica officinalis* L in rat, *Inflammopharmacology*, **19**: 327-334.
- Nampoothiri, S. V., Prathapan, A., Cherian, O. L., Raghu, K. G., Venugopalan, V. V., and Sundaresan, A. (2011) In vitro antioxidant and inhibitory potential of *Terminalia bellerica* and *Emblica officinalis* fruits against LDL oxidation and key enzymes linked to type 2 diabetes, *Food and Chemical Toxicology*, **49**: 125-131.
- Patel, S. S. and Goyal, R. K. (2011) Prevention of diabetes-induced myocardial dysfunction in rats using the juice of the *Emblica officinalis* fruit, *Exp. Clin. Cardiol.*, **16(3)**: 87-91.
- Patil, B. S., Kanthe, P. S., Reddy, C. R., and Das, K. K. (2019) *Emblica officinalis* (Amla) ameliorates high-fat diet-induced alteration of cardiovascular pathophysiology, *Cardiovascular and Hematological Agents in Medicinal Chemistry*, **17(1)**: 52-63.
- Reddy, V. D., Padmavathi, P., Kavitha, G., Gopi, S., and Varadacharyulu, N. C. (2011) *Emblica officinalis* ameliorates alcohol-induced brain mitochondrial dysfunction in rats, *Journal of Medicinal Food*, **14**: 62-68.
- Sabarwal, N., Varghese, D., Barik, R., Khandelwal, A., Jain, A., and Jain, S. (2009) Development and evaluation of polyherbal formulations for hair growth activity, *Phcog. Net.*, **1(2)**: 165-170.
- Sai, R. M., Neetu, D., Deepti, P., Vandana, M., Ilavazhagan, G., Kumar, D. (2003) Cytoprotective activity of Amla (*Emblica officinalis*) against chromium (VI)-induced oxidative injury in murine macrophages, *Phytotherapy Research*, **17**: 430-433.
- Saini, A., Sharma, S., and Chhibber, S. (2008) Protective efficacy of *Emblica officinalis* against *Klebsiella pneumonia*-induced pneumonia in mice, *Indian J. Med. Res.*, **128**: 188-193.
- Sarkhel, S., Chakravarty, A. K., Das, R., Gomes, A., and Gomes, A. (2011) Snake venom neutralizing factor from the root extract of *Emblica officinalis* Linn., *Orient. Pharm. Exp. Med.*, **11(1)**: 25-33.
- Sharma, P., Joshi, T., Joshi, T., Chandra, S., and Tamta, S. (2020) In silico screening of potential antidiabetic phytochemicals from *Phyllanthus emblica* against therapeutic targets of type-2 diabetes, *Journal of Ethnopharmacology*, **248(2)**: 112268.
- Sidhu, S., Pandhi, P., Malhotra, S., Vaiphei, K., and Khanduja, K. L. (2011) Beneficial effects of *Emblica officinalis* in l-arginine-induced acute pancreatitis in rats, *Journal of Medicinal Food*, **14**: 147-155.

- Singh, E., Sharma, S., Pareek, A., Dwivedi, J., Yadav, S., and Sharma, S. (2011) Phytochemistry, traditional uses and cancer chemopreventive activity of Amla (*Phyllanthus emblica*): The Sustainer, *Journal of Applied Pharmaceutical Science*, 2(1): 176-183.
- Singh, M. K., Dwivedi, S., Yadav, S. S., Sharma, P., and Khattri, S. (2014) Arsenic-induced hepatic toxicity and its attenuation by fruit extract of *Emblica officinalis* (amla) in mice, *Indian Journal of Clinical Biochemistry*, 29(1): 29-37.
- Sripanidkulchai, B. and Junlatat, J. (2014) Bioactivities of alcohol-based extracts of *Phyllanthus emblica* branches: antioxidation, antimelanogenesis, and antiinflammation, *Journal of Natural Medicines*, 68(3): 615-622.
- Srivasuki, K. P. (2012) Nutritional and Health Care Benefits of Amla, *Journal of Pharmacognosy*, 3(2): 147-151.
- Variya, B. C., Bakrania, A. K., and Patel, S. S. (2016) *Emblica officinalis* (Amla): A review for its phytochemistry, ethnomedicinal uses, and medicinal potentials with respect to molecular mechanisms, *Pharmacological Research*, 111: 180-200.
- Vasudevan, M, and Parle, M. (2007) Memory enhancing activity of Anwalachurna (*Emblica officinalis* Gaertn.): An Ayurvedic preparation, *Physiology and Behavior*, 91: 46-54.
- Xiang, Y., Pei, Y., Qu, C., Lai, Z., Ren, Z., Yang, K. (2011) *In vitro* Anti-Herpes Simplex Virus Activity of 1,2,4,6-Tetra-*O*-galloyl- β -d-glucose from *Phyllanthus emblica* L. (Euphorbiaceae), *Phytotherapy Research*, 25: 975-982.
- Yin, Y., Liu, X., Liu, J., Cai, E., Zhu, H., Li, H. (2018) Beta-sitosterol and its derivatives repress lipopolysaccharide/ d-galactosamine-induced acute hepatic injury by inhibiting the oxidation and inflammation in mice, *Bioorganic & Medicinal Chemistry Letters*, 28(9): 1525-1533.
-